

**Generation of GLP Accredited Residue
Data for linuron herbicide to set new WHP
and MRL for domestic and export carrots**

Phillip Frost
Peracto Pty Ltd

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FINAL REPORT

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Residue Data for linuron herbicide
to set new WHP and MRL for
domestic and export carrots**



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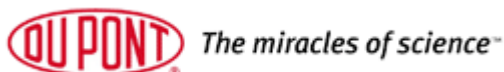
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MEDIA SUMMARY

There are over 7,500 hectares of carrots grown in Australia, worth \$150 million at the farmgate (ABS, 2003). All crops are established by direct seeding into well prepared raised beds. Carrots are grown in every state, with the main production being in Victoria, followed by Western Australia and South Australia.

All carrot crops require good weed control, especially during the establishment period, as the crops are delicate and do not compete well with weeds. The herbicide active ingredient linuron is widely used as both a pre and early post emergence herbicide for control of grass and broadleaf weeds in carrot crops.

The different carrot growing regions have different growing times and a wide maturity time depending on the season. It can range from 60 days for baby carrots to 120 days for early spring crops.

The carrot industry has identified the need for maintaining the use of linuron for grass and broadleaved weed control for domestic and export markets. When applied for weed control in long season carrots, the withholding period of 10 weeks is acceptable. The short season carrot varieties are important to domestic and export markets but cannot utilise the benefits of linuron as the season is shorter than 10 weeks.

A total of 8 residue trials were conducted, from 2008 to 2010, in specified regions throughout Australia, on heavy and light soil types, domestic, baby and export carrots and for crops with different sowing timings. All the data from this project has been presented to HAL in a detailed GLP report encompassing the field and analytical phase. This data will be used to support an application to the Australian Pesticides and Veterinary Medicines Authority (APVMA) to reduce the withholding period of linuron in carrots.

The data generated through this project will be used to help set a new withholding period and a maximum residue limit (MRL) for linuron in carrots and improve access to domestic and export markets.

TECHNICAL SUMMARY

There are over 7,500 hectares of carrots grown in Australia, worth \$150 million at the farmgate (ABS, 2003). All crops are established by direct seeding into well prepared raised beds. Carrots are grown in every state, with the main production being in Victoria, followed by Western Australia and South Australia.

All carrot crops require good weed control, especially during the establishment period, as the crops are delicate and do not compete well with weeds. The herbicide active ingredient linuron is widely used as both a pre and early post emergence herbicide for control of grass and broadleaf weeds in carrot crops. Linuron is a urea herbicide which inhibits photosynthesis.

The different carrot growing regions have different growing times and a wide maturity time depending on the season. It can range from 60 days for baby carrots to 120 days for early spring crops.

The carrot industry has identified the need for maintaining the use of linuron for grass and broadleaved weed control for domestic and export markets. When applied for weed control in long season carrots, the withholding period of 10 weeks is acceptable. The short season carrot varieties are important to domestic and export markets but cannot utilise the benefits of linuron as the season is shorter than 10 weeks. These trials aim to generate the data to determine if the withholding period can be reduced to more acceptable levels.

A total of 8 residue trials were conducted, from 2008 to 2010, in specified regions throughout Australia, on heavy and light soil types, domestic, baby and export carrots and for crops with different sowing timings. All the data from this project has been presented to HAL in a detailed GLP report encompassing the field and analytical phase. The data generated through this project will be used to help set a new withholding period and a maximum residue limit (MRL) for linuron in carrots and improve access to domestic and export markets.

The field investigation phases of this study were conducted using Peracto Pty Ltd's Standard Operating Procedures, which comply with the OECD Principles of Good Laboratory Practice Number 1 (revised 1997), Paris 1998 and Number 13, June 2002, GLP Facility No: 14609. All specimens were analysed by AgriSolutions Australia at their laboratory at Deception Bay in Brisbane, Facility No: 14951.

The levels of linuron residue in carrot samples was determined for carrots treated with linuron post sowing pre emergence (1104 g ai/ha) alone and also carrots treated with a post sowing pre emergence treatment (1248 g ai/ha) followed by post emergence treatments at either 4, 6, 8, 10, 12 and 14 weeks before harvest (Table 1). Residues of linuron in treated carrot samples taken at commercial harvest following a post-sowing/pre-emergence application only ranged from 0.02 mg/kg to less than the LOQ.

