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Response of cumin (*Cuminum cyminum* L.) cultivars to nutrient management practices in arid zone of Rajasthan, India

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Abstract

A field study was conducted at Satheen Village (Rajasthan) to investigate different nutrient management practices on the production of two cultivars of cumin (*Cuminum cyminum*) in arid zone. Cultivar RZ-19 was superior to local cultivar with respect to seed yield (21.5% higher) and its attributes. The net returns and benefit:cost ratio obtained with RZ-19 was much higher compared to that of local variety. All the nutrient management practices recorded significantly higher yield and its attributes over control. However, the maximum seed yield of 586 kg ha^{-1} was recorded with integrated nutrient management practices involving *tumba* cake (*Citrullus colocynthis*) with 50% recommended dose of fertilizers and application of bio-fertilizer (*Azotobacter chroococcum* + phosphate solubilizing bacteria), whose yield was at par with that of integrated nutrient management practices involving application of 5 t farm yard manure. Maximum returns (Rs. 20,300/-) and benefit:cost ratio (2.51) was obtained in integrated nutrient management practices involving application of 5 t of farm yard manure.

Keywords: cumin, *Cuminum cyminum*, integrated nutrient management, yield.

Introduction

Cumin *(Cuminum cyminum* L.) is grown largely in the arid zone of India, especially in Rajasthan and Gujarat. However, the average productivity of the crop in the region is very low (392 kg ha^{-1}) mainly due to use of non-descript seed and inadequate supply of nutrients. The present study was undertaken to investigate the role of cultivars and effect of different nutrient management practices including organic farming, chemical agriculture and integrated nutrient management practices on the productivity and net returns of cumin in the arid zone of Rajasthan.

Materials and methods

The field experiment was conducted in Satheen Village, Jodhpur (Rajasthan) during *rabi* season of 2002–03 and 2003–04. The soil of the experimental site was sandy loam in texture, low in organic carbon (0.28%) and available N (142 kg ha^{-1}), medium in available P (13.20 kg ha^{-1}) and high in available K (310 kg ha^{-1}). The experiment was laid out in a split plot design having two cultivars (local variety and RZ–19) in main plots and six different nutrient management practices namely, F_1 (control), F_2 [40:40 kg N, P_2O_5 ha^{-1}, as 100% recommended dose of fertiliz-

ers (RDF)], F_3 [10 t farm yard manure (FYM) ha^{-1} + *Azotobacter chroococcum* + phosphate solubilising bacteria (PSB)], F_4 [*tumba* cake (*Citrullus colocynthis*) 2 t ha^{-1} + *A. chroococcum* + PSB], F_5 [50% RDF + 5 t FYM + *A. chroococcum* + PSB] and F_6 [50% RDF + 1 t *tumba* cake + *A. chroococcum* + PSB] in subplots with three replications. The organic manures (FYM and *tumba* cake) were applied before sowing at the time of land preparation, while half of N and 100% of P_2O_5 were applied at the time of sowing as basal application. The remaining N was top dressed at 35 days after sowing. In treatments F_3 to F_6, cumin seed was inoculated with carrier based culture of *A. chroococcum* and PSB, while uninoculated seed was used in treatments F_1 and F_2. Cumin seed (12 kg ha^{-1}) was sown on 16 and 12 November, during 2002 and 2003, respectively, in furrows 30 cm apart by broadcasting and covered lightly with soil under dry conditions. The crop was grown with all other recommended package of practices and was harvested on 19 and 17 March during the respective seasons. Observations on yield attributes and yield were recorded at the time of harvesting. Economic returns were calculated considering the prevailing market price of inputs and outputs.

Results and discussion

Performance of cultivars

There were significant differences in yield among the cumin cultivars during both the years (Table 1). RZ-19 recorded significantly higher number of branches, umbels and seeds $plant^{-1}$ and 1000 seed weight than the local cultivar. There was significant improvement in seed yield of RZ-19, which was 25.0% and 19.6% higher compared to local cultivar during 2002–03 and 2003–04, respectively. Total seed yield obtained during 2002–03 was lower than that of 2003–04 in both the cultivars, as the crop was adversely affected by aphid infestation during 2002–03. Based on pooled analysis, increase in seed yield of RZ-19 was 21.5% compared to that of local cultivar with higher net returns and benefit : cost ratio. These results are in conformity with those of Patidar *et al.* (2004).

Table 1. Yield and yield attributes of cumin as influenced by cultivars and nutrient management

