Economic Affairs, Vol. 61, No. 4, pp. 677-682, December 2016
DOI: 10.5958/0976-4666.2016.00084.X

Effect of Inorganic and Organic Sources of Nutrients on Physico-chemical Composition of Mango (*Mangifera indica* L) cv. Amrapali

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Abstract

A field investigation was conducted to study the Effect of inorganic and organic sources of nutrients on physico-chemical composition of mango (*Mangifera indica* L) cv. Amrapali under high density orchard at Horticulture Complex, Maharajpur, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during 2012-13 and 2013-14. A total of twenty four treatment combinations of inorganic and organic sources on nutrient were tested in factorial randomized block design with three replications. The fruit weight (177.5 g), length (9.67 cm) and width (7.68 cm) was recorded with the application of 125% recommended dose of chemical fertilizer and the higher TSS (22.60^{0}B), total sugar (18.87%), non-reducing sugar (13.94%), reducing sugar (4.94%), ascorbic acid (60.08mg 100g pulp^{-1}) and TSS: Acid ratio (66.86) was recorded with recommended dose of chemical fertilizer applied in combination of Vermicompost (25 kg plant^{-1}) + Oil cake (2.5 kg plant^{-1}) + Azotobacter + VAM + Trichoderma viridi + PSB (100g plant^{-1} of each inoculants).

Keywords: Composition, Amrapali, inorganic, organic

Mango (*Mangifera indica* L.) is an important crop in tropical and sub tropical regions of the world. The National productivity of India is stagnant since long time. Out of the new plantations, mango alone occupied major share. Now-a-days several operations involved in improving the yield and quality of mango. Regular bearer variety with small canopy is very important. Amrapali is a mango hybrid (Dashehari × Neelum) and gaining popularity for its dwarf stature and regular bearing in nature.

Amrapali has already occupied a major area in newly planted mango orchard in high density planting and replacing the traditional cultivars. In general, compact and small trees canopy capturing and conversion of sunlight into the fruit biomass (dry matter content) is an important process in fruit production in a better way than the larger ones. In present scenario of crop production, awareness of food quality has sifted our nutrient management system owing to excess and imbalanced use of nutrients and impact on food quality of produce and environment. The continuous nutrient mining from the soil deteriorate crop productivity and ultimately soil health. So there is need to evolve economically attractive and ecological sound means to reduce external inputs and to improve the renewable source of energy and becomes imperative to select the efficient techniques of crop production. Crop having low nutrient requirement may emerge as potential crop under organic management without losing remunerative price to farmers and additional benefits to assess the impact of organic management on quality.

It has realized that optimum yields from efficient use of nutrients under high density planting, high yielding varieties and better management of the orchards may result in higher mango productivity which can be considered to a revolution in mango production by avoiding the risk of soil and water pollution. Keeping the above points in view, the present study has been carried out to assess the impact of different sources of nutrient on quality of mango cv. Amrapali.

Materials and Methods

A field experiment was conducted at Horticulture Complex, Maharajpur, JNKVV during 2012-13 and 2013-14. The soil of experimental site was clay in texture (58.4% clay, 21.5 silt and 20.1% sand) natural in reaction (pH 7.4) having 0.25 dS m^{-1}electric conductivity, medium available N(230.7 kg ha^{-1}), low in P (12.6 kg ha^{-1}) and medium in K (340.2kg ha^{-1}) and low in organic carbon (0.47%). The experiment consisted of four level of NPK fertilizer (F_1:Without fertilizer, F_2: 75% of RDF (310: 100: 270 NPK g $plant^{-1}$), F_3: (100% of RDF (415: 130: 360 NPK g $plant^{-1}$) and F_4: 125% of RDF (520: 160: 450 NPK g $plant^{-1}$) and six organic sources O_1: Oil cake 2.5 kg $plant^{-1}$, O_2: Azotobacter+VAM + *Trichoderma viridi* + PSB (100g of each $plant^{-1}$), O_3: Vermicompost (25 kg $plant^{-1}$), O_4: Vermicompost (25 kg $plant^{-1}$) + Oil cake (2.5 kg $plant^{-1}$), O_5: Vermicompost (25 kg $plant^{-1}$) + Azotobacter + VAM + *Trichoderma viridi* + PSB (100g of each $plant^{-1}$), O_6: Vermicompost (25 kg $plant^{-1}$) + Oil cake (2.5 kg $plant^{-1}$) +Azotobacter + VAM+ *Trichoderma viridi* + PSB (100g of each $plant^{-1}$) were fertilized. For the study, seventy two plants of mango var. Amrapali planted at 2.5 × 2.5 m under high density were randomly selected and replicated thrice. Fruits were sampled separately from each tree at full maturity. Weights of five randomly selected mature ripe fruits from each plant were recorded. Fruit size in terms of length (from the apex to stem end). The fruit diameter was recorded by vernier callipers. Pulp stone pulp peel and peel stone rated was calculated by weighing the ripe fruits, pulp, peed and stone (after feeling).