Table 1. Results of residue analysis

Weeks after last application	4	6	8	10	12	14
Residue level (mg/kg)	0.04 - 0.01	0.03 - <0.01	0.02 - <0.01	<0.01	<0.01	<0.01

INTRODUCTION

There are over 7,500 hectares of carrots grown in Australia, worth \$150 million at the farmgate (ABS, 2003). All crops are established by direct seeding into well prepared raised beds. Carrots are grown in every state, with the main production being in Victoria, followed by Western Australia and South Australia.

The different carrot growing regions have different growing times and a wide maturity time depending on the season. It can range from 60 days for baby carrots to 120 days for early spring crops.

All carrot crops require good weed control, especially during the establishment period, as the crops are delicate and do not compete well with weeds.

The carrot industry has identified the need for maintaining the use of linuron for grass and broadleaved weed control for domestic and export markets. When applied for weed control in long season carrots, the withholding period of 10 weeks is acceptable. The short season carrot varieties are important to domestic and export markets but cannot utilise the benefits of linuron as the season is shorter than 10 weeks.

The data generated through this project will be used to help set a new withholding period and a maximum residue limit (MRL) for linuron in carrots and improve access to domestic and export markets.

MATERIALS AND METHODS

The field investigation phases of this study were conducted using Peracto Pty Ltd's Standard Operating Procedures, which comply with the OECD Principles of Good Laboratory Practice Number 1 (revised 1997), Paris 1998 and Number 13, June 2002, GLP Facility No: 14609. All specimens were analysed by AgriSolutions Australia at their laboratory at Deception Bay in Brisbane, Facility No: 14951.

The formulation of the pesticide used in the study was as follows:

Table 2. Test substance

Product name	Active ingredient (ai)	Concentration of active ingredient	Formulation
Dupont Linuron 480 SC	linuron	500 g/L	Suspension Concentrate

This study was conducted at eight field sites; Binningup, Western Australia, Wanneroo, Western Australia, and two sites each at Devon Meadows, Victoria, North Motton, Tasmania and Kindred, Tasmania.

The list of trials undertaken and completed is as follows:

Table 3. Trial sites

Site #	Crop	Soil type	Sowing timing	State
1	Baby carrots	Light sandy	Feb	VIC
2	Baby carrots	Light sandy	June	VIC
3	Domestic carrots	Heavy clay	Jan	TAS
4	Domestic carrots	Heavy clay	Sep	TAS
5	Export carrots	Heavy clay	Jan	TAS
6	Export carrots	Heavy clay	Oct	TAS
7	Export carrots	Light sandy	Jan	WA
8	Export carrots	Light sandy	Dec	WA

The treatment information and sample timings were as follows:

Table 4. Treatment information

Trt	Formulated test substance	Active ingredient	Rates of test substance (g/ha)	Rates of active (g a.i./ha)	Application timings
T1	Untreated control	Nil	N/A	N/A	N/A
T2	DuPont Linuron 480 SC	linuron	2.3	1104	Post-sowing/ Pre-emergence
T3	DuPont Linuron 480 SC	linuron	2.3	1104	Post-sowing/ Pre-emergence
			2.6	1248	Post-emergence

Table 5. Application and sampling timings for domestic and baby carrots (Sites 1 to 4)

Application timing								Sample timings
Treatment number	Post sowing/ pre-emergence	Post-emergence						
		14 WBH	12 WBH	10 WBH	8 WBH	6 WBH	4 WBH	
T1 – UTC								Harvest
T2	X							2WBH,harvest & 2WAH
T3	X	X						14WALA
T3	X		X					12WALA
T3	X			X				10WALA
T3	X				X			8WALA
T3	X					X		6WALA
T3	X						X	4WALA

WBH = Weeks Before Harvest

WALA = Weeks After Last Application

WAH = Weeks After Harvest

Table 6. Application and Sampling Timings for Export Carrots (Sites 5 to 8)

Application timing							Sample timings
Treatment number	Post sowing/ pre-emergence	Post-emergence					
		14 WBH	12 WBH	10 WBH	8 WBH	6 WBH	
T1 – UTC							Harvest
T2	X						Harvest
T3	X	X					14WALA
T3	X		X				12WALA
T3	X			X			10WALA
T3	X				X		8WALA
T3	X					X	6WALA

WBH = Weeks Before Harvest

WALA = Weeks After Last Application

RESULTS AND DISCUSSION

A GLP compliant field trial report and analytical report, to GLP standard was prepared and submitted to Horticulture Australia Ltd. The results are summarised below.

