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Effect of Weed and Nutrient Management on Growth, Yield and Quality of Coriander (*Coriandrum sativum* L.)

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ABSTRACT

A field experiment was conducted at Udaipur during 2002-03 and 2003-04 with 11 weed and three nutrient management practices to study the effect on growth, yield and quality of coriander (*Coriandrum sativum*). Weed management practices significantly reduced weed density, dry matter and nutrient uptake by weeds and improved growth (plant height), yield attributes (umbels/plant and weight of seeds/umbel), seed and biological yield, quality parameters (essential oil content and oil out turn) and nutrient uptake by crop as compared to control. Two hand weedings (HW) at 30 and 45 DAS resulted in maximum reduction in weed density, dry weight and nutrient depletion by weeds and gave the highest seed (1.59 t/ha) and biological yield (4.11 t/ha) of coriander. However, maximum essential oil content, oil out turn and B : C ratio (2.13) were obtained by pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS. Both the treatments remained at par in reduction of weed dry matter and nutrient uptake by weeds and resulted in maximum weed control efficiency (88.50%) as compared to rest of the practices. Balanced fertilization with 60 kg N+30 kg P+30 kg K+30 kg S/ha also significantly improved weed dry weight and nutrient uptake by weeds, but simultaneously enhanced crop nutrient uptake, plant height, umbels/plant, 1000 seed weight, seed and biological yield, essential oil content, oil out turn and B : C ratio over N+P and N+P+K application. Treatment of pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS resulted in the highest seed yield, maximum weed control efficiency (88.50%) and B : C ratio (2.13). However, minimum nutrient uptake by crop and maximum nutrient removal by weeds were noted under weedy check.

Key words : Coriander, weed management, nutrient management, nutrient uptake, weed control efficiency

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an important seed spice crop of humid south eastern plains of Rajasthan, which is used both as medicinal as well as flavouring agent i. e. curry powder, pickling and confectionery. Coriander, a short-stature crop with slow initial growth, is severely smothered due to the infestation of weeds at early stages of growth, which causes severe competition and may result in complete crop failure (Kushwaha *et al*., 2002). It is well known fact that weeds compete with crop plants for water, nutrients, space and solar radiations resulting in reduction of yield by 20 to 50%. To minimize the magnitude of nutrients drained by weeds and effective utilization of resources by the crop, control of weeds is essential. Kushwaha *et al*. (2002) and Yadav *et al*. (2004a) reported that herbicides caused an appreciable decrease in density, dry weight and depletion of nutrients by weeds. Since single method is not able to control weeds to the desired level in coriander, integration of chemical and mechanical methods might be an answer to achieve higher weed control efficiency, which in turn, may decrease the depletion of nutrient by weeds. In intensive agriculture, balanced fertilization is a key nutrient in determining the level of crop productivity. Hence, application of N, P, K and S in right amount and proportion, and when it is needed the most seems to be a practical proposition. As limited information is available about the nutrient depletion by weeds under integrated weed and nutrient management in coriander, therefore, present investigation was undertaken to study the effect of herbicide plus hand weeding and nutrient management on crop productivity and nutrient uptake by the crop as well as depletion by weeds.

MATERIALS AND METHODS

The experiment comprising 11 weed management practices in main plots and three nutrient management practices in sub-plots was conducted on clay loam soil of Rajasthan College of Agriculture, Udaipur, during winter season 2002-03 and 2003-04. The treatments comprised one hand weeding (HW) at 30 days after sowing (DAS), two hand weedings at 30 and 45 DAS, application of pendimethalin 1.0 kg/ha pre-

emergence (PE), oxyflurofen 0.25 kg/ha PE, metribuzin 0.30 kg/ha PE and oxadiargyl 75.0 g/ha PE either alone or alongwith one hand-weeding at 45 DAS and three nutrient management practices i. e. 60 kg N+30 kg P/ha, 60 kg N+30 kg P+30 kg K/ha and 60 kg N+30 kg P+30 kg K+30 kg S/ha. In addition to these, weedy check was also maintained. These treatments were replicated thrice in split plot design. The soil was medium in available N (276.9 kg/ha) and P (19.0 kg/ha), high in organic C (0.80%) and available K (365.5 kg/ha) with pH 8.1. Coriander 'CS-6' was sown on 16 October 2003 and 23 October 2004 in rows 30 cm apart and seeds were placed at a depth of 3.0 cm using 20 kg seed/ha. Half dose of N (30 kg/ha) and full dose of P, K and S (each 30 kg/ha) as per treatments were applied basal and remaining half dose of N (30 kg/ha) was top dressed one month after sowing. Flat fan nozzle was used for herbicidal application, using a spray volume of 500 l/ha. Plant protection measures and irrigations were followed as per recommendation. Weed counts (number/$m^{2)}$ and weed dry weight (g/m^2) were recorded by putting a quadrate (0.25 m^2) at two random spots in each plot at harvesting stage of crop. Nutrient uptake by weeds and crop were calculated by multiplying the dry matter yield with the nutrient content. Weed control efficiency (WCE) was also calculated on the basis of dry matter production of weeds. The crop was harvested on 20 February 2004 and 28 February 2005. The experimental data recorded for growth, yield, quality parameters and economics were statistically analyzed. Data on weed density and dry weight of weeds were transformed using $\sqrt{(x+0.5)}$ before statistical analysis.

