

Original Research Article

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Effect of Bio-fertilizers on Growth and Leaf Yield of Coriander (*Coriandrum sativum* L.)

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ABSTRACT

A field experiment was conducted during winter 2018-19 at Instructional farm, S'O'A (Deemed to be University), Bhubaneswar, to study the effect of bio-fertilizers particularly *Azotobacter* and *Azospirillum* with inorganic fertilizers like Nitrogen, Phosphorous & Potash on growth and leaf yield of coriander and to find out the most appropriate combinations of inputs for coriander. The experiment was evaluated in randomized block design. The experiment was composed of ten treatments in various combinations of organic and inorganic fertilizers. Maximum leaf yield (26.22 q/ha) was recorded by using 100% recommended dose of fertilizers (60-40-40 kg/ha) along with bio-fertilizers i.e. *Azotobacter* (5 kg/ha) and *Azospirillum* (5 kg/ha). Combined effects of bio-fertilizers along with inorganic chemical fertilizers boosted plant yield attributing characters to exhibit maximum level which in turn produced the highest yield.

Keywords

Coriander,
Biofertilizer,
Leaf yield and
growth

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Introduction

Coriander (*Coriandrum sativum*) also known as cilantro, Chinese parsley or dhanis is an annual herb mainly cultivated for fruit (dried seed) as well as for tender green leaves. In India, it is widely cultivated in Rajasthan, UP, Gujarat, Madhya Pradesh and Tamilnadu. The green leaves are good source of Vitamin- A& C. The young plants are being used in

preparation of chutney, curries, soup and sauce due to its aromatic flavour. Leaves and seeds are extensively used as a spice & food flavouring agents throughout the world (Singh & Singh, 1996).

Being the land of spices India is foremost country in the world with regard to production of coriander. There is a good demand of coriander in international market as a spice

(Shreekumar, 1997). *Azospirillum* and *Azotobacter* association in combination enhance availability of nitrogen which can assist the host plant to increase the growth (Gaur, 1990). *Azospirillum* and *Azotobacter* produce growth promoting hormones like IAA, GA that increase nitrogen content in soil (Prabhu *et al.*, 2001)

In spite of great utility of coriander, little attention has been paid to evolve suitable package of practices for its profitable cultivation. In the recent years, a lot of emphasis has been given on the possibility of utilizing indigenously available bio-fertilizers to meet the nutrient requirement by the crops. Bio fertilizers have emerged as important components of integrated nutrient system which help in improving crop yields by supplying the nutrients in adequate amount.

Materials and Methods

The field experiment was carried out at the instructional farm of Institute of Agricultural Sciences, Bhubaneswar in the year 2018-19. The present field experiment was carried out with variety Jajpur Local, Ten treatments were laid out in Randomized Block Design (RBD) with 3 replications. A spacing of (15 x 10) cm was maintained. The fertilizer dose of

60:40:40 N-P-K kg/ha is recommended. Full dose of P₂O₅, full dose of K₂O along with half dose of N₂ were applied on plots as basal dose. The rest half of N₂ amount was applied in 2 split doses at 15 days interval. *Azotobacter* @ 5 kg/ha, *Azospirillum* @ 5 kg/ha, or combination of both were applied before sowing in the field as per plot layout. Pramukh (19-19-19) was sprayed @ 5 g per liter of water after cutting of the leaves.

Five sample plants from each plot were tagged randomly to record data on growth and yield attributing characters. The experimental data were analyzed statistically by the method of analysis of variance as outlined by Panse and Sukhatme (1985). All other cultural operations were carried out as per recommended package of practices. The 1st cut (Coriander leaves) was given 30 days after sowing of the seeds. Thereafter, two cuttings were given each at 30 days interval.

The mean data and physio-chemical estimates were subjected to proper statistical analysis in randomized block design. The F-tests were used for testing the significance of findings. Standard error for each factor was worked out and to compare the two treatment means, the critical difference (C.D) was calculated at 5% level of significance.

