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Short communication

Application of *Azospirillum* and nutrients on yield, quality parameters and economics of black pepper

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ABSTRACT

A field experiment was conducted at Experimental Farm, Peruvannamuzhi to study the effect of *Azospirillum*, along with nutrients on yield of black pepper. The treatments consisting of various nutrients and bio-fertilizer *Azospirillum* were tested in split plot design and there had four replications. Recommended N 50% + Mg significantly increased the yield (1,741 g /plant) and accrued highest net return (Rs. 39,548) and benefit: cost ratio (1.9). No pronounced effect of inoculums and nutrient application on quality parameters of berries was observed.

Key words: *Azospirillum*, economics, quality, magnesium, yield.

Black pepper known as king of spices is an important foreign exchange earner for the country. India is the major producer and consumer of black pepper. The productivity of black pepper is low in India (261 kg ha⁻¹). Use of the bio-fertilizer *Azospirillum* improved nitrogen nutrition of crops and reduced the nitrogen fertilizer requirement (Bashan and Holguin, 1). *Azospirillum* inoculation improved growth of rooted cuttings in nursery (Thankamani *et al.*, 7). However, beneficial effect of *Azospirillum* with secondary nutrients such as calcium and magnesium and micronutrients, zinc, boron and molybdenum on yield of black pepper in the field was not studied so far. Hence, the present study was taken to test the efficacy of application of *Azospirillum* along with nutrients on yield and quality parameters of black pepper and to work out feasibility of application of *Azospirillum*.

A two year experiment was conducted at IISR, Experimental Farm, Peruvannamuzhi using the black pepper cv. Subhakara. Six-month-old rooted black pepper plants were planted in the basins of two-year-old support tree *Ailanthus* sp. during June. The treatments consist of two main plots (A = with *Azospirillum* and B = without *Azospirillum*) and five sub-plot treatments, FYM 10 kg (T1); recommended N 50% + 10 kg FYM (T2); recommended N (50%) + Zn, B, Mo (T3); recommended N (50%) + Mg (T4); and NPK alone, control (T5). The experiment was laid out in split plot, with four replications and six plants was there per treatment and spacing provided was 3 m × 3 m per plot.

As per-treatments, recommended fertilizer 140: 55: 270 g/plant, other nutrients such as lime - 500 g, magnesium sulphate - 200 g, zinc sulphate - 30 g, borax - 10 g, sodium molybdate - 2.5 g were applied to the plants. *Azospirillum* strain isolated from black pepper garden of experimental farm was multiplied on agar medium under laboratory conditions (Govindarajan and Thangaraju, 2) and applied to the plants (10⁸cfu/g) twice during May and October in a year. The plants were irrigated during summer months and plant protection measures were followed as per the package of practices recommendation of IISR, Calicut.

Leaf samples were collected during May and analysed for nutrients using standard procedures. Observations on yield and quality parameters were taken during fourth and fifth year and the data was statistically analyzed for variance (Panse and Sukhatme, 4). The cost of cultivation and economics was worked out based on prevailing market rates. In the present experiment, the treatment recommended N 50% + Mg recorded higher yield and increase of 21% in yield was observed compared to control. Beneficial effect of *Azospirillum*, may be due to nitrogen fixation and due to production of phyto-hormones like IAA, GA and cytokinin-like substances, which stimulate growth and induce changes in root morphology which in turn may influence assimilation of nutrients and better nutrient uptake (Srinivasan *et al.*, 5; Sangeeth *et al.*, 6).

Among the inorganic nutrients, application of magnesium increased the yield of black pepper. Magnesium is the one of the component in chlorophyll molecule might have increased the capture of solar

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radiation which in turn increased the photosynthesis and yield. Deficiency of calcium, magnesium and aluminum toxicity is the major yield limiting factors in pepper growing soils of low pH. Beneficial effects due to application of calcium and Magnesium was reported in black pepper (Anon, 3)

During second year, leaf content of nitrogen and phosphorous, was significantly higher in *Azospirillum* applied plants, whereas, effect of different nutrients was not significant (Table 2). Effect of *Azospirillum* on quality parameters (oleoresin and piperine) of black pepper was not significant.

Economics worked out for the treatments with *Azospirillum* and without *Azospirillum*. The treatment inorganic nitrogen 50% + magnesium along with *Azospirillum* recorded maximum gross (Rs. 84,888) and net return Rs. 39,548/ha with better yield in both the years. Benefit-cost (B:C) ratio (1.9) was also higher for this treatment followed by application of NPK alone (1.3). Application of *Azospirillum* reduced the nitrogen needed for black pepper. Thus the treatment inorganic nitrogen 50% + magnesium emerged on the best alternative technology to boost black pepper yield.

Table 1. Effect of *Azospirillum* and nutrients on yield of black pepper.

Treatment	Yield (FW) g/ vine 1 st year			Yield (FW) g/ vine 2 nd year		
	AZO*	WOA**	Mean	AZO	WOA	Mean
T1	531.8	656	594	1154.5	630.00	892.0
T2	738.0	583	661	550.0	831.0	550.0
T3	776.0	625	701	612.50	729.0	612.5
T4	2087	1093	1590	2207.10	1275.4	1741.
T5	667.0	403	535	1950.00	935.0	1442.
Mean	935	598		1461	790.0	
CD _(0.05)						
MP		51.0			109.0	
T		114.0			153.5	
IA		161.0			164	

*AZO = *Azospirillum* sp., WOA = Without *Azospirillum* sp.; MP = Main plot, T = Treatment, IA = Interaction, T1 = FYM 10 kg, T2 = 50% recommend nitrogen + 10 kg FYM, T3 = 50% recommended nitrogen + Zn, B, Mo; T4 = 50% recommended nitrogen + Mg; T5 = NPK alone, control.

Table 2. Nutrient status (%) in the leaves after application of *Azospirillum* and nutrients.

	Nitrogen			Phosphorus			Potassium		
	AZO*	WOA**	Mean	AZO	WOA	Mean	AZO	WOA	Mean
T1	2.50	2.52	2.51	0.19	0.12	0.15	2.46	1.37	1.9
T2	2.75	2.42	2.59	0.17	0.16	0.16	2.42	1.90	2.1
T3	2.62	2.53	2.58	0.19	0.13	0.15	2.50	1.47	2.0
T4	2.83	2.61	2.72	0.17	0.18	0.20	2.40	1.95	2.2
T5	2.42	2.43	2.43	0.18	0.12	0.14	2.3	2.17	2.3
Mean	2.62	2.50		0.18	0.14		2.4	1.77	
CD _(0.05)									
MP		0.08			0.13			0.13	
T		0.19			0.04			0.30	
IA		0.27			0.05			0.42	

*AZO = *Azospirillum* sp., WOA= Without *Azospirillum* sp.; MP = Main plot, T = Treatment, IA = Interaction, T1 = FYM 10 kg, T2 = 50% recommend nitrogen + 10 kg FYM, T3 = 50% recommended nitrogen + Zn, B, Mo; T4 = 50% recommended nitrogen + Mg; T5 = NPK alone, control.

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