Total soluble solids (TSS) were measured by a hand refractometer and the values were corrected at 20°C (Ranganna, 1986). Titrable acidity was determined by filtrating a know quantity of blended (homogenized) pulp, diluted with distilled water, against NaOH solution (IN), using phenolphthalein as indicator and results were expressed as percentage of citric acid. TSS acid ratio was calculated by dividing the TSS value by acidity, total, reducing and non-reducing sugar from the pulp of ripe fruits was analyzed as suggested by Ranganna (1986). The experimental data were subjected to factorial analysis of variance for randomized block design and the differences tested at $p < 0.05$.

Results and Discussion

Physical composition of fruit

The superior physical fruit quality with respect to fruit weight (173 g), length (9.39 cm), width (7.11cm), pulp: peel ratio (3.20), pulp: stone ratio (3.16) and peel: stone ratio (1.01) were observed under 125% of RDF (520:160:450g NPK $plant^{-1}$). The increase in quality of fruit is associated with dry matter content due to the fact that better nutrient availability and enhancing the uptake of solvent from rhizosphere resulting accumulation of more photosynthates and their translocation as well as synthesis of different growth regulator. The above findings in accordance with Gawande *et al.* (1998) and Patel *et al.* (2010).

The maximum fruit weight (170 g), length (8.79 cm), width (6.92 cm), pulp: peel ratio (3.34) and pulp: stone ratio (3.40) was recorded with an application of Vermicompost (25 kg $plant^{-1}$) + Oil cake (2.5 kg $plant^{-1}$) + Azotobacter + VAM + Trichoderma viridi + PSB @100g $plant^{-1}$ each. The increase in fruit weight and pulp weight might be on account of incorporation of vermicompost, oilcake, and biofertilizers. Organic manures and biofertilizers have direct relation in N fixation, solubilizing phosphorus, production of phytohormone which increased the uptake of nutrients. These observations are in agreement with the Madhavi *et al.* (2008) in mango and Patel *et al.* (2010) in sapota. Yadav *et el*. (2011) reported that the quality improvement of fruits might be due to proper supply of nutrients and induction of growth hormones which stimulated cell division, cell elongation increase in number and weight of fruits, better root development and better translocation of water uptake and deposition of nutrients. This might be attributed due to improvement in fertilizer use efficiency while applied alongwith the organic Ranjan and Ghosh (2006).

Application of chemical fertilizers alongwith organic as a source of nutrients bring out the significant changes in physical composition of fruit. The maximum fruit weight (177.5 g), length (9.67 cm) and width (7.68 cm) was recorded with the application of 125% recommended dose of chemical fertilizer along with Vermicompost (25 kg $plant^{-1}$) + Oil cake (2.5 kg $plant^{-1}$) + Azotobacter

Table 1: Effect of integrated nutrient management on physical composition of mango fruits under high density orchard