Treatment Details

Notations	Treatments
T ₁	100 % RDF (Control)
T ₂	100 % RDF+ <i>Azotobacter</i> @ 5 kg/ha
T ₃	100 % RDF+ <i>Azospirillum</i> @ 5 kg/ha
T ₄	100 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>
T ₅	75 % RDF + <i>Azotobacter</i> @ 5 kg/ha
T ₆	75 % RDF + <i>Azospirillum</i> @ 5 kg/ha
T ₇	75 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>
T ₈	50 % RDF+ <i>Azotobacter</i> @ 5 kg/ha
T ₉	50 % RDF+ <i>Azospirillum</i> @ 5 kg/ha
T ₁₀	50 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>
(RDF :- N:P₂O₅:K₂O @ 60-40-40 kg/ha)	

Results and Discussion

The present investigation is intended to estimate the effects of bio-fertilizers with graded doses of chemical fertilizers like N, P and K on the growth and yield of Coriander (*Coriandrum sativum* L). An integrated approach to nutrient management involving judicious combination of different chemical fertilizers (Nitrogen, Phosphorous and Potash) and bio inoculants (*Azotobacter*, *Azospirillum*) on the growth and yield of coriander could be a rewarding approach in this context.

Plant height(cm)

The plant height was recorded in different dates of growth of plant i.e. 30 days, 60 days, 90 days and finally 110 days (Table 1). At 30 days maximum plant height was recorded in T₄ (13.58 cm) which was significantly superior than rest of the treatments followed by T₇ (12.61 cm) which remained at par with T₁₀ (12.26 cm). However, lowest height was recorded in T₁ (9.75 cm).

Similar results were also obtained with respect to height of plant at 60 days as well as 90 days where the highest heights were measured to be 42.61 cm and 53.26 cm respectively which was significantly higher than rest of treatments.

Maximum height was recorded in T₄ (56.17 cm) after 110 days of planting which was significantly superior than other treatments. However, the lowest height was recorded in T₁(49.82 cm) which was significantly inferior to other treatments tried in the experiment.

The result revealed that the plant height in Coriander was greatly influenced by combined application of N, P, K & bio-fertilizers, which might be attributed to longer amount of sustained supply of nutrients

during growth period. The greater increase in plant height may also be due to build-up colonies of applied bio-fertilizers inoculates and their growth promoting substances as reported by Tien *et al.*, (1979) in pearl millet.

Number of branches per plant

Maximum no. of branches per plant was recorded in T₄ (5.67) which was significantly higher than rest of the treatments followed by T₇ (4.67) and T₁₀ (4.33) (Table 1). However, the lowest no. of branches per plant was recorded in T₁ (2.33) which was significantly inferior than rest of the treatments.

Combined effects of 100% N, P, K in combination with *Azotobacter* and *Azospirillum* resulted in production of maximum number of branches per plant. This clearly indicates that bio-fertilizers along with N, P, K got a cumulative effect in association with N₂, thus enhancing its requirement by the crop.

Number of leaves per plant

Maximum number of leaves was recorded in 30 days of planting in T₄ (8.87) which was significantly superior to all other treatments followed by T₇ (8.13) and T₁₀ (7.37) (Table 2). However, the lowest value was recorded in T₁ (5.53).

Similar trend was also recorded on the leaf no. at 60 days of planting where T₄ (12.37) was the highest and significantly superior than other treatments followed by T₇ (11.43) and T₁₀ (10.58). The lowest value was recorded in T₁ (8.37) which is control.

Leaves are the major sites of photosynthesis. Production of leaf is generally influenced by environment as well as nutrition. The no. of leaves per plant showed significant variation due to various leaves of organic & inorganic

fertilizers. *Azospirillum* and *Azotobacter* in combination enhances the available nitrogen status which might helps in enhancing the photosynthesis activity (Pooja *et al.*, 2017).

