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Influence of nitrogen, *Azospirillum* sp. and farmyard manure on growth, yield and incidence of stem gall disease in coriander (*Coriandrum sativum* L.)

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Abstract

The influence of *Azospirillum* sp. (biofertilizer), nitrogen fertilizer, farmyard manure and their combinations on coriander (*Coriandrum sativum*), was studied at Ajmer (Rajasthan). *Azospirillum* sp. inoculation along with nitrogen and farmyard manure increased plant height and number of primary branches plant^{-1} as compared to *Azospirillum* sp. alone and absolute control. Number of umbels plant^{-1} and number of grains umbel^{-1} increased significantly when *Azospirillum* sp. was applied in combination with 100% nitrogen + 5 t farmyard manure, 75% nitrogen + 5 t farmyard manure and 50% nitrogen + 5 t farmyard manure ha^{-1}. Higher seed yield was recorded in *Azospirillum* sp. + 100% nitrogen + 5 t farmyard manure (10.8 q ha^{-1}) followed by *Azospirillum* sp. + 75% nitrogen + 5 t farmyard manure (10.2 q ha^{-1}) and *Azospirillum* sp. + 50% nitrogen + 5 t farmyard manure ha^{-1} (9.7 qha^{-1}). The use of *Azospirillum* sp. + 50% nitrogen + 5 t farmyard manure ha^{-1} was the most economical treatment for obtaining higher seed yield. The *Azospirillum* sp. treatment combinations also reduced the incidence of the seed-borne stem gall disease of coriander.

Keywords: coriander, *Coriandrum sativum, Azospirillum* sp., biofertilizer, nitrogen, farmyard manure, yield.

The average productivity of coriander (*Coriandrum sativum* L.) (seed) in India ranges between 700–800 kg ha^{-1} as against a genetic potential of 1600–2000 kg ha^{-1}. The production of coriander seeds can be increased considerably through integrated nutrient management. Singh (1998) stressed the need to enhance the contribution of biofertilizers to meet about one third of plant nutrient needs. Biofertilizers, being less expensive, ecofriendly, and sustainable are likely to assume greater significance as a compliment or supplement to inorganic fertilizers. Similarly, organic nutrition for spices is especially important, as they provide quality food. Keeping these facts in view, the present investigation was carried out to find out the effect of *Azospirillum* sp., nitrogen sources and their combinations on growth and yield of coriander and incidence of stem gall disease.

The study was conducted during winter (*rabi)* season in 2000–01 and 2001–02 at National Research Centre on Seed Spices, Ajmer, in coriander variety RCr 41. The 12 treatments were: absolute control,farmyard manure (FYM) 5 t ha^{-1}, FYM 10 t ha^{-1}, 100% recommended N (N_1), 75% recommended N (N_2), 50% recommended N (N_3), *Azospirillum* sp.

alone, *Azospirillum* sp. + FYM 5 t ha^{-1}, *Azospirillum* sp. + FYM 10 t ha^{-1}, *Azospirillum* sp. + FYM 5 t ha^{-1} + N_1, *Azospirillum* sp. + FYM 5 t ha^{-1} + N_2 and *Azospirillum* sp. + FYM 5 t ha^{-1} + N_3. The treatmetns were replicated thrice in a randomized block design. The experimental field had loamy sand soil with pH 8.04, EC 0.076 dSm^{-1}, organic carbon 0.23% and available N 178.65 kg ha^{-1}, P_2O_5 12 kg ha^{-1} and K_2O 85 kg ha^{-1}. *Azospirillum* sp. was applied both as seed inoculation (500 g ha^{-1}) and soil application (2.5 kg ha^{-1}). The seeds were sown in well prepared 3 m x 2 m size flat beds at a spacing of 45 cm x 30 cm. The recommended fertilizer dose was 40 kg N, 30 kg P_2O_5 and 20 kg K_2O ha^{-1}. The entire dose of P and K and ½ N were applied at the time of sowing and the remaining dose, one month after sowing. Observations were recorded on plant growth and yield attributes. The intensity of stem gall, a fungal disease (caused by *Protomyces macrosporus* Unger), was recorded at crop maturity as per the scale given by Lakra (1993).

All the manurial treatments were superior to absolute control with respect to plant height, number of umbels $plant^{-1}$, number of seeds $umbel^{-1}$, 1000 seed weight and yield, whereas, the treatments did not influence number of primary branches, days to 50% flowering, days to maturity and number of umbellets $umbel^{-1}$ (Table 1). The better availability of nutrients in these treatments might have resulted in higher growth and yield as compared to control.

