Indian J. Hort. 67(2), June 2010: 181-184

Integrated nutrient management in litchi cv Bombai in new alluvial zone of West Bengal

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ABSTRACT

The study with organic manures and biofertilizers with or without chemical fertilizer combinations was conducted on litchi cv. Bombai. Results revealed that different combinations involving the use of organic nutrition to reduce the chemical fertilizers and had significant effect on yield, fruit quality and leaf mineral content. The treatment consisting of 50 kg/tree FYM + 150 g *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree/year through fertilizer showed maximum yield (98.72 kg/plant) and also have a significant improvement in terms of TSS, total sugars, ascorbic acid, TSS : acid ratio, fruit weight and fruit size. This treatment also recorded maximum leaf N and K content with maximum (8.3×10^6 cfu g^{-1} soil) microbial population in rhizophere soil of litchi orchard. Treatment with only organic manure and biofertilizers also resulted in improvement in fruit quality over application of only chemical fertilizer but had less effect on productivity. Fruits under application of organic manures and biofertilizer recorded maximum (22.45 mg/100 g peel) anothocyanin content over other treatments.

Key words: Fertilizer trial, organic supplements, fruit quality, litchi.

INTRODUCTION

Litchi (*Litchi chinensis* Sonn.) is one of most excellent, delicious fruit of sub-tropical region of the world. Due to its exacting climatic requirements, its commercial cultivation is restricted to states of India like Bihar, Jharkhand, West Bengal, eastern U.P. Haryana, Uttarakhand, Assam and Tripura. In West Bengal it is widely cultivated in some districts. The crop has a tremendous export potentiality. At the export front, the demand is tremendous. Chemical fertilizers are mostly in use for their cultivation, which have some deleterious effect on fruit quality besides adverse effect on soil, water and environmental conditions. An integrated use of organic manures, bio-fertilizers and chemical fertilizers could help in achieving the goal of obtaining safer food and environment for the people. Litchi crop is highly responsive to fertilizers and exhibit sensitiveness to availability of nutrients. Keeping view the above facts, the present investigation was undertaken.

MATERIALS AND METHODS

The study was conducted during 2006-2008 at the farmer's field of litchi orchard in Murshidabad district on 30-year old trees of litchi cv. Bombai spaced at 10 m × 10 m. The plants were uniform in growth and vigour. The orchard soil was clayloam having pH 6.80, 0.52% organic carbon, available nitrogen 271 kg/ha, phosphorus 28.81 kg/ha and potassium 210.0 kg/ha. The recommended fertilizer dose (1000 : 500 : 1000 g NPK/plant/year) was used as control. The recommended dose was manipulated so as to reduce the quantity of inorganic fertilizers through the use of organic supplements. The various combinations of nutrients were as T_1 - Control (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree), T_2 (50 kg/tree FYM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree), T_3 (50 kg/tree FYM + 150 g *Azotobacter* + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree), T_4 (50 kg/tree FYM + 150 g *Azotobacter* + 100 g VAM + 500 g N: 250 g P_2O_5 : 500 g K_2O/tree), T_5 (150 g *Azotobacter* + 100 g VAM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree), T_6 (150 g *Azotobacter* + 100 g VAM + 50 kg FYM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree) & T_7 (50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree). Experiment was laid down in randomised block design with (7) seven treatments and three replications. Different combinations of nutrients were applied in July. Bio-fertilizers were applied after 60 days of application of chemical fertilizers. The biofertilizers were applied around of trunk the rhizosphere (15 cm) of plants. Chemical fertilizers were applied through drip around the trunk.

The data on fruit yield, fruit size, pulp weight and fruit weight were recorded at the time of harvesting. Bio-chemical composition like TSS, total sugars, acidity ascorbic acid and anthocyanin contents were estimated at harvest using standard procedures (Ranganna, 9). Leaf mineral content (N, P and K) were also estimated using standard procedure. Soil microbial population was counted using method as described by Collin and Lyne (4).

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RESULTS AND DISCUSSION

Table 1 indicated that different combinations of nutrient significantly increased the physical properties of fruits. T_4 (50 kg/tree FYM + 150 g *Azotobacter* + 100 g VAM + 500 g N : 250 P_2O_5 : 500 g K_2O/tree showed maximum fruit weight (24.84 g), fruit size (3.7/3.0 cm), peel weight (14.99 g) and yield (98.72 kg/plant) followed by T_1 (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree) while T_7 (50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree) recorded minimum of these character with minimum (83.44 kg/plant) yield. Increase in yield and physico-chemical parameters of fruits might be on account of their direct role in nitrogen fixation, production of phytohormone like substances and increased uptake of nitrogen (Govindan and Purushothaman (6). Similar observation was also noted by Singh and Singh (11) in banana and Biswas (3) in litchi. Bio-chemical constituents were also affected by the application of different nutrients (Table 2). Data showed significant effect of treatments on fruit quality parameters. The

Table 1. Effect of different organic and inorganic fertilizer combinations on yield and physical quality characters of litchi fruits.

