

Original Research Article

Effect of Fertilizer Levels on Physico-chemical Parameters and Yield of Fruits in Mango Cv. Alphonso

R. G. Manjarekar, M. H. Khanvilkar, S. S. Karle, G. D. Shirke and P. G. Ahire

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri -415 712, Maharashtra, India

**Corresponding author*

ABSTRACT

Alphonso is the best commercial mango variety because of its excellent flavour and sub acidic taste and long shelf life. There is great demand for the fruits as well as processed products of this cultivar in the national as well as in international market. Its supply to long distance or keeping it for longer period without loss of its chemical quality is thus, essential. The effect of fertilizer levels on the quality aspect was significant. However, till date no systematic attempt has been made to study the effect of fertilizer levels on physico-chemical parameters in mango fruits. There was no significant effect of different levels of fertilizers on physical parameters viz., length, breadth, weight, volume and specific gravity of fruits at harvest and on ripe stage. At ripe stage, there was slight reduction in the weight of the fruits. While there was significant effect of different levels of fertilizers on the chemical parameters viz. T.S.S., acidity, reducing sugars, total sugars and calcium. The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits were higher than the interior fruits in terms of total fruits or number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T_4) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tend to produce more vegetative growth than the reproductive growth.

Keywords

Fertilizer levels,
Physico-chemical parameters,
Yield of fruits,
Alphonso mango

Introduction

Alphonso is the best commercial mango variety because of its excellent flavour, sub acidic taste and long shelf life. The demand for this variety in internal as well as external markets is increasing. Its supply to long distance or keeping it for longer period without loss of its chemical quality is thus, essential. Konkan region of Maharashtra (particularly Ratnagiri and Sindhudurg districts) contributes about 62.20 percent area under mango cultivation. About 90 per cent of the area is covered by Alphonso

cultivar. There are some major drawbacks with this cultivar such as alternate bearing, low productivity, spongy tissue etc. which are probably due to lack of nutrients uptake.

If proper manuring is done by the growers at the right time, this important crop is saved from deterioration and production can be increased to an appreciable extent. The effect of fertilizer levels on the quality aspect was significant. However, till date no systematic attempt has been made to study

the effect of fertilizer levels on physico-chemical changes in mango fruits. Hence, the present investigation was carried out with objective to study the effect of fertilizer levels on physico-chemical parameters and yield of fruits in Alphonso mango.

Materials and Methods

The experiment was conducted at the Department of Horticulture, College of Agriculture, Dapoli, Dist.-Ratnagiri, Maharashtra.

The seventy two Alphonso trees of 20 years age having uniform growth and vigour constituted as the experimental material. The experiment was conducted in Randomized Block Design with three replications. The treatment details are given below.

T₁= No fertilizers (control)

T₂= Recommended dose of NPK*

T₃= Recommended dose of NPK + ½ Recommended dose of NPK

T₄= Double Recommended dose of NPK

T₅= 4.5 kg N + Recommended dose of P and K

T₆= 1.5 kg P₂O₅ + Recommended dose of N and K

T₇= 2 kg K₂O + Recommended dose of N and P

T₈= Soil application of Micro-nutrient complex (i.e. Ormichem 2 kg/tree) + Recommended dose of NPK

T₉= Soil application of lime (Calcium carbonate i.e. 10 kg/tree) + Recommended dose of NPK

T₁₀= Foliar application of KH₂PO₄ (2% spray) + Recommended dose of NPK

T₁₁= Organic manures only (50 kg/tree)

T₁₂= Foliar application of multi-nutrient complex (2% spray) + Recommended dose of NPK

*Recommended dose of NPK = 1.5 kg N, 0.5 kg P₂O₅ and 0.6 kg K₂O/tree/year i.e. 3 kg Urea + 3 kg Single Super Phosphate + 1 kg Muriate of Potash

The manures and fertilizers as per treatments were applied at 1st fortnight of July, in the trenches (30 cm wide and 15 cm deep) which were dug half the distance of the canopy of the tree from its trunk. Farm yard manure 50 kg/tree was commonly applied. Further paclobutrazol (cultural) 5 g a.i. /tree was also applied by soil drenching in the first fortnight of August.