RESULTS AND DISCUSSION

Weeds

The major weed flora of experimental field consisted of *Chenopodium murale*, *Spergula arvensis*, *Melilotus indica*, *Anagallis arvensis*, *Cyperus rotundus* and *Convolvulus arvensis*. Among the broad-leaf weeds, *C. murale* and *M. indica* were dominant weeds. Irrespective of weed and nutrient management practices, density, dry weight of weeds, weed control efficiency and nutrient depletion by weeds were higher in 2004-05 than in 2003-04. The crop experienced severe weed competition during 2004-05 which might be due to favourable environmental conditions leading to vigorous growth of weeds. All the weed management practices caused significant reduction in weed density, dry weight of weeds and N, P, K and S depletion at crop harvest in comparison to weedy check (Table 1). In general, weed management practices reduced 36.58 to 69.03% and 51.71 to 88.50% density and dry matter of total weeds, respectively, as compared to weedy check. However, lowest density and dry weight of total weeds were recorded under two hand weedings at 30 and 45 DAS, followed by pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS. Similarly, plot receiving two hand weedings at 30 and 45 DAS registered highest weed control efficiency (88.50%), followed by application of pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS (88.14%). The effective control of weeds under these treatments resulted in the highest weed control efficiency and lower nutrient depletion by weeds. Similar results were reported by Pareek *et al.* (2000) and Mehriya *et al*. (2007). Weedy check recorded the highest weed density, weed dry weight and nutrient depletion by weeds owing to their greater competitive ability than crop plant put forth highest biomass under weedy condition.

Nutrient management did not influence weed density, but significantly increased dry weight of weeds and nutrient depletion by weeds. Table 1 shows that the germination of weed seeds was not influenced by the nutrient management. While application of 60 kg N+30 kg P+30 kg K+30 kg S/ha registered an increase of 12.8 and 6.0% weed dry weight over N+P and N+P+K fertilization, respectively. This might be due to more availability of nutrients resulting in higher growth and development of weeds. These results are in conformity with those reported by Pareek *et al.* (2000).

Crop

Growth and yield : All weed management practices significantly improved the growth (plant height) and yield attributes (umbels/plant and weight of seeds/umbel) of coriander over weedy check. The highest values were recorded under two hand weedings at 30 and 45 DAS, followed by pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS, oxyflurofen 0.25 kg/ha+one hand weeding at 45 DAS and oxadiargyl 75 g/ha+one hand weeding at 45 DAS (Table 2). However, two hand weedings and pendimethalin+one hand weeding were found at par with each with respect to all parameters. Two hand weedings at 30 and 45 DAS removed the early as well as late flushes of weeds and provided complete weed free environment to crop throughout the

Table 1. Effect of weed and nutrient management on weed density, dry matter and nutrient uptake (kg/ha) by weeds (Pooled data of two years)

