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Effect of weed control and nitrogen on yield, nutrient removal and quality parameters of cumin (*Cuminum cyminum* L.)

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Abstract

A field experiment was conducted at Jobner (Rajasthan), to evaluate the effect of different weed control measures and levels of nitrogen on yield, nutrient uptake and quality parameters of cumin (*Cuminum cyminum*). The results showed that two hand weedings at 25 and 50 days after sowing was the most effective treatment that increased the seed yield by 292.9% over weedy check. Among the herbicides, pre-plant trifluralin @ 1.08 kg ha^{-1} was the best treatment (4.94 q ha^{-1}) that was comparable to trifluralin @ 2.16 kg ha^{-1} and pendimethalin @ 1.00 kg ha^{-1}. Nitrogen content in seed and straw of cumin and uptake of nitrogen and phosphorus also significantly improved by different weed control treatments. Maximum protein content (17.60%) was recorded with trifluralin @ 1.08 kg ha^{-1} and essential oil content (2.52%) with pendimethalin @ 1.00 kg ha^{-1}. The study also revealed that application of nitrogen @ 30 kg ha^{-1} which was on par with 45 kg ha^{-1}, significantly increased seed and straw yield, nutrient uptake and protein content in cumin in comparison to application of nitrogen @ 15 kg ha^{-1}.

Key words: cumin, *Cuminum cyminum*, nitrogen, nutrient content and uptake, quality, weed control, yield.

Introduction

Heavy weed infestation not only reduces the yield of cumin (*Cuminum cyminum* L.) but also adversely affects its quality parameters (Bhati 1993). Another major constraint restricting the yield potential of cumin is poor nutrition especially nitrogen deficiency, which is of common occurrence in Indian soils. The present paper aims to report the effect of different weed control measures and nitrogen levels on yield, nutrient uptake and quality parameters of cumin.

Materials and methods

The field experiment was conducted during two consecutive *rabi* seasons of 2000–01 and 2001–02 at SKN College of Agriculture, Jobner (Rajasthan). The soil of the experimental field was loamy sand in texture, alkaline in reaction (pH 8.1), low in organic carbon (0.21%) and available nitrogen (127.72 kg ha^{-1}) and medium in available phosphorus (17.17 kg ha^{-1}) and potash (154.43 kg ha^{-1}). The experiment was conducted in a split plot design and replicated thrice. The main plot treatments comprised of 10 weed control measures whereas, 3 levels of nitrogen were assigned to sub-plots (Table 1). Cumin variety 'RZ-209' spaced 30 cm apart was sown on 7th December and 30th November during the

first and second year, respectively. An uniform dose of 20 kg P_2O_5 ha^{-1} was drilled in all the plots at the time of sowing. Half dose of nitrogen was applied as basal and the remaining half was top dressed at first irrigation through urea as per treatments. Trifluralin and fluchloralin were incorporated prior to sowing as per treatments, whereas, pendimethalin was applied as pre-emergence treatment. Hand weeding was done at 25 and 50 days after sowing as per treatments. Usual crop husbandry practices were followed to raise a good crop. Data on growth and yield were recorded and the crop was harvested on 21st and 29th March during the first and second year, respectively. Representative samples of seed and straw taken at harvest were subjected to chemical analysis for estimation of nutrient content and quality parameters of cumin.

Results and discussion

Seed and straw yield

Adoption of any weed control measure significantly increased seed and straw yield of cumin over weedy check (Tables 1 and 2). Two hand weedings done at 25 and 50 days after sowing recorded the maximum seed (5.50 q ha^{-1}) and straw yield (7.97 q ha^{-1}) during both the years as well as in pooled analysis. Successive increase and significant improvement in seed and straw yield in comparison to lower levels was observed in preplant application of trifluralin from 0.72 to 1.08 kg ha^{-1}. However, it was comparable with trifluralin @ 2.16 kg ha^{-1} and pendimethalin @ 1.00 kg ha^{-1}. Fluchloralin @ 1.125 kg ha^{-1} and one hand weeding done at 25 days after sowing also increased the seed yield to 213.6% and 224.3%, respectively over control. The increase in seed yield due to weed control measures might be the result of suppressing weed growth that rendered favourable conditions like increased availability of moisture, nutrients and space for proper development of the crop (Gora *et al.* 1996; Amin & Wahab 1998). Application of nitrogen also appreciably improved seed and straw yield of cumin which may be attributed to low nitrogen content in soil. The crop responded to nitrogen only up to 30 kg ha^{-1}. Thereafter, the increase in seed yield was not significant. These findings are in close conformity with those reported by Jangir & Singh (1996). Plots that were hand-weeded twice and applied with either 45 kg N ha^{-1} or 30 kg N ha^{-1}, were at par and produced significantly higher seed yield (6.12 q ha^{-1} and 5.84 q ha^{-1}, respectively). However, among the herbicide combinations, maximum seed yield was obtained with trifluralin @ 1.08 kg ha^{-1} and 45 kg N ha^{-1}.