In each treatment fruits harvested at the 'C' stage of maturity described by Cheema and Dani (1934) and ripened at ambient temperature. The fruits were assessed for their physico-chemical composition at harvest, on ripening stage. The physical parameters like length, breadth were determined by using Vernier callipers, weight was determined by electronic weighing balance, volume was determined by water displacement method, specific gravity was determined by dividing weight upon volume and colour was determined by visual observations. Whereas in chemical parameters the total soluble solids were determine by a hand refractometer. Reducing sugars were estimated by the method of Lane and Eynon (1923) and total sugars after acid hydrolysis by the same method. Acidity was determined according to (A.O.A.C., 1975). Starch was determined by the method of Ranganna (1985). Calcium

content in the fruit samples was determined by Versenate titration method as described by Sankaram (1966).

Yield of each tree was recorded by counting the total number of fruits per tree in direction wise.

Results and Discussion

Physical parameters of Alphonso mango fruits at harvest and on ripening stage

The data pertaining to changes in physical characteristics of Alphonso mango fruits during harvest and on the ripe stage are presented in Table 1.

It is seen from these data that there is no significant effect of different levels of fertilizers on physical parameters viz., length, breadth, weight, volume and specific gravity of fruits at harvest and on ripe stage. At ripe stage, there was slight reduction in the weight of the fruits. However, there was significant effect on weight of fruits due to fertilizer treatments. The highest fruit weight (232.17) was recorded in the trees receiving the foliar spray of multi-nutrient complex alongwith recommended NPK (T₁₂) treatment which is at par with T₁, T₂, T₄ and T₁₁ treatment.

Further, it was observed that these physical parameters viz., length, breadth, weight, volume and specific gravity of fruits was found to decrease with ripening process. The study indicates that the reduction in these constituents or parameters could be attributed to loss of moisture, respiration and transpiration also, during ripening process. This findings is in conformity with the observations reported by Sadhu and Bose (1976), Dabhade and Khedkar (1980), Limaye *et al.*, (1984), Gole (1986), Patil (1990) and Patil (1996).

Alphonso mango fruits exhibited light green colour at harvest irrespective of fertilizer levels. However, a little difference was observed in colour of fruits after ripening. The trees which were treated with higher doses of potassium along with recommended N and P (T₇) showed reddish blush on their shoulders while rest of the fruits showed golden yellow colour. The change in colour of fruits from light green to golden yellow and also the pulp colour changes during ripening, creamish to yellowish is due to the increase in the rate of biosynthesis of carotenoid pigments during ripening process. Similar findings were also reported by Najundaswamy *et al.*, (1966), Palaniswamy *et al.*, (1974) and Patil (1990). The appreciable change in colour on the shoulders (reddish blush) on the Alphonso mango fruits by potassium treatment appears to be the influence of potassium by way of increasing the anthocyanin pigments in the fruits (Bharagava, 1993).

Chemical parameters of alphonso mango fruits at harvest and on ripening stage

The data pertaining to changes in chemical characteristics of Alphonso mango fruits during harvest and on the ripe stage are presented in Table 2.

It is seen from these data that the trees which received higher nitrogen along with recommended dose of P and K (T₅) showed highest T.S.S. (9.48⁰B) content than the rest of the treatments. While the trees which received higher phosphorus along with recommended dose of N and K (T₆) showed lowest T.S.S. (8.03⁰B) at harvest. During ripening process, there was significant effect of different doses of fertilizers on total soluble solids (T.S.S.). Trees supplied with higher potash along with recommended dose of N and P (T₇) recorded highest T.S.S. (18.73⁰B) which is significantly superior

over control (T₁), while trees without any fertilizers (T₁) recorded lowest T.S.S. i.e. (17.60⁰B).

The trees supplied with higher phosphorus along with recommended N and K (T₆) recorded significantly highest acidity (3.78%), while the trees which received high nitrogen along with recommended P and K (T₅) recorded lowest acidity (3.41%) at harvest. At ripe stage, the trees supplied with control (T₁) treatment shows higher acidity (0.48%), while the trees supplied with the higher potash along with recommended N and P (T₇) shows lower acidity (0.34%). There was decrease in acidity from harvest to ripe stage in Alphonso mango irrespective of different doses of fertilizers.

Higher reducing sugars content was recorded (2.41%) in trees supplied with higher nitrogen along with recommended dose of P and K (T₅) treatment and lower reducing sugars content was recorded (1.22%) in trees receiving higher phosphorus along with recommended N and K (T₆) treatment at harvest. However, tree receiving foliar spray of multi-nutrient complex along with recommended dose of N, P and K (T₁₂) shows higher non-reducing sugars (1.46%) which are significantly superior over control.

