

Efficacy of biofertilizers on the performance of rainfed coriander (*Coriandrum sativum*) in vertisols

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Abstract

Biofertilizers are cheap, eco-friendly, improve soil fertility and plant nutrition within short time, and are effective components in organic farming. The present study was undertaken with nine treatment combinations containing *Azospirillum* Sp., *Azotobactor* sp. and PSB and combination of *Azospirillum* and PSB, *Azotobactor* and PSB, Vermicompost, *Trichoderma viride*, 100 % inorganic Nitrogen and control in RBD with three replications. Inoculation of microorganisms and FYM @ 5 t/ha applied along with recommended dose of inorganic Nitrogen @ 100 % N had shown significant influence on growth parameters when compared with absolute control. However, the influence of microorganisms is significant only on number of secondary branches and number of umbels per plant when compared to 100% N. Plant height, number of primary and secondary branches were significantly more in treatment with 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha (66.4 cm, 6.2 and 15.4 respectively) than control (58.3 cm, 4.4 and 8.7 respectively). Among all the treatment combinations, 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha recorded highest seed yield (1004.0 kg/ha) which is significantly superior to 100% N alone (877.7 kg/ha). In addition to the increase yield, the treatment recorded an incremental Benefit Cost Ratio of 1.63. The increase in yield in treatments with *Azospirillum*, PSB and FYM along with 100% RDF may be due to better uptake of Nitrogen and Phosphorous and enhanced food accumulation.

Keywords: *Coriandrum sativum*, *Azospirillum*, *Azotobactor*, PSB, *Trichoderma viride*, Vermicompost, Biofertilizer, Nitrogen Fixation, Coriander.

Introduction

Organic farming is getting more popular these days, which accentuates shift from high volume production system to high value production system. For achieving this, management practices that conserve soil health, efficient nutrient supply systems that rely on organics instead of chemicals and integrated pest management play vital role. Among these, efficient, cheap and reliable

nutrient supply system will ensure sustainability of the organic farming system. Biofertilizers in combination with organic manures found as effective component in organic farming for reliable and cheap supply of nutrients. These combinations were ecologically safe and improve soil fertility by improving the soil physical, chemical, and biological condition.

Various rhizosphere-associated organisms are

extensively studied and appeared to have significant potential for commercial application (Bashan and Holguin, 1997). They fix atmospheric N and enrich the soil with available form of nitrogen. Use of *Azospirillum* not only improves N nutrition in crops but also reduces the use of chemical N fertilizers. As early as 1979, it was reported that the response to the seed inoculation with *Azospirillum brasilense* without Nitrogen was equivalent to the application of 40 kg N/ha alone in Sorghum (Subba Rao *et al.*, 1979). Similar responses were widely reported on many other crops subsequently. Savings up to forty percent of recommended chemical Nitrogen fertilizer dose was reported (Dart in 1986). Coriander is cultivated in Andhra Pradesh with little chemical inputs as a rainfed crop in Vertisols. The crop productivity is as low as 350 kg/ha. In view of this, improving the crop productivity using organics and biofertilizers is desirable and cost effective. Therefore, the present study was undertaken to evaluate the impact of seed dressing with *Azospirillum* with or without chemical N source and FYM on crop growth and seed yield.

Materials and methods

The field experiment was conducted during 2004-05 rabi season at Regional Agricultural Research Station, Lam using the variety Sadhana. The experimental soil was vertisols with medium in available N, medium in available P₂O₅ and high in exchangeable K₂O. The soil organic carbon content was 0.30% (low). Preceding the experiment, green manure crop i.e. Sunhemp was grown and incorporated in the soil. The experiment was laid out in Randomized Block Design with nine treatments in three replications. The nine treatment combinations contained *Azospirillum*, *Azotobacter*, and PSB and combination of *Azospirillum* and PSB, *Azotobacter* and PSB, Vermicompost, *Trichoderma viride* i.e. all the above treatments are in combination with 100% inorganic N and FYM @ 5 t/ha, 100 % inorganic N alone and control. Biofertilizers were applied as seed inoculants by seed dressing (500 g/ha). The

