

## Effect of Different Weed Management Practices on Weeds and Yield of Cumin

M.L. Mehriya, R.S. Yadav, R.P. Jangir and B.L. Poonia

Agricultural Research Station, Rajasthan Agricultural University, Mandore 342 304, Jodhpur, India

**Abstract:** *Chenopodium murale*, *C. album* and *Rumex dentatus* were the predominant weeds in the experimental field. Oxyfluorfen at 50 or 75 g ha<sup>-1</sup>, and oxadiargyl at 50 g ha<sup>-1</sup> applied at 20 DAS along with one hand weeding at 35 DAS, being at par among themselves, brought maximum reduction in weed biomass production of *Chenopodium* spp. as well as total weeds, thereby recording (93.9-96.2%) higher weed control efficiency. However, maximum dry weight of *Rumex dentatus* was reduced due to the application of paraquat at 0.4 kg ha<sup>-1</sup> + one hand weeding. Integration of oxyfluorfen at 50 or 75 g ha<sup>-1</sup> along with one hand weeding gave comparable seed yield to weed free check and consequently provided maximum B:C ratio (2.92). Oxadiargyl+hand weeding resulted in statistically at par seed yield to that obtained with combined application of oxyfluorfen+hand weeding. Amongst the sole herbicidal treatments, oxyfluorfen 50 or 75 g ha<sup>-1</sup> or oxadiargyl 50 g ha<sup>-1</sup> applied at 20 DAS recorded higher WCE (83.3-88.9%) and produced significantly higher growth and yield attributing characters which led to higher seed yield, net returns and B:C ratio compared to fluchloralin 1.0 kg ha<sup>-1</sup> PPI (recommended herbicidal control).

**Key words:** Cumin, weeds, herbicide, weed control efficiency.

Cumin (*Cuminum cyminum* L.) is extensively grown in western Rajasthan because of its adaptability to agroclimatic conditions of this area. Cumin, being a short stature crop with slow initial growth, heavily infested with several weed species which cause severe competition, resulting in yield reduction of cumin upto 99% (Yadav *et al.*, 2004). Many herbicides such as pendimethalin and fluchloralin, applied as pre-emergence/pre-plant incorporation (PPI) have been found effective for controlling weeds in cumin (Parihar and Singh, 1994), but these dinitroanilines are reported to have residual effects on succeeding crop of pearl millet in western Rajasthan and Gujrat (Yadav

*et al.*, 2004; Patel and Mehta, 1989). Moreover, cumin being irrigated crop, weeds emerge up to later stage of crop growth. Therefore, alternative cost effective and eco-friendly herbicides especially post-emergence ones need to be identified for controlling weeds in cumin. Since single method of weed control is not able to control weeds to the desired level in crops like cumin, so integration of chemical and mechanical methods might be more effective to manage the weeds in this crop. In light of above considerations, the present study was carried out to test the efficacy of various herbicides alone and along with one hand weeding in cumin.

## Materials and Methods

The experiment was conducted during the winter seasons of 2003-04 and 2004-05 at the Agricultural Research Station, Mandore, Jodhpur, to find out the effect of weed management practices on the weeds and yield of cumin. The soil was sandy loam (13.0% clay, 10.7% silt and 76.3% sand) in texture, low in organic carbon (0.13%) and available nitrogen (170 kg ha<sup>-1</sup>), medium in available phosphorus (26 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and available potassium (391 kg K<sub>2</sub>O ha<sup>-1</sup>) contents with a pH of 8.0. The treatments comprised of application of paraquat (0.4 kg ha<sup>-1</sup>), glyphosate (0.5 kg ha<sup>-1</sup>) applied 7 days after sowing (DAS) either alone or along with one hand weeding at 35 DAS; oxadiargyl (50 g ha<sup>-1</sup>) at 7 or 20 DAS and oxyfluorfen (50 or 75 g ha<sup>-1</sup>) at 20 DAS either alone or with one hand weeding and the recommended fluchloralin at 1.0 kg ha<sup>-1</sup> PPI (pre-plant incorporation). In addition to these, weedy check and weed-free control were also tried. Fifteen treatments were replicated three times in a randomized block design. Dry sowing of cumin variety RZ-19 was done in rows 30 cm apart on 23 November 2003 and 21 November 2004 and then irrigation was applied. Another light irrigation was given at 9 DAS to ensure good germination. A basal dose of half nitrogen (15 kg N ha<sup>-1</sup>) and full dose of phosphorus (20 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) were drilled uniformly just before sowing. The remaining half dose of N was top dressed at the time of 3<sup>rd</sup> irrigation (32 DAS). Flat-fan nozzle was used for herbicide application, using 500 L water ha<sup>-1</sup>. Plant protection measures were followed as per recommendation of package and practices of crops for zone Ia, 2002-03.

