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Effect of bio-fertilizer azospirillum on growth and yield parameters of coriander (*Coriandrum sativum* L.) cv. Pant Haritima

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Abstract

The experiment was conducted during 2007-2008 to 2009-2010 at experimental field of the Department of Horticulture, Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar. A Combination of bio-fertilizer Azospirillum + Inorganic Nitrogen + FYM gave better performance as compared to single application of bio-fertilizer Azospirillum, organic FYM, inorganic nitrogen and other combination. The combination treatment as soil application of inorganic N (100%) of RDF + Azospirrilum @ 15kg ha^{-1} + FYM @ 5 t ha^{-1} (T_1) gave the maximum plant height (144.62 cm), number of branches per plant (8.28), number of umbels per plant (72.03), number of umbellates per umbel (6.76), number of grains per umbel (54.64) and yield per plot (1.05 kg/4.8m^2) and increased the yield 71.65 percent over control followed by combination treatment (T_2) as soil application of inorganic N (75%) of RDF + Azospirrilum @ 15kg ha^{-1} + FYM @ 5 t ha^{-1} i.e. Plant height (141.59 cm), number of branches per plant (8.12), number of umbels per plant (65.35), number of umbellates per umbel (6.26), number of grains per umbel (45.72) and yield per plot (0.95 kg/4.8m^2) i.e. per hectare (1.98t ha^{-1}) and increase the yield 55.90 per cent over control. Considering economics, the maximum net profit Rs. 31,600 ha^{-1} and benefit : cost (Rs.1.94) were found in treatment (T_1) as soil application of inorganic N (100%) of RDF + Azospirrilum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1}.

Key words : Azospirillum, bio-fertilizer, coriander, yield

Introduction

India is one of the largest producers of coriander in the world. Coriander (*Coriandrum sativum* L.) is an annual herb with several branches and lacy leaves with jagged edges belonging to the family *Apiaceae*. It is native of Mediterranean region. This aromatic herb is found in many parts of the world. In India, coriander is mainly cultivated in Rajasthan and Gujarat with a sizeable acreage in Madhya Pradesh, Tamil Nadu and Bihar. It is cultivated in an area of 3, 40,500 ha with the production of 2,22,400 tonns. Rajasthan alone shares 40-45% of the area and production. The higher productivity could be determined by selection of suitable varieties, balance nutrition, optimum water management and timely plant protection measures. Among these factors, the use of bio-fertilizers has currently attained a special significance in crop production to address the sustainability issues and tremendous success had been achieved in several crops. Bio-fertilizers have a potential use in horticulture and very few applications of bio-fertilizer use in coriander were found. Therefore, the present study was taken to investigate the impact of bio-fertilizers single or in combination with different level of inorganic nitrogen and FYM on yield and yield parameter on coriander during Rabi season.

Materials and methods

A field experiment was carried out for three consecutive year 2007-08 to 2009-2010 at experimental field, Department of Horticulture, Tirhut College of Agriculture, RAU, Pusa, Dholi, Muzaffarpur, Bihar. The experiment was allotted by All India Co-ordinated Research Project on Spices (ICAR). The soil was sandy loam and calcareous in nature (Table1). The experiment was laid out in Randomized Block Design with three replication. The seeds were sown in the 3rd week of october every year. The plot size for each treatment was 3.0 x 1.6 m^2 with spacing of 30 cm x 20 cm. The treatment details are given below.

- T_1 - Inorganic N (100%) of RDF + Azospirillum @ 15kg ha^{-1} + FYM-5t ha^{-1}.
- T_2 - Inorganic N (75%) of RDF + Azospirillum @ 15kg ha^{-1} + FYM-5t ha^{-1}.
- T_3 - Inorganic N (50%) of RDF + Azospirillum @ 15kg ha^{-1} + FYM-5t ha^{-1}.
- T_4 - FYM - 5t ha^{-1} + Azospirillum @ 15kg ha^{-1}.
- T_5 - FYM – 5t ha^{-1} alone.
- T_6 - FYM-10 t ha^{-1} + Azospirillum @ 15kg ha^{-1}.

T_7 - 10 t ha^{-1} alone.

T_8 - 100% inorganic nitrogen

T_9 - Azospirillum @ 15kg ha^{-1}.

T_{10} - Control.

Observations on growth were recorded from five random plants of each treatment and replication using standard procedure and yield was recorded per plot (kg) and per hectare (t/ha).

