

Original Research Article

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Effect of INM Practices on Yield, Yield Attributes and Economics of Coriander (*Coriandrum sativum* L.)

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ABSTRACT

The experiment was conducted during two Rabi seasons of the year 2015-17 at the experimental site of the Department of Horticulture, College of Agriculture, O. U. A. T., Bhubaneswar. Combination of bio-fertilizers (*Azotobacter*+ *Azospirillum*+ PSB) + inorganic fertilizers + FYM gave better performance as compared to only bio-fertilizers (*Azotobacter*+ *Azospirillum*+ PSB)/ organic manure/ inorganic fertilizers and other combinations. The treatment results a soil application of inorganic fertilizers (100% of RDF) with bio-fertilizers (*Azotobacter*+ *Azospirillum*+ PSB) @ 2.5 kg ha⁻¹ and FYM @ 5 t ha⁻¹ which resulted the maximum plant height (26.93 cm), number of primary branches per plant (6.93), number of compound leaves per plant (38.74), yield (8.0 t ha⁻¹) followed by the soil application of inorganic fertilizer (75% of RDF) + bio-fertilizers (*Azotobacter*+ *Azospirillum*+ PSB) @ 2.5 kg ha⁻¹ + FYM @ 5 t ha⁻¹ with respect to plant height (26.14 cm), number of primary branches per plant (6.53) and herbage yield (7.8t ha⁻¹). Regarding economics of the experiment, the maximum net profit Rs. 10769 ha⁻¹ and benefit : cost (2.09) were computed in the treatment having a soil application of inorganic fertilizer (100% of RDF) + Biofertilizers (*Azotobacter*+ *Azospirillum*+ PSB) @ 2.5 kg ha⁻¹ + FYM @ 5 t ha⁻¹.

Keywords

Biofertilizer,
Coriander,
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Management,
PSB, FYM, Yield.

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Introduction

Coriander (*Coriandrum sativum* L.), a widely grown condiment crop of the tropics is very popular from cuisines to food court. India is the largest producer of coriander both in terms of area (547421 ha) and production (527390 tonnes). It is not only used for culinary purposes but also as a condiment as well as a nutraceutical. It is an herbaceous annual member of *Apiaceae* family under the order *Apiales*. Coriander requires cool climate during vegetative growth stage and warm dry climate at flowering. It can be cultivated in all most all types of soils but in well drained

loamy soil it flourishes well. The quality of seed is superior and essential oil content is more when the crop is grown in cooler regions and at higher altitudes. The stems, leaves, and seeds of coriander are used in a number of culinary preparations. The green plant in India is used in soups, salads and chutneys (Ilyas, 1980). The name “cilantro” is frequently used in American English to refer to the green herb or the dried leaves of coriander (Lamberts, 1990). Considering the organic production which is gaining momentum at present, the use of bio-

fertilizers has attained a special significance in crop husbandry to address the sustainability problem and tremendous success has been achieved in this crop. As a thumb rule the higher productivity could be determined by selection of suitable varieties, balance nutrition, optimum water management and timely plant protection measures. In recent years, bio-fertilizers acquired a potential position in horticulture, but scanty information is available on bio-fertilizer use especially in coriander.

Application of bio-fertilizers such as PSB, *Azotobacter*, *Azospirillum* has reduced the use of chemical fertilizers but provided high quality organic products free of harmful agrochemicals for the safety of public health (Salem and Awad, 2005; Mahfouz and Sharaf Eldin, 2007). The fertility status of soil is not that high suffice the entire nutrient demand of the crop. Hence, external supply of nutrients through manure and fertilizers has become the need of the hour. Therefore, a balance fertilizer dosage with FYM, vermicompost and bio-fertilizer as per the crop type needs to be standardized which facilitates to calculate the entire nutrient requirement of the crop throughout its gestation period which culminating to a bumper yield. Standardization of genotypes for their performance in different locations with varied cultural practices for an overall increase in the yield in one hand and generating a good economic return to the farmer in other hand is most important.

Materials and Methods

The field experiment was conducted under irrigated condition during *Rabi* 2015-16 and repeated in 2016-17 at the demonstration plot of the Department of Vegetable Science, College of Agriculture, OUAT, Bhubaneswar, which is situated at 22° 15' North latitude, 80° 22' East longitude and in an altitude of 25.5 m above the mean sea level (MSL). It comes

under eastern coastal part of Odisha. Soil of the experimental site was medium clay soil. Before the initiation of the experiment the soil samples were collected and analyzed for the physical and chemical characteristics by following different standard methods.