Treatments	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Pulp: peel ratio	Pulp: stone ratio	Peel : stone ratio
Without fertilizer+ O C (2.5kg)	7.00	5.25	144.2	2.69	2.89	1.09
Without fertilizer + Azt + VAM + *TV*	6.93	4.48	146.7	2.22	2.71	1.23
Without fertilizer+ VC (25 kg)	7.18	5.42	151.5	2.56	3.06	1.21
Without fertilizer+ VC (25 kg) + OC(2.5 kg)	7.08	5.35	153.5	2.75	2.90	1.10
Without fertilizer+ VC (25 kg) + Azt + VAM + *TV*	7.35	5.48	156.5	2.65	3.18	1.22
Without fertilizer+ VC (25 kg) + OC(2.5 kg)+ Azt + VAM + *TV* (100g each)	7.45	5.68	157.2	2.65	3.24	1.22
75% RDF+ OC(2.5kg)	7.40	5.37	154.2	2.78	2.94	1.08
75% RDF+ Azt + VAM + *TV*, (100g each)	7.17	4.83	154.8	2.23	2.68	1.20
75% RDF+ VC (25 kg)	8.33	6.10	158.2	2.60	3.20	1.27
75%RDF + VC (25 kg) + OC (2.5 kg)	7.93	6.20	162.2	2.72	3.00	1.16
75% RDF+ VC (25 kg) + Azt + VAM + *TV*	8.37	6.87	163.0	2.78	3.28	1.19
75% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	8.43	7.05	170.0	3.38	3.47	1.04
100% RDF+ OC (2.5kg)	9.22	6.57	165.3	2.96	2.93	1.04
100% RDF+ Azt + VAM + *TV*	8.78	6.23	164.7	2.94	2.75	1.05
100% RDF+ VC (25 kg)	9.30	6.80	167.2	2.85	3.23	1.18
100% RDF + VC(25 kg)+OC (2.5 kg)	9.25	6.63	170.2	3.40	3.19	1.00
100% RDF+ VC (25 kg) + Azt + VAM + *TV*	9.57	7.07	171.7	3.34	3.31	1.00
100% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	9.62	7.27	175.3	3.30	3.43	0.97
125% RDF+ OC(2.5kg)	9.30	7.68	169.0	2.83	2.93	1.04
125% RDF+ Azt + VAM + *TV*	9.03	6.28	169.7	2.81	2.83	0.99
125% RDF+ VC (25 kg)	9.35	6.95	171.3	3.08	3.30	1.13
125%RDF + VC(25 kg) + Oil cake (2.5 kg)	9.33	6.80	173.5	3.05	3.20	1.01
125% RDF+ VC (25 kg) + Azt + VAM + *TV*	9.70	7.28	177.0	3.57	3.26	0.93
125% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	9.67	7.68	177.5	4.17	3.47	0.93
CD at 5%						
Fertilizer	0.37	0.36	2.30	0.20	0.11	0.11
Organic Sources	0.45	0.45	2.82	0.24	0.13	NS
Interaction (F × O)	0.91	0.89	5.65	NS	NS	NS

Table 2: Effect of inorganic and organic sources of nutrients on chemical composition of mango fruit under high density orchard

Treatments	TSS (^{0}B)	Total sugar (%)	Non reducing sugar (%)	Reducing sugar (%)	Ascorbic acid (mg/ 100g)	Acidity (%)	TSS: acid ratio	Total phenol
Without fertilizer+ O C (2.5kg)	20.3	15.4	3.7	11.9	47.6	0.37	54.91	0.21
Without fertilizer + Azt + VAM + *TV*	20.0	15.1	3.5	11.6	44.3	0.39	51.02	0.20
Without fertilizer+ VC (25 kg)	20.4	15.5	3.9	11.9	50.4	0.36	56.64	0.21
Without fertilizer+ VC (25 kg) + OC(2.5 kg)	20.6	15.6	3.7	11.9	48.4	0.37	55.46	0.21
Without fertilizer+ VC (25 kg) + Azt + VAM + *TV*	20.6	15.9	4.0	12.0	51.9	0.35	58.69	0.21
Without fertilizer+ VC (25 kg) + OC(2.5 kg)+ Azt + VAM + *TV* (100g each)	20.7	16.1	4.2	12.2	54.6	0.35	58.72	0.21
75% RDF+ OC(2.5kg)	21.0	16.4	3.8	12.2	50.3	0.36	57.83	0.22
75% RDF+ Azt + VAM + *TV*, (100g each)	20.9	16.2	4.0	11.8	47.1	0.39	54.38	0.22
75% RDF+ VC (25 kg)	21.3	16.4	4.4	12.1	53.6	0.36	59.69	0.22
75%RDF + VC (25 kg) + OC (2.5 kg)	21.5	16.5	4.2	12.1	50.8	0.37	58.98	0.22
75% RDF+ VC (25 kg) + Azt + VAM + *TV*	21.7	16.9	4.5	12.8	55.9	0.35	62.49	0.22
75% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	21.7	17.1	4.6	12.6	56.1	0.35	62.63	0.23
100% RDF+ OC (2.5kg)	22.2	18.3	4.4	13.6	55.4	0.36	62.71	0.26
100% RDF+ Azt + VAM + *TV*	22.2	18.3	4.4	13.3	52.0	0.38	58.80	0.26
100% RDF+ VC (25 kg)	22.4	18.5	4.8	13.7	58.1	0.35	64.45	0.27
100% RDF + VC(25 kg)+OC (2.5 kg)	22.5	18.7	4.7	13.8	55.7	0.36	62.92	0.27
100% RDF+ VC (25 kg) + Azt + VAM + *TV*	22.6	18.8	4.9	13.9	59.8	0.34	66.76	0.27
100% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	22.6	18.9	4.9	13.9	60.1	0.34	66.84	0.29
125% RDF+ OC(2.5kg)	21.8	17.5	4.3	12.7	54.5	0.35	61.64	0.23
125% RDF+ Azt + VAM + *TV*	21.9	17.3	4.4	12.9	50.5	0.38	58.08	0.23
125% RDF+ VC (25 kg)	22.0	17.7	4.6	13.1	57.1	0.35	63.68	0.24
125%RDF + VC(25 kg) + Oil cake (2.5 kg)	22.1	17.7	4.7	13.1	55.0	0.36	62.04	0.24
125% RDF+ VC (25 kg) + Azt + VAM + *TV*	22.1	17.8	4.9	13.4	58.9	0.34	65.81	0.25
125% RDF+ VC (25 kg) + OC (2.5 kg)+ Azt + VAM + *TV*	22.2	18.0	4.9	13.5	59.0	0.34	65.88	0.25
CD at 5%								
Fertilizer	0.23	0.22	0.35	0.25	2.20	NS	2.06	2.13
Organic Sources	0.24	0.27	0.42	0.31	2.70	0.03	2.53	NS
Interaction (F × O)	0.49	0.55	0.86	0.63	8.26	NS	NS	NS