Nutrient content and uptake

The nitrogen content in crop dry matter at 70 days after sowing and in seed and straw at harvest and uptake of nitrogen and phosphorus at all the stages were significantly influenced by weed control treatments (Table 3). However, the phosphorus content at any of the stages was not significant. Maximum uptake of nitrogen and phosphorus was achieved with two hand weedings at 70 days after sowing in seed and straw at harvest. Other promising treatments observed in order of their effectiveness were, pre-plant incorporation of trifluralin @ 1.08 kg ha^{-1}, preemergence pendimethalin @ 1.0 kg ha^{-1} and trifluralin @ 2.16 kg ha^{-1}. The lower levels of trifluralin, pre-plant fluchloralin @ 1.125 kg ha^{-1} and one hand weeding also significantly enhanced the nutrient uptake but proved less effective in this regard. Significant reduction in nitrogen content of cumin under unweeded control and trifluralin @ 0.72 kg ha^{-1} can be assigned to the inefficient weed control achieved by these treatments causing heavy weed infestation which posed heavy weed-crop competition for absorption of nutrients. The increase in seed and straw yields coupled with higher nutrient content seems to be responsible for higher uptake of nitrogen and phosphorus by the crop under these treatments (Patel & Mehta 1989).

Increase in nitrogen level from 15 kg ha^{-1} to 30 kg ha^{-1} also brought about significant variation in nitrogen content of cumin dry matter at 70 days after sowing and in seed and straw

Table 1. Effect of weed control treatments and nitrogen levels on seed and straw yield of cumin

Treatment	Seed yield (q ha^{-1})			% increase	Straw yield (q ha^{-1})		
	2000–01	2001–02	Pooled	over control	2000–01	2001–02	Pooled
Weed control							
Weedy check	1.62	1.18	1.40	-	3.54	3.70	3.62
Trifluralin 0.72 kg ha^{-1}	3.41	2.45	2.93	109.3	4.85	5.21	5.03
Trifluralin 0.84 kg ha^{-1}	4.26	3.25	3.75	167.9	5.79	6.12	5.95
Trifluralin 0.96 kg ha^{-1}	4.90	3.94	4.42	215.7	6.50	6.89	6.70
Trifluralin 1.08 kg ha^{-1}	5.41	4.47	4.94	252.9	7.06	7.53	7.30
Trifluralin 2.16 kg ha^{-1}	5.34	4.36	4.85	246.4	6.92	7.19	7.05
Pendimethalin 1.00 kg ha^{-1}	5.31	4.29	4.80	242.9	6.84	7.22	7.03
Fluchloralin 1.125 kg ha^{-1}	4.82	3.97	4.39	213.6	6.16	6.72	6.44
HW once at 25 DAS	4.97	4.12	4.54	224.3	6.36	6.87	6.62
HW twice at 25 & 50 DAS	5.93	5.07	5.50	292.9	7.67	8.26	7.97
SEm ±	0.14	0.14	0.10	-	0.20	0.23	0.15
CD (P=0.05)	0.41	0.41	0.28	-	0.57	0.68	0.43
Nitrogen level							
15 kg ha^{-1}	3.92	3.14	3.53	-	5.44	5.79	5.61
30 kg ha^{-1}	4.91	3.96	4.43	25.5	6.47	6.90	6.69
45 kg ha^{-1}	4.97	4.03	4.50	27.5	6.59	7.03	6.81
SEm ±	0.05	0.05	0.05	-	0.07	0.08	0.07
CD (P=0.05)	0.15	0.15	0.15	-	0.19	0.22	0.21