The experimental soil had sandy loam in texture by following Bouyoucos hydrometer method (Piper, 1966) having 5.1 mg kg⁻¹ organic carbon, KMnO₄ extractable N-246 kg ha⁻¹, Olsen's P-20 kg ha⁻¹ and 1 N ammonium acetate extractable K-380 kg ha⁻¹ (Page *et al.*, 1982) The experiment consisted of 10 treatments viz fertility levels 100% RDF (N-60, P-40, K-20 kg ha⁻¹) supplied as inorganic fertilizer, 50% RDF through inorganic sources and its combinations with FYM @ 5 tonnes ha⁻¹. *Azotobacter* 2.5 kg ha⁻¹, PSB @ 2.5 kg ha⁻¹ in sole application and their combinations with control, the experiment was laid out in 3 replications. The FYM @ 5 tonnes ha⁻¹ was incorporated in to soil, 15 days before sowing of coriander crop. Coriander variety Surabhi was sown during November 2016 and 2016 at 30 cm row spacing apart. Soil fertility was characterized on the basis of N.P.K in soil for control treatment since the data followed the homogeneity test, pooling was done over the seasons and mean data were interpreted.

The data collected from the experiment were analyzed statistically by following the procedure described by Gomez (1984). The level of significance used in "F" and "t" tests was considered at P=0.05 level. Critical difference values were calculated where ever the F test was significant.

Results and Discussion

The biometric observations of different characters were recorded to study the effect of integrated nutrient management practices on morphomatrix and yield attributes of coriander (Tables 1-3).

A perusal of the detailed data revealed that, there was no significant difference among all the treatment combinations with respect to germination and there was more than 90% of germination in all plots.

Further, was revealed that, application of different doses of fertilizer, FYM, and biofertilizer influenced the plant height significantly. The highest mean for plant height was obtained in treatment T₈ (26.93 cm) which was at par with T₇ (26.14 cm) and T₆ (25.35 cm) but differed significantly from T₃ (20.44 cm), T₅ (16.57cm), T₂ (14.11 cm), T₄ (11.64 cm) this may be due to the synergistic effect of inorganic and organic fertilizer which is in agreement with Sahu *et al.*, (2014), Tripathi *et al.*, (2013) and Hamte *et al.*, (2013). The lowest value was recorded in the treatment T₁(11.00 cm) i.e. control which was at par with T₄ where biofertilizers were applied (11.64 cm) it may be due to nutrient mineralizing capacity of *Azotobacter*, *Azospirillum* and PSB. However the treatments were in an increasing trend with a maximum plant height (26.93 cm) in T₈ and minimum in control T₁ (11.00 cm), according to the present analysis, integrated application of biofertilizers with inorganic fertilizers have increased plant height by enhancing the nitrogen content and the rate of photosynthesis which is in agreement with (Migahed *et al.*, 2004; Choudhary *et al.*, 2004).

The numbers of primary branches per plant were not varied significantly among the treatments. Maximum numbers of primary branches per plant were recorded in T₈ (6.93) which was at par with the treatments T₇ (6.53), T₆ (6.10), T₃ (5.8), T₂ (4.40), T₄(4.07) and differed significantly from control T₁ (3.93). However the treatments were in an increasing trend with a maximum number of primary branches per plant (6.93) in T₈ and minimum in control T₁ (3.93).

This study found that a combine application of farm yard manure, inorganic fertilizer and biofertilizer showed a significant deference of number of primary branches per plant in comparison to other treatments (Tripathi *et al.*, 2013; Nagar *et al.*, 2010).

The application of different combinations of NPK, FYM and biofertilizer significantly influenced the number of compound leaves of coriander. Maximum number of compound leaves per plant were recorded with the treatment T₈(38.74) which was at par with the treatments T₇(38.12) and T₆ (37.56) and differs significantly from T₃ (33.52), T₅ (30.57), T₂ (28.00), T₄ (23.12) and the minimum was recorded in control T₁ (17.04).