Treatments	Weed density (No./m^2)*	Weed dry weight (q/ha)	Weed control efficiency (%)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
Weed management							
Weedy check	17.6	22.7	-	51.8	8.0	51.6	6.1
One HW at 30 DAS	9.6	6.6	71.1	11.1	1.9	11.1	1.5
Two HW at 30 and 45 DAS	5.5	2.7	88.5	5.1	0.7	5.1	0.6
Pendimethalin 1.0 kg/ha	8.4	7.6	66.7	11.8	2.5	12.8	1.6
Oxyfluorfen 0.25 kg/ha	9.5	8.3	63.3	13.0	2.9	13.9	1.8
Metribuzin 0.30 kg/ha	11.2	10.9	51.7	22.9	3.6	22.2	2.7
Oxadiargyl 75 g/ha	10.5	10.6	53.4	21.1	3.4	20.5	2.6
Pendimethalin 1.0 kg/ha+1 HW at 45 DAS	5.8	2.7	88.1	5.3	0.8	5.1	0.7
Oxyfluorfen 0.25 kg/ha+1 HW at 45 DAS	7.3	3.7	83.5	7.4	1.1	7.2	0.9
Metribuzin 0.30 kg/ha+1 HW at 45 DAS	9.6	6.2	72.7	10.6	1.7	10.3	1.4
Oxadiargyl 75 g/ha+1 HW at 45 DAS	8.7	5.8	74.4	9.4	1.5	9.3	1.2
S. Em ±	0.1	0.2	-	0.9	0.1	0.9	0.04
LSD (P=0.05)	0.3	0.7	-	2.5	0.3	2.6	0.1
Nutrient management (kg/ha)							
60 N+30 P	9.3	7.5	67.0	14.5	2.4	14.0	1.7
60 N+30 P+30 K	9.4	8.0	64.9	15.3	2.6	15.5	1.9
60 N+30 P+30 K+30 S	9.5	8.5	62.8	16.4	2.7	16.6	2.1
S. Em ±	0.05	0.08	-	0.2	0.03	0.2	0.03
LSD (P=0.05)	NS	0.2	-	0.5	0.1	0.6	0.1

*Values are $\sqrt{(x+0.5)}$ transformed, HW–Hand weeding, DAS–Days after sowing. NS–Not Significant.

growing season. Pendimethalin, being broad spectrum herbicides when supplemented by one hand weeding at 45 DAS suppressed the weed growth for a longer period. This improvement in growth and yield parameters of coriander might be attributed to the reduction in weed competitiveness with the crop for the available inputs i. e. light, water, nutrients, space, etc. which ultimately favoured better environment for growth and development of the crop. Similar findings were also reported by Mehriya *et al*. (2007) in cumin.

Two hand weedings at 30 and 45 DAS resulted in highest seed and biological yield of coriander. Pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS being at par with two hand weedings, proved next best treatment. The increased seed and biological yield were obviously the results of better growth and yield contributing parameters of crop. Weed management resulted in significant improvement in quality (essential oil content and oil outturn) compared to weedy check. Maximum essential oil content (0.41%) and oil outturn (6.47 kg/ha) were recorded in pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS, followed by two hand weedings at 30 and 45 DAS. Oil outturn is largely a function of seed yield, therefore, increased yield under pendimethalin+one hand weeding and two hand weedings seems to have increased oil outturn. Similar results were also noticed by Mehriya *et al.* (2007).

Nutrient management had significant effect on growth and yield attributes viz., umbels/plant and weight of 1000 seeds and yield (Table 2). Taller plants with more umbels/plant and test weight and yields were recorded with the application of N+P+K+S compared to N+P and N+P+K application. The increase in seed yield owing to application of 60 kg N+30 kg P+30 kg K+30 kg S/ha over 60 kg N+30 kg P+30 kg K/ha was 18.0 and 8.36%, respectively. Marked increase in seed, straw and biological yield with N+P+K+S fertilization seems to be due to exploitation of crop genetic potential for vegetative and reproductive growth upto greater extent. The results are in close accordance with the findings of Tripathi *et al*. (2001). Application of N+P+K+S significantly improved the essential oil content and oil outturn from seed over N+P and N+P+K combination. Significant improvement in essential oil

Table 2. Effect of weed and nutrient management on growth, yield attributes, yield, quality and nutrient uptake by coriander (Pooled data of two years)

