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Influence of sheep manure, vermicompost and biofertilizer on growth, yield and profitability of cumin (*Cuminum cyminum* L.) production

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Abstract

A field study on effect of various sources of organic manure (sheep manure and vermi compost) with and without biofertilizer (*Azotobacter* sp.) on performance of cumin (*Cuminum cyminum* L.) was conducted at Ajmer (Rajasthan) during rabi 2003, 2004 and 2005. Application of biofertilizer alone as well as in combination with sheep manure, vermicompost and recommended doses of fertilizer resulted in higher growth, yield attributes and yield over absolute control. The association of biofertilizers with all sources of nutrients proved beneficial and resulted in higher growth and yield. Application of recommended doses of fertilizer with seed inoculation by biofertilizer proved to be superior for realizing higher net return and benefit:cost ratio.

Keywords: biofertilizer, cumin, *Cuminum cyminum* L., fertilizer, sheep manure, vermi-compost

Introduction

Traditionally nutrient management in cumin (*Cuminum cyminum* L.) is being done by application of chemical fertilizers. In nutrient management systems, biofertilizers form an alternative low cost and eco-friendly input which can reduce the chemical fertilizer dose by 25%–50% (Pattanayak *et al*. 2007). However, meagre information is available on the combined effect of organic source of nutrition with biofertilizers on cumin. Therefore, an attempt was made to evaluate different organic sources of nutrition with biofertilizer for realizing higher yield and profitability in cumin.

Materials and methods

The field experiment comprising of absolute control, three levels of sheep manure (5.0, 7.5 and 10.0 t ha^{-1}), vermicompost (2.0, 3.0 and 4.0 t ha^{-1}) and recommended fertilizer with and without biofertilizer was conducted in a randomized block design with three replications at the research farm of National Research Centre on Seed Spices, Ajmer (Rajasthan) during rabi 2003, 2004 and 2005. The soil of the experimental site was sandy loam with a pH of 8.9 and having 0.23% organic carbon and 75.2, 32.8 and 233.5 kg ha^{-1} available N, P_2O_5 and K_2O, respectively. The organic sources of nutrients were applied before sowing. The seed of cumin (Var.RZ-19) was treated with biofertilizer (*Azotobacter* sp) before sowing for which 125 g jaggery was boiled in one liter of water and allowed to cool at room temperature. Culture @ 50 g kg^{-1} seed was poured in this jaggery solution and stirred well. This slurry

was spread on seed then mixed thoroughly and allowed to dry in shade and after drying, the seeds were sown with a row to row spacing of 30 cm and during first manual weeding plant to plant distance of 10 cm was maintained. Diseases and pests were controlled by use of neem based organic pesticides.

Five plants were selected randomly from each plot and their dry weight was taken after drying in oven at 70°C till constant weight was obtained. Observations on plant height, branches plant^{-1}, yield attributing characters like umbel plant^{-1}, umbellate umbel^{-1} and seed umbellate^{-1} and yield were recorded. Profitability of different sources of application in cumin was determined by calculating economic parameters like cost of cultivation, gross return, net return and benefit:cost ratio (BCR) based on prevailing market prices of input as well as produce. The trend of response of all the treatments under study remained the same during all the years of study. Hence, pooled analysis was carried out as per the procedure of Panse & Sukhamte (1985).

Results and discussion

Growth parameters

Application of different sources of organic nutrition significantly influenced plant height at all growth stages, branches plant^{-1} and dry matter accumulation plant^{-1}. At 30 and 60 days after sowing (DAS) the highest plant height and dry matter accumulation was recorded by application of recommended fertilizers and seed inoculation with *Azotobacter* sp. At 90 DAS and maturity, application of 7.5 t sheep manure ha^{-1} with biofertilizer gave significantly higher plant height, dry matter accumulation and branches plant^{-1} (Table 1). During early crop growth stages the higher growth parameters of cumin with application of recommended doses of fertilizer might be due to early release of nutrients from inorganic fertilizer which promoted higher growth but in the later stages organic source along with biofertilizers released nutrient slowly for a longer period which

Table 1. Effect of sheep manure, vermicompost and biofertilizers on growth parameters of cumin (Pooled data of 2003, 2004 and 2005)

Treatment	Plant height (cm)			Dry matter accumulation plant $^{-1}$ (g)			No of Branches plant^{-1}
	40 DAS	80 DAS	Maturity	40 DAS	80 DAS	Maturity	
T_1: Absolute control	4.20	21.80	25.40	0.58	1.45	3.82	3.00
T_2: VC 2.0 t ha^{-1}	5.20	24.60	30.40	0.75	1.85	4.68	3.40
T_3: VC 3.0 t ha^{-1}	5.70	25.80	31.70	0.84	1.95	4.93	3.40
T_4: VC 4.0 t ha^{-1}	6.10	26.40	32.60	0.93	2.12	5.18	3.60
T_5: SM 5.0 t ha^{-1}	5.30	24.80	30.80	0.80	1.95	4.92	3.60
T_6: SM 7.5 t ha^{-1}	5.20	26.40	32.10	0.88	1.96	5.12	3.80
T_7: SM 10.0 t ha^{-1}	5.30	26.30	32.00	0.87	1.92	5.08	3.70
T_8: RDF	5.40	26.20	31.70	0.89	1.94	5.04	3.40
T_9 : Bio-fertilizer	4.80	23.40	28.90	0.69	1.68	4.12	3.30
T_{10} VC 2.0 t ha^{-1} + BF	6.20	25.60	31.60	0.87	2.12	4.88	3.60
T_{11}: VC 3.0 t ha^{-1} +BF	6.50	26.90	32.40	0.92	2.40	5.12	3.70
T_{12} :VC 4.0 t ha^{-1} +BF	6.90	27.80	33.70	0.94	2.45	5.84	3.90
T_{13}: SM 5.0 t ha^{-1} + BF	6.40	25.80	31.90	0.92	2.30	5.24	3.80
T_{14}: SM 7.5 t ha^{-1}+BF	6.90	27.60	33.20	0.97	2.60	5.84	4.00
T_{15}: SM 10.0 t ha^{-1}+BF	6.80	27.40	33.00	0.96	2.55	5.72	3.90
T_{16}: RDF+BF	7.20	27.10	32.60	1.13	2.58	5.8	4.00
SEm±	0.25	1.05	1.27	0.04	0.09	0.21	0.15
CD (P=0.05)	0.72	3.02	3.67	0.11	0.26	0.61	0.42