While the trees receiving higher phosphorus along with recommended N and K (T₆) treatment recorded lowest (1.06%) non-reducing sugars at harvest stage. On the contrary, during ripe stage, trees which received one and half times extra recommended dose of fertilizers (T₃) shows higher reducing sugars (4.20%). While the lowest reducing sugar was observed in the trees supplied with foliar spray of KH₂PO₄ along with recommended dose of fertilizer (T₁₀). However, the trees receiving the foliar

spray of KH₂PO₄, along with recommended dose (T₁₀) shows higher non-reducing sugars content (11.33%), while the lowest (10.49%) recorded in the trees supplied with one and half times extra recommended dose (T₃) and double dose of recommended fertilizers (T₄) treatments.

Higher total sugars content was noticed (3.86%) in the trees which received higher nitrogen along with recommended P and K (T₅) treatment, while lowest (2.28%) was noticed in trees supplied with high doses of phosphorus along with recommended N and K (T₆) treatment. On the contrary, at ripe stage, the highest total sugars content (15.31%) was noticed in the trees which received organic manures only (T₁₁), while lowest total sugars (14.06%) was noticed in trees which received higher nitrogen along with recommended dose of P and K (T₅) treatment. Generally, the sugars content was increase from harvesting to ripe stage due to conversion of starch into sugars.

Highest calcium in pulp was noticed in the trees supplied with soil application of calcium carbonate along with recommended fertilizers (T₉) treatment at harvest (84.83 mg/100 g) and at ripe stage (96.19 mg/100 g) while lowest was noticed in control (T₁) treatment both at harvest (51.49 mg/100 g) and at ripe stage (89.51 mg/100 g).

Effect of fertilizer levels on yield of fruits

The data pertaining to the effect of fertilizer levels and foliar spray of nutrients on yield of Alphonso mango are presented in Table 3.

The direction plays a key role on the bearing of the trees. It was observed that irrespective dose of fertilizers, fruits bears on North side had significantly lesser number of fruits than any other direction.

Table.1 Effect of fertilizer levels on physical characteristics of Alphonso mango fruits at harvest and at ripe stage

Treat-ments	At harvest stage							At ripe stage						
	Length (cm)	Breadth (cm)	Weight (cm)	Volume (ml)	Sp. gravity	Colour of fruit	Colour of pulp	Length (cm)	Breadth (cm)	Weight (cm)	Volume (ml)	Sp. gravity	Colour of fruit	Colour of pulp
T ₁	8.82	7.30	229.83	226.65	1.014	Light green	Creamish	8.80	7.27	206.50	204.08	1.012	Golden yellow	Orange yellow
T ₂	8.80	7.36	226.08	223.38	1.012	Light green	Creamish	8.79	7.25	208.50	206.43	1.010	Golden yellow	Orange yellow
T ₃	9.02	7.58	245.50	241.22	1.018	Light green	Creamish	8.34	7.03	182.50	179.53	1.016	Golden yellow	Orange yellow
T ₄	9.02	7.53	240.50	236.71	1.016	Light green	Creamish	8.99	7.36	222.50	219.55	1.014	Golden yellow	Orange yellow
T ₅	8.66	7.38	224.33	221.64	1.012	Light green	Creamish	8.57	6.94	190.58	188.65	1.010	Golden yellow	Orange yellow
T ₆	8.67	7.19	207.42	204.59	1.014	Light green	Creamish	8.56	7.14	198.67	196.31	1.012	Golden yellow	Orange yellow
T ₇	8.55	7.30	210.17	206.18	1.019	Light green	Creamish	8.48	7.03	192.83	189.65	1.017	Golden yellow with reddish blush	Orange yellow
T ₈	8.71	7.36	223.00	219.02	1.018	Light green	Creamish	8.53	7.08	197.67	194.45	1.016	Golden yellow	Orange yellow
T ₉	8.73	7.24	214.50	211.08	1.016	Light green	Creamish	8.61	6.96	192.83	190.26	1.013	Golden yellow	Orange yellow
T ₁₀	9.03	7.01	206.17	203.07	1.015	Light green	Creamish	8.97	6.81	178.83	176.52	1.013	Golden yellow	Orange yellow
T ₁₁	8.99	7.40	231.92	229.33	1.011	Light green	Creamish	8.87	7.35	221.67	219.84	1.008	Golden yellow with blush	Orange yellow
T ₁₂	9.09	7.43	248.50	243.67	1.020	Light green	Creamish with yellow tinge	9.01	7.36	232.17	227.98	1.018	Golden yellow	Orange yellow
S.E. ±	0.190	0.151	13.164	13.148	0.002	-	-	0.175	0.154	11.021	10.993	0.002	-	-
C.D. (5%)	N.S.	N.S.	N.S.	N.S.	N.S.	-	-	N.S.	N.S.	32.321	N.S.	N.S.	-	-