Treatments	Plant height (cm)	Umbels/ plant	1000-seed weight (g)	Seed yield (t/ha)	Biological yield (t/ha)	Essential oil content (%)	Oil outturn (kg/ha)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)	B : C ratio
Weed management												
Weedy check	64.8	17.5	9.4	0.53	1.41	0.351	1.9	6.9	3.1	14.6	3.0	1.58
One HW at 30 DAS	86.7	24.7	10.2	1.23	3.26	0.382	4.7	20.2	8.1	38.0	7.7	1.88
Two HW at 30 and 45 DAS	98.0	28.1	10.9	1.58	4.11	0.402	6.4	31.9	11.1	51.4	10.5	2.03
Pendimethalin 1.0 kg/ha	82.6	25.4	10.3	1.04	2.70	0.386	4.0	16.5	6.8	31.5	6.4	1.55
Oxyfluorfen 0.25 kg/ha	78.4	25.1	10.3	0.90	2.41	0.381	3.4	14.0	5.9	27.9	5.6	1.16
Metribuzin 0.30 kg/ha	70.2	23.5	10.0	0.83	2.16	0.38	3.1	12.4	5.2	24.5	4.9	1.08
Oxadiargyl 75 g/ha	73.3	24.2	10.1	0.85	2.23	0.377	3.2	12.9	5.5	25.8	5.1	1.22
Pendimethalin 1.0 kg/ha+1 HW at 45 DAS	95.3	27.1	10.9	1.57	3.96	0.409	6.5	30.7	10.7	48.8	10.0	2.13
Oxyfluorfen 0.25 kg/ha+1 HW at 45 DAS	91.2	26.0	10.5	1.33	3.59	0.39	5.2	22.7	9.2	42.6	8.8	1.67
Metribuzin 0.30 kg/ha+1 HW at 45 DAS	86.8	25.4	10.2	1.25	3.33	0.376	4.7	20.6	8.4	39.2	8.0	1.54
Oxadiargyl 75 g/ha+1 HW at 45 DAS	87.5	25.6	10.4	1.28	3.38	0.382	4.9	21.3	8.6	40.0	8.2	1.68
LSD (P=0.05)	4.5	1.7	0.4	0.08	0.20	0.016	0.4	1.7	0.5	2.8	0.6	0.18
Nutrient management (kg/ha)												
60 N+30 P	80.1	22.8	9.8	1.03	2.74	0.364	3.8	17.3	6.8	30.9	6.3	1.36
60 N+30 P+30 K	83.2	25.0	10.3	1.13	2.96	0.386	4.4	19.1	7.5	35.5	7.0	1.50
60 N+30 P+30 K+30 S	86.2	26.4	10.8	1.22	3.18	0.4	4.9	20.9	8.2	38.5	8.0	1.63
LSD (P=0.05)	2.0	0.7	0.2	0.03	0.09	0.007	0.1	0.7	0.3	1.3	0.3	0.08

HW–Hand weeding, DAS–Days after sowing.

Table 3. Seed yield and nitrogen uptake by crop and weeds as influenced by interaction among level of nutrient and weed management practices (Pooled data of two years)

Weed management	Seed yield (t/ha)			Uptake by crop (kg/ha)			N depletion by monocot weeds (kg/ha)		
	N+P	N+P+K	N+P+K+S	N+P	N+P+K	N+P+K+S	N+P	N+P+K	N+P+K+S
Weedy check	0.52	0.53	0.53	6.82	6.88	7.03	12.69	13.14	13.50
Weedy check	1.22	1.23	1.25	19.75	20.22	20.58	3.59	3.76	4.01
One HW at 30 DAS	1.40	1.57	1.78	27.67	31.41	36.70	1.27	1.67	2.00
Two HW at 30 and 45 DAS	0.98	1.07	1.08	15.49	16.93	17.11	3.51	3.90	4.51
Pendimethalin 1.0 kg/ha	0.84	0.92	0.93	12.99	14.45	14.49	3.87	4.30	4.85
Oxyfluorfen 0.25 kg/ha	0.78	0.86	0.84	11.77	12.86	12.59	8.54	6.60	6.93
Metribuzin 0.30 kg/ha	0.80	0.88	0.88	11.98	13.41	13.21	6.03	6.26	6.52
Oxadiargyl 75 g/ha	1.40	1.55	1.77	26.39	29.76	35.82	1.39	1.62	1.96
Pendimethalin 1.0 kg/ha+1 HW at 45 DAS	1.17	1.31	1.5	20.31	22.29	25.35	1.43	1.74	2.02
Oxyfluorfen 0.2 kg/ha+1 HW at 45 DAS	1.10	1.22	1.42	18.07	20.38	23.19	3.22	3.49	3.71
Metribuzin 0.30 kg/ha+1 HW at 45 DAS	1.13	1.26	1.43	18.99	21.21	23.75	2.72	2.91	3.09
LSD (P=0.05)									
Weed management at same level of nutrient management	0.12				2.43			0.54	
Nutrient management at the same level of weed control	0.11				2.20			0.56	

HW–Hand weeding, DAS–Days after sowing.

content of seed with N+P+K+S fertilization seems to be an account of greater availability of metabolites to seed, which facilitated greater conversion into fatty acids/ essential oil. Oil out turn is largely a function of seed yield; therefore, it increases with balanced fertilization. These findings are in conformity withy those of Pareek *et al.* (2000).