recommended dose of fertilizers i.e. 30 kg N, 40 kg P₂O₅, 20 kg K₂O/ha, and FYM @ 5 t/ha were broadcasted as basal dose as per the treatment requirements. Observations were recorded on plant height, number of primary and secondary branches, days to fifty percent flowering, number of umbels per plant, umbellets per umbel, and days to maturity. The data was subjected to statistical analysis for ascertaining the responses to various treatments.

Results and discussion

The results revealed that inoculation of microorganisms *Azospirillum*, Phosphobacteria and FYM @ 5 t/ha applied along with recommended dose of inorganic Nitrogen @ 100 % N had shown significant influence on growth parameters when compared with absolute control (Table 1). However, the influence of microorganisms is significant only on number of secondary branches and number of umbels per plant when compared to 100% N. Plant height, number of primary branches, number of umbels per plant and number of umbellets per umbel were significantly more in treatment with 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha (66.4 cm, 6.2 and 15.4 respectively) than control (58.3 cm, 4.4 and 8.7 respectively). More number of secondary branches were recorded with *Azotobacter*, PSB and FYM @ 5 t/ha (15.4) which is significantly superior to control (8.7) and 100% N alone (10.2). Maximum number of umbels per plant was recorded in 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha (26.9) which is significantly superior to 100% N alone (19.8) and control (13.3).

Regarding days taken for fifty percent flowering, Vermicompost application @ 5t/ha has taken maximum days (45.3) which is significant when compared to control. However, influence of treatments on days taken for fifty percent flowering is insignificant when compared with 100% N alone. Similarly, influence of treatments on days taken for maturity is insignificant when

Table 1. Impact of biofertilizers on crop growth and yield of rainfed Coriander.

Name of the treatment	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of days to 50% flowering	Days to Maturity	No. of umbels/plant	No. of umbellets per umbel	Yield per ha (kg)
N 100%+ <i>Azospirillum</i> + 5 t/ha FYM	73.7	5.6	13.7	42.7	83.3	24.6	5.9	984.0
100% N + <i>Azotobacter</i> + 5 t/ha FYM	72.4	5.5	14.1	43.3	84.3	22.5	5.8	978.0
100% N + PSB + 5 t/ha FYM	74.0	5.8	13.7	44.3	84.7	22.1	5.9	940.0
100% N + <i>Azospirillum</i> + PSB + 5 t/ha FYM	74.8	6.2	14.0	43.3	85.3	26.9	6.0	1004.0
100% N+ <i>Azotobacter</i> + PSB + 5 t/ha FYM	66.4	6.2	15.4	43.3	85.0	26.7	5.5	992.0
100% N + Vermicompost + 5 t/ha FYM	69.7	5.3	10.9	45.3	84.3	23.1	5.5	992.0
100% N+ <i>Trichoderma</i> <i>viride</i> + 5 t/ha FYM	70.8	5.5	11.7	44.3	83.0	19.5	5.1	928.0
100% N	65.9	5.3	10.2	44.3	85.7	19.8	5.2	877.7
Control	58.3	4.4	8.7	42.3	82.7	13.3	4.8	739.7
CD	9.4	1.3	4.5	1.5	1.5	5.6	0.9	122.5
C . V %	7.8	14.0	21.0	2.0	1.0	14.7	9.5	7.6

compared with 100% N alone but significant when compared to control.

