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## Effect of integrated nutrient management on quality, content, uptake and available nutrient status in soil after harvest of cumin (*Cuminum cyminum* L.)

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### Abstract

A field experiment was carried out at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *rabi* season of 2017-18 to study the effect of integrated nutrient management on quality, content, uptake and available nutrient status in soil after harvest of cumin. The experiment consisting ten treatments was laid out in randomised block design with four replications on loamy sand soil. Various practices did not showed any significant effect on volatile oil content (%) of cumin. A significant increase in nitrogen content in seed and straw was obtained with application of 50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>). It also recorded significantly higher N, P and K uptake in seed and straw. Treatment 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>) recorded significantly higher value for available N, while treatment 100% RDN through vermicompost + *Azotobacter* + PSB (T<sub>3</sub>) recorded significantly higher value for available P<sub>2</sub>O<sub>5</sub> status in soil after harvest of cumin crop.

**Keywords:** Cumin, vermicompost, *Azotobacter*, PSB

### Introduction

Seed spices are known as an integral part of Indian culture that's why India is known as home of spices. Among all the major seed spices, cumin (*Cuminum cyminum* L.) locally known as "Jeeru" is one of the important spice crop. Cumin is enriched in essential flavouring ingredient among all the spices. The seeds or powdered are used in soaps, sausages, beverages, pickles, cheese, bread and seasoning cakes etc. Cumin aldehyde or cuminal is 36.31 per cent in cumin which attributes the specific value added aroma. It has carminative, stomatic, anti-diarrheal and dyspeptic medicinal properties. Cumin occupies 47.0 per cent of total seed spices area but accounts for 35.7 per cent of total seed spices production in the country. Adequate mineral fertilization is considered to be one of the most important pre-requisites with respect to plant nutrients for better growth and development of a plant. The gap between the nutrient removal and supply cannot be bridge up by the application of any single nutrient but this has to be achieved with balanced use of fertilizers. Indian farmers pay reasonable attention to cultivation, especially in respect of seedbed preparation, manuring and irrigation, however sufficient attention has not been paid to nutrient management aspect which remains one of the constraints in boosting up the production. Organic manure and bio-fertilizer play important role in crop production. It acts on the soil physical properties, organic matter promotes formation of soil crumb, thus makes the soil friable and thereby, facilitates the proper movement of air and water as well as absorption of rain water. It also adds plant nutrients to the soil and organic acid during dry matter decomposition which act on the insoluble nutrients reserve in the soil and make them available. Inoculation of seed with *Rhizobium* recorded higher protein content due to more nitrogen fixation and better utilization by plants. As nitrogen is an integral part of protein, higher availability and uptake of nitrogen under *Rhizobium* inoculation resulted in higher protein content in seed (Ola *et al.*, 2014) [6]. The PSB like pseudomonas and bacillus also enhances the availability of phosphorus to the plant by converting inherent insoluble phosphorus into soluble form. The PSB like pseudomonas striata bacterial inoculation was found as equivalent to supply 50 kg P<sub>2</sub>O<sub>5</sub> per hectare through single

superphosphate (Gour *et al.*, 1980) [4]. Thus, microbial inoculation has been considered to be an integral part of integrated nutrient management system in major crops.

### Material and Methods

The present investigation was conducted during the *rabi* season in 2017-18 at Agronomy Instructional Farm of Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dantiwada. It is situated in the North Gujarat Agro-climatic Zone. The soil of research farm was loamy sand in texture, poor in fertility and water holding capacity, having pH 7.61, EC 0.11 dS/m; low in organic carbon (0.31%) and available N (136.56 kg/ha) and medium in available P<sub>2</sub>O<sub>5</sub> (43.41 kg/ha) and K<sub>2</sub>O (254.02 kg/ha). The experiment consisting ten treatments comprised of 100% RDN through fertilizer (T<sub>1</sub>), 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>), 100% RDN through vermicompost + *Azotobacter* + PSB (T<sub>3</sub>), 100% RDN through castorcake + *Azotobacter* + PSB (T<sub>4</sub>), 75% RDN through FYM + 25% RDN through fertilizer + *Azotobacter* + PSB (T<sub>5</sub>), 75% RDN through vermicompost + 25% RDN through fertilizer + *Azotobacter* + PSB (T<sub>6</sub>), 75% RDN through castorcake + 25% RDN through fertilizer + *Azotobacter* + PSB (T<sub>7</sub>), 50% RDN through FYM + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>8</sub>), 50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>) and 50% RDN through castorcake + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>10</sub>) were laid out in randomised block design with four replications. Seeds of cumin variety GC 4 was developed by Main Seed Spices Research Station, Jagudan. Biofertilizers namely *Azotobacter* and PSB consortium were procured from Department of Microbiology, Anand Agricultural University, Anand. For seed treatment 10 g jaggery was boiled in 100 ml of water for half an hour and then cooled. In cooled jaggery solution 25 ml biofertilizer of each culture was poured separately and stirred well. The seeds of cumin variety GC 4 was mixed thoroughly with the solution of culture and were allowed to dry in shade. The seeds were sown on the same day in bed size of 5.0 × 3.6 m<sup>2</sup>. Seeds were sown at 30 cm line spacing by broadcasting. The crop was fertilized as per treatments. The required quantity of FYM, vermicompost, castor cake were worked out and applied at 15 days before sowing of cumin crop. The full dose of phosphorus and 1/3<sup>rd</sup> dose of nitrogen were applied as basal in the previously opened furrow to all the plots in form of SSP and Urea, respectively. The remaining 2/3<sup>rd</sup> dose of nitrogen was applied in two equal split in the form of urea at 10 and 30 DAS. Weeds are controlled by manual hand weeding as per need of the crop. Harvesting of the crop was done manually by pulling the dry plants out of the soil and threshing. The following formula was used for calculation of nutrient uptake by seed and straw.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)} \times \text{Seed/Straw yield (kg/ha)}}{100}$$

