Indian J. Weed Sci. **41** (1 & 2) : 71-75 (2009)

Effect of Integrated Weed and Nutrient Management on Weed Density, Productivity and Economics of Coriander (*Coriandrum sativum*)

R. K. Nagar, B. S. Meena and R. C. Dadheech
Department of Agronomy
Maharana Pratap University of Agriculture and Technology, Udaipur-313 001 (Rajasthan), India

ABSTRACT

A field experiment was conducted during the winter season of 2003-04 and 2004-05 at Udaipur to study the effect of integrated weed and nutrient management on weed density and productivity of coriander (*Coriandrum sativum* L.). Among the weed management practices, hand weeding twice (HW) at 30 and 45 days after sowing (DAS) and pre-emergence application of pendimethalin at 1.0 kg/ha+hand weeding at 45 DAS were at par. These treatments significantly reduced the density and dry weight of weeds over other treatments and significantly increased yield attributes of coriander resulting in higher seed yield (1.58 and 1.57 t/ha) and net return (Rs. 23,930 and 24,072 /ha) as a result of higher weed control efficiency (88.50 and 88.14%) and lower weed index (0.63% of pendimethalin+HW), respectively. *Chenopodium murale Spergula arvensis* and *Melilotus indica* were the most pre-dominant weeds. Nutrient management did not significantly influence weed density. Application of 60 kg N+30 kg P+30 kg K+30 kg S/ha significantly increased yield attributes, seed yield, net returns and B : C ratio in comparison to N+P and N+P+K fertilization owing to lower weed index and registered higher seed yield by 18.0 and 8.36%, respectively.

Key words : Coriander, density, productivity, weed control efficiency

INTRODUCTION

Coriander (*Coriandrum sativum* L.) is an important winter season commercial seed crop in Rajasthan, which is also grown as medicinal crop in many parts of the country. Coriander is cultivated under irrigated condition and weeds pose great problem which compete with the crop for soil moisture, nutrients and space during initial stage of slow growth resulting in decline in productivity. Yield loss upto 60% has been reported (Kushwaha *et al*., 2002). Yadav *et al.* (2004) reported that herbicides caused an appreciable decrease in density, dry weight and depletion of nutrients by weeds in cumin. Integration of chemical weed control with hand weeding (mechanical) and a suitable fertility level could prove to be more effective and economically viable. Keeping in view, the higher nutrient requirement of coriander and higher cost involved in weed control, the present study was undertaken to find out suitable control measures in relation to varying fertility regime for improving the productivity of coriander.

MATERIALS AND METHODS

A field experiment was conducted at Instructional Farm, Rajasthan College of Agriculture, Udaipur, during **rabi** seasons of 2003-2004 and 2004-05. The soil of the experimental field was clay loam in texture, slightly alkaline in reaction (pH 8.1), medium in available N (276.9 kg/ha) and P (19.0 kg/ha) and high in available K (365 kg/ha) and organic C (0.80%). Thirty-three treatment combinations consisting of 11 weed management practices (weedy check, hand weeding (HW) at 30 days after sowing (DAS), hand weeding twice at 30 and 45 DAS, pendimethalin 1.0 kg/ha, oxyfluorfen 0.25 kg/ha, metribuzin 0.30 kg/ha, oxadiragy1 75 g/ha, pendimethalin 1.0 kg/ha+HW at 45 DAS, oxyfluorfen 0.25 kg/ha+HW at 45 DAS, metribuzin 0.30 kg/ha+HW at 45 DAS and oxadiargy1 75 g/ha+HW at 45 DAS) in main plots and three nutrient management treatments (i) 60 kg N+30 kg P/ha, (ii) 60 kg N+30 kg P+30 kg K/ ha and (iii) 60 kg N+30 kg P+30 kg K+30 kg S/ha) in sub-plots were tested in split plot design with three replications. Coriander variety 'CS-6' was sown on 16 and 23 October and harvested on 20 and 28 February in the respective seasons. Herbicidal solutions were sprayed 2 DAS as pre-emergence spray with the help of knapsack sprayer using flat fan nozzle and a spray volume of 500 l/ha. As per schedule hand weeding in the respective plots was done with hand hoe (kudali). All the fertilizer nutrients viz., half dose of nitrogen and full doses of phosphourus, potassium and sulphur were applied as basal application before sowing as per treatment and remaining half dose of N