Among all the treatment combinations, 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha recorded highest seed yield (1004.0 kg/ha) which is significantly superior to 100% N alone (877.7 kg/ha) and control (739.7 kg/ha). The higher seed yield may be due to presence of significantly higher number of umbels (26.9) and number of umbellets per umbel (6.0) in the above treatment when compared to 100% N alone

(19.8 and 5.2 respectively). Prabu *et al.*(2000) reported that significant increase in yields can be obtained with 25% RDF + FYM @ 10t/ha + *Azospirillum* + PSB over hundred percent of RDF. In addition to the increase yield, the treatment i.e. 100 % N in combination with *Azospirillum*, PSB and FYM @ 5 t/ha recorded, an incremental Benefit Cost Ratio of 1.63 (Table 2).

The growth enhancement due to application of microorganisms may be due to amelioration of nutrient availability to plant

Table 2. Incremental Benefit Cost Ratio of using biofertilizers in coriander

Name of	Yield per ha (kg)	Cost of Cultivation	Additional Yield over Farmers Practice (T8)	Gross Income	Net Income	Additional Income over Farmers Practice	Additional Cost incurred over Farmers Practice	Incremental Benefit Cost Ration
N 100%+ <i>Azospirillum</i> + 5 t/ha FYM	984.0	5209.0	106.0	24600.0	19391.0	1450.0	1200.0	1.21
N 100%+ <i>Azotobactor</i> + 5 t/ha FYM	978.0	5209.0	100.0	24450.0	19241.0	1300.0	1200.0	1.08
N 100% + PSB + 5 t/ha FYM	940.0	5209.0	62.0	23500.0	18291.0	350.0	1200.0	0.29
N 100%+ <i>Azospirillum</i> + PSB + 5 t/ha FYM	1004.0	5209.0	126.0	25100.0	19891.0	1950.0	1200.0	1.63
N 100%+ <i>Azotobactor</i> + PSB + 5 t/ha FYM	992.0	5209.0	114.0	24800.0	19591.0	1650.0	1200.0	1.38
N 100%+ Vermicompost + 5 t/ha FYM	992.0	5209.0	114.0	24800.0	19591.0	1650.0	1200.0	1.38
N 100%+ <i>Trichoderma viride</i> + 5 t/ha FYM	928.0	5209.0	50.0	23200.0	17991.0	50.0	1200.0	0.04
N 100%	878.0	4009.0	-	21950.0	17941.0	-	-	-
Control	740.0	3489.0	-	18500.0	15011.0	-	-	-

system due to the intervention of these organisms. In the case of *Trichoderma viride*, the protection against soil pathogens and growth promotion was insignificant over application of 100% N alone. This may be due to the plants were not invaded by any pathogenic fungi. The improvement in yield attributes may be due to enhanced root growth, better uptake of nutrients in the presence of these organisms and thus higher photosynthesis for better sink-source relationship. The increase in growth and yield attributing characters due to biofertilizer inoculation along with organic and inorganic Nitrogen may be due to

beneficial effect of biofertilizer on nitrogen fixation, production of phytohormone like substances and increase in uptake of nutrients such as nitrogen. (Govindan and Purushothaman, 1984). Phytohormones by *Azospirillum*, which simulates growth and induce changes in root morphology in turn influencing assimilation of nutrients (Summer 1990). Improved field emergence and increased seedling vigour with *Azospirillum* seed treatment in Coriander was reported (Vasugi and Thangaraj 1997). Enhancement of plant growth and yield attributing characters may also be ascribed due to the influence of Nitrogen, the chief component

of protein, essential for the formation of protoplasm, which leads to cell division and cell enlargement (Bakly, 1974). According to Dhanapal *et al.* (1978), *Azospirillum* produces bioactive substances having similar effect as that of growth regulators besides nitrogen fixation. Higher crop growth and yield was reported in various crops in the treatments applied with Phosphobacterium along with 50% of recommended dose of chemical fertilizers (Ranga Reddy et al. 2003).

The application of *Azospirillum* in combination with PSB, FYM @ 5t/ha along with 100% N fertilization offers higher productivity over application of inorganic N alone. The higher incremental benefit cost ratio of this treatment (1.63) also indicates the economic gain of this application in Coriander cultivation.

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