+ VAM + Trichoderma viridi + PSB (100g plant^{-1} of each inoculants). The fruit weight and size are highly correlated with dry matter content and balanced level of hormones. Superior physical fruit quality may be due to the fact that, organic manure combined with fertilizers enhances the nutrient availability by enhancing the capability of plants to better solute uptake from rhizosphere; also these are known for accumulation of dry matter and their translocation as well as favour synthesis of different growth regulators. The findings are in accordance with Gawande *et al.* (1998) and Patel and Naik (2010) in sapota.

Chemical composition of fruit

The fruit quality in terms of TSS (22.42 ^{0}B), total sugar (18.41%), non-reducing sugar (13.72%), reducing sugar (4.69%), ascorbic acid (56.84mg 100g pulp^{-1}), phenol (42.53mg litter^{-1}) TSS: Acid ratio (63.51) was maximum with an application of recommended dose of chemical fertilizer. Improvement in the quality of fruit might be due to proper absorption and desired quantity of nutrients made available to plant with the use of chemical fertilizers. These results are in accordance with the findings of Robertse and Stassen (2004).

The fruit quality improved with an addition of organic sources of nutrients and maximum TSS (21.80 ^{0}B), total sugar (17.75%), non-reducing sugar (13.06%), reducing sugar (4.69%) and ascorbic acid (57.46 mg 100g pulp^{-1}) and (63.41) was recorded with an application of Vermicompost 25 kg plant^{-1} + Oil cake 2.5 kg plant^{-1} + Azotobacter + VAM + Trichoderma + PSB (100g each plant^{-1}) and minimum acidity 0.343 with maximum TSS acid ratio (63.41) with vermicompost + @25kg plant^{-1} + bioinoculant. Inoculation of Azotobacter, PSB and VAM along with organics might have performed regulatory role on absorption of nutrients and translocation of metabolites especially carbohydrates which positively increase the quality of fruits. Results are in accordance with the findings of Ram *et al.* (2007), Madhavi *et al.* (2008) and Baviskar *et al.* (2011) Patel and Naik. (2010) they reported that carbohydrates reserve in roots and stem hydrolyzed into sugar during ripening which improve the fruit quality.

The combined use of chemical fertilizers and organic source resulted significant changes in chemical composition of fruits. The higher TSS (22.60^{0}B), total sugar (18.87%), non-reducing sugar (13.94%), reducing sugar (4.94%), ascorbic acid (60.08mg 100g pulp^{-1}) and TSS: Acid ratio (66.86) was recorded with recommended dose of chemical fertilizer and Vermicompost @ 25 kg plant^{-1} + Oil cake @ 2.5 kg plant^{-1} + Azotobacter + VAM + Trichoderma + PSB (100g plant^{-1} each). It might be due to balance fertilization stimulated cell division. Cell elongation which increases the size and weight of fruit, better root development promotes the nutrients absorption translocation of food and water as well as deposition of photosynthets.

This was in accordance with the results of Yadav *et al.* (2012). Nitrogen stimulates the functioning of enzymes in the physiological processes, which have improved the total soluble solids content of the fruits. The highest total sugar was attributed the involvement of nitrogen in various energy sources like amino acids and amino sugars. Similar findings are in the line with the Dutta *et al.* (2010) and Sharma *et al.* (2013). Kumar et al. (2008) reported that increased total sugar in apple fruit due to accumulation of more photosynthets might be ascribed to uptake of more nitrogen and potassium in plant system.

Acknowledgements

The first author is thankful to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur authority for providing facilities and technical guidance during the course of investigation of Ph. D. research work.

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