Azospirillum sp. in combination with chemical nitrogen and FYM resulted in increased plant height, and number of primary branches $plant^{-1}$ compared control. The days to 50% flowering and days to seed maturity remained unaltered due to the treatments. The yield contributing character - number of umbels $plant^{-1}$ increased in treatments with *Azospirillum* sp. + 100% N + 5 t FYM and *Azospirillum* sp. + 75% N + 5 t FYM as compared to bioinoculant alone, whereas, the number of umbellets $umbel^{-1}$ remained unaffected by the treatments. The number of seeds $umbel^{-1}$ and test weight were higher in

Table 1. Effect of *Azospirillum* sp., nitrogen and farmyard manure on growth and yield components of coriander (mean pooled data of two years)

Treatment	Plant height (cm)	Number of primary branches $plant^{-1}$	Days to 50% flower-ing	Days to seed maturity	Number of umbels $plant^{-1}$	Number of umbellets $umbel^{-1}$	Number of seeds $umbel^{-1}$	1000 seed weight	Yield q ha^{-1}	Stem gall disease intensity (%)
Absolute control	58.6	5.0	81	148	22.2	4.8	18.3	11.5	6.4	18.0
FYM 5 t ha^{-1}	72.5	5.2	79	145	28.4	5.0	26.3	12.2	7.2	16.0
FYM 10 t ha^{-1}	73.0	5.2	79	146	30.6	5.0	28.4	12.3	7.8	17.0
100% N (N_1)	78.0	5.3	80	143	32.8	5.0	32.6	12.0	8.4	18.0
75% N (N_2)	78.0	5.2	80	144	34.6	5.0	33.2	12.2	8.3	16.0
50% N (N_3)	76.0	5.5	79	144	32.4	5.1	30.2	11.8	8.2	16.0
Azospirillum sp.	64.0	5.2	78	143	30.2	5.2	32.4	11.4	7.2	8.0
Azosp. + FYM 5 t ha^{-1}	77.5	5.5	78	142	32.2	5.2	34.4	12.0	8.8	8.0
Azosp. + FYM 10 t ha^{-1}	79.6	5.4	77	141	36.2	5.0	36.2	12.1	9.2	8.0
Azosp. + N_1 + FYM 5 t ha^{-1}	82.8	6.4	76	140	39.4	5.0	42.2	12.8	10.8	7.0
Azosp. + N_2 + FYM 5 t ha^{-1}	80.2	6.2	78	140	38.2	5.0	40.2	12.5	10.2	8.0
Azosp.+ N_3 + FYM 5 t ha^{-1}	79.2	6.2	80	142	36.2	5.1	36.4	12.4	9.7	8.0
CD (P = 0.05)	12.4	0.9	NS	NS	6.4	NS	11.4	0.4	1.8	3.5

all the treatment combinations except absolute control which was on par with bioinoculant alone.

The nutritional treatments recorded higher seed yield over control. The magnitude of yield increase was high in *Azospirillum* sp. + 100% N + 5 t FYM, *Azospirillum* sp. + 75% N + 5 t FYM and *Azospirillum* sp. + 50% N + 5 t FYM. The higher magnitude of increase in yield can be attributed to the increased efficiency of *Azospirillum* sp. to fix atmospheric nitrogen and secretion of growth promoting substances which accelerates physiological processes like root proliferation, uptake of nutrients and water and photosynthesis. These results corroborate with the findings of other workers in other crops such as barley (Rao *et al.* 1979), black pepper (Kandiannan *et al.* 2000), okra (Raj & Kumari 2001) and brinjal (Kamili *et al.* 2002).

The *Azospirillum* sp. treatment combinations reduced the incidence of stem gall disease (7%–8%) compared to untreated plots (16%–18%). Besides increasing nitrogen fixing abilities, the microbial inoculant might have suppressed fungal population in soil due to secretion of growth promoting and anti-fungal substances as reported by earlier workers (Tien *et al.* 1979; Sharma *et al.* 1986).

The study indicated that the microbial inoculant *Azospirillum* sp. can improve plant growth and yield of coriander (seed) and reduce the incidence of stem gall disease. The treatment combination *Azospirillum* sp. + 50% N + 5 t FYM proved better for enhancing seed yield of coriander and thereby saving supply of chemical N by 50%. *Azospirillum* sp. treatment in combination with 10 t FYM ha^{-1} yielded organic coriander seed of 9.2 q ha^{-1} which was only 15% less as compared to chemical N combination treatments and can be recommended for organic farming system.

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