International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 858-861

Received: 04-09-2018
Accepted: 08-10-2018

Y Ravikiran
Department of Fruit Science, College of Horticulture, SKLTSHU, Hyderabad, Telangana, India

M Hanuman Nayak
Department of Fruit Science, Scientist and Head (H) VRS, Rajendranagr, SKLTSHU, Hyderabad, Telangana, India

Veena Joshi
Department of Fruit Science, Assistant Professor, College of Horticulture, SKLTSHU, Hyderabad, Telangana, India

D Saida Naik
Department of Crop Physiology, Associate professor, College of Agriculture, PJTSAU, Hyderabad, Telangana, India

Correspondence
Y Ravikiran
Department of Fruit Science, College of Horticulture, SKLTSHU, Hyderabad, Telangana, India

Effect of integrated nutrient management and micronutrients on post harvest quality parameters and shelf life of mango (*Mangifera indica* L.) Cv. Banganapalli under high density planting

Y Ravikiran, M Hanuman Nayak, Veena Joshi and D Saida Naik

Abstract
The field experiment was conducted to know the effect of integrated nutrient management and micronutrients on post harvest quality parameters and shelf life of mango (*Mangifera indica* L.) Cv. Banganapalli under high density planting. The results indicated that maximum total soluble solids (17.76 ^{0}Brix), total sugars (13.43 %), Reducing sugars (5.23 %), Non reducing sugars (8.20 %), Ascorbic acid (32.36 mg/100g pulp) and Shelf life (12.90 days) with minimum acidity (0.304 %) are exhibited by the application of F_2M_2 - 50% RDF + 50% VC +250 g *Azotobacter* + (0.8%) $ZnSO_4$ + (0.5%) H_3BO_3 + (0.5%) $FeSO_4$ / tree.

Keywords: mango, INM, micronutrients, quality parameters, shelf life

Introduction
Mango (*Mangifera indica* L.) is one of the most important fruit crop among the tropical fruits of India. It is designated as "King of fruits". It belongs to the family Anacardiaceae and originated in South East Asia. In India, mango is cultivated in an area of 2.21 million hectares with a production of 18.50 MT and 8.3 MT/ha productivity. In India major mango growing states are Uttar Pradesh, Karnataka, Andhra Pradesh, Telangana, Bihar, West Bengal and Gujarat. Telangana state occupies 4th position in mango cultivation in India. In Telangana area, production and productivity of this crop is 1.89 lakh ha, 17.33 lakh tonnes and 9.1 MT/ha respectively. (NHB Data base, 2015).

In recent years, high density planting system of mango is getting popularity. Fruit plant removes large amount of essential nutrient reserves in the soil. Over the time, continues depletion of nutrients decreases fruit yield and soil fertility and lead to soil degradation. On the other hand, excess or continuous use of inorganic fertilizers as source of nutrient in imbalance proportion creates problems, causing economic inefficiency, threaten the environment and human beings. The use of bio-fertilizers and on farm organics as a sources of nutrient is gaining popularities in recent years because of higher cost and hazardous effect of chemical fertilizers. Appropriate measure to ensure optimum nutrient status of soil will go to long way in maintaining mango tree in various stages which will ensure optimum level of productivity in sustainable manner.

Various experiments have been conducted earlier on foliar spray of micro-nutrients in different fruit crops and shown significant response to improve quality of fruits (Kumar *et al.,* 2004) [17]. These micronutrients helps in absorption of major nutrients (Thirupathaiah *et al.,* 2017) [37] there by fruit quality will increase. The weight loss can be decreased by the application of calcium may be due to its role in the maintenance of fruit firmness, retardation of respiratory rates as well as transpiration and delayed senescence (Bangirth *et al.,* 1972; Jones *et al.,* 1970; Mika, 1983; Singh *et al.,* 1982) [5, 13, 19, 31]. Therefore, present investigation was carried out to know the effect of integrated nutrient management and micronutrients on post harvest quality parameters and shelf life of mango (*Mangifera indica* L.) Cv. Banganapalli under high density planting.