was applied as top dressing at 30 DAS. Weed density was recorded at 60 DAS by counting the individual weeds present in 0.25 m^2 area from each plot by using 0.5 x 0.5 m quadrat. Weed control efficiency and weed index were also worked out to assess the efficiency of different weed control treatments. Data on weed density were subjected to square root transformation. The experimental data recorded for yield attributes and yield parameters and economics were statistically analyzed for level of significance.

RESULTS AND DISCUSSION

Weed Growth

The dominating weeds in coriander were *Chenopodium murale* L, *Spergula arvensis* L., *Melilotus indica* (L.) All. Fl. Ped., *Anagallis arvensis* L., *C. album* L., *Convolvulus arvensis* L., *Cyperus rotundus* L. and *Cynodon dactylon* L. Among these, *C. murale*, *S. arvensis* and *M. indica* were the most predominant dicot weed species with an average density of 55.9% and among monocots, density of *C. rotundus* was maximum during both the years. Among the weed management treatments, maximum weed population and dry weight of monocot, dicot and total weeds were recorded in weedy check (Tables 1 and 2). Hand weeding twice at 30 and 45 DAS significantly reduced the weed population and weed dry weight over the control on pooled basis. Hand weeding twice or application of pendimethalin 1.0 kg/ha as pre-emergence spray+hand weeding at 45 DAS were at par with each other. Pendimethalin 1.0 kg/ha+hand weeding at 45 DAS was at par with oxyfluorfen 0.25 kg/ha+hand weeding in reducing dry weight of

Table 1. Weed count* at 60 DAS (No./ m^2) as affected by weed and nutrient management (Pooled data of 2003-04 and 2004-05)