Table 7. Results of Residue Analysis (All Sites)

Weeks after last application	4	6	8	10	12	14
Residue level (mg/kg)	0.04 - 0.01	0.03 - <0.01	0.02 - <0.01	<0.01	<0.01	<0.01

Residues of linuron in treated carrot samples taken at commercial harvest following a post-sowing/pre-emergence application only ranged from 0.02 mg/kg to less than the LOQ.

Table 8. Residue results for analyses of linuron – Trial site 1, Victoria

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S1/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S1/T2/2WBH	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S1/T2/harvest	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S1/T2/2WAH	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S1/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	Not sampled
HAL/S1/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S1/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S1/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01
HAL/S1/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.03
HAL/S1/T3/4WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.04

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 9. Residue results for analyses of linuron – Trial site 2, Victoria

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S2/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S2/T2/2WBH	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S2/T2/harvest	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S2/T2/2WAH	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S2/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S2/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S2/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S2/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S2/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S2/T3/4WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 10. Residue results for analyses of linuron – Trial site 3, Tasmania

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S3/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S3/T2/2WBH	Dupont Linuron 480 SC	1104	Root	0.01
HAL/S3/T2/harvest	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S3/T2/2WAH	Dupont Linuron 480 SC	1104	Root	<LOQ
HAL/S3/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S3/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S3/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S3/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02
HAL/S3/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02
HAL/S3/T3/4WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 11. Residue results for analyses of linuron – Trial site 4, Tasmania

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S4/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S4/T2/2WBH	Dupont Linuron 480 SC	1104	Root	0.01
HAL/S4/T2/harvest	Dupont Linuron 480 SC	1104	Root	0.01
HAL/S4/T2/2WAH	Dupont Linuron 480 SC	1104	Root	Not sampled
HAL/S4/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S4/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S4/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S4/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S4/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01
HAL/S4/T3/4WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 12. Residue results for analyses of linuron – Trial site 5, Tasmania

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S5/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S5/T2/harvest	Dupont Linuron 480 SC	1104	Root	0.01
HAL/S5/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S5/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S5/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S5/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02
HAL/S5/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.03

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 13. Residue results for analyses of linuron – Trial site 6, Tasmania

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S6/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S6/T2/harvest	Dupont Linuron 480 SC	1104	Root	0.02
HAL/S6/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S6/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S6/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S6/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01
HAL/S6/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 14. Residue results for analyses of linuron – Trial site 7, Western Australia

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S7/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S7/T2/harvest	Dupont Linuron 480 SC	1104	Root	0.02
HAL/S7/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S7/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S7/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S7/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02
HAL/S7/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.03

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

Table 15. Residue results for analyses of linuron – Trial site 8, Western Australia

Specimen number	Test item	Formulation rate linuron (g a.i./ha)	Specimen type	Total linuron residues ¹ (mg/kg)
HAL/S8/T1/harvest	Untreated control	Nil	Root	<LOQ
HAL/S8/T2/harvest	Dupont Linuron 480 SC	1104	Root	0.02
HAL/S8/T3/14WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S8/T3/12WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S8/T3/10WALA	Dupont Linuron 480 SC	1104 + 1248	Root	<LOQ
HAL/S8/T3/8WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.01
HAL/S8/T3/6WALA	Dupont Linuron 480 SC	1104 + 1248	Root	0.02

LOQ = 0.01 mg/kg for linuron in carrot specimens.

Please see section 14.2 Precision, for %C.V. as applicable to the final results.

Note 1: Results are the sum of linuron plus 3,4-dichloroaniline, expressed as linuron equivalents

WALA = Weeks After Last Application

WBH = Weeks Before Harvest

WAH = Weeks After harvest

TECHNOLOGY TRANSFER

The data generated through this project will be used to help set a new withholding period and a maximum residue limit (MRL) for linuron in carrots and improve access to domestic and export markets.

Any changes to the withholding periods will be reflected on the product labels.

RECOMMENDATIONS

None applicable at this time.

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