Leaf area (cm²)

Maximum leaf area was recorded in T₄ (11.31 cm²) which was significantly higher than rest of the treatments followed by T₇ (10.72 cm²) and T₁₀ (10.20 cm²) (Table 2). It was further observed that least leaf area was recorded with T₁ (8.77 cm²) which was significantly inferior to other treatments.

Leaf area expansion is one of the indications of response growth factor and also a direct indication of photosynthetic potentiality of a plant. Higher leaf area index is due to activity of *Azotobacter* & *Azospirillum* that produce growth promoting hormones like IAA,GA or substances that increase N₂ content in soil (Rangappa *et al.*, 1997).

Total chlorophyll (mg/g)

The total chlorophyll content was maximum in T₄ (1.17 mg/g), which was significantly superior to rest of the treatments followed by T₇ (1.13 mg/g) & T₁₀ (1.09 mg/g) (Table 2).

However, lowest total chlorophyll content of leaf was observed in T₁ (1.04 mg/g) which was significantly inferior to all other treatments tried in experiment.

The combined effects of *Azotobacter* and *Azospirillum* has helped to absorb more amounts of available nutrients utilized for different growth parameters like plant height, number of branches per plant as well as chlorophyll content of leaves.

The chlorophyll content will ultimately be utilized for production of more no. of food material which will be exhibited in the form of plant height, leaf number etc. there by

resulting more of vegetative growth i.e. yield (Nagar *et al.*, 2009).

Leaf yield

A significant variation was marked in the yield of the coriander leaf which was taken in 30 days, 60 days and 90 days (Table 3). Maximum yield was recorded in T₄ (375.67g, 384.67g, 288.33 g) which was significantly higher than rest of the treatments. However, the lowest yield was recorded with T₁ (190.67g, 214.33g, 140.67g) which was statistically inferior to rest of the treatments tried in the experiment.

Data revealed that maximum yield was recorded with T₄ (1048.67g) which was significantly higher than all the treatments followed by T₇ (941.99g), T₁₀ (890.33g). The lowest value was recorded with T₁ (541.67g). A significant variation was marked in total yield (q/ha) in all the treatments.

The maximum yield was observed in T₄ (26.22 q/ha) which was significantly higher than rest of treatments tried followed by T₇ (23.55 q/ha) and T₁₀ (22.26 q/ha). However, lowest value was marked in T₁ (13.61 q/ha) which was significantly inferior to rest of the treatments.

The increase in yield might be due to increased supply of major plant nutrients that are required in huge quantities for growth and development of the plant. *Azotobacter* and *Azospirillum* fix atmospheric N₂ which accelerate fast cell division, cell multiplication, cell elongation, protein & protein synthesis in plants.

The plant treated with bio-fertilizer becomes more active and enable to synthesize required amount of hormones to promote leaf production thereby increasing leaf yield (Aishwath *et al.*, 2010).

Table.1 Effect of biofertilizers on plant height & no. of branches per plant of coriander

Treatments		Plant height (cm)				No. of branches per plant
		30 days	60 days	90 days	Total (110 days)	
T ₁	100 % RDF	9.75	38.52	47.73	49.82	2.33
T ₂	100 % RDF + <i>Azotobacter</i>	11.56	40.62	51.55	53.39	3.67
T ₃	100 % RDF + <i>Azospirillum</i>	10.44	40.18	51.35	53.70	3.67
T ₄	100 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	13.58	42.61	53.26	56.17	5.67
T ₅	75 % RDF + <i>Azotobacter</i>	11.48	40.31	50.79	52.07	3.33
T ₆	75 % RDF + <i>Azospirillum</i>	10.98	39.77	48.96	51.18	3.33
T ₇	75 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	12.61	41.87	52.87	54.90	4.67
T ₈	50 % RDF + <i>Azotobacter</i>	10.91	39.41	49.37	51.37	2.67
T ₉	50 % RDF + <i>Azospirillum</i>	11.06	38.89	48.59	50.30	2.67
T ₁₀	50 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	12.26	41.32	52.43	53.80	4.33
	Mean	11.46	40.35	50.69	52.67	3.63
	SE(M)	0.22	0.33	0.57	0.42	0.29
	C.D (0.05)	0.65	1.41	1.68	1.26	0.87