Treatments	*Chenopodium murale*	*Spergulla arvensis*	*Melilotus indica*	*Anagallis arvensis*	*Chenopodium album*	*Convolvulus arvensis*	*Cypress rotundus*	*Cynodon dactylon*
Weed management								
Weedy check	6.86 (46.58)	5.89 (34.23)	4.96 (24.31)	4.49 (19.68)	4.01 (15.57)	2.97 (8.35)	5.26 (27.22)	4.26 (17.77)
1 HW (30 DAS)	2.38 (5.20)	2.36 (5.09)	2.39 (5.43)	2.31 (4.89)	2.15 (4.14)	2.35 (5.03)	2.76 (7.33)	2.39 (5.27)
2 HW (30 and 45 DAS)	1.85 (2.98)	1.76 (2.64)	1.88 (3.14)	1.73 (2.52)	1.49 (1.72)	1.56 (1.98)	2.35 (5.11)	1.43 (1.625)
Pendimethalin 1.0 kg/ha	2.21 (4.47)	2.51 (5.94)	2.63 (6.51)	2.17 (4.25)	2.08 (3.83)	2.13 (4.07)	3.54 (12.13)	2.36 (5.09)
Oxyfluorfen 0.25 kg/ha	2.56 (6.08)	2.81 (7.47)	3.08 (9.11)	2.24 (4.52)	2.14 (4.09)	2.18 (4.25)	3.65 (13.07)	2.43 (5.48)
Metribuzin 0.30 kg/ha	3.59 (12.48)	3.75 (13.65)	3.25 (10.29)	3.31 (10.52)	2.76 (7.14)	2.74 (7.08)	4.06 (16.04)	3.25 (10.16)
Oxadiargyl 75 g/ha	3.15 (9.61)	2.85 (7.65)	2.70 (6.97)	3.24 (10.15)	2.62 (6.39)	2.64 (6.49)	4.00 (15.64)	3.23 (9.94)
Pendimethalin 1.0 kg/ha +1 HW (45 DAS)	1.98 (3.50)	2.01 (3.64)	1.91 (3.26)	1.81 (2.86)	1.65 (2.26)	1.64 (2.20)	2.44 (5.62)	1.62 (2.19)
Oxyfluorfen 0.25 kg/ha +1 HW (45 DAS)	2.05 (3.79)	2.61 (6.37)	2.73 (7.10)	1.93 (3.27)	1.72 (2.50)	1.89 (3.17)	2.66 (6.78)	1.84 (2.91)
Metribuzin 0.30 kg/ha +1 HW (45 DAS)	2.96 (8.38)	3.11 (9.21)	2.87 (7.97)	2.49 (5.73)	2.51 (5.84)	2.31 (4.86)	3.06 (8.99)	2.39 (5.28)
Oxadiargyl 75 g/ha +1 HW (45 DAS)	2.58 (6.19)	2.32 (4.91)	2.25 (4.58)	2.44 (5.53)	2.45 (5.53)	2.20 (4.35)	2.94 (8.41)	2.28 (4.85)
LSD (P=0.05)	0.21	0.17	0.33	0.18	0.13	0.17	0.32	0.23
Nutrient management (kg/ha)								
60 N+30 P	2.91 (9.82)	2.85 (8.81)	2.75 (7.84)	2.52 (6.51)	2.32 (5.33)	2.22 (4.63)	3.32 (11.37)	2.48 (6.36)
60 N+30 P+30 K	2.92 (9.95)	2.90 (9.13)	2.79 (8.06)	2.55 (6.70)	2.32 (5.37)	2.23 (4.70)	3.33 (11.50)	2.50 (6.40)
60 N+30 P+30 K+30 S	2.94 (10.02)	2.97 (9.55)	2.82 (8.28)	2.61 (6.95)	2.33 (5.42)	2.26 (4.81)	3.35 (11.52)	2.52 (6.47)
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

*Values are $\sqrt{(x + 0.5)}$ transformed. Original values are in parentheses. NS–Not Significant.

Table 2. Effect of integrated weed and nutrient management on dry weight of weeds, weed control efficiency, weed index, yield attributes, seed yield and economics of coriander (pooled data of two years)

Treatments	Dry weight of weeds at harvest (kg/ha)			Weed control efficiency (%)	Weed index (%)	Branches/ plant	Umbels/ plant	Seeds/ umbel (g)	Test weight (g)	Seed yield (t/ha)	Net returns (Rs./ha)	B : C ratio
	Monocot	Dicot	Total									
Weed management												
Weedy check	559.83	1708.66	2268.49	-	66.46	7.19	17.48	19.36	9.39	0.53	4,354	0.58
One HW (30 DAS)	285.72	369.26	654.98	71.13	22.15	12.17	24.66	26.42	10.24	1.23	18,131	1.88
Two HW (30 and 45 DAS)	78.44	182.44	260.87	88.50	-	13.96	28.13	34.93	10.92	1.58	23,930	2.03
Pendimethalin 1.0 kg/ha	286.84	468.73	755.57	66.70	34.18	12.06	25.35	28.94	10.27	1.04	14,227	1.55
Oxyfluorfen 0.25 kg/ha	291.82	539.81	831.62	63.34	43.03	11.66	25.06	27.75	10.26	0.90	10,925	1.16
Metribuzin 0.30 kg/ha	312.26	783.24	1095.50	51.71	47.47	10.80	23.45	25.62	9.99	0.83	9,641	1.08
Oxadiargyl 75 g/ha	296.42	761.13	1057.54	53.38	46.20	11.23	24.18	26.38	10.09	0.85	10,575	1.22
Pendimethalin 1.0 kg/ha+HW (45 DAS)	81.20	187.77	268.98	88.14	0.63	13.86	27.10	33.98	10.87	1.57	24,072	2.13
Oxyfluorfen 0.25 kg/ha+ HW (45 DAS)	84.20	290.43	374.64	83.48	15.82	12.55	26.00	29.50	10.48	1.33	18,488	1.61
Metribuzin 0.30 kg/ha +HW (45 DAS)	258.67	359.79	618.46	72.74	20.89	12.47	25.41	27.26	10.21	1.25	17,103	1.54
Oxadiargyl 75 g/ha + HW (45 DAS)	248.85	333.06	581.91	74.35	19.00	12.32	25.56	28.53	10.37	1.28	18,073	1.68
S. Em ±	7.13	27.94	24.70	-	-	0.29	0.59	0.77	0.15	0.03	624	0.06
LSD (P=0.05)	20.37	79.86	70.59	-	-	0.83	1.69	2.20	0.42	0.08	1,783	0.18
Nutrient management (kg/ha)												
60 N+30 P	239.44	509.82	749.26	66.97	34.80	10.96	22.82	25.87	9.76	1.03	13,573	1.36
60 N+30 P+30 K	252.78	544.35	797.14	64.86	28.48	11.91	25.03	27.78	10.27	1.13	15,373	1.50
60 N+30 P+30 K+30 S	267.11	577.92	845.03	62.75	22.78	12.65	26.42	30.53	10.81	1.22	17,287	1.63
LSD (P=0.05)	9.20	22.72	24.58	-	-	0.38	0.68	1.04	0.19	0.03	767	0.08