Materials and Methods
A field experiment was conducted on 10 years old mango trees at Horticulture Research

Station, Ashwaraopeta, Bhadradri kothagudem during 2017-2018. Soil of the experimental site was sandy clay loamy with pH of 6.7 and electrical conductivity of 0.12 milliohms/cm. It had 179.2 kg/ha of available Nitrogen and 47.2 kg/ha of Phosphorus and 228.7 kg/ha of potassium with uniform topography. The experiment was laid out in Factorial Randomized Block Design (FRBD) with nine treatments and replicated in thrice and fifty four plants of mango Cv. Banganapalli planted (5 × 5m) under high density were randomly selected for this study. The experiment consist of three levels of fertilizer F_1- 100% RDF/tree, F_2- 50% RDF + 50% VC + 250 g of *Azotobacter*/tree, F_3- 50% RDF + 50% FYM + 250 g of *Azotobacter*/ tree and three levels of micronutrients M_1-(0.5%) $ZnSO_4$ + (0.2%) H_3BO_3 + (0.2%) $FeSO_4$ / tree, M_2- (0.8%) $ZnSO_4$ + (0.5%) H_3BO_3 + (0.5%) $FeSO_4$ / tree, M_3-Water spray / tree.

Results and Discussion

Total soluble solids

The different interaction of fertilizers and micronutrients did not exhibit any significant effect on total soluble solids.

Maximum TSS (17.76 ^{0}Brix) recorded with application of F_2M_2 and the second maximum TSS (17.55 ^{0}Brix) recorded with F_2M_1. Minimum TSS (16.50 ^{0}Brix) recorded with application of F_1M_3. Similar results was observed in (Dutta *et al.,* 2016) [9] in mngo suggested that increase in physicochemical parameters in fruits due to bio-fertilizer might be because of their role in nitrogen fixation, production of phytohormone and increased uptake of nitrogen as reported by Dutta and Kundu (2012) [8].

Zinc has great role in improving fruit quality supported by Sharma (2002) [26], Sharma (2003) [27], Sharma (2008) [28]. The results are in close conformity with the findings of Singh *et al.,* (2008) [32] and Yadav *et al.,* (2010) [38] in aonla.

Table: Effect of integrated nutrient management and micronutrients on post harvest quality parameters and shelf life of mango (*Mangifera indica* L.) Cv. Banganapalli under high density planting

Treatments	TSS (^{0}Brix)	Total Sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	Ascorbic acid (mg/100g)	Acidity (%)	Shelf life (days)
T_1 - F_1M_1	16.86	12.38	4.65	7.73	28.43	0.327	11.16
T_2 - F_1M_2	17.10	12.29	4.71	7.58	28.93	0.320	11.53
T_3 - F_1M_3	16.50	12.29	4.21	8.08	27.53	0.333	10.73
T_4 - F_2M_1	17.55	12.64	5.15	7.49	31.30	0.311	12.63
T_5 - F_2M_2	17.76	13.43	5.23	8.20	32.36	0.304	12.90
T_6 - F_2M_3	16.93	12.03	4.83	7.20	28.26	0.321	11.80
T_7 - F_3M_1	17.30	12.35	4.98	7.37	29.26	0.318	12.20
T_8 - F_3M_2	17.43	12.31	5.12	7.19	29.60	0.312	12.46
T_9 - F_3M_3	17.33	12.19	4.87	7.32	28.83	0.319	11.73
Fertilizers	0.24	0.36	0.09	0.39	0.44	0.004	0.40
Micronutrients	0.24	0.36	0.09	NS	0.44	0.004	0.40
F×M	NS	0.63	NS	0.68	0.76	NS	0.69

Total sugars

The interaction of fertilizers and micronutrients exhibit significant effect on total sugars. The maximum total sugars (13.43 %) was recorded with application of F_2M_2 followed by the application of F_3M_2 i.e. (12.64 %). The minimum total sugars (12.19 %) was recorded with application of F_3M_3

Dutta *et al.,* (2016) [9] proved that increase in physicochemical parameters in fruits due to bio-fertilizer might be because of their role in nitrogen fixation. Production of phytohormone and increased uptake of nitrogen as reported by Dutta and Kundu (2012) [8].

According to Yashwant *et al.,* (2018) [39] increase in quality parameters might be due to accumulation of higher level of water soluble compounds viz, total sugars, vitamins, minerals, which were synthesized, translocated and accumulated due to chemical changes during the fruit development and maturity of fruits. The water soluble compounds in developing fruits might have increase due to various levels of nutrients. The present findings are also in agreement with the observations recorded in other fruits by Meena *et al.* (2005) [18] on guava Cv. Sardar, Animesh and Ghosh (2009) [2] in litchi Cv. Bombai, Shukla *et al.* (2011) on aonla fruits 'Banarasi, Modi *et al*., (2012) [21] in papaya Cv. Madhu Bindu.

Reducing sugars

The interaction of fertilizers and micronutrients did not exhibit any significant effect on reducing sugars.

The significant increasing in reducing sugars might be due to the application of NPK could be attributed to the involvement of nitrogen in various energy sources like amino acids and amino sugars. These results are in conformity with the results obtained by Kaul and Bhatanagar (2006) [16] in kinnow and Kashyap *et al.,* (2012) [15] in mandrin. Similar findings were earlier reported by Sharma *et al.,* (2013) [25].