Table.2 Effect of biofertilizers on leaf no. (30 and 60 days), leaf area and total chlorophyll content of leaf of coriander

Treatments		Yield (g/plot)				Total Yield (q/ha)
		(30 days)	(60 days)	(90 days)	Total	
T ₁	100 % RDF	190.67	214.33	140.67	545.67	13.64
T ₂	100 % RDF + <i>Azotobacter</i>	275.33	284.67	226.67	786.67	20.03
T ₃	100 % RDF + <i>Azospirillum</i>	282.33	298.33	232.33	812.99	20.33
T ₄	100 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	375.67	384.67	288.33	1048.67	26.22
T ₅	75 % RDF + <i>Azotobacter</i>	248.33	270.33	207.67	726.33	18.16
T ₆	75 % RDF + <i>Azospirillum</i>	230.67	246.67	188.33	665.67	16.64
T ₇	75 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	328.33	353.33	260.33	941.99	23.55
T ₈	50 % RDF + <i>Azotobacter</i>	215.33	235.33	180.67	631.33	15.78
T ₉	50 % RDF + <i>Azospirillum</i>	206.67	223.33	168.67	598.67	14.97
T ₁₀	50 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	316.33	331.67	242.33	890.33	22.26
	Mean	266.97	284.27	213.60	764.83	19.16
	SE(M)	6.48	4.53	3.82	8.03	0.22
	C.D(0.05)	19.26	13.47	11.34	23.85	0.67

Table.3 Effect of biofertilizers on yield (30, 60 and 90 days) of coriander

Treatments		Leaves / plant (30 days)	Leaves / plant (60 days)	Leaf area (cm ²)	Total Chlorophyll Content of Leaf (mg/g)
T₁	100 % RDF	5.53	8.37	1.04	8.77
T₂	100 % RDF + <i>Azotobacter</i>	7.13	10.3	1.09	10.13
T₃	100 % RDF + <i>Azospirillum</i>	6.70	9.93	1.08	9.88
T₄	100 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	8.87	12.37	1.17	11.31
T₅	75 % RDF + <i>Azotobacter</i>	6.57	9.17	1.09	9.69
T₆	75 % RDF + <i>Azospirillum</i>	6.43	8.9	1.08	9.53
T₇	75 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	8.13	11.43	1.13	10.72
T₈	50 % RDF + <i>Azotobacter</i>	6.13	8.9	1.06	9.17
T₉	50 % RDF + <i>Azospirillum</i>	6.07	9.03	1.07	9.03
T₁₀	50 % RDF + <i>Azotobacter</i> + <i>Azospirillum</i>	7.37	10.58	1.09	10.20
	Mean	6.89	9.9	1.09	9.84
	SE(M)	0.22	0.15	0.01	0.17
	C.D(0.05)	0.66	0.43	0.03	0.49

Application of different levels of N, P and K in combination with bio-fertilizers increased the vegetative part yield per plant, thereby increasing yield per hectare. Maximum yield of 26.22 q/ha was recorded by using 100% recommended dose of chemical fertilizers along with bio-fertilizers i.e. *Azotobacter* and *Azospirillum*.

The highest yield of this treatment was the sum total effect of different yield attributing characters particularly height of plant, number of branches, number of leaves etc. However, other biometric observations exhibited higher values because growth characters also top the list in this experiment. Yield per unit area also increased significantly over control but combined effects of bio-fertilizers boosted the yield attributing characters to exhibit maximum level which in turn produced

highest yield (vegetative part).

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