Treatment	Branches $plant^{-1}$		Umbels $plant^{-1}$		Seeds $plant^{-1}$		1000 seed weight (g)		Seed yield (kg ha^{-1})	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
Cultivar										
Local	6.60	8.72	11.15	18.90	172.50	260.68	4.20	4.93	352	586
RZ-19	7.25	9.75	13.20	17.42	201.93	274.92	4.38	5.20	440	701
CD (P=0.05)	NS	0.76	1.80	1.12	26.20	9.57	NS	0.21	37	76
Nutrient management practices										
F_1-Control	5.50	7.75	9.80	15.70	147.20	245.50	4.10	4.80	321	515
F_2-40:40 kg N, P_2O_5 ha^{-1} (100% RDF)	6.15	8.85	12.25	18.40	181.50	268.00	4.30	4.90	406	634
F_3-10 t FYM + *Ac* + PSB	6.25	8.55	11.50	17.56	166.20	254.20	4.35	5.0	376	650
F_4-2 t *tumba* cake + *Ac* + PSB	6.62	8.95	12.80	17.70	192.00	267.10	4.40	5.10	390	657
F_5-50% RDF + 5 t FYM + *Ac* + PSB	8.25	10.30	15.10	19.40	215.50	287.80	4.44	5.20	435	690
F_6-50% RDF + 1 t *tumba* cake + *Ac* + PSB	8.76	11.00	12.20	20.10	221.60	283.60	4.74	5.25	453	720
CD (P=0.05)	1.59	1.31	2.54	1.86	17.65	8.14	NS	0.27	27	32

Y_1=2002-03, Y_2=2003-04; RDF=Recommended dose of fertilizers; FYM=Farm yard manure; *Ac=Azospirillum chroococcum*; PSB=Phosphate solubilizing bacteria

Efficiency of nutrient management practices

There was significant increase in all the yield attributes of cumin except 1000 seed weight during 2002–03 with different nutrient management practices during both the years over control (Table 1). Among the different treatments, F_4 (INM practices with *tumba* cake) produced the highest number of branches, umbels and seed plant^{-1} along with 1000 seed weight. All the yield attributes in organic farming treatments F_3 and F_4 were lower than those of chemical treatment F_2, but higher than that of control (F_1) during the first year. INM practices with *tumba* cake (F_6) recorded maximum seed yield of cumin compared to other treatments during both the years (Table 1). Organic farming treatments F_3 and F_4 recorded lower seed yields in the first year compared to chemical treatment (F_2). Mishra & Maheshwari (1988) had reported that about 30% N and a small fraction of P and K in organic manures are available to crops during the first season and the rest during the subsequent season. In subsequent years there is stabilization of yield with organic manures resulting in sustainable production (Ahmed 1994; Singh *et al.* 1997). In the present study also, the yields of cumin with organic manures were higher than those of chemical treatment during the second year. Prasad & Power (1997) indicated that yields of wheat and rice under organic farming were reduced during initial years, but subsequently improved in sustainable crop production compared to chemical/ conventional agriculture. Maximum cumin yield under INM practices might be due to improved soil physical, chemical and biological properties, resulting in higher fertilizer use efficiency (Prasad & Power 1997; Prasad 1999). Hegde & Dwivedi (1993) reported higher production of many cereals under INM practices due to maximum availability of nutrients and their absorption by the plants as a result of conjunctive use of organic, inorganic and biological sources. The efficiency of bio-inoculants is known to increase when applied with organic manures (Rao 2004). Among the organic manures, treatments with *tumba* cake produced higher seed yield of cumin than that of FYM. Higher yield with *tumba* cake might be attributed to the supply of sufficient sulphur to cumin which responds to sulphur application as well as control of cumin wilt by oil seed cakes (Diyora & Khandar 1995).

Economics

The highest gross returns (Rs. 34,200), net returns (Rs. 22,100) and benefit:cost ratio (2.82) were realized with the improved cultivar, RZ-19 compared to local cultivar. This is in conformity with the study of Patidar *et al.* (2004) who had reported RZ-19 as the best among improved as well as local varieties of cumin. Among different nutrient manage-

Table 2. Effect of cultivars and nutrient management on economic returns of cumin (mean of 2 years data)

Treatment	Av. seed yield (kg ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
Cultivar					
Local	469	10,900	28,140	17,240	2.58
RZ-19	570	12,100	34,200	22,100	2.82
Nutrient management practices					
F_1-Control	418	11,600	25,080	13,480	2.16
F_2-40:40 Kg N, P_2O_5 ha^{-1} (100% RDF)	520	12,800	31,200	18,400	2.44
F_3-10 t FYM + *Ac* + PSB	514	14,100	30,840	16,740	2.19
F_4-2 t *tumba* cake + *Ac* + PSB	523	18,120	31,410	13,270	1.73
F_5-50% RDF + 5 t FYM + *Ac* + PSB	562	13,450	33,750	20,300	2.51
F_6-50% RDF + 1t *tumba* cake + *Ac* + PSB	586	15,460	35,190	19,590	2.28

RDF=Recommended dose of fertilizers; FYM=Farm yard manure; Ac=*Azospirillum chroococcum*; PSB=Phosphate solubilizing bacteria

ment practices, INM practice with FYM showed maximum net returns of Rs. 20,300 and the highest benefit:cost ratio of 2.51 while minimum net returns and the lowest benefit:cost ratio was observed with organic farming practice with *tumba* cake. Though maximum gross returns of Rs. 35,190 were obtained with INM practice having *tumba* cake, net returns and benefit:cost ratio were reduced due to high cost of *tumba* cake.

The study indicated that integrated nutrient management practices involving organic manures and bio-inoculants with judicious use of chemical fertilizers along with improved cultivars is beneficial in achieving higher yield and net returns over chemical / organic agriculture in cumin. However, the behaviour of these different nutrient management practices is to be monitored for achieving sustainable production and soil health for a longer period.

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