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Effect of integrated nutrient management on yield parameters of coriander (*Coriandrum sativum* L.) cultivars under Telangana conditions

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Abstract
A field experiment was conducted during *rabi* 2017-18 at PG block, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, Telangana, India, to study the effect of integrated nutrient management on seed yield of coriander (*Coriandrum sativum* L.) cultivars. The experiment was evaluated in randomized block design with factorial concept consists two factors like Cultivars and Inorganic, Organic and Bio fertilizers. The first factor comprised of two cultivars i.e. AD-1 and Suguna besides the second factor consists fertilizer levels of F_1 - 100% RDF (15-40-20 NPK Kg ha^{-1}), F_2 - 75% RDF + Farmyard Manure (FYM @10 t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application). F_3 - 75% RDF + Vermicompost (VC @ 5t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application), F_4 - 50% RDF + Farmyard Manure (FYM @10 t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application), F_5 - 50% RDF + Vermicompost (VC @ 5t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application). Ten treatment combinations were replicated thrice. Among the treatments, F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) with the variety V_2-Suguna recorded maximum number of seeds per umbel, 1000 seed weight, seed yield per plant, seed yield per plot, seed yield per hectare and least number of days taken to seed setting and seed harvest.

Keywords: *Azospirillum*, PSB, FYM, vermicompost, RDF, AD-1 and Suguna

Introduction
Coriander (*Coriandrum sativum* L.) is an annual herbaceous plant locally known as *Dhania* belongs to the family Apiaceae and is native to the Mediterranean region. The name was derived from the Greek word 'koris' and was given on accounts of its unpleasant odour of unripe green fruits. Coriander is extensively grown in Bangladesh, India, Russia, Central Europe and Morocco and it has been cultivated since human antiquity (Bhuiyan *et al.*, 2009) [1]. India is the biggest producer, consumer and exporter of coriander in the world and is mainly grown in Rajasthan, Gujarat, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Orissa, Karnataka and Telangana.

In India coriander is cultivated in an area of 6.74 lakh ha with a production of 8.83 lakh MT, where as in Telangana, the area and production are 10,000 ha and 400 MT respectively (National Horticulture Board, 2016) [9].

In recent years, bio fertilizers have emerged as an important component of integrated nutrient supply system and have shown promise to improve crop yields and nutrient supplies. *Azotobacter*, PSB and *Azospirillum* are the most wide spread bio fertilizers significantly contributing N, P and K to plants and also providing resistance to drought situation (Maheshwari *et al.*, 1991) [4].

The application of nutrients through various sources is newer approach and being advocated for sustainable production. The integrated nutrient management has a crucial role in improving the plant physiology characters that builds levels of resistance and reduces the incidence of disease and pest attacks (Mirchandani and Mirchandani, 2005) [6]. Nitrogen fixing bacteria like *Azospirillum* have a great potential to reduce the nitrogenous fertilizer requirements whereas, Phosphorus solubilising bacteria is known to make the soil fixed phosphorus in to readily available form, subsequently increased the productivity of the crops.

Materials and Methods

Present field experiment was conducted during *rabi* 2017-18 at PG block, College of Horticulture, Sri Konda Laxman Telangana State Horticultural University, Hyderabad, Telangana, India.

The experiment was carried out with two varieties i.e. AD-1 and Suguna with five fertilizer levels i.e. 100% RDF (15-40-20 NPK Kg ha^{-1}), 75% RDF + Farmyard Manure (FYM @10 t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application), 75% RDF + Vermicompost (VC @ 5t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application), 50% RDF + Farmyard Manure (FYM @10 t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application), 50% RDF + Vermicompost (VC @ 5t ha^{-1}) + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) in a Factorial Randomized Block Design and replicated thrice. Seeds were sown in the plot of 2 m × 1.5 m at spacing of 30 cm × 10 cm.

The recommended dosages of N, P and K @ 15:40:20 kg ha^{-1} were applied in the form of urea, single super phosphate and muriate of potash respectively. Urea was applied in the three splits, the first as basal application and the other two doses at 25 and 50 days after sowing. The entire dose of single super phosphate and muriate of potash were applied at the time of sowing as basal dose. The vermicompost and the farmyard Manure were incorporated in to respective plots just prior to sowing of seed and then slightly covered with the fine soil.

Slurry of 200 g of each of *Azospirillum* and Phosphorous Solubilising Bacteria were dissolved in 1000 ml of jaggery solution (100 g of jaggery in 1000 ml of water) separately and combination of both 100 g *Azospirillum* and 100 g Phosphorous Solubilising Bacteria were dissolved in 1000 ml of jaggery solution. The coriander seeds were dipped in the slurry for about 30 minutes before sowing. Need based cultural and plant protection operations were taken up to the seed harvest. Five plant samples from each replication were selected at random to record data on growth characters. The experimental data was analysed statistically by the method of analysis of variance as out lined by Panse and Sukhatme (1985) [10].

Results and Discussion

Yield parameters

Yield parameters such as number of seeds per umbel, 1000 seed weight, days taken to seed setting, days taken to seed harvest, seed yield per plant, seed yield per plot and seed yield per hectare showed a significant difference between fertilizer levels and varieties.

Among the treatments, F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) with the variety V_2-Suguna recorded maximum number of seeds per umbel (40.40), 1000 seed weight (13.71 g) (Table 1.), minimum number of days taken to seed setting (78.43 days) and seed harvest (89.46 days) (Table 2.).

Similarly, maximum seed yield per plant (5.50 g), seed yield per plot (385.00 g) and seed yield per hectare (1283.33 kg) was recorded in the same treatment combination (Table 3.).

