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Effect of bio-fertilizers on nutrient status and fruit quality of Himsagar mango grown in new alluvial zones of West Bengal

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ABSTRACT

An investigation was carried out during 2008-2010 at the Research Station to study the effect of bio-fertilizers on nutrient status and fruit quality of Himsagar mango grown in new alluvial zone of West Bengal with the object to avoid indiscriminate use of chemical fertilizers and pesticides to save the natural eco-system and increase the nutrient status of soil and fruit quality. Experimental findings revealed that, different combination of bio-fertilizers significantly improved the soil fertility and fruit quality of mango. Among different treatments, combined application of Azotobacter + Azospirillum + AM + PSM was most effective in improving the soil and fruit. The same treatment recorded maximum organic carbon (0.97%), available N (294.11 kg ha^{-1}), P (37.44 kg ha^{-1}) and K (231.00 kg ha^{-1}) with maximum soil bacterial population as compared to control or RDF (recommend dose of fertilizer). Leaf nutrients were also improved with the application of bio-fertilizers. Therefore, it can be concluded that Azotobacter + Azospirillum + AM + PSM helps in improving the soil fertility and fruit quality of Himsagar mango.

Key words: Biofertilizers, fruit quality, leaf nutrients, mango, soil nutrients

The indiscriminate use of chemical fertilizers and pesticide has resulted in serious damage to the natural eco-system. It has therefore become imperative to move eco-friendly approach for sustainable fruit production. Biofertilizers and bio-pesticides which are microbial origin, offers themselves as viable alternatives. Organic products have a growing domestic as well as global market and fetch premium prices over conventionally grown products. Mango is one of the most excellent delicious fruits of tropical and sub-tropical region of the world. At the export front, the demand of organic mango is very high. In this backdrop, the present investigation was undertaken to study the effect of biofertilizers on fruit quality of himsagar mango.

MATERIALS AND METHODS

The study was carried out during 2008-2010 at the University Research Station, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, India (22.40^{0}N latitude and 88.30^{0}E longitude with an average altitude of 9.75 m above the sea level) on 12 years old mango cv. Himsagar plantation spaced at 10 m x 10 m. The orchard soil was clay loam having pH 6.20, organic carbon 0.52%, total nitrogen – 0.039%, available phosphorus 45.3 kg/ha, and available potassium – 58.10 kg/ha, soil bacterial population 2.5 x 10^5 cfug^{-1} soil. The various treatments were as T_1 (*Azotobacter* + VAM), T_2 (*Azospirillum* + VAM), T_3 (*Azotobacter* + *Azospirillum* + AM), T_4 (*Azotobacter* + PSM (*Bacillus megatherium*), T_5 (*Azospirillum* + PSM), T_6 (*Azotobacter* + *Azospirillum* + PSM), T_7 (*Azotobacter* + *Azospirillum* + AM + PSM), T_8 (1000 : 500 : 1000 N : P : K g/plant/year – RDF), T_9 (Control). The bio-fertilizer @ 200 g/plant/year along with 2 kg FYM were applied separately around the tree in the month of July which was collected from Nodule Research Laboratory of Bidhanchandra Krishi Viswavidyalaya. The experiment was laid out in Randomized block design with 3 replications. Soil properties and leaf nutrients (N, P and K) were analyzed following the all standard methods as described by N (Black, 1965), P (Jackson, 1960), K (Piper, 1956) and Organic Carbon (Jackson, 1973). Physico-chemical analysis were done following the standard methods as described by Ranganna (2000). Soil microbial population was counted using the methods as described by Collins and Lyne (1985).

RESULTS AND DISCUSSION

Soil nutrient status and soil bacterial population

Different combination of bio-fertilizers significantly increased the soil pH, organic carbon and available N, P and K as shown in Table 1. Among different treatment combination, T_7 (*Azotobacter* + *Azospirillum* + AM + PSM) showed maximum organic carbon (0.97%), available N (294.11 kg ha^{-1}), P (37.44 kg ha^{-1}) and K (231.00 kg ha^{-1}) followed by T_6 (*Azotobacter* + *Azospirillum* + PSM) and T_5 (*Azospirillum* + PSM) with neutral soil pH (6.91) whereas RDF treated plots recorded lower soil pH (6.19) and less availability of nutrients. Soil bacterial population was found maximum (7.9 x 10^6 cfug^{-1} soil) with application of *Azotobacter* + *Azospirillum* + PSM followed by application of *Azotobacter* + *Azospirillum* + AM + PSM (7.7 x 10^6 cfug^{-1} soil).

Leaf minerals status and bacterial population

Perusal of data presented in table-2 revealed that different treatments of bio-fertilizers significantly increased the leaf nutrient content and soil bacterial population.