### Results and Discussion

#### Effect on nutrient content in seed and straw

Significantly higher nitrogen content in seed (2.37%) and straw (0.693%) was found with treatment 50% RDN through

vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>) which being at par with treatment 50% RDN through castorcake + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>10</sub>), 50% RDN through FYM + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>8</sub>) and 100% RDN through fertilizer (T<sub>1</sub>). While, phosphorus and potassium content in seed and straw did not differ any significant effect of various treatments. Treatment 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>) recorded significantly the minimum nitrogen content in seed and straw of cumin.

**Table 1:** Effect of integrated nutrient management on nutrient content in cumin

Treatments	Nutrient content in seed (%)			Nutrient content in straw (%)		
	N	P	K	N	P	K
T <sub>1</sub>	2.31	0.332	0.801	0.671	0.066	1.265
T <sub>2</sub>	2.00	0.323	0.804	0.604	0.060	1.292
T <sub>3</sub>	2.08	0.327	0.808	0.626	0.062	1.304
T <sub>4</sub>	2.06	0.325	0.806	0.620	0.061	1.302
T <sub>5</sub>	2.16	0.330	0.812	0.650	0.063	1.309
T <sub>6</sub>	2.19	0.332	0.817	0.661	0.065	1.316
T <sub>7</sub>	2.18	0.331	0.815	0.655	0.064	1.311
T <sub>8</sub>	2.34	0.333	0.819	0.676	0.067	1.325
T <sub>9</sub>	2.37	0.336	0.825	0.693	0.068	1.362
T <sub>10</sub>	2.36	0.335	0.823	0.685	0.068	1.341
S.Em. ±	0.04	0.003	0.021	0.010	0.002	0.034
C. D. (P=0.05)	0.10	NS	NS	0.03	NS	NS
C. V. %	3.23	1.78	5.08	2.99	5.71	5.12

Integrated application of inorganic and organic sources of nutrients significantly increased the nitrogen, phosphorus and potassium content and their uptake by crop. The successive increase in fertilizer levels and addition of vermicompost increased the nutrient content and uptake. This might be due to increased supply of all essential nutrient directly through organic and inorganic source to crop, indirectly through checking the losses of nutrient from soil solution and by increasing in the nutrient use efficiency. Similar observations have been reported by Dubey *et al.* (2012) [2] in fenugreek. It is well known that addition of vermicompost separately or combined with RDF could increase the micronutrient concentration in the soil and increase the adsorption power of soil for cations and anions particularly phosphates and nitrates and they were released slowly for the benefit of the crop during entire growth period which leads to higher nutrient content in plant. The results confirm the findings of Shivran *et al.* (2014) [7] in blond psyllium.

#### Effect on nutrient uptake by seed and straw

Significantly higher N, P and K uptake by seed of 13.10, 1.86 and 4.56 kg/ha, respectively were found with the treatment 50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>), which remained at par with treatment 50% RDN through castorcake + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>10</sub>), 50% RDN through FYM + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>8</sub>) and 100% RDN through fertilizer (T<sub>1</sub>). Treatment 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>) recorded significantly the minimum N, P and K uptake by seed of 8.04, 1.29 and 3.22 kg/ha, respectively in cumin.

**Table 2:** Effect of integrated nutrient management on nutrient uptake in cumin

Treatments	Nutrient uptake by seed (kg/ha)			Nutrient uptake by straw (kg/ha)		
	N	P	K	N	P	K
T <sub>1</sub>	11.56	1.66	4.00	5.20	0.51	9.79
T <sub>2</sub>	8.04	1.29	3.22	3.86	0.39	8.27
T <sub>3</sub>	8.88	1.40	3.47	4.20	0.42	8.75
T <sub>4</sub>	8.68	1.37	3.39	4.06	0.40	8.52
T <sub>5</sub>	9.95	1.52	3.74	4.66	0.45	9.37
T <sub>6</sub>	10.49	1.59	3.92	4.94	0.48	9.83
T <sub>7</sub>	10.09	1.54	3.78	4.73	0.46	9.45
T <sub>8</sub>	12.06	1.71	4.23	5.36	0.53	10.57
T <sub>9</sub>	13.10	1.86	4.56	6.00	0.59	11.82
T <sub>10</sub>	12.37	1.76	4.32	5.61	0.55	10.98
S.Em. ±	0.58	0.08	0.22	0.23	0.03	0.52
C. D. (P=0.05)	1.67	0.24	0.64	0.66	0.08	1.51
C. V.%	10.96	10.54	11.40	9.32	11.31	10.70

