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RESEARCH PAPER

Effect of rate and time of nitrogen application on seed yield, quality and economics of cumin (*Cuminum cyminum* L.) under loamy sand soils

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Abstract : A field experiment was conducted at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Rabi* season of 2008-09 wherein twenty treatment combinations comprising of four levels of nitrogen (20, 30, 40 and 50 kg ha^{-1}) and five times of nitrogen application *i.e.,* 50 per cent as basal + 50 per cent at 30 DAS, 25 per cent as basal + 25 per cent at 8-10 DAS + 50 per cent at 30 DAS, 33 $\frac{1}{3}$ per cent as basal + 33 $\frac{1}{3}$ per cent at 8-10 DAS + 33$\frac{1}{3}$ per cent at 30 DAS, 50 per cent at 8-10 DAS + 50 per cent at 30 DAS and 33 per cent at 8-10 DAS + 33 per cent at 30 DAS + 33 $\frac{1}{3}$ per cent at 50 DAS were tested. Crop fertilized with 50 and 40 kg N ha^{-1} recorded statistically at par seed yield but significantly higher than the lower levels of nitrogen. Increasing levels of nitrogen improved protein and oil content in the seed. Similar trend was observed in case of uptake of N and P by the crop as well as for buildup of N status of soil with increasing N levels. Application of nitrogen in three equal splits at 8-10, 30 and 50 DAS recorded maximum seed yield, but in case of quality parameters, nitrogen and phosphorus uptake by crop as well as available nitrogen content in soil it remained at par with application of nitrogen in two equal splits at 8-10 and 30 DAS. The package involving 50 kg N ha^{-1} applied in three equal splits at 8-10, 30 and 50 DAS was found more remunerative.

Key Words : Cumin, Nitrogen level, Split, Yield, Nutrient uptake

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INTRODUCTION

Cumin is a tropical plant grown in sandy loam to medium black soil during *Rabi* season where atmospheric humidity is low during flowering and seed formation stages. It is mostly grown on light textured soils deficient in organic matter and nitrogen as well poor water holding capacity. Nitrogen effect being manifested quickly on plant growth and ultimately on crop yields. Nitrogen being a constituent of protoplasm and chlorophyll, it is intimately involved in the process of photosynthesis, respiration and protein synthesis. Availability of nitrogen is most important for growing plants as it is a major and indispensable constituent of proteins and nucleic acid molecules, nucleotides, enzymes, alkaloids, vitamins and chlorophyll. The effect of rate and time of nitrogen application varies with soil plant environment. Hence, to standardise the dose and time of application of nitrogen to cumin for sandy loam soils of North Gujarat, the investigation was taken up.

MATERIALS AND METHODS

The field experiment was conducted on loamy sand soil during *Rabi* season of the year 2008-2009. The experimental plot was low in organic matter, available nitrogen and medium in available phosphorus and potash and free from excess salt. Twenty treatment combinations comprising of four levels of nitrogen (20, 30, 40 and 50 kg ha^{-1}) and five times of nitrogen application *i.e.,* 50 per cent as basal + 50 per cent at 30 DAS;

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25 per cent as basal + 25 per cent at 8-10 DAS + 50 per cent at 30 DAS; 33 $\frac{1}{3}$ per cent as basal + 33 $\frac{1}{3}$ per cent at 8-10 DAS + 33 $\frac{1}{3}$ per cent at 30 DAS; 50 per cent at 8-10 DAS + 50 per cent at 30 DAS and 33 $\frac{1}{3}$ per cent at 8-10 DAS + 33 $\frac{1}{3}$ per cent at 30 DAS + 33 $\frac{1}{3}$ per cent at 50 DAS were evaluated in Randomized Block Design with Factorial concept and replicated four times.

The seeds of cumin variety GC 4 were treated with thirum 3.0 g per kg seed to protect the crop from fungal diseases. Line sowing was performed on 7th November, 2008, using 12 kg seed rate ha^{-1}. The herbicide pendimethalin 1 kg ha^{-1} was applied as pre-emergence and two interculturings and hand weedings at 30 and 60 DAS were carried out to keep crop weed free. The blight disease was not seen but as preventive measure mancozeb 0.25 per cent was sprayed at 40, 50, 70 and 80 DAS. Incidence of powdery mildew was observed which was controlled by dusting of sulphur @ 25 kg ha^{-1}.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Effect of nitrogen :

The seed and straw yields as well as the quality parameters of cumin improved with increase in levels of nitrogen from 20 to 50 kg ha^{-1} but differences between two higher levels *viz.*, 50 and 40 kg N ha^{-1} were not found significant, except for volatile oil yield. Application of 50 and 40 kg N ha^{-1} recorded seed yield of 476 and 452 kg ha^{-1}, respectively which accounted 24.28 and 15.53 per cent higher over 20 kg N ha^{-1} (Table 1). These finding are in accordance with those reported by Patel *et al.* (1992), Jangir and Singh (1996), as well as Yadav *et al.* (2004).

Nitrogen and phosphorus uptake by crop as well as available nitrogen status in soil increased significantly with increase in nitrogen level to 40 kg ha^{-1}.