Result and discussion

The effect of bio-fertilizer Azospirillum, FYM and inorganic nitrogen alone and combined effect of Azospirillum, FYM and inorganic nitrogen were presented in Table 2 and economics in Table 3**.**

All the treatment of bio-fertilizer Azospirillum, FYM and inorganic nitrogen alone and combined effect were found significant as compare to control and except treatment (T_7) 10 t ha^{-1} FYM and treatment (T_9) bio-fertilizer Azospirillum @ 15kg ha^{-1} alone regarding height of the plant. However, only two treatments (T_1) inorganic N (100%) of RDF + Azospirillum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1} and (T_2) inorganic N (75%) of RDF + Azospirillum @ 15kg ha^{-1} + FYM @ 5t ha^{-1} were found significantly higher regarding number of branches per plant and rest treatments of bio-fertilizer were not recorded significantly superior over control. Among the treatments maximum plant height (144.62 cm) and number of branches per plant (8.28) were recorded with treatment (T_1) inorganic N (100%) of RDF + Azospirillum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1} followed by treatment (T_2) inorganic N (75%) of RDF + Azospirillum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1} with 141.59 cm plant height and 8.12 branches per plant. However, minimum plant height (127.72 cm) and number of branches per plant (7.16) were noticed with treatment (T_9) Azospirillum @ 15 kg ha^{-1} alone. Increase in growth related attributes due to bio-fertilizer application has also been reported by Kuruthamani *et al.*, (5), Wange (6), Thiiakovatty and Ramaswamy (7) and Chattoo *et al.*, (2) in other vegetable crops. The improvement in growth related attributes could be because of certain growth promoting substance, secreted by bio-fertilizers, besides increasing the availability of atmospheric nitrogen and soil phosphorus, which might have led to better root and shoot development, better uptake of water, nutrients and their transportation.

All the treatments were found significant regarding number of umbels per plant, number of umbllets per umbel and yield per plot as compared to control except soil application of bio-fertilizer Azospirillum @ 15 kg ha^{-1}. However, treatments T_1, T_2, T_3 and T_8 gave the significant effect on number of grains per umbel as compare to control and rest treatments were found at par with control. Treatment T_1 produced maximum number of umbels per plant (72.03), number of umbellates per umbel (6.76), number of grains per umbel (54.64) and yield per plot (1.05 kg 4.8m^{-2}) which produced 71.65 % higher yield over control (T_{10}) followed by treatment T_2 i.e. number of umbels per plant (65.35), number of umbellates per umbel (6.26), number of grains per umbel (45.72) and yield per plot (0.95kg/4.8m^2) or per hectare (1.98t ha^{-1}) which is produced 55% higher yield as compare to control (T_{10}). However, treatment (T_{10}) control and (T_9) bio-fertilizer Azosprillum produced the minimum number of umbels per plant 41.94 & 48.68, number of umbellets per umbel 5.10 & 5.72, number of grains per umbel 33.39 & 34.60 and yield per plot 0.61kg & 0.72 kg/4.8m^2 or per hectare 1.27t and 1.50t ha^{-1} respectively. Similar observation was also made by Gaur (4), Kuruthamani *et al.*, (5), Wange (8), *Chattoo et al.*, (1), Thiiakavathy and Ramaswamy (7) and Chattoo *et al.*, (2) in other vegetable crops. Azospirillum is a group of bacteria and useful in increasing yield, quality and production of crop when they are used in combination with organic manure and organic fertilizer in a balanced proportion. Chemical fertilizers makeup only a few mine roles to the plant where as bio-fertilizers all the macro and micro nutrients. Many crop show potassium deficiency because of excessive use of nitrogen based fertilizer. Excessive potassium dose decrease available nutrient in Horticulture crop such as vitamins, acid and carotene reported by Dixit (3). The increase in yield attributes may be due to better root proliferation, uptake of nutrients and water, higher leaf area, more photosynthesis and enhanced food accumulation, increasing availability of atmospheric nitrogen and phosphorus by microbial inoculants might have played a vital role in increasing the yield and yield related attributes of Coriander.