Table.2 Effect of fertilizer levels on chemical composition of Alphonso mango fruits at harvest and at ripe stage

Treatments	At harvest stage						At ripe stage					
	T.S.S. (° Brix)	Acidity (%)	Reducing sugars (%)	Non- reducing sugars (%)	Total sugars (%)	Calcium (mg/100 gm)	T.S.S. (° Brix)	Acidity (%)	Reducing sugars (%)	Non- reducing sugars (%)	Total sugars (%)	Calcium (mg/100 gm)
T ₁	8.20	3.73	1.24	1.10	2.34	81.49	17.60	0.48	3.53	11.24	14.77	89.51
T ₂	8.30	3.69	1.29	1.17	2.46	82.16	18.20	0.43	4.18	10.82	15.00	92.85
T ₃	8.73	3.58	1.32	1.28	2.60	82.83	18.63	0.36	4.20	10.49	14.70	91.51
T ₄	9.12	3.46	2.37	1.36	3.73	83.49	18.33	0.41	4.13	10.49	14.62	90.18
T ₅	9.48	3.41	2.41	1.45	3.86	82.16	18.52	0.44	3.35	10.71	14.06	89.51
T ₆	8.03	3.78	1.22	1.06	2.28	82.83	17.80	0.45	3.76	10.80	14.56	93.52
T ₇	8.25	3.62	1.25	1.39	2.64	80.83	18.73	0.34	4.13	11.11	15.24	90.18
T ₈	8.47	3.65	2.30	1.28	3.58	82.83	18.60	0.37	3.92	11.01	14.92	90.84
T ₉	8.37	3.70	1.34	1.14	2.48	84.83	18.40	0.45	3.83	11.02	14.85	96.19
T ₁₀	8.43	3.68	1.25	1.40	2.65	84.16	18.57	0.42	3.29	11.33	14.62	92.18
T ₁₁	8.35	3.52	2.14	1.34	3.48	82.16	18.43	0.38	4.12	11.19	15.31	91.51
T ₁₂	8.53	3.62	1.26	1.46	2.72	82.83	18.48	0.43	3.57	11.28	14.85	90.85
S.E. ±	0.033	0.052	0.033	0.060	0.057	0.742	0.080	0.026	0.035	0.097	0.111	1.164
C.D. (5%)	0.097	0.152	0.096	0.175	0.168	N.S.	0.235	0.076	0.102	0.285	0.325	3.413

Table.3 Effect of fertilizer levels at different directions on yield of fruits (in nos.) in mango cv. Alphonso

Treatments	Direction wise Yield of fruits (in numbers)					Mean fruit yield
	East	West	North	South	Interior	
T ₁	87.000	95.500	63.000	93.666	156.666	99.166
T ₂	129.500	118.166	108.666	131.833	200.166	137.666
T ₃	104.666	96.833	75.833	105.500	145.500	105.666
T ₄	76.666	67.333	46.000	76.333	114.000	76.066
T ₅	106.500	92.000	62.666	77.000	147.666	97.166
T ₆	113.166	105.833	89.000	103.500	156.833	113.666
T ₇	117.666	95.500	79.666	91.333	152.166	107.266
T ₈	109.500	85.833	66.000	99.166	141.000	100.300
T ₉	136.666	135.500	94.833	138.333	162.333	133.533
T ₁₀	134.333	111.666	83.333	103.000	182.666	123.000
T ₁₁	96.666	132.500	84.166	115.666	163.000	118.400
T ₁₂	80.666	123.000	51.666	116.666	144.000	103.200
Mean	107.75	104.972	75.402	104.333	155.500	109.591
	Direction		Treatment		Direction X Treatment	
S.E. ±	7.139300		11.060155		24.731259	
C.D. (5%)	19.990231		30.968732		69.248191	
	Sig.		Sig.		N. S.	

However, the inside i.e. interior part of the trees bears much more fruits which was significantly superior to all other direction. The study further indicated that there was non-significant difference on number of fruits present on East, West and South sides.

