Evaluation of oxadiargyl herbicide in various Australian horticultural crops

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Summary Oxadiargyl was screened for weed efficacy and crop safety in a range of annual horticultural crops in Australia. Oxadiargyl is a selective herbicide, which belongs to the oxadiazole chemical group. The product acts by inhibition of protoporphyrinogen oxidase and has both pre- and early post-emergent weed activity.

Australian trial work has shown the product is active on a range of broadleaf and grass weeds at 400 g a.i. ha^{-1}, applied pre-weed emergence. Key weeds controlled include *Amaranthus powellii* S.Watson, *Solanum nigrum* L., *Chenopodium album* L., *Nicandra physaloides* (L.) Gaertn., *Echinochloa crus-galli* (L.) P.Beauv. and *Eleusine indica* (L.) Gaertn. Oxadiargyl has been shown to have high levels of crop safety to crops including cauliflower, cabbage, broccoli, capsicums and potatoes.

Continued availability and development of new crop protection products in horticultural crops in Australia continues to be a production issue due to limited availability. Oxadiargyl herbicide potentially offers a new class of herbicide chemistry for management of weeds in a range of horticultural crops in Australia. The product also has a number of characteristics that make it particularly suited to annual horticultural crops including a short residual activity period, broad weed spectrum and use in a wide range of soil types.

Keywords Oxadiargyl, herbicide, *Amaranthus powellii*, *Solanum nigrum*, *Chenopodium album*, *Nicandra physaloides*, *Echinochloa crus-galli*, *Eleusine indica,* cauliflower, cabbage, broccoli, potato, lettuce, capsicum, carrot.

INTRODUCTION

Oxadiargyl is a selective herbicide, which belongs to the oxadiazole chemical group and acts by the inhibition of protoporphyrinogen oxidase. The product acts on germinating weeds as the shoots come into contact with treated soil. Oxadiargyl acts principally via contact with only very limited translocation. Oxadiargyl has both pre- and early post-emergent weed activity, on a range of both grass and broadleaf weeds. A number of pre-emergent herbicides are strongly affected by soil components such as clay and organic matter, which can greatly influence their efficacy and crop safety. The efficacy and crop safety of oxadiargyl is not affected by soil type compared with other herbicides such as metolachlor or clomazone.

Globally, oxadiargyl was developed for rice and sugar cane; however the product is also being evaluated in sunflower, transplanted vegetables and perennial crops (Thomson 1997).

MATERIALS AND METHODS

Oxadiargyl has been evaluated in replicated small plot trials for the past five years in Australia. Trials were conducted in commercial irrigated vegetable crops in various production regions throughout Australia. Trials had between three and four replicates and herbicide treatments were applied with flat fan nozzles, generally applying water rates of between 200 and 300 L ha^{-1} at an application pressure of between 200 and 300 kPa. In all trials oxadiargyl was applied post-plant pre-crop emergence or pre-plant in transplanted crops. A 400 g a.i. L^{-1} suspension concentrate formulation of oxadiargyl was used in all trials. Plot sizes were between 10 and 30 m^2. Assessments were conducted as whole plot subjective ratings using the European Weed Research System (EWRS) scales for weed control efficacy (1 = total weed control, 9 = no effect on weeds) and crop tolerance (1 = healthy plant, 9 = crop killed) (Puntener 1981). Oxadiargyl has been compared with a range of other herbicides used both alone and in combinations.

RESULTS

Crop safety Transplanted vegetable crops including broccoli, cabbage, cauliflower, lettuce and capsicum showed high tolerance to oxadiargyl at between 200 and 400 g a.i. ha^{-1} applied pre-transplant (Table 1). The product was also safe when applied post-plant pre-emergence in potatoes. Oxadiargyl was not safe when applied post-plant pre-emergence at 400 g a.i. ha^{-1} to carrots and cucurbit crops including pumpkins and squash (Table 1).

Despite the variation in soil types on which the trials were conducted the low standard error values for both the crop safety and weed efficacy ratings suggest that soil type is having minimal effect on the efficacy of this herbicide, which supports the findings of Dickmann *et al*. (1997).

Table 1. Average EWRS crop tolerance ratings in annual horticultural crops for oxadiargyl applied pre-transplant or pre-crop emergence.

Crop	Application timing*	Rate (g a.i. ha^{-1})	No. sites	Average EWRS rating	Standard error
Broccoli	PT	400	4	1.9	0.3
Cabbage	PT	400	3	1.4	0.4
Capsicum	PT	400	3	1.6	0.5
Cauliflower	PT	400	1	1.0	–
Lettuce	PT	200	2	2.2	1.2
Carrots	PE	200	2	4.1	1.3
Carrots	PE	400	1	7.8	–
Potato	PE	400	3	2.0	0.6
Pumpkin	PE	400	1	4.0	–
Squash	PE	400	1	6.0	–

* PT = pre-transplant, PE = post-sowing pre-crop emergence.

Weed control efficacy Trials conducted over a number of sites throughout Australia have shown oxadiargyl at 400 g a.i. ha^{-1} effectively controls a range of broadleaf and grass weeds including *Amaranthus powellii* S.Watson, *Solanum nigrum* L., *Chenopodium album* L., *Nicandra physaloides* (L.) Gaertn., *Echinochloa crus-galli* (L.) P.Beauv. and *Eleusine indica* (L.) Gaertn. (Table 2).

Oxadiargyl showed some activity on both *Raphanus raphanistrum* L. and *Polygonum aviculare* L. However, these weeds were not controlled effectively, with EWRS ratings of 4.7 and 6.3 respectively (Table 2).

Table 2. Average EWRS weed control ratings for different weed species for oxadiargyl applied pre-weed emergence at 400 g a.i. ha^{-1}.

Weed	No. sites	Average EWRS rating	Standard error
Amaranthus powellii	3	2.7	0.2
Chenopodium album	6	2.1	0.5
Eleusine indica	3	1.3	0.1
Nicandra physaloides	4	1.9	0.9
Polygonum aviculare	1	6.3	–
Raphanus raphanistrum	4	4.7	1.3
Solanum nigrum	9	2.4	0.5

DISCUSSION

Continued availability and development of new crop protection products in horticultural crops in Australia continues to be a production issue due to limited availability of products. Oxadiargyl herbicide potentially offers a new class of herbicide chemistry for management of weeds in a range of horticultural crops.

Oxadiargyl is a potential herbicide in crops such as lettuce and capsicums, for which few effective herbicides are registered, and also offers a solution to industry problems such as control of Solanaceae weeds, such as *Solanum nigrum*, in crops such as potatoes and capsicums, which are from the same family.

The product also has a number of characteristics that make it particularly suited to annual horticultural crops including short residual activity period, broad weed spectrum and high crop safety on a wide range of soil types.

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