Treatment	Fruit wt. (g)	Fruit size (L : D)	Pulp weight (g)	Yield (kg/plant)
T1 - Control (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree)	21.72	3.3 / 3.0	12.74	97.44
T2 - 50 kg/tree FYM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	20.74	3.0 / 2.7	12.12	95.44
T3 - 50 kg/tree FYM + 150 g *Azotobacter* + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	21.78	3.1 / 2.9	12.41	96.77
T4 - 50 kg/tree FYM + 150 g *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	24.84	3.7 / 3.0	14.99	98.72
T5 : 150 g *Azotobacter* + 100 g VAM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	22.42	3.1 / 2.9	12.31	97.41
T6 - 150 g *Azotobacter* + 100 g VAM + 50 kg FYM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	22.72	3.2 / 3.1	12.00	96.77
T7 - 50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree	20.17	3.2 / 2.9	11.95	83.44
CD at 5%	0.72	0.34 / 0.24	0.36	3.03

Table 2. Effect of organic and inorganic combinations on bio-chemical composition of litchi fruits.

Treatment	TSS (°Brix)	Total sugars (%)	Acidity (%)	Ascorbic acid (mg/100 g)	TSS : acid ratio	Anthocyanin content (mg/ 100 g FW)
T1 - Control (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree)	19.80	13.72	0.79	33.44	25.06	20.11
T2 - 50 kg/tree FYM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	13.40	13.82	0.62	30.72	31.29	21.12
T3 - 50 kg/tree FYM + 150g *Azotobacter* + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	19.80	13.92	0.63	31.88	31.42	21.72
T4 - 50 kg/tree FYM + 150g *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	21.40	14.85	0.50	33.95	42.80	22.00
T5 : 150 g *Azotobacter* + 100 g VAM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	20.00	13.95	0.62	30.11	32.25	21.79
T6 - 150 g *Azotobacter* + 100 g VAM + 50 kg FYM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	20.40	14.00	0.59	33.11	34.57	21.84
T7 - 50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree	20.00	13.72	0.51	31.72	39.21	22.45
CD at 5%	0.75	3.03	0.03	0.66	-	0.42

highest TSS, total sugars, ascorbic acid and TSS : acid ratio were recorded in T_4 (50 kg/tree FYM + 150 g *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 + 500 g K_2O/tree) which was followed by T_6 (150 g *Azotobacter* + 100 g VAM + 50 kg FYM + 400 g N : 200 g P_2O_5 + 400 g K_2O/tree). The fruit acidity was maximum in T_1 - Control (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree)) followed by T_4 (50 kg/tree FYM + 150 *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree). However, T_7 (50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree) recorded maximum content of anthocyanin followed by T_4. The improvement in fruit quality may be due to improvement in soil physical properties, water holding capacity, bulk density *etc.,* and chemical properties like nutrient status, soil pH and hormone (Chattopadhyay, 5). Experimental results are in line with findings of Pereira and Mitra (7) and Ram *et al.* (10) who reported that fruit quality was found superior with organic manures + biofertilizers compared to only inorganic fertilizers. Perusal of data presented in Table 3 revealed that different treatment of nutrients significantly influenced the leaf N and K content. T_4 (50 kg/tree FYM + 150 *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 + 500 g K_2O/tree) showed maximum leaf N (1.89% dry wt.) and K (0.87% dry wt.) content. No significant difference was observed in P_2O_5 content of leaf. Application of different nutrients increased the soil nitrogen, phosphorus and potassium content. The higher nutrient status of soil due to organic manure might be due to slow release of nutrients from organic manures and better uptake of nutrients by the plant which in turn increase the leaf mineral content of litchi. The present findings are in close conformity with the earlier findings of Naik and Haribabu (8) in guava.

Microbial population in rhizosphre soil of litchi tree improved after application of different treatments. Bacterial count was recorded maximum in T_4 followed by T_5 while T_1 showed least count of bacteria (Table 3). Micro-organisms are important component of soil environment (Arshad and Frankenberger, 2). Their larger number is indicative of better soil health and improved nutrient availability to the plant and the fruits. Thus, utilization of organic 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*., 1). Therefore, integrated application of organic manures and bio-fertilizers alongwith chemical fertilizers may be a better option for enhancing yield and fruit quality of litchi.

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Table 3. Effect of organic and inorganic fertilizer combinations on leaf nutrient content and microbial population in rhizosphere soil of litchi.

Treatment	N (% dry wt.)	P (% dry wt.)	K (% dry wt.)	Microbial population (Bacteria) (cfu g^{-1} soil)
T1 - Control (1000 g N : 500 g P_2O_5 : 1000 g K_2O/tree)	1.82	0.27	0.79	2.7 × 105
T2 - 50 kg/tree FYM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	1.72	0.24	0.71	4.3 × 105
T3 - 50 kg/tree FYM + 150g *Azotobacter* + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	1.80	0.29	0.71	6.1 × 106
T4 - 50 kg/tree FYM + 150g *Azotobacter* + 100 g VAM + 500 g N : 250 g P_2O_5 : 500 g K_2O/tree	1.89	0.37	0.87	8.3 x 106
T5 : 150 g *Azotobacter* + 100 g VAM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	1.72	0.39	0.79	7.0 x 106
T6 - 150 g *Azotobacter* + 100 g VAM + 50 kg FYM + 400 g N : 200 g P_2O_5 : 400 g K_2O/tree	1.80	0.31	0.78	6.3 x 106
T7 - 50 kg FYM + 150 g *Azotobacter* + 100 g VAM/tree	1.74	0.31	0.77	5.1 x 106
CD at 5%	0.06	NS	2.16	-

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Received: September, 2009; Revised: March, 2010; Accepted : April, 2010