Significantly higher N, P and K uptake by straw of 6.00, 0.59 and 11.82 kg/ha, respectively were found with the treatment 50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>) which remained at par with treatment 50% RDN through castorcake + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>10</sub>) and 50% RDN through FYM + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>8</sub>). Treatment 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>) recorded significantly the minimum N, P and K uptake by straw of 3.86, 0.39 and 8.27 kg/ha, respectively in cumin.

The nutrient uptake is a function of yield and nutrient concentration in plant. Thus, significant improvement in uptake of nutrient might be attributed to their concentration in seed and straw and associated with higher seed and straw yield. This might also be attributed to better availability of nutrients in the soil under these treatments. These findings are in agreement with those of Gamar *et al.* (2018) [3] in fennel and Choudhary and Shivran (2009) [1] in isabgol.

### Effect on quality parameters

The data pertaining to volatile oil content showed that the volatile oil content was not significantly influenced due to different organic and inorganic sources of integrated nutrient management. However, numerically higher volatile oil content (4.19%) obtained with T<sub>9</sub> (50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB). while, lower volatile oil content (3.71%) observed with T<sub>2</sub> (100% RDN through FYM + *Azotobacter* + PSB).

### Effect on available nutrients status in soil after crop harvest

The data showed that except available potassium, available nitrogen and phosphorus in soil after harvest of cumin crop were significantly affected due to different treatments. Significantly higher available nitrogen (155.00 kg/ha) in soil after harvest of the crop was observed under treatment 100% RDN through FYM + *Azotobacter* + PSB (T<sub>2</sub>), which remained statistically at par with rest of the treatments except treatments 50% RDN through FYM + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>8</sub>), 50% RDN through vermicompost + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>9</sub>), 50% RDN through castorcake + 50% RDN through fertilizer + *Azotobacter* + PSB (T<sub>10</sub>) and 100% RDN through fertilizer (T<sub>1</sub>). The lowest available nitrogen (138.20 kg/ha) in soil after harvest of the crop was registered under treatment 100% RDN through fertilizer (T<sub>1</sub>).

Significantly higher available phosphorus (56.42 kg/ha) in soil after harvest of the crop was recorded under the treatment 100% RDN through vermicompost + *Azotobacter* + PSB (T<sub>3</sub>) but it remained statistically at par with the rest of the treatments except 100% RDN through fertilizer (T<sub>1</sub>). The lowest available phosphorus (49.50 kg/ha) in soil after harvest of the crop was registered under treatment 100% RDN through fertilizer (T<sub>1</sub>).

**Table 3:** Effect of integrated nutrient management on available nutrient status in soil after harvest and volatile oil content of cumin

Treatments	Available nutrient status in soil after harvest (kg/ha)			Volatile oil content (%)
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
T <sub>1</sub>	138.20	49.50	251.00	4.11
T <sub>2</sub>	155.00	55.93	268.00	3.71
T <sub>3</sub>	153.50	56.42	264.55	3.79
T <sub>4</sub>	152.22	56.12	263.98	3.80
T <sub>5</sub>	150.21	55.19	267.25	3.99
T <sub>6</sub>	149.15	55.52	263.41	4.07
T <sub>7</sub>	148.46	55.37	261.25	4.01
T <sub>8</sub>	145.25	54.13	266.11	4.14
T <sub>9</sub>	142.83	54.54	260.14	4.19
T <sub>10</sub>	140.27	54.46	258.98	4.17
S.Em. ±	3.28	0.82	7.21	0.13
C. D. (P=0.05)	9.53	2.39	NS	NS
C. V.%	4.45	3.00	5.49	6.56

It is evident from data that there was marginal improvement in P and K and significant improvement in available nitrogen due to inoculation with biofertilizers. The available soil nitrogen increased with biofertilizers may be due to better utilization of native nitrogen with increase in nitrogen fixation. Similarly, the marginal value of P and K might be due to mineralization of soil organic matter and solubilizing effect of acids produced during respirations. The results confirm the findings of Shivran *et al.* (2014) [7] in blond psyllium. The combined effect of inorganic source and vermicompost played a very important role due to their synergistic effect. Application of vermicompost increased the supply of easily assimilated major as well as micronutrients to plants besides mobilizing unavailable nutrients into available form. The results confirm the findings of Munnu singh (2011) [5] in coriander, Singh *et al.* (2018) [8] in dill and Choudhary and Shivran (2009) [1] in isabgol.

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