monocot, dicot and total weeds. These treatments effectively controlled early as well as late flushes of weeds and did not allow weeds to regenerate resulting in lower density and dry weight of weeds. The results are in agreement with the findings of Mehriya *et al.* (2007). The highest weed control efficiency (88.50%) was obtained with hand weeding twice at 30 and 45 DAS, followed by pendimethalin 1.0 kg/ha+hand weeding at 45 DAS (88.14%) and oxyfluorfen 0.25 kg/ha+hand weeding at 45 DAS (83.48%). The effective control of weeds under these treatments resulted in the highest weed control efficiency and lower nutrient depletion by weeds. Pre-emergence application of pendimethalin 1.0 kg/ha+hand weeding at 45 DAS recorded lowest weed index (0.63%), followed by oxyfluorfen+hand weeding at 45 DAS, whereas the highest weed index (66.46%) was observed in the weedy check. This resulted in reduced seed yield due to uncontrolled weeds. The result confirms the findings of Sethivel (2001).

Nutrient management practices had no significant effect on weed population (Table 1). This shows that the germination of weed seeds was not influenced by the fertilization. However, application of 60 kg N+30 kg P+30 kg K+30 kg S/ha significantly improved weed dry matter as compared to N+P and N+P+K fertilization. This may be attributed to vigorous growth and development of weeds owing to higher uptake of nutrients by weeds (Table 2) under balanced fertilization. Similar results were reported by Channabasavanna *et al.* (2002). Among the nutrient management practices, application of N+P+K+S proved to be the most effective in reducing weed index (22.78%) due to lower reduction in yield by weeds. Similarly, plot receiving N+P+K+S application registered the lowest weed control efficiency (62.75%) owing to higher uptake of nutrients by weeds resulting in increased weed dry matter.

Crop Productivity

Weed management practices had significant effect on yield attributes of coriander (Table 2). Hand weeding twice at 30 and 45 DAS gave significantly higher seed yield of coriander compared with all other weed control treatments except penedimethalin 1.0 kg/ha +hand weeding at 45 DAS. This might be due to effective control of weeds which in turn significantly increased the branches/plant, umbels/plant, seeds/umbel and test weight and consequently improved the seed yield of coriander under these treatments (Mehriya *et al*., 2007). Integration of either one hand weeding at 45 DAS to all herbicide applications or one hand weeding caused further significant increase in seed yield of coriander by 49 to 51% over alone application, indicating importance of culture treatments. Nutrient management with 60 kg N+30 kg P+30 kg K+30 kg S/ha also significantly increased branches/plant, umbels/plant, seeds/umbel, test weight and seed yield of coriander as compared to N+P and N+P+K fertilization (Table 2). Application of N+P+K+S significantly increased seed yield by 18.0% over N+P and 8.36% over the N+P+K application. The significant improvement in above these parameters with N+P+K+S balanced nutrition could be ascribed to be due to exploitation of crop genetic potential for vegetative and reproductive growth upto greatest extent. The results corroborate with the findings of Tripathi *et al*. (2001).