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Table 1: Effect of biofertilizers on soil pH, organic carbon, N, P, K and total bacterial population

Treatments	pH	Organic carbon (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	Total bacterial population (cfug^{-1} soil)
T_1	6.71	0.71	278.11	29.12	217.44	6.9 x 10^6
T_2	6.74	0.70	281.21	29.97	218.72	7.1 x 10^6
T_3	6.81	0.81	284.75	31.41	218.79	7.4 x 10^6
T_4	6.71	0.79	291.11	32.11	220.11	7.3 x 10^6
T_5	6.89	0.87	294.11	33.11	224.11	7.4 x 10^6
T_6	6.88	0.91	293.12	33.31	225.12	7.8 x 10^6
T_7	6.91	0.97	294.11	37.44	231.00	7.7 x 10^6
T_8	6.19	0.51	290.32	30.12	224.11	2.4 x 10^5
T_9	6.20	0.52	271.00	28.00	200.00	2.7 x 10^5
SEm (±)	**0.03**	**0.04**	**0.01**	**0.10**	**0.12**	**0.49**
LSD (0.05)	**0.11**	**0.12**	**0.03**	**0.32**	**0.39**	**1.40**

Table 2: Effect of bio-fertilizers on leaf nutrient content and microbial population in soil of mango

Treatments	N (% dry wt.)	P (% dry wt.)	K (% dry wt.)
T_1	1.85	0.37	0.87
T_2	1.87	0.37	0.91
T_3	1.81	0.39	0.90
T_4	1.87	0.41	0.93
T_5	1.91	0.42	0.97
T_6	1.92	0.39	0.98
T_7	1.97	0.47	0.98
T_8	1.88	0.37	0.99
T_9	1.81	0.28	0.80
SEm (±)	**0.02**	**0.03**	**0.11**
LSD (0.05)	**0.06**	**0.07**	**0.32**

Combined application of *Azotobacter* + *Azospirillum* + AM + PSM recorded maximum N (1.97% dry wt.) and P (0.47% dry wt.) content while T_8 (Recommended dose of fertilizers) recorded maximum K (0.99% dry wt.) content.

Fruit quality and yield

Experimental data indicated that fruit qualities were influenced by the application of different bio-fertilizers. Maximum fruit weight (214.14 g), fruit length/diameter (8.92/8.11 cm) and yield (36.41 kg plant^{-1}) were obtained from combined application of *Azotobacter* + *Azospirillum* + AM + PSM followed by application of *Azospirillum* + PSM; whereas, minimum values were observed with control plants. Like physical characters, bio-chemical composition of fruits was also influenced by different treatments. Maximum total soluble solids (19.20^0 Brix), total sugar (14.71%) and □-carotene content (6952 µg 100^{-1} g) were from combined application of obtained from *Azotobacter* + *Azospirillum* + AM + PSM.

The same treatment also showed maximum shelf life at ambient room temperature. The combined application of bio-fertilizers has shown beneficial impact on soil nutrient status. The increase in organic carbon of soil which might be due to the addition of organic matter through organic manure or microbial and recycling of organic materials in the form of crop residue which brings the soil pH nearer to neutral and increased the nutrient availability. The results are in close conformity with the earlier findings of Verma and Bhardwaj (2005) in apple. Increase in physico-chemical parameters of fruits might be on account of their role in nitrogen fixation, production of phytohormone like substances and increased uptake of nitrogen (Govindan and Purushothaman, 1984). Similar observation was also noted by Biswas (2009) in litchi. Besides, microorganisms are important component of soil environment (Arshad and Franke benger, 1992). Thus, utilization of bio-fertilizer could be better preposition for improving biological attributes of soil, which in turn may increase quality, productivity potential of various crops (Allen *et al.*, 2002).

Table 3: Effect of bio-fertilizers on physico-chemical qualities and shelf life mango cv. Himsagar

Treatments	Fruit wt.(g)	Fruit length (cm)	Diameter (cm)	Yield (kg plant^{-1})	TSS (^{0}Brix)	Total Sugar (%)	Acidiy (%)	β-carotene (µg 100^{-1} g)	Shelf life* (days)
T_1	204.72	8.00	7.90	34.71	17.80	13.11	0.28	6027	6
T_2	207.11	8.11	7.62	34.11	17.80	13.12	0.29	6144	6
T_3	209.72	8.17	8.11	34.97	18.40	13.47	0.31	6192	6
T_4	207.11	8.00	7.67	33.72	18.60	13.72	0.29	6315	6
T_5	206.17	8.11	7.91	33.92	18.80	13.69	0.28	6332	5
T_6	209.92	8.14	7.97	35.72	18.80	13.91	0.25	6411	6
T_7	214.14	8.92	8.11	36.41	19.20	14.71	0.22	6952	8
T_8	212.11	8.42	8.14	33.71	16.00	13.90	0.32	5001	4
T_9	200.00	7.67	7.11	32.00	16.20	13.70	0.35	5120	4
SEm±	**0.11**	**0.10**	**0.05**	**0.01**	**0.03**	**0.02**	**0.003**	**0.34**	**0.01**
LSD (0.05)	**0.31**	**0.31**	**0.17**	**0.02**	**0.09**	**0.06**	**0.01**	**0.92**	**0.03**

*Note: * at ambient room temperature*

From the present study, it can be concluded that bio-fertilizers are effective in improving soil nutrient status and fruit quality of mango. Among different treatments combined application of *Azotobacter* + *Azospirillum* + AM + PSM was found to be most effective.

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