Similar results have been obtained by Gaya (2008). Kahlon and Uppal (2005) [14] Arvind bhatt *et al.,* (2012) [4] who suggested that conversion of starch and polysaccharides into simple sugar with the advancement of storage was responsible for the increase of reducing sugar, and onward decline was due to the utilization of sugar in evapotranspiration and other bio chemical activities.

Non reducing sugars

The interaction of fertilizers and micronutrients exhibited significant effect on the content of non reducing sugars. The maximum content of non reducing sugars (8.20 %) was recorded with application of F_2M_2 on par on par with the application of F_1M_3 i.e. (8.08 %). The minimum content of non reducing sugars (7.19 %) was recorded with application of F_3M_2.

The increase in non reducing sugar content of fruits by the use of recommended dose of NPK fertilizers might be due to the enhancement in uptake of nutrients which lead to increased catalytic activities by which the complex substances (starch) degrade into simple sugars and thereby improve the fruit quality. The present results are in accordance with the findings of Dutta *et al* (2009) [10] and Binepal *et al* (2013) [6] in guava. Arvind bhatt *et al.,* (2012) [4] reported that conversion of starches and polysaccharides into simple sugar with the advancement of storage was responsible for the

increase of non reducing sugar and onward decline was due to the utilization of sugar in evapotranspiration and other bio chemical activities.

Ascorbic acid

The interaction of fertilizers and micronutrients exhibited significant effect on ascorbic acid. The maximum ascorbic acid (32.36 mg/100g) was recorded with application of F_2M_2 followed by the application of F_3M_2 i.e. (31.30 mg/100g). The minimum ascorbic acid (27.53 mg/100g) was recorded with application of F_3M_3. The results are in close conformity with the report of Pandey *et al*., 1990 [23] in guava. Due to the balanced absorption of macro and micro nutrients which have exerted regulatory role as an important constituent of endogenous factors in affecting the quality of the fruits. The carbohydrate reserves of the roots and stems are drawn upon heavily which might have resulted in higher sugar contents in fruits as has also been reported by Dey, 2005 [7].

The increase in ascorbic acid content of fruit juice with the application of micronutrients is due to increase synthesis of catalytic enzymes and co-enzyme (Shivanand *et al*., 2017) [29].

Acidity

The interaction of fertilizers and micronutrients did not exhibit any significant effect on acidity. Dutta *et al.,* (2016) [9] found that fruits grown under organic manure and biofertilizer had better fruit quality. The increase in physicochemical parameters in fruits due to bio-fertilizer might be due to their role in nitrogen fixation, production of phytohormone-like substances and increased uptake of nitrogen as reported by Dutta and Kundu (2012) [8]. Further microorganisms are an important component of soil environment and utilization of biofertilizer could be a better preposition for improving biological attributes of soil, which in turn may increase quality and productivity potential of various crops (Allen *et al*., 2002) [1] and Arshad and Frankemberger, (1992) [3].

Acidity was reduced in borax treated fruits which might be due to early ripening induced by this treatment during which degradation of acid might have occurred. It was also observed that total soluble solids increased at the expense of acidity in fruits. The acidity under the influence of borax might have converted into sugars and their derivatives by the reaction involving the reversal of glycolytic path way or be used in respiration (Sukhjit kaur 2017) [36]. These results are close conformity with Mishra and Khan (1981) [20] and Singh *et al*., (2016) [33] in litchi, Gohlani *et al.,* (2012) [12] in custard apple and Sharma *et al.,* (2013) [25] and Gaur *et al.,* (2014) [11] in guava.

Shelf life

The interaction of fertilizers and micronutrients exhibit significant effect on shelf life. The maximum shelf life (12.90 days) was recorded with application of F_2M_2 on par with the application of F_3M_2 - 50% RDF i.e. (12.63 days). The minimum shelf life (10.73 days) was recorded with application of F_1M_3.

Purnendra kumar *et al.,* (2017) [24] reported that might be due to altered physiology and biochemistry of the fruit as influenced by both organic and inorganic fertilizers that reduced respiration and transpiration which intern resulted in low cumulative physiological loss in weight and increased shelf life in guava.

Singh *et al.,* (2017) [35] found that the increase in shelf life of mango fruits might be due to increase in concentration of boron of middle lamella of cell wall which provide physical strength to cell wall and improve fruit colour development and appearance. These findings are in accordance with the findings of Bhatt *et al*., (2012) [4] and Singh *et al*., (2012) [34] in mango.