The highest number of seeds per umbel was recorded in F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) might be due to higher plant height, more number of secondary branches per plant, maximum number of umbels per plant and umbellate per umbel. Moreover, it might be due to balanced C: N ratio, increased decomposition, mineralization, availability of native and applied macro and micro-nutrients, resulted in accelerated carbohydrates synthesis, led to better translocation from sink to source (Singh *et al.* 2015) [14]. These findings were in consonance with the report of Sahu *et al.,* (2014) [13] in coriander.

The maximum 1000 seed weight was recorded in F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) might be due to more number of seeds per umbel as compared to other fertilizer level treatments.

The least number of days taken to seed setting and seed harvest was registered in F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) might be due to the same treatment recorded minimum number of days taken to first flowering and 50 per cent flowering rather than other fertilizer level treatments.

The highest seed yield per plant was registered in F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) might be due to more number of umbels per plant, umbellate per umbel, seeds per umbel and maximum 1000 seed weight of this fertilizer level treatment over the others.

These results were in accordance with that of Tripathi *et al.,* (2013) [15] in coriander who reported that integrated nutrient management practice improved the growth and yield contributing characters.

Similarly findings are in line with the Mounika *et al.,* (2018) [7] who stated that balanced fertilizer application improved the availability of phosphorous, nitrogen and other nutrients, helped in increasing the yield attributing characters.

The highest seed yield per hectare was recorded in F_3-75% RDF + Vermicompost @ 5t ha^{-1} + *Azospirillum* and PSB (5g Kg^{-1} of seed as seed inoculation + 5 Kg ha^{-1} as soil application) might be due to maximum seed yield per plant and plot of this treatment over the others.

These lines are in line with that of Pooja *et al.,* (2017) [11] in coriander, who found that practicing of integrated nutrient management improved the nutrient uptake, photosynthesis activity and moreover resistant to pests and diseases, ultimately resulted in more seed yield.

Table 1: Effect of integrated nutrient management on number of seeds per umbel and 1000 seed weight (g) in coriander cultivars

Fertilizers / Treatments(F)	Number of seeds per umbel			1000 seed weight (g)		
	V_1	V_2	Mean	V_1	V_2	Mean
F_1	28.70	29.20	28.95^{e}	10.19	10.63	10.41^{e}
F_2	34.50	37.30	35.90^{b}	12.05	13.19	12.62^{b}
F_3	35.10	40.40	37.75^{a}	12.54	13.71	13.13^{a}
F_4	30.20	32.10	31.15^{cd}	10.96	11.36	11.16^{cd}
F_5	31.30	33.40	32.35^{c}	11.32	11.63	11.48^{c}
Mean	31.96^{b}	34.48^{a}		11.41^{b}	12.10^{a}	
	SEm ±	CD at 5%		SEm ±	CD at 5%	
Fertilizers(F)	0.47	1.38		0.09	0.26	
Varieties(V)	0.29	0.87		0.06	0.16	
(V × F)	0.66	1.95		0.12	0.37	

Table 2: Effect of integrated nutrient management on days taken to seed setting and days taken to seed harvest in coriander cultivars

Fertilizers / Treatments (F)	Days taken to seed setting			Days taken to seed harvest		
	V_1	V_2	Mean	V_1	V_2	Mean
F_1	91.58	90.41	91.00^{e}	102.58	101.41	102.0^{e}
F_2	85.66	79.44	82.55^{ab}	96.66	90.47	93.56^{ab}
F_3	84.61	78.43	81.52^{a}	95.64	89.46	92.55^{a}
F_4	89.68	86.00	87.84^{cd}	100.68	97.00	98.84^{cd}
F_5	87.75	85.88	86.82^{c}	98.79	96.92	97.85^{c}
Mean	87.86^{b}	84.03^{a}		98.87^{b}	95.05^{a}	
	SEm ±	CD at 5%		SEm ±	CD at 5%	
Fertilizers(F)	0.68	2.02		0.68	2.01	
Varieties(V)	0.43	1.28		0.43	1.27	
(V × F)	0.96	2.86		0.96	2.84	

Table 3: Effect of integrated nutrient management on seed yield per plant (g), seed yield per plot (g) and seed yield per hectare (kg) in coriander cultivars

Fertilizers / Treatments(F)	Seed yield per plant (g)			Seed yield per plot (g)			Seed yield per hectare (kg)		
	V_1	V_2	Mean	V_1	V_2	Mean	V_1	V_2	Mean
F_1	3.40	3.50	3.45^{e}	238.00	245.00	241.50^{e}	793.33	816.67	805.00^{e}
F_2	4.30	4.90	4.60^{b}	301.00	343.00	322.0^{b}	1003.33	1143.33	1073.33^{b}
F_3	4.50	5.50	5.00^{a}	315.00	385.00	350.00^{a}	1050.00	1283.33	1166.67^{a}
F_4	3.60	4.00	3.80^{d}	252.00	280.00	266.00^{d}	840.00	933.33	886.67^{d}
F_5	3.80	4.10	3.95^{c}	266.00	287.00	276.50^{c}	886.67	956.67	921.67^{c}
Mean	3.92^{b}	4.40^{a}		274.40^{b}	308.00^{a}		914.67^{b}	1026.67^{a}	
	SEm ±	CD at 5%		SEm ±	CD at 5%		SEm ±	CD at 5%	
Fertilizers(F)	0.04	0.13		3.00	8.91		9.99	29.68	
Varieties(V)	0.03	0.08		1.90	5.63		6.32	18.77	
(V × F)	0.06	0.18		4.24	12.59		14.13	41.98	

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