All the weeds falling within 0.25 m<sup>2</sup> quadrat at random were cut close to the ground and were collected species wise in paper bags and weighed after drying them in oven at 65°C for 8 hours. Weed control efficiency (WCE) was computed following Umrani and Boi (1982).

$$WCE = [(W_C - W_T) / W_C] \times 100$$

where, W<sub>C</sub> is dry weight of weeds in weedy check plot, W<sub>T</sub> is dry weight of weeds in treated plot.

## Results and Discussion

### *Effect on weeds*

Weed flora of the experimental field consisted of *Chenopodium murale* L., *Chenopodium album* L., *Rumex dentatus* L., *Asphodeuls tenuifolius* L., *Launea asplenifolia* L., *Cynodon dactylon* L. and *Cyperus rotundus* L. However, predominant weeds were *C. murale* L. (70.0%), *C. album* L. (16.3%) and *R. dentatus* L. (2.6%). The dry weight of *Chenopodium* spp., *Rumex dentatus* and total weeds reduced significantly by all the weed control treatments compared to weedy check (Table 1). Application of 50 or 75 g ha<sup>-1</sup> of oxyfluorfen or oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS significantly reduced the dry matter of *Chenopodium* spp. and total weeds compared to fluchloralin 1.0 kg ha<sup>-1</sup> (PPI). Yadav *et al.* (2004) also reported that oxadiargyl at 50 g ha<sup>-1</sup> had a better control of weeds in cumin. Although oxyfluorfen at 50 or 75 g or oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS had better control of *Chenopodium* spp., yet *Rumex dentatus* was significantly better controlled by fluchloralin at 1.0 kg ha<sup>-1</sup>. Application of oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS significantly lowered the dry weight of individual, as

Table 1. Effect of weed control treatments on weed population, weed dry weight and weed control efficiency (WCE) in cumin at 90 DAS (pooled over two seasons)

Treatment	Dose (g ha <sup>-1</sup> )	Time of applica- tion	Weed population (m <sup>-2</sup> )	Weed dry weight (g m <sup>-2</sup> )					WCE (%)
				<i>C. murale</i>	<i>C. album</i>	<i>R. dentatus</i>	Other weeds	Total weeds	
Weedy check			15.0 (238)	163.1	77.2	105.7	41.7	387.7	0.0
Weed free			0.7 (0)	0.0	0.0	0.0	0.0	0.0	100.0
Fluchloralin	1000	PPI	6.0 (37)	56.2	18.8	13.0	4.1	92.1	76.2
Paraquat	400	7 DAS	10.7 (117)	74.1	43.9	64.7	17.9	200.6	48.3
Paraquat +HW	400	7 DAS	5.3 (29)	30.9	19.8	0.9	11.3	62.9	83.8
Glyphosate	500	7 DAS	11.7 (140)	104.6	78.4	86.3	10.6	279.9	27.8
Glyphosate+ HW	500	7 DAS	5.5 (33)	36.7	26.7	13.7	2.7	79.7	79.4
Oxadiargyl	50	7 DAS	7.1 (50)	47.2	19.6	56.3	2.6	125.7	67.6
Oxadiargyl+ HW	50	7 DAS	3.8 (15)	21.1	16.6	11.2	2.5	51.3	86.8
Oxadiargyl	50	20 DAS	5.0 (25)	16.0	10.2	36.8	2.0	64.9	83.3
Oxadiargyl+ HW	50	20 DAS	2.8 (7)	7.5	9.1	3.0	3.9	23.5	93.9
Oxyfluorfen	50	20 DAS	4.8 (24)	13.2	11.6	30.5	3.4	58.6	84.9
Oxyfluorfen+ HW	50	20 DAS	2.9 (8)	5.9	5.6	4.1	3.2	18.7	95.2
Oxyfluorfen	75	20 DAS	4.5 (20)	8.2	6.8	25.0	2.9	42.9	88.9
Oxyfluorfen+ HW	75	20 DAS	2.2 (5)	3.3	3.0	3.9	4.5	14.7	96.2
CD (P=0.05)			0.7	4.5	3.3	3.5	6.7	11.5	-