Conclusion

From this study, it can be concluded that T_5 (F_2M_2) -50% RDF + 50% VC +250 g *Azotobacter* + (0.8%) $ZnSO_4$ + (0.5%) H_3BO_3 + (0.5%) $FeSO_4$ per tree can be recommended for increased quality parameters (Total soluble solids, Total sugars, Reducing sugars, Non reducing sugars and Ascorbic acid), reduce the acidity and increase shelf life of mango Cv. banganapalli is under high density planting system for fruits.

References

1. Allen MF, Jasper DA, Zak TC. Microorganisms. In: Handbook of Ecological Restoration. Cambridge university Press. 2002; pp.257-78.
2. Animesh S, Ghosh B. Effect of foliar application of micro nutrients on retention, Yield and quality of fruit in litchi Cv. Bombay. Environment and Ecology. 2009; 27(1):89-91.
3. Arshad M, Frankemberger Jr. WT. Microbial production of plant growth regulators, pp. 307-348. - In: MEETING F.B. Jr. (ed.) Soil microbial ecology. Application in agricultural and environmental management. Marcel Dekker, Inc. New York, USA., 1992
4. Arvind, Bhatt, Mishra NK, Mishra DS, Singh CP. Foliar application of potassium, calcium, zinc and boron enhanced yield, quality and shelf life of mango. Hort Flora Research Spectrum. 2012; 1(4):300-305.
5. Bangirth P, Dilley DR, Dewey DH. J. Amer. Soc. Hort. Sci. 1972; 97:679-682.
6. Binepal MK, Tiwari R, Kumawat BR. Effect of integrated nutrient management on physico-chemical parameters of guava under Malwa Plateau conditions of Madhya Pradesh. Annals of Plant and Soil Research. 2013; 15(1):47-49.
7. Dey P, Rai M, Kumar S, Nath V, Das B, Reddy NN. Effect of biofertilizers on physico-chemical characteristics of guava *Psidium guajava* L. fruit. Indian Journal of Agricultural Sciences. 2005; 75(2):95-96.
8. Dutta P, Kundu S. Effect of biofertilizers on nutrient status and fruit quality of Himsagar mango grown in new alluvial zones of West Bengal. Journal of Crop and Weed. 2012; 8(1):72-74.
9. Dutta P, Das K, Patel A. Influence of organics, inorganic and bio-fertilizers on growth, fruit quality, and soil characters of Himsagar mango grown in new alluvial zone of West Bengal, India. Advances in Horticultural Science. 2016; 30(2):81-85.
10. Dutta P, Maji SB, Das BC. Studies on the response of bio-fertilizer on growth and productivity of guava. Indian Journal of Horticulture. 2009; 66(1):39-42.
11. Gaur B, Beer K, Hada TS, Kanth N, Syamal MM. Studies on the effect of foliar application of nutrients and GA_3 on fruit yield and quality of winter Season Guava. *The Ecoscan*. 2014; 6:479-483.
12. Gohlani S, Bisen BP. Effect of different coating material on the storage behavior of custard apple (*Annona squamosa* L.). The Bioscan. 2012; 7(4):637-640.
13. Jones R, Wyn G, Lunt OR. Bot. Re view. 1970; 36:407-423.