HW=hand weeding; DAS=days after sowing

Table 2. Combined effect of weed control treatments and nitrogen levels on seed yield of cumin (pooled mean of two years)

Weed control treatment	Nitrogen level (kg ha^{-1})		
	15	30	45
Weedy check	1.26	1.58	1.37
Trifluralin 0.72 kg ha^{-1}	2.46	3.10	3.25
Trifluralin 0.84 kg ha^{-1}	3.01	4.03	4.22
Trifluralin 0.96 kg ha^{-1}	3.60	4.71	4.96
Trifluralin 1.08 kg ha^{-1}	4.35	5.19	5.30
Trifluralin 2.16 kg ha^{-1}	4.26	5.26	5.04
Pendimethalin 1.00 kg ha^{-1}	4.16	5.03	5.22
Fluchloralin 1.125 kg ha^{-1}	3.86	4.80	4.54
HW once at 25 DAS	3.81	4.83	5.00
HW twice at 25 & 50 DAS	4.56	5.84	6.12
For N at same level of W			
SEm ±			0.16
CD (P=0.05)			0.46
For W at same or different levels of N			
SEm ±			0.17
CD (P=0.05)			0.47

Values indicate seed yield in q ha^{-1}

HW=hand weeding; DAS=days after sowing; N=nitrogen; W=weed control

Table 3. Effect of weed control treatments and nitrogen levels on nutrient content and uptake of cumin (pooled mean of two years)

Treatment	N content (%)			P content (%)			N uptake (kg ha^{-1})			P uptake (kg ha^{-1})		
	70 DAS	At harvest		70 DAS	At harvest		70 DAS	At harvest		70 DAS	At harvest	
		Seed	Straw		Seed	Straw		Seed	Straw		Seed	Straw
Weed control												
Weedy check	1.803	2.399	0.800	0.592	0.636	0.380	2.77	3.38	2.90	0.907	0.896	1.375
Trifluralin 0.72 kg ha^{-1}	1.886	2.620	0.903	0.590	0.640	0.387	4.27	7.72	7.72	1.331	1.884	1.946
Trifluralin 0.84 kg ha^{-1}	1.961	2.753	0.925	0.593	0.650	0.394	5.52	10.41	10.41	1.673	2.445	2.346
Trifluralin 0.96 kg ha^{-1}	1.983	2.757	0.976	0.598	0.650	0.395	6.45	12.31	12.31	1.945	2.885	2.649
Trifluralin 1.08 kg ha^{-1}	2.044	2.816	0.980	0.595	0.649	0.398	7.29	13.99	13.99	2.125	3.216	2.916
Trifluralin 2.16 kg ha^{-1}	1.970	2.737	0.973	0.613	0.644	0.392	6.50	13.31	13.31	2.020	3.134	2.760
Pendimethalin 1.00 kg ha^{-1}	1.937	2.793	0.958	0.604	0.651	0.399	6.80	13.42	13.42	2.115	3.129	2.806
Fluchloralin 1.125 kg ha^{-1}	2.005	2.748	0.930	0.596	0.640	0.389	6.24	12.14	12.14	1.860	2.812	2.509
HW once at 25 DAS	2.021	2.734	0.912	0.591	0.644	0.390	6.41	12.46	12.46	1.870	2.931	2.577
HW twice at 25 & 50 DAS	2.014	2.804	0.988	0.603	0.649	0.396	7.71	15.55	15.55	2.324	3.581	3.169
SEm ±	0.042	0.050	0.022	0.012	0.015	0.008	0.21	0.41	0.41	0.065	0.099	0.099
CD (P=0.05)	0.121	0.143	0.064	NS	NS	NS	0.60	1.17	1.17	0.187	0.284	0.285
Nitrogen level												
15 kg ha^{-1}	1.890	2.632	0.885	0.591	0.638	0.387	4.98	9.42	5.02	1.550	2.257	2.174
30 kg ha^{-1}	1.972	2.719	0.933	0.596	0.647	0.392	6.35	12.24	6.30	1.915	2.877	2.632
45 kg ha^{-1}	2.025	2.797	0.984	0.606	0.651	0.396	6.67	12.75	6.79	1.987	2.940	2.710
SEm ±	0.027	0.031	0.013	0.007	0.008	0.004	0.12	0.23	0.12	0.038	0.053	0.047
CD (P=0.05)	0.075	0.087	0.036	NS	NS	NS	0.33	0.64	0.35	0.106	0.150	0.132
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