Economics of the experiment

The perusal of Table 3 reveals the cost of cultivation and benefit cost ratio of coriander. Maximum cost of cultivation Rs.35,200 was recorded with treatment (T_6) FYM @ 10t ha^{-1} + Azospirillum @ 15 kg ha^{-1} followed by treatment T_7 (Rs.34,000.00). However, Gross return was maximum Rs.65,400 from treatment (T_1) inorganic N (100%) of RDF + Azospirillum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1} followed by treatment (T_2) inorganic N (75%) of RDF + Azospirillum @ 15 kg ha^{-1} + FYM @ 5t ha^{-1} i.e. Rs.59,400. Similarly, net profit was maximum Rs.31, 600 with treatment (T_1) followed by treatment T_2 (Rs.25,750). The benefit: cost ratio was markedly influenced by different treatments and it was maximum in treatment (T_1) i.e. 1:1.94 followed by treatment T_2 (1:1.44).

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Table 1. Physical and Chemical properties of experimental plot.

Properties	Unit	Years		
		2007-08	2008-09	2009-2010
A. Physical Properties.				
1. Soil Type		Sandy loam	Sandy loam	Sandy loam
2. Clay Content	%	7.20	7.5	7.30
3.Bulk Density	g/cc	1.05	1.02	1.01
4. Moisture at field capacity	%	37.20	36.50	36.30
5. Moisture at field	%	17.80	18.50	18.20
6. Moisture at wilting	%	7.20	6.50	6.20
B. Chemical Properties				
7. PH		7.5	7.60	7.5
8. Conductivity	dsm^{-1}	0.38	0.30	0.33
9. Available N	kg/ha	86.00	80.00	95.00
10. Available P	kg/ha	16.50	18.08	20.00
11. Available K	kg/ha	88.80	85.00	88.00
12. Available Ca	µg/g	2800.00	3000.00	2900.00
13. Available Mg	µg/g	248.00	250.00	250.00
14. Available Zn	µg/g	0.65	0.60	0.50
15. Available Fe	µg/g	1.62	1.57	1.50
16. Available Mn	µg/g	5.00	4.00	4.00
17. Available Cu	µg/g	1.40	1.34	1.35
18. Available B	µg/g	0.38	0.40	0.40
19. Available S	µg/g	0.68	0.70	0.70

Table 2. Response of bio-fertilizer Azospirillum on yield attributes of coriandercoriander (pooled mean of three years)

Character / Treatment	Height of the plant (cm)	No. of branches per plant	No. of Umbels per plant	No. of Umbellate per umbel	No. of Grains per umbel	Yield per plot (Kg)	Yield (t/ha)	Increase in yield over check
T_1	144.62	8.28	72.03	6.76	54.64	1.05	2.18	71.65
T_2	141.59	8.12	65.35	6.26	45.72	0.95	1.98	55.90
T_3	140.52	7.88	65.35	5.84	44.53	0.89	1.88	48.03
T_4	131.54	7.27	49.97	5.84	36.14	0.73	1.53	20.47
T_5	130.33	6.67	53.13	5.83	37.23	0.76	1.59	21.25
T_6	131.83	7.19	53.82	5.94	36.03	0.82	1.61	26.77
T_7	129.99	7.17	54.10	5.92	35.55	0.80	1.67	31.49
T_8	139.10	7.55	60.04	6.12	41.78	0.79	1.64	29.13
T_9	127.72	7.16	48.68	5.72	34.60	0.72	1.50	18.11
T_{10}	116.18	6.45	41.94	5.10	33.39	0.61	1.27	-
SEM ±	4.77	0.65	2.46	0.22	1.95	0.04	0.10	-
CD=(P=0.05)	14.17	1.58	7.29	0.65	5.79	0.12	0.28	-
CV (%)	6.19	12.49	7.52	6.48	8.56	8.35	9.92	-

Table3. Economics of bio-fertilizer Azospirillum on Coriander

Treatments	Gross income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net profit (Rs/ha)	Cost: benefit ratio
T_1	65,400	33,800	31,600	1:1.94
T_2	59,400	33.650	25,750	1:1.77
T_3	56,400	33,500	22,900	1:1.68
T_4	45,900	33,200	12,700	1:1.38
T_5	46,200	32,000	14,200	1:1.44
T_6	48,300	35,200	13,100	1:1.37
T_7	50,100	34,000	16,100	1:1.47
T_8	49,200	30,600	18,600	1:1.61
T_9	45,000	31,200	13,800	1:1.44
T_{10}	38,100	30,000	8,100	1:1.27

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