Maximum mean leaf area was recorded with treatment T₈ (156.46 cm²) which was at par with the treatments T₇ (155.66 cm²), T₆ (154.96) and differed significantly from T₃ (142.940 cm²), T₅ (128.00 cm²), T₂ (114.00 cm²) and the minimum leaf area was recorded in treatment T₁ (77.67cm²) which happened to be the control. The inorganic fertilizer application increased leaf area in comparison to other treatments, which may be due to the effect of adequate amount of nitrogen probably present in experimental site. Similar results reported by Nagar *et al.*, (2010).

Effect of INM practices on yield attributes

The fresh leaf weight of coriander was significantly influenced by different treatments as in table 2.

The highest mean, fresh leaf weight ha⁻¹ was recorded in treatment T₈ (6.06t) which was at par with T₇ (5.86t), T₆ (5.60t) but differed significantly from T₃ (4.52t), T₅ (3.59t), T₂ (2.60t), T₄ (1.79t) and the lowest value was recorded in T₁ i.e. 0.79 t ha⁻¹(Kumar *et al.*, 2009).

Table.1 Effect of INM practices on growth parameters

Treatments	Germination (%)	Plant height (cm)	No. of primary branches plant ⁻¹	No. of compound leaf plant ⁻¹	Leaf area (cm ²)	Chlorophyll content (spad value)	Leaf Yield (t/ha)
T ₁ = Control. (N ₀ P ₀ K ₀ And FYM ₀)	95.00	11.00	3.93	17.04	077.67	0.98	1.66
T ₂ = FYM @ 5 t/ha alone.	95.04	14.11	4.40	32.47	114.00	1.46	3.14
T ₃ = RDF (100%)	95.33	20.44	5.80	35.47	142.94	2.24	5.26
T ₄ = Biofertilizers (Azotobacter+ Azospirillum+ PSB)	95.00	11.64	4.07	23.71	100.67	1.34	2.59
T ₅ = FYM+ Biofertilizers (Azotobacter+ Azospirillum+ PSB)	95.00	16.57	5.10	31.05	128.00	1.81	4.32
T ₆ = FYM +RDF (50%) +Biofertilizers (Azotobacter+ Azospirillum+ PSB)	95.37	25.35	6.10	37.56	154.96	2.46	7.19
T ₇ = FYM+RDF(75%)+ Biofertilizers (Azotobacter+ Azospirillum+ PSB)	95.67	26.14	6.53	38.12	155.66	2.55	7.80
T ₈ = FYM+RDF(100%)+ Biofertilizers (Azotobacter+ Azospirillum+ PSB)	95.67	26.93	6.93	38.74	156.46	2.62	8.00
CD(0.05)	01.55	02.16	0.49	03.02	011.97	0.06	0.62
CV%	00.93	06.50	5.24	05.61	005.32	1.88	6.82

Table.2 Effect of integrated nutrient management on fresh weight of coriander

Treatments	Fresh Weight (ton ha ⁻¹)		Dry weight(ton ha ⁻¹)	
	Leaf	Total Plant	Leaf	Total Plant
T ₁ = Control. (N ₀ P ₀ K ₀ And FYM ₀)	00.79	1.66	0.01	0.35
T ₂ = FYM @ 5 tha ⁻¹ alone.	02.60	3.46 (108.0)	0.24	0.42
T ₃ = RDF (100%)	04.52	5.26 (216.0)	0.44	0.59
T ₄ = Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	01.79	2.59(056.0)	0.23	0.39
T ₅ = FYM+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	03.59	4.32(106.0)	0.37	0.48
T ₆ = FYM +RDF (50%) +Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	05.60	7.19(333.0)	0.55	0.74
T ₇ = FYM+RDF(75%)+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	05.86	7.80(369.8)	0.58	0.77
T ₈ = FYM+RDF(100%)+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	06.06	8.00(381.9)	0.60	0.79
CD(0.05)	00.79	0.62	0.05	0.07
CV (%)	75.85	6.82	1.06	0.86

Table.3 Effect of INM practices on economics

Treatments	Cost of cultivation (Rs.)	Gross return (Rs.)	Net profit (Rs.)	B:C
T ₁ = Control. (N ₀ P ₀ K ₀ And FYM ₀)	20375	33200	12200	0.63
T ₂ = FYM @ 5 tha ⁻¹ alone	40875	69200	28325	0.69
T ₃ = RDF (100%)	44855	105200	60345	1.34
T ₄ = Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	33915	51800	17885	0.52
T ₅ = FYM+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	41415	86400	44985	1.08
T ₆ = FYM +RDF (50%) +Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	46863	143800	96937	2.06
T ₇ = FYM+RDF(75%)+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	49587	156000	106413	2.14
T ₈ = FYM+RDF(100%)+ Biofertilizers (<i>Azotobacter</i> + <i>Azospirillum</i> + PSB)	52311	160000	10769	2.09