HW=hand weeding; DAS=days after sowing

at harvest and uptake of nitrogen and phosphorus at all the stages (Table 3). The increased uptake was due to the cumulative effect of increased yields of seed and straw as well as increased nitrogen contents. Nutrient content and uptake were not affected significantly due to interactive effect of weed control and nitrogen levels. Similar results were also reported by Bhati (1990) in cumin.

Quality parameters

Quality parameters of cumin namely, protein and essential oil contents in seed were also significantly influenced by different weed control treatments (Table 4). Trifluralin @ 1.08 kg ha^{-1}, twice hand weeding and pendimethalin @ 1.0 kg ha^{-1} resulted in protein contents of 17.60%, 17.52% and 17.46%, respectively, which was significantly higher in comparison to weedy check and trifluralin @ 0.72 kg ha^{-1}. As protein content in seed is a function of its nitrogen content, increased content of nitrogen under these treatments seems to be the reason for attaining higher protein content in cumin seed (Mehta & Bhadoria 1982). Pendimethalin @ 1.0 kg ha^{-1} recorded the maximum essential oil content (2.52%) in seed which was on par with trifluralin @ 0.96 kg ha^{-1}, hand weeding twice and trifluralin @ 1.08 kg ha^{-1}. This improvement can be ascribed to the healthy seed setting under comparatively weed free environment and also seems to be directly associated with the higher test weight under these treatments that produced bolder seeds than unweeded control. These results are in accordance with those reported by Bhati (1993). Application of 30 kg N ha^{-1} also resulted in significant enhancement in protein content over 15 kg N ha^{-1} but remained on par with 45 kg N ha^{-1} wherein the maximum protein content of 17.48% was recorded. Essential oil was not affected by different levels of nitrogen. The interactive effect of weed control and nitrogen levels did not significantly influence quality parameters of cumin. Similar results were also reported by Bhati (1990).

Table 4. Effect of weed control treatments and nitrogen levels on quality parameters of cumin

Treatment	Essential oil content (%)			Protein content (%)		
	2000–01	2001–02	Pooled	2000–01	2001–02	Pooled
Weed control						
Weedy check	2.08	2.12	2.10	15.22	14.77	14.99
Trifluralin 0.72 kg ha^{-1}	2.30	2.24	2.27	16.50	16.25	16.37
Trifluralin 0.84 kg ha^{-1}	2.36	2.29	2.33	17.41	17.01	17.21
Trifluralin 0.96 kg ha^{-1}	2.46	2.52	2.49	17.59	16.88	17.23
Trifluralin 1.08 kg ha^{-1}	2.40	2.44	2.42	18.07	17.12	17.60
Trifluralin 2.16 kg ha^{-1}	2.38	2.32	2.35	17.16	17.05	17.10
Pendimethalin 1.00 kg ha^{-1}	2.60	2.45	2.52	17.51	17.40	17.46
Fluchloralin 1.125 kg ha^{-1}	2.32	2.42	2.37	17.78	16.57	17.17
HW once at 25 DAS	2.28	2.49	2.39	17.33	16.85	17.09
HW twice at 25 & 50 DAS	2.56	2.38	2.47	17.78	17.27	17.52
SEm ±	0.09	0.09	0.06	0.44	0.44	0.31
CD (P=0.05)	0.27	NS	0.18	1.31	1.31	0.90
Nitrogen level						
15 kg ha^{-1}	2.34	2.32	2.33	16.61	16.29	16.45
30 kg ha^{-1}	2.36	2.39	2.38	17.25	16.73	16.99
45 kg ha^{-1}	2.42	2.40	2.41	17.84	17.13	17.48
SEm ±	0.04	0.12	0.04	0.22	0.22	0.19
CD (P=0.05)	NS	NS	NS	0.61	0.64	0.54
Interaction	NS	NS	NS	NS	NS	NS

HW=hand weeding; DAS=days after sowing

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