14. Kahlon PS, Uppal RS. Effect of post harvest treatments on shelf life of mango Cv. Chausa. Haryana Journal of Horticultural Sciences. 2005; 34(1-2):51-53.
15. Kashyap P, Pramanick KK, Meena KK, Meena V. Effect of Nitrogen and Phosphorus application on yield and quality of pomegranate Cv. Ganesh under rainfed conditions. Indian Journal of Horticulture. 2012; 69(3):322-327.
16. Kaul MK, Bhatnagar P. Nutritional studies in Kinnow. Indian Journal of Arid Horticulture. 2006; 1(1):23-24.
17. Kumar S, Verma DK. Effect of micro-nutrients and NAA on yield and quality of litchi cv. Dehradun. Proceedings of International Sem. on Recent Trend in Hi-tech Horticulture and Post Harvest Tech., 2004, pp.193.
18. Meena RP, Mohammed S, Lakhawat SS. Effect of foliar application of urea and zinc sulphate on fruit quality and yield of pruned guava trees (*Psidium guajava* L.) Cv. 'Sardar' under high density planting system. Udyanika. 2005; 11(2):90-93.
19. Mika A. *Acta Hort.* 1983; 138:15-21.
20. Mishra RR, Khan I. Progressive Horticulture. 1981; 13(3-4):87-90.
21. Modi PK, Varma LR, Bhalerao PP, Verma P, Khade A. Micro nutrient spray effects on growth, yield and quality of papaya (*Carica papaya* L.) Cv. Madhu Bindu. Madras Agricultural Journal. 2012; 99(7, 9):500-502.
22. National Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India, 2015. *http:nhb.gov.in/area-pro/database-2015*.
23. Pandey RC, Pathak RA, Pathak RK. Physico – chemical changes associated with growth and development of fruit in ber *Zizyphus mauritiana* Lamk. Indian Journal Horticulture. 1990; 47:1247.
24. Purnendra KS, Dikshit SN, Sharma HG. Studies on the effect of cowdung slurry, chemical fertilizers and bio-fertilizers on fruit quality and shelf life of guava (*Psidium guajava* L.) under Chhattisgarh plains. International Journal of Chemical Studies. 2017; 5(5):1669-1672.
25. Sharma A, Wali VK, Bakshi P, Jastora A. Effect of organic and inorganic fertilizers on quality and shelf life of guava (*Psidium guajava* L.) Cv. Sardar. The Bioscan. 2013; 8(4):1247-1250.
26. Sharma AK, Singh K, Mishra SP. Effect of foliar spray of zinc sulphate, 2,4,5-T and GA_3 on quality of Kagzi lime (*Citrus aurantifolia* Swingle). Orissa Journal of Horticulture. 2002; 30(2):115-118.
27. Sharma AK, Singh K, Mishra SP. Effect of foliar spray of zinc sulphate, 2,4,5-T and GA_3 on quality of Kagzi lime (*Citrus aurantifolia* Swingle). Orissa Journal of Horticulture. 2003; 31(2):29-32.
28. Sharma JR, Bhatia SK, Gupta RB, Singh S, Gehlot R. Influence of nutrients and growth regulators on yield and quality of ber (*Ziziphus mauritiana* Lamk.) fruits cv. Umran. Haryana Journal of Horticulture Science. 2008; 37(3/4):217-219.
29. Shivanand MM, Ram D, Ankit P, Ashok KM. Effect of foliar feeding of micro-nutrients on physico-chemical attributes of aonla (*Emblica officinalis* Gaertn) Cv. NA-7 under high density planting. International Journal of Current Microbiology and Applied Sciences. 2017; 6(5):1951-1957.
30. Shukla HS, Kumar V, Tripathi VK. Effect of gibberellic acid and boron on development and quality of aonla fruits 'Banarasi'. Acta Horticulturae. 2011; 890:375-380.
31. Singh BP, Gupta OP, Chauhan KS. Indian J Agri. Sci. 1982; 52(4):235-239.
32. Singh JK, Prasad J, Singh HK, Anshuman Singh. Effect of micronutrients and plant growth regulators on plant growth and fruit drop in aonla (*Emblica officinalis* Gaertn.) fruits Cv. Narendra Aonla-10. Plant Archives. 2008; 8:911-913.
33. Singh N, Kaur A, Gill BS. International Journal of Development Research. 2016; 6(7):8686-8688.
34. Singh P, Varma LR. Effect of different plant nutrients and its integrated treatment on flowering, fruiting behavior, yield and quality of mango cv. Kesar. GAU Research Journal. 2012; 36(1):44-46.
35. Singh S, Parekh NS, Pradeep KV. Effect of soil and foliar application of multi-micronutrients on fruit quality, shelf life of fruits and nutrient content of leaf of mango (*Mangifera indica* L.) var. Amrapali. International Journal of Chemical Studies. 2017; 5(4):305-308.
36. Sukhjit Kaur. Effect of micronutrients and plant growth regulators on fruit set, fruit retention, yield and quality attributes in litchi Cv. Dehradun. Chemical Science Review and Letters. 2017; 6(22):982-986.
37. Thirupathaiah G, Shirol AM, Nagesh N, Venugopal U, Sampath PM. Effect of micronutrients on post harvest quality and shelf life of sapota Cv. Kalipatti. International Journal of Agriculture Sciences. 2017; 9(14):4084-4086.
38. Yadav, Subhash, Shukha HS, Ram RA. Studies on foliar of NAA, GA_3, boric acid and Ca $(NO_3)_2$ on fruit retention, growth, application yield and quality of aonla (*Emblica officinalis* Gaertn.) cv. Banarasi. Horticulture Journal. 2010; 23(2):64-67.
39. Yashwant P, Atul Y, Bhanu P, Shivam Dileep KT. Effect of foliar spray of micro nutrients on yield and quality of Aonla (*Emblica officinallis* Gaertn. L.) Cv. NA-6. Journal of Pharmacognosy and Phytochemistry. 2018; 1659-1662.