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Selectivity and Phytotoxicity of Oxadiargyl on Cumin and Weeds and its Residual Effect on Succeeding Mothbean and Pearl Millet

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ABSTRACT

Oxadiargyl at 50 g ha^{-1} applied 20 days after sowing proved most effective in minimizing weed growth and enhancing the seed yield of cumin which was similar to that of pendimethalin at 1.0 kg ha^{-1}. Oxadiargyl at 75 g ha^{-1} and above showed some phytotoxicity symptoms on cumin leaves which was recovered at later stages. Residual effect of oxadiargyl was not observed on succeeding crops of mothbean and pearl millet.

INTRODUCTION

Cumin (*Cuminum cyminum* L.) is a short statured crop with slow initial growth which makes it incapable of offering competition to aggressive weeds leading to reduction in seed yield of cumin upto the extent of 80% (Choudhary and Gupta, 1991). Pendimethalin and fluchloralin were found effective in cumin for control of weeds (Mehta and Bhadoriya, 1982; Parihar and Singh, 1994), but had residual effects on succeeding summer pearl millet in western Rajasthan and Gujarat conditions (Patel and Barevadia, 1999; Yadav and Lal, 2001), therefore, alternative cost effective and ecofriendly herbicides specially post-emergence ones are also needed in controlling the weeds. Hence, the present study was planned to test the selectivity and phytotoxicity of oxadiargyl on cumin and weeds.

MATERIALS AND METHODS

A field experiment was conducted during winter seasons of 1998-1999, 1999-2000 and 2000-01 at Agricultural Research Station, Mandor-Jodhpur. The soil was loamy sand, low in organic carbon (0.21%), medium in phosphorus (13.0 kg ha^{-1}) and high in potash (350 kg K ha^{-1}) with a pH of 8.1. The treatments comprised doses of oxadiargyl (50, 60, 75, 150 and 300 g ha^{-1}), pendimethalin at 1.0 kg ha^{-1}, weedy and weed-free checks. The treatments were replicated four times in a randomized block design. Dry sowing of cumin (cv. RZ 19) was done at row spacing of 30 cm and then irrigation was applied to ensure good germination. Irrigations were given at 10, 35, 60 and 85 days after sowing (DAS) as per the recommendation.

Oxadiargyl was applied 20 DAS as early post-emergence after complete emergence of cumin. Pendimethalin was sprayed one day after sowing. Herbicides were applied with a manually operated knapsack sprayer at spray volume of 500 l ha^{-1} Phytotoxic effect on crop was recorded upto 10 days of herbicide spray. For this, 10 plants were selected at random from each plot and total number of leaves and those showing phytotoxicity, if any, were counted. The extent of phytotoxicity was recorded based on 0-10 scale where, 0 means no phytotoxicity and 10 means 91-100% phytotoxicity.

To assess the residual effect of herbicides on the succeeding crops in summer season just after the harvesting of cumin, the seeds of pearl millet (cv. Raj 171) and mothbean (cv. RMO 40) were sown in the inter row spaces of cumin stubbles without disturbing the soil. For this, each plot was divided in two parts and five rows (30 cm apart) were assigned to pearl millet and remaining five rows to moth bean and thus making the plot size (1.5 m x 4.0 m) for each crop. Seeds of both the crops were pre-tested for germination. Irrigations and other packages were given as per the recommendations for summer season.

RESULTS AND DISCUSSION

Effect on Weeds

The dominant weeds of the experimental plots were : lambsquarter (*Chenopodium album* L. and *Chenopodium murale* L. and Goldan dock *(Rumex dentatus* L.). The other weeds present were wild onion (*Asphodelus tenuifolius* L.), Indian clover *(Melilotus indica* L.) and nut sedge (*Cyperus rotundus* L.).

The density and dry weight of weeds were significantly reduced by all the treatments compared with weedy check (Table 1). Oxadiargyl at all the doses had significantly less density and dry weight of weeds than pendimethalin at 1.0 kg ha^{-1}. Oxadiargyl at all the doses was equally effective in controlling C. *album.* Oxadiargyl suppressed the growth of *R. dentatus* and reduced its dry weight but could not control effectively. Pendimethalin was effective in controlling *R. dentatus.*

Effect on Crop

Oxadiargyl at 75 g ha^{-1} showed some burning at tips and surface of leaves of cumin, however, it was recovered after seven days of herbicide application. The higher doses of oxadiargyl (150 and 300 g ha^{-1}) showed leaf burning from 21-90% on 5th day of application, however, plants recovered at later stage. Oxadiargyl at 75 g ha^{-1} had wilting effect from 1-10%, whereas at 300 g ha^{-1} it was 11 to 20% affecting normal plant stand of the crop.