Fresh plant weight per hectare

During the field trial, application of different combinations of fertilizer and other amendments significantly influenced the herbage yield of the plants per hectare (Table 2). The highest mean fresh weight ha⁻¹ was recorded in treatment T₈ (8 ton) which was at par with T₇ (7.80ton) and significantly differed from T₆ (7.19 ton), T₃ (5.26 ton), T₅ (4.32 ton), T₂ (5.26 ton), and T₄ (2.59 ton). The T₁ (control) recorded the lowest mean fresh plant weight of 1.66 ton ha⁻¹. The data further revealed that on fresh weight basis, the herbage yield plot receiving combination treatment of T₈ showed 381.9% more over control. Similar finding have been reported by Kumar *et al.*, (2009) about the effects of N fertilizer (0, 30, 60 or 90 kg/ha) and biofertilizers (*Azotobacter*, *Azospirillum* and *Azotobacter* + *Azospirillum*) on the yield and quality of coriander (cv. RCr-435). The application of N up to 60 kg/ha significantly increased the plant weight.

The dry leaf weight of coriander varied significantly due to varied combinations of nutrient application and other amendments. The maximum dry leaf weight ha⁻¹ was recorded in T₈ (0.60 t) which is at par with T₇ (0.58 t), T₆ (0.55t) and differed significantly from T₃ (0.44 t), T₅ (0.037 t), T₂ (0.24 t), T₄ (0.23t) and the lowest was recorded in T₁ (0.01 t) i.e. control.

Effect of INM practices on dry plant weight

The highest dry plant weight ha⁻¹ of 0.79 ton was recorded in T₈ treatment which is at par with T₇ (0.77 t), T₆ (0.74 t) and significantly differs from T₃ (0.59 t), T₅ (0.48 t), T₂(0.42 ton), T₄(0.39 t) and the lowest mean dry plant weight ha⁻¹ of 0.35 ton was recorded in T₁ i.e. control. However the treatments are in an increasing trend with a maximum dry leaf

weight in T₈ (0.6t) and minimum in control T₁ (0.01t). Effect of biofertilizer on the dry weight of plant was due to increased nitrogen uptake and the growth rate improvement (Mahfouz and Sharaf Eldin, 2007). The result of present work agrees with the reports of Kumar *et al.*, (2009) on *Artemisia pallens* and Valadabadi and Farahani (2011) on *Nigella sativa*.

Effect of INM practices on economics

The economic feasibility of the biofertilizer treatments indicated that, the B: C ratio of the treatments T₇ and T₈ has got the highest value 2.14 and 2.09 respectively followed by T₆ (2.06). Highest B:C ratio was obtained as 2.14 in case of FYM + RDF (75%) + biofertilizers (*Azotobacter*+ *Azospirillum*+ PSB) (2.14) and 2.06 in the case of FYM + RDF(50%)+ biofertilizers (*Azotobacter*+ *Azospirillum*+ PSB), which indicates that the substitution of inorganic fertilizer with biofertilizers and FYM resulted at par yield with the use of FYM+RDF(100%)+ biofertilizers (*Azotobacter*+ *Azospirillum*+ PSB). But there was cost saving on the use of inorganic fertilizer up to a tune of 50%.

In conclusion the results revealed that the highest plant height, no of branches, herbage yield and dry weight of plant were obtained by using 100% K and 75% NP along with *Azotobacter*, *Azospirillum* and PSB) which was significantly superior to the rest of the treatment combinations with respect to all characters taken under investigation. By substitution of 25% of inorganic fertilizer with biofertilizers can lower the cost of cultivation with little saving of the fertilizer cost. Basal application of FYM @ 5 t/ha at the last ploughing along with 75% of the recommended dose of fertilizer (i.e. 20:30:20) and soil inoculation with biofertilizers like *Azotobacter*, *Azospirillum* and PSB at the rate of 12 kg/hectare is recommended to achieve

the maximum potential yield of coriander cultivar Surabhi in the coastal agro climate of Odisha.

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