However, little higher number of fruits present on Eastern sides. In general, though the total number of fruits at interior side was more than East, West, North and South direction, the overall peripheral number of fruits is much more than total fruits in interior side.

The fertilizers also play significant role on bearing of mango trees. The recommended dose of fertilizers (T₂) produces highest number of fruits (137.66) than any other treatments which was significantly superior over the control and it was at par with the trees supplied with soil application of calcium carbonate along with recommended

dose (T₉), the trees supplied with foliar spray of KH₂PO₄ along with recommended dose (T₁₀), organic manures only (T₁₁), trees supplied with higher phosphorus and recommended dose of N and K (T₆), higher potash and recommended dose of N and P (T₇) in that order.

The trees which received double dose of fertilizers (T₄) yielded poorly which was at par with the trees do not received fertilizer doses (T₁) and which receives higher doses of nitrogen and recommended P and K (T₅) and the trees supplied with ormichem and recommended dose (T₈) and foliar spray of multi-nutrient spray and recommended dose (T₁₂). The data cannot be compared as such study has not been conducted elsewhere, besides this is being one year data, it will very difficult to draw any conclusion. However, overall results indicate that high N favours more vegetative growth leading to poor crop yield.

There was no significant effect of different levels of fertilizers on physical parameters viz., length, breadth, weight, volume and specific gravity of fruits at harvest and on ripe stage. At ripe stage, there was slight reduction in the weight of the fruits. While there was significant effect of different levels of fertilizers on the chemical parameters viz. T.S.S., acidity, reducing sugars, total sugars and calcium.

The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits were higher than the interior fruits in terms of total fruits or number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T₄) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tend to produce more vegetative growth than the reproductive growth.

References

A.O.A.C. (1975). Official Methods of Analysis. Association of Official Analytical Chemists. 12th Edition, Washington

Bhargava B.S.(1993). Role of potassium in the fruits of mango. *Advances in Horticulture*, 2 : 947-960.

Cheema, G.S. and Dani, P.G. (1934). Report on the export of mangoes to Europe. *Dept. Agric. Bombay*, Bulletin No. 170, pp.17-18.

Dabhade, R.S. and D.M. Khedkar (1980). Studies on drying and dehydration of raw mangoes for preparation of mango powder (Amchur). Physico- chemical composition of raw mangoes during growth and development. *Indian Food Packer*. 34(3): 3-17.

Gole, R.S. (1986). Studies on fruit development and some aspects of post harvest handling of mango (*Mangifera indica* L.) fruits. A M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri.

Lane, J.H. and L. Eynon (1923). Determination of reducing sugars by Fehling's solution with methylene blue as internal indicator. *J. Soc. Chem. Ind.*, 42:32.

Limaye, V.P., M.M. Patil, B.L. Lad, M.B. Magdum, R.T. Gunjate and M.J. Salvi (1984). Ratna- A new mango hybrid. *J. Maharashtra Agric. Univ.* 90(1): 60-61.

Nanjundaswamy, A.M.; Laxminarayana Shetty; A.Rahim and G.S. Sidhappa (1966). A note on proximate, mineral and vitamin composition of some important varieties of mangoes of Andhra Pradesh. *Indian Food Packer*, 20 (3):22-26

Palaniswamy, K.P.; C.R. Muthukrishnan and K.G. Shanmugavelu (1974). Physico-chemical characteristics of some varieties of mango. *Indian Food Packer*, 28 (5):12-19.

Patil, M.N.(1996). Studies on physico-chemical composition and processing of mango (*Mangifera indica* L.) Cvs. Alphonso, Ratna, Kesar, Pairi and Amrapali. A M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri.

Patil, S.A.(1990). Evaluation of mango (*Mangifera indica* L.) Cvs. Alphonso, Ratna, Pairi and Kesar for physico-chemical composition and processing. A M.Sc. (Agri.) thesis submitted to Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri.

Ranganna, S. (1985). Manual of analysis of fruit and vegetable products. Tata Mc. Graw-Hill Publishing Company Ltd., New Delhi.

Sadhu, M.K. and T.K. Bose (1976). Studies on mango (*Mangifera indica* L.) cultivars. I. Morphological and physico-chemical studies of some promising mango cultivars of the district Murshidabad, West Bengal. Indian

Food Packer, 30 (5):24-32.

Sankaram, A. (1966). A Laboratory Manual for Agricultural Chemistry, *Asia Publishing House*, Bombay-1, pp. 97-99.