VC=Vermicompost; SM=Sheep manure; BF=Biofertilizer (*Azotobacter* sp.); RDF=Recommended dose of fertilizer; DAS=Days after sowing

Table 2. Effect of sheep manure, vermicompost and biofertilizers on yield and economics of cumin production (Pooled data of 2003, 2004 and 2005)

Treatment	Umbels plant^{-1}	Seeds Umbel^{-1}	Seed yield plant^{-1} (g)	Seed yield (kg ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	BCR
T_1 : Absolute control	11.25	18.25	1.06	84	9390	10500	1110	1.12
T_2: VC 2.0 t ha^{-1}	13.14	20.14	1.25	103	11390	12875	1485	1.13
T_3: VC 3.0 t ha^{-1}	14.25	21.25	1.46	132	12390	16500	4110	1.33
T_4: VC 4.0 t ha^{-1}	14.85	22.45	1.53	143	13390	17875	4485	1.33
T_5: SM 5.0 t ha^{-1}	13.45	21.14	1.36	133	11990	16625	4635	1.39
T_6: SM 7.5 t ha^{-1}	14.66	22.24	1.62	206	13380	25750	12370	1.92
T_7: SM 10.0 t ha^{-1}	14.32	22.12	1.45	198	14390	24750	10360	1.72
T_8: RDF	14.05	22.06	1.48	181	11675	22625	10950	1.94
T_9: Bio-fertilizer	12.12	19.14	1.19	92	9490	11500	2010	1.21
T_{10}: VC 2.0 t ha^{-1} + BF	14.06	20.85	1.45	128	11490	16000	4510	1.39
T_{11}: VC 3.0 t ha^{-1} + BF	14.86	21.92	1.60	166	12490	20750	8260	1.66
T_{12} :VC 4.0 t ha^{-1} + BF	14.95	22.81	1.72	178	13490	22250	8760	1.65
T_{13}: SM 5.0 t ha^{-1} + BF	14.85	21.14	1.57	169	12100	21125	9025	1.75
T_{14}: SM 7.5 t ha^{-1} + BF	15.42	23.14	1.89	218	13480	27250	13770	2.02
T_{15}: SM 10.0 t ha^{-1} + BF	15.35	23.06	1.76	214	14490	26750	12260	1.85
T_{16}: RDF + BF	15.21	23.09	1.79	207	11775	25875	14100	2.20
SEm±	0.58	0.87	0.06	7.43	-	-	-	-
CD (P=0.05)	1.66	2.52	0.18	21.45	-	-	-	-

VC=Vermicompost; SM=Sheep manure; BF=Biofertilizer (*Azotobacter* sp.); Selling price of cumin Rs 125 kg^{-1}

promoted higher crop growth. These results corroborate with those reported by Mehta *et al*. (2007a & b) in ajwain and dill.

Yield and yield attributes

Application of different organic and inorganic sources of nutrients significantly influenced yield and yield attributes of cumin. Application of sheep manure, vermicompost at all levels and recommended fertilizers with and without biofertilizer resulted in significantly higher yield attributing characters namely umbel plant^{-1}, umbellate umbel^{-1}, and seed umbellate^{-1} and yield over absolute control. Application of sheep manure @ 7.5 t ha^{-1} with biofertilizers resulted in the highest yield attributes and yield which was at par with sheep manure 10.0 t ha^{-1} and 4.0 t ha^{-1} of vermicompost with biofertilizers (Table 2). Sheep manure and vermicompost release nutrients over longer period of time resulting in better growth and development which resulted in higher yield attributes and yield of cumin. Mehta *et al* (2007a & b) and Meena *et al*. (2009) reported higher yield of ajwain and dill with application of increasing levels of organic source of nutrients. Prabhu *et al*. (2000) reported significantly higher yield of coriander with 25% recommended dose of fertilizer + FYM @ 10 t ha^{-1} + *Azospirillum* sp. + VAM over other combination of nutrient sources.

Economic analysis

Economic analysis of the study revealed that the highest gross return was recorded with application of sheep manure 7.5 t ha^{-1} along with biofertilizers followed by recommended fertilizers and seed inoculation with biofertilizers. The highest net return and benefit:cost ratio (BCR) was obtained with application of recommended fertilizers and seed inoculation with biofertilizers. Inoculation of seed with biofertilizers in combination with different sources of organic nutrition resulted in higher gross return, net return and BCR over sole application of organic nutrients.

Based on this study it is concluded that application of recommended doses of fertilizer combined with seed inoculation with biofertilizer is better for realizing higher net return and BCR in cumin production.

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