HW = One hand weeding at 35 DAS, DAS = Days after sowing, PPI = Pre-plant incorporation, Weed density transformed to  $\sqrt{n+0.5}$ .

well as total weeds compared to its application at 7 DAS. This might be due to the re-emergence of weeds after 7 DAS in this treatment. Similarly, paraquat at 0.4 or 0.5 kg ha<sup>-1</sup> of glyphosate applied at

7 DAS (before the emergence of cumin) failed to decrease the dry matter of weeds in cumin. Integration of herbicides with one hand weeding at 35 DAS significantly decreased the dry weight of individual and

Table 2. Effect of weed control treatments on attributes, seed yield and economics of cumin (pooled over two seasons)

Treatment	Dose (g ha <sup>-1</sup> )	Time of application	Final plant stand (‘000’ ha <sup>-1</sup> )	Umbels plant <sup>-1</sup>	Umbellets umbel <sup>-1</sup>	Test weight (g)	Seed yield (kg ha <sup>-1</sup> )	Net returns (Rs. ha <sup>-1</sup> )	Benefit: cost ratio
Weedy check			168	5.80	4.28	3.37	61	-8646	0.29
Weed free			489	15.13	5.25	4.14	692	26427	2.70
Fluchloralin	1000	PPI	391	12.63	5.02	3.93	488	15936	2.19
Paraquat	400	7 DAS	257	7.08	4.33	3.51	94	-7255	0.43
Paraquat +HW	400	7 DAS	417	11.40	4.72	3.69	470	14401	2.00
Glyphosate	500	7 DAS	243	6.52	4.28	3.40	104	-6579	0.48
Glyphosate+ HW	500	7 DAS	402	11.78	4.67	3.68	511	16681	2.16
Oxadiargyl	50	7 DAS	403	11.43	4.73	3.72	456	14721	2.15
Oxadiargyl+ HW	50	7 DAS	434	13.47	4.77	3.94	575	20318	2.40
Oxadiargyl	50	20 DAS	444	13.77	5.10	4.01	577	21996	2.71
Oxadiargyl+ HW	50	20 DAS	470	14.65	5.17	4.01	638	24823	2.80
Oxyfluorfen	50	20 DAS	447	11.53	5.12	3.95	578	22189	2.75
Oxyfluorfen+ HW	50	20 DAS	483	14.58	5.07	4.04	643	25593	2.92
Oxyfluorfen	75	20 DAS	452	13.12	5.07	3.95	563	21143	2.65
Oxyfluorfen+ HW	75	20 DAS	490	14.92	5.13	4.00	650	25948	2.92
CD (P=0.05)			50	1.40	0.49	0.36	50	3043	-

total weeds compared to sole application of herbicides. Oxyfluorfen at 50 or 75 g ha<sup>-1</sup>+hand weeding at 35 DAS or oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS+hand weeding at 35 DAS significantly lowered dry weight of weeds compared to all other integrated treatments. Higher WCE was recorded in the plots treated with oxyfluorfen 75 g ha<sup>-1</sup> at 20 DAS (88.9%) followed by oxyfluorfen 50 g ha<sup>-1</sup> at 20 DAS (84.9%),

and oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS (83.3%) compared to fluchloralin 1.0 kg ha<sup>-1</sup> (76.2%). The WCE further increased with the integration of one hand weeding with the herbicidal treatments and the maximum WCE was obtained due to oxyfluorfen 50 and 75 g ha<sup>-1</sup> at 20 DAS+ one hand weeding (95.2 and 96.2%, respectively) followed by oxadiargyl 50 g ha<sup>-1</sup> at 20 DAS + one hand weeding (93.9%).

### Effect on crop

All the weed control treatments significantly decreased plant mortality as compared to weedy check (Table 2). The plant stand ( $4,90,000 \text{ ha}^{-1}$ ) was minimum due to oxyfluorfen ( $75 \text{ g ha}^{-1}$ ) with one hand weeding and being at par to weed free and the treatments involved oxyfluorfen and oxadiargyl applied at 20 DAS registered significantly better stand over remaining treatments. The treatments including oxadiargyl, paraquat and glyphosate applied at 7 DAS with one hand weeding significantly increased the number of survived plants as compared to their sole application. This might be attributed to minimum crop-weed competition in these treatments. Umbels  $\text{plant}^{-1}$  increased by 161 and 151%, test weight by 23 and 17% in weed free and application of oxyfluorfen  $50 \text{ g ha}^{-1}$  with one hand weeding compared with weedy check plots, respectively. Similar trends were obtained by Parihar and Singh (1994). Both the doses of oxyfluorfen and oxadiargyl applied at 20 DAS significantly increased the number of umbellets  $\text{umbel}^{-1}$  over weedy check.

All the weed control treatments produced significantly higher mean seed yield of cumin compared with weedy check except paraquat and glyphosate treated plots. The ineffectiveness of these herbicides in controlling weeds might be attributed to the fact that a good number of weeds also germinated after the second irrigation at 9 DAS (given to obtain uniform germination of cumin) which acquired substantial amount of dry matter at the later stages of crop growth. Secondly, both paraquat and glyphosate were effective as post-emergence to existing weeds and did not

kill the weeds that emerged after their application. Significantly higher seed yield was recorded due to application of oxyfluorfen at 50,  $75 \text{ g ha}^{-1}$  and oxadiargyl  $50 \text{ g ha}^{-1}$  at 20 DAS superimposed with one hand weeding compared with all other weed control treatments except weed free environment because of effective control of weeds and consequently higher number of umbels per plant and test weight. Amongst the herbicides used, oxadiargyl  $50 \text{ g ha}^{-1}$  at 7 DAS was found inferior to its application at 20 DAS. Integration of one hand weeding with different herbicides produced significantly higher seed yield of cumin compared to its alone applications.

Application of oxadiargyl  $50 \text{ g ha}^{-1}$ , oxyfluorfen at 50 and  $75 \text{ g ha}^{-1}$  had some tip-burning of leaves particularly in  $75 \text{ g ha}^{-1}$  dose (data not given), however, the crop recouped after some time. Yadav *et al.* (2004) also reported similar results. Of the different treatments, the highest benefit:cost ratio was obtained in oxyfluorfen at 50 and  $75 \text{ g ha}^{-1}$  + hand weeding (2.92) followed by oxadiargyl  $50 \text{ g ha}^{-1}$  at 20 DAS (2.80) and were found higher than weed free treatment (2.70). This might be because of more mandays engaged and consequently more cost was required to create weed free conditions for entire period in the season.

It was concluded from the two-year field study that oxyfluorfen or oxadiargyl  $50 \text{ g ha}^{-1}$  each applied at 20 DAS followed by one hand weeding at 35 DAS controlled the weeds effectively and produced higher seed yield of cumin. Economically also, these treatments gave higher net returns and B:C ratio than other treatment combinations.

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