The interaction effect of weed and nutrient management practices on umbels/plant, seeds/umbel and seed yield was significant (Table 3). Application of either balanced fertilization or weed management practices is not sufficient to achieve maximum yield of coriander. Maximum yield of seed was obtained when nutrient management practices were supported with suitable weed management practices. Application of NPKS fertilization alongwith hand weeding twice produced significantly higher umbels/plant (31.98), seeds/umbel (42.38) and seed yield (1.78 t/ha) as compared to hand weeding twice fertilized either with N+P or N+P+K.

Economics

All the weed management practices fetched significantly higher net returns and B : C ratio over weedy cheek (Table 2). Pendimethalin 1.0 kg/ha+hand weeding at 45 DAS gave the maximum net returns (Rs. 24,072/ ha) and B : C ratio (2.13) followed by hand weeding twice. This might be owing to higher weed control efficiency in these treatments (88.14 and 88.50%). Whereas lowest net returns and B : C ratio were recorded under unweeded control. The lower net returns and B : C ratio in hand weeding twice might be because of more man days engaged, and consequently more cost was required to create weed-free condition for entire period in the crop season. Fertilization with N+P+K+S gave the significantly highest returns (Rs. 17,287/ha) and B : C ratio (1.63) over N+P and N+P+K (Table 2) owing to high seed yield under balanced nutrition condition. It

Table 3. Interaction effect of integrated weed and nutrient management on umbels/plant, seeds/umbel and seed yield of coriander (Pooled data of two years)

Weed management	Umbels /plant			Seeds/umbel			Seed yield (t/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	16.68	17.55	18.21	19.17	19.12	19.79	0.52	0.53	0.53
One HW (30 DAS)	24.32	24.78	24.88	26.04	26.36	26.87	1.22	1.23	1.25
Two HW (30 and 45 DAS)	24.07	28.33	31.98	27.90	34.50	42.38	1.40	1.57	1.78
Pendimethalin 1.0 kg/ha	23.91	25.42	26.71	26.77	28.59	31.46	0.98	1.07	1.08
Oxyfluorfen 0.25 kg/ha	20.04	26.82	28.33	26.43	27.81	29.00	0.84	0.92	0.93
Metribuzin 0.30 kg/ha	21.90	23.66	24.79	24.30	25.11	27.45	0.78	0.86	0.84
Oxadiargyl 75 g/ha	23.82	24.24	24.48	25.53	25.97	27.64	0.80	0.88	0.88
Pendimethalin 1.0 kg/ha+HW (45 DAS)	22.90	27.24	31.16	27.49	33.69	40.74	1.40	1.55	1.77
Oxyfluorfen 0.25 kg/ha+HW (45 DAS)	24.42	26.13	27.44	27.07	29.57	31.86	1.17	1.31	1.5
Metribuzin 0.30 kg/ha+HW (45 DAS)	24.66	25.22	26.37	26.70	26.77	28.31	1.10	1.22	1.42
Oxadiargyl 75 g/ha+HW (45 DAS)	24.33	26.01	26.33	27.16	28.15	30.29	1.13	1.26	1.43
LSD (P=0.05)	2.26*	2.49**		3.44*	3.55**		0.11*	0.12**	

* For nutrient management at same weed management practice.
** For weed management practices at same level of nutrient management.

may be concluded that application of 60 kg N+30 kg P+30 kg K+30 kg S/ha alongwith pre-emergence application of pendimethalin 1.0 kg/ha followed by hand weeding at 45 DAS could be most remunerative practice in coriander.

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