Significantly higher number of plants survived in the plots treated with oxadiargyl (50-75 g ha^{-1}) and was at par with pendimethalin at 1.0 kg ha^{-1} and weed-free treatment (Table 2). This may be attributed to minimum crop-weed competition in these

Table 1. Effect of oxadiargyl on density and dry weight of weeds in cumin (Pooled over three years)

Treatment	Dose (g ha^{-1})	Stage of application (DAS)	Density at 40 DAS (No. m^{-2})			Dry weight at 60 DAS (g m^{-2})		
			C. album	*R. dentatus*	Total	*C. album*	*R. dentatus*	Total
Oxadiargyl	50	20	3.5	5.1	14	4.4	46.8	55.1
Oxadiargyl	60	20	4.8	4.8	14	4.5	45.6	53.2
Oxadiargyl	75	20	4.5	4.2	12	5.1	52.5	50.8
Oxadiargyl	150	20	2.7	3.5	8	3.0	40.4	45.3
Oxadiargyl	300	20	1.2	3.3	6	3.0	39.8	43.6
Pendimethalin	1000	1	14.5	2.7	20	25.5	15.5	45.6
Weed-free	-	-	0.0	0.0	0	0.0	0.0	0.0
Weedy	-	-	265.0	5.2	273	158.9	69.4	219.9
LSD (P=0.05)	-	-	2.6	1.3	5	4.3	7.2	12.6

DAS–Days after sowing.

Table 2. Effect of oxadiargyl on growth, yield attributes and seed yield of cumin (Pooled over three years)

Treatment	Dose (g ha^{-1})	Stage of application (DAS)	Plant stand (No. m^{-2})		Height (cm)	Branches (No. $plant^{-1}$)	Umbels $plant^{-1}$ (No. $plant^{-1}$)	Seed yield (kg ha^{-1})
			Initial	40 DAS				
Oxadiargyl	50	20	70.2	64.7	31.2	5.4	29.1	393
Oxadiargyl	60	20	68.8	64.4	30.5	5.7	29.2	374
Oxadiargyl	75	20	67.2	62.5	28.5	5.1	28.3	334
Oxadiargyl	150	20	69.2	58.8	26.1	4.8	30.0	313
Oxadiargyl	300	20	69.0	42.0	25.8	4.6	34.0	260
Pendimethalin	1000	1	70.3	66.0	32.4	5.5	32.0	385
Weed-free	-	-	70.8	66.2	34.2	5.7	32.6	427
Weedy	-	-	69.4	17.6	28.9	2.6	8.2	02
LSD (P=0.05)	-	-	NS	2.6	3.2	0.4	3.6	32

NS–Not Significant.

treatments. Although the crop-weed competition was also minimum in the higher doses (150-300 g ha^{-1}) of oxadiargyl, yet the plant stand was significantly lower due to phytotoxicity. Plant height was at par in weed-free plots, pendimethalin at 1.0 kg ha^{-1} and of oxadiargyl at 50 and 60 g ha^{-1}. Oxadiargyl at 75-300 g ha^{-1} significantly reduced the plant height of cumin compared to weed-free and pendimethalin. More umbels $plant^{-1}$ in higher doses (150-300 g ha^{-1}) of oxadiargyl were due to the lower plant stand ha^{-1} in these treatments (Table 2).

All the treatments produced significantly higher seed yield of cumin than weedy check (Table 2). Highest seed yield of cumin was obtained in weed-free plots. Oxadiargyl at 50 g ha^{-1} produced seed yield of cumin statistically at par with pendimethalin at 1.0 kg ha^{-1}. Higher doses of oxadiargyl significantly reduced seed yield of cumin because of lesser plant stand, reduced height and branches $plant^{-1}$.

Table 3. Residual effect of herbicides on succeeding pearl millet and moth bean in summer season (Pooled over two years)

Treatment	Dose (g ha^{-1})	Stage of application (DAS)	Plant stand (No. m^{-2})		Yield (kg ha^{-1})	
			Pearl millet	Moth bean	Fodder of pearl millet	Seed yield of moth bean
Oxadiargyl	50	20	17.5	23.1		
Oxadiargyl	60	20	17.8	21.8	9440	360
Oxadiargyl	75	20	17.9	23.5	9540	360
Oxadiargyl	150	20	19.3	21.5	8765	340
Oxadiargyl	300	20	18.1	21.7	8840	320
Pendimethalin	1000	1	5.8	23.6	5240	370
Weed-free	-	-	18.0	23.2	981	360
Weedy	-	-	19.2	24.0	8835	320
LSD (P=0.05)	-	-	6.0	NS	206	NS

NS–Not Significant.

Residual Effect on Succeeding Crops

Oxadiargyl had no adverse effect on the plant stand and yield of succeeding crops of pearl millet and moth bean (Table 3). However, plant stand and fodder yield of succeeding pearl millet were adversely affected by pendimethalin (recommended control). Patel *et al.* (1999) and Yadav and Lal (2001) also reported phytotoxicity of pendimethalin applied in cumin on the germination of succeeding pearl millet in summer season. No phytotoxic effect of pendimethalin was observed on succeeding moth bean crop (Table 3).

It was concluded from the three years' study that oxadiargyl at 50 g ha^{-1} as early post-emergence effectively controlled weeds in cumin and produced seed yield comparable with pendimethalin at 1.0 kg ha^{-1} as pre-emergence. Oxadiargyl had no residual effects on succeeding pearl millet and moth bean crop in summer seasons.

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