Application of nitrogen @ 50 kg ha^{-1} accrued the maximum net realization of Rs.31718 ha^{-1} and benefit cost ratio of 3.52 which were closely followed as Rs.29597 ha^{-1} and 3.37, respectively with 40 kg N ha^{-1}. However, the highest net incremental cost benefit ratio (1: 27.90) was recorded with application of 40 kg N ha^{-1} (Table 2).

Effect of time of nitrogen application :

Varying time of nitrogen application significantly influenced seed and straw yields, protein content, volatile oil content of seed and volatile oil yield of cumin (Table 2). Top dressing of nitrogen in three equal splits produced maximum seed yield as well as highest protein and oil content. The same treatment recorded highest oil yield remaining at par with that of topdressing of N in two equal splits. Application of 50 per cent N as basal + 50 % N in top dressing at 30 DAS showed lowest performance in respect to yield and quality parameters. These findings are closely in agreement with Bhati *et al.* (1987), Bhati (1990) and Gora *et al.* (1996b).

Application of nitrogen in three equal splits (8-10, 30

Table 1: Effect of rate and time of nitrogen application on yield and quality parameters of cumin

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)	Protein content (%)	Volatile oil content (%)	Volatile oil yield (kg ha^{-1})
Rate of nitrogen (N) (kg ha^{-1})						
(N_1) 20	383	642	37.32	15.14	3.77	14.45
(N_2) 30	412	701	37.07	15.38	3.89	16.06
(N_3) 40	452	804	35.90	15.60	3.98	18.08
(N_4) 50	476	833	36.35	16.40	4.09	19.49
S.E.±	8.85	12.29	0.55	0.29	0.04	0.41
C.D. at 5 %	25	34.82	NS	0.84	0.14	1.18
Time of nitrogen application (T)						
(T_1) 50 % as basal + 50 % at 30 DAS	412	722	36.35	15.04	3.83	15.88
(T_2) 25 % as basal + 25 % at 8-10 DAS+ 50 % at 30 DAS	422	723	36.91	15.14	3.88	16.41
(T_3) 33 $\frac{1}{3}$ % at basal + 33 $\frac{1}{3}$ % at 8-10 DAS+ 33 $\frac{1}{3}$ % at 30 DAS	425	747	36.37	15.38	3.89	16.60
(T_4) 50 % at 8-10 DAS + 50 % at 30 DAS	438	760	36.60	15.96	4.01	17.70
(T_5) 33 $\frac{1}{3}$ % at 8-10 DAS + 33 $\frac{1}{3}$ % at 30 DAS + 33 $\frac{1}{3}$ % at 50 DAS	454	773	37.08	16.63	4.03	18.41
S.E.±	0.020	9.89	0.61	0.33	0.05	0.46
C.D. at 5 %	0.058	28	NS	0.94	0.15	1.32
Interaction (N x T)	NS	NS	NS	NS	NS	NS
C.V. (%)	6.72	9.19	6.71	8.53	5.64	11.03

Table 2: Effect of rate and time of nitrogen application on nitrogen and phosphorous uptake as well as economics of cumin

Treatments	Phosphorus uptake by crop (kg ha-1)	Nitrogen uptake by crop (kg ha^{-1})	Available nitrogen content in soil (kg ha^{-1})	Net realization (Rs.ha^{-1})	Benefit Cost Ratio (BCR)
Rate of nitrogen (N) (kg ha^{-1})					
(N_1) 20	4.12	14.46	168	23402	2.91
(N_2) 30	4.58	15.41	171	25988	3.10
(N_3) 40	5.21	17.04	182	29597	3.37
(N_4) 50	5.41	17.57	186	31718	3.52
S.E.±	0.070	0.16	4	-	-
C.D. at 5 %	0.2	0.47	11	-	-
Time of nitrogen application (T)					
(T_1) 50 % as basal + 50 % at 30 DAS	4.46	15.61	169	25833	3.06
(T_2) 25 % as basal + 25 % at 8-10 DAS+ 50 % at 30 DAS	4.59	15.71	170	26713	3.13
(T_3) 33 $\frac{1}{3}$ % at basal + 33 $\frac{1}{3}$ % at 8-10 DAS+ 33 $\frac{1}{3}$ % at 30 DAS	4.81	16.07	176	26992	3.15
(T_4) 50 % at 8-10 DAS + 50 % at 30 DAS	5.04	16.43	182	28251	3.26
(T_5) 33 $\frac{1}{3}$ % at 8-10 DAS + 33 $\frac{1}{3}$ % at 30 DAS + 33 $\frac{1}{3}$ % at 50 DAS	5.25	16.77	186	29689	3.36
S.E.±	0.078	0.18	4	-	-
C.D. at 5 %	0.22	0.53	12	-	-
Interaction (N x T)	NS	NS	NS	-	-
C.V. (%)	6.51	4.66	10.19	-	-

and 50 DAS) was found statistically at par with T_2 (8-10 and 30 DAS) in case of removal of N and P by the crop as well as buildup of N status of soil. Both these treatments showed superiority over rest of the treatments. These results are in line of works reported by Gora *et al.* (1996a).

Application of nitrogen in three equal splits was found more remunerative and beneficial over other treatments.

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