Nutrient uptake : Different weed control treatments resulted in significantly higher N, P, K and S uptake by coriander compared to weedy check (Table 2). The maximum N, P, K and S uptake by crop was also registered under two hand weddings at 30 and 45 DAS and was found statistically at par with pendimethalin 1.0/ha+one hand weeding at 45 DAS. The higher nutrient uptake by crop under aforesaid treatments may be due to higher crop biomass production coupled with more nutrient content. Yadav *et al.* (2004b) and Mehriya *et al.* (2007) also reported higher uptake of nutrients by cumin in herbicide-treated plots.

Uptake of nutrients (N, P, K and S) by crop was significantly increased due to N+P+K+S fertilization over that recorded under N+P and N+P+K fertilization. This might be due to the fact that uptake of nutrients is primarily governed by total biomass production and secondarily by nutrient status at cellular level. Thus, improvement in both these under N+P+K+S application resulted in higher uptake of nutrients by crop. Similar findings have also been reported by Yadav *et al.* (2004a) in cumin.

Interaction effect : Interactive effect of weed management and nutrient management was also found significant in respect of seed yield and N uptake by crop (Table 3). At N+P+K+S fertilization, seed yield and N uptake by crop in two hand weedings were significantly higher as 1.78 t/ha and 36.70 kg/ha, respectively, and this combination remained at par with pendimethalin+one hand weeding. The respective values for weedy check were 0.53 t/ha and 7.03 kg/ha. Such a high N uptake by crop with above treatments can be interpreted in terms of high biological yield and N content in plant tissue. Two hand weedings alongwith N+P fertilization recorded significantly lowest N depletion by monocot weeds and remained at par with two hand weedings with N+P+K fertilization, pendimethalin+one hand weeding and oxyfluorfen+one hand weeding with N+P or N+P+K fertilization. This indicates that where the removal of N by weeds was more, the corresponding uptake by the crop was less and vice versa. The results further revealed that under unrestricted weed growth plots fertilized with N+P, N+P+K and N+P+K+S, N removal by crop was

46.3, 47.6 and 48.0% lesser than that of weeds, respectively.

Economics : Pendimethalin 1.0 kg/ha+one hand weeding at 45 DAS also realized maximum benefit : cost ratio (2.13), that was found at par with two hand weedings (2.03), but significantly better as compared to other weed management practices (Table 2). This might be owing to higher weed control efficiency in this treatment (88.50%). Amongst nutrient management practices of 60 kg N+30 kg P+30 kg K+30 kg S/ha also realized maximum benefit : cost ratio (1.63).

It was concluded that integration of pendimethalin 1.0 kg/ha with one hand weeding at 45 DAS or two hand weedings at 30 and 45 DAS alongwith application of 60 kg N+30 kg P+30 kg K+30 kg S/ha proved the most remunerative practice in coriander.

REFERENCES

Kushwaha, H. S., M. L. Tripathi and V. B. Singh, 2002. Weed management in coriander (*Coriandrum sativum*). In : *Proc. Second Int. Agron. Congr. on Balancing Food and Environment Security : A Continuing Challenge*, Singh, Panjab, Ahlawat, I. P. S and Gautam, R. C. (eds.). pp. 985-987. Indi. Soc. of Agron., IARI, New Delhi.

Mehriya, M. L., R. S. Yadav, R. P. Jangir and B. L. Poonia, 2007. Nutrient utilization by cumin (*Cuminum cyminum*) and weeds as influenced by different weed control methods. *Ind. J. Agron.* **52** : 176-179.

Pareek, N. K., N. L. Jat and R. G. Pareek, 2000. Response of coriander (*Coriandrum sativum* L.) to nitrogen and plant growth regulators. *Haryana J. Agron.* **16** : 104-109.

Tripathi, A. K., R. K. Pandya and M. L. Tripathi, 2001. Effect of nitrogen, phosphorus and potassium on stem gall disease and yield of coriander. *Ann. Plant Protec. Sci.* **9** : 337-339.

Yadav, S. S., D. P. Sharma, G. L. Keshwa and R. D. Yadav, 2004a. Weed management studies in cumin (*Cuminum cyminum*) at different levels of nitrogen. In : Proc. Nat. Semi. on New Perspectives in Commercial Cultivation, Processing and Marketing of Seed Spices and Medicinal Plants, held at Jobner, Jaipur, Rajasthan during 25-26 March.

Yadav, S. S., O. P. Sharma, P. D. Kumawat and R. D. Yadav, 2004b. Effect of weed control and nitrogen on yield, nutrient removal and quality parameters of cumin (*Cuminum cyminum* L.). *J. Spices and Aromatic Crops* **13** : 22-27.