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Influence of Post Flowering Foliar Application of Nutrients on Yield and Quality Attributes of Mango (*Mangifera indica* L.) *cv.* Alphonso

Gharge V. R.*, Sanas M.P.* and Shinde S.M.*

ABSTRACT: *The present investigation was carried out during two consecutive years (2011 and 2012) to find out the effect of foliar application of nutrients on yield and quality attributes of Alphonso mango. Fruit yield was highest in terms of number (184.17) was noticed in treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages. The treatment T_1 (KNO_3 1% each at pea, marble and egg stages) recorded the highest TSS (20.97 ^{0}B), total sugars (15.71 %), than control. However, the control recorded the highest titratable acidity (0.46%).*

INTRODUCTION

Mango is the most popular and favourite fruit of our country and is relished by people because of its attractive appearance, pleasant fragrance and luscious taste. Among various varieties of mango grown in India Alphonso variety is famous for excellent fruit quality. However, it is prove to poor fruiting due to excessive fruit drop and biennial in habit. In recent years, foliar nutrient sprays like urea 2 % and KNO_3 1% at different growth stages of mango playing important role in improving yield and quality of fruits. In view of this, studies were made to evaluate the influence of foliar sprays on yield and quality parameters of mango.

MATERIALS AND METHODS

The experiment was conducted on twenty five years old Alphonso mango trees, located at Department of Horticulture, College of Agriculture, Dapoli during 2011 and 2012. The experiment was laid out in a randomized block design with fourteen treatments, each replicated thrice. The water soluble fertilizers namely potassium nitrate (13:00:45), urea (46:00:00), monopotassium phosphate (00:52:34), potassium sulphate (00:00:50), Sujala (19:19:19), and Naphthalene Acetic Acid (NAA) were applied as foliar spray as per the treatments given in the table 1.

Table 1
Application of the Post Flowering Foliar Sprays on Alphonso Mango Trees at Peanut, Marble and Egg Stages

Treatment	*At peanut stage*	*At marble stage*	*At egg stage*
T_1	KNO_3 (1%)	KNO_3 (1%)	KNO_3 (1%)
T_2	KNO_3 (1%)	KNO_3 (1%)	MPP (0.5%)
T_3	KNO_3 (1%)	MPP (0.5%)	MPP (0.5%)
T_4	Urea (2%)	Urea (2%)	Urea (2%)
T_5	Urea (2%)	KNO_3 (1%)	MPP (0.5%)
T_6	Urea (2%)	KNO_3 (1%)	KNO_3 (1%)
T_7	Urea (2%)	MPP (0.5%)	MPP (0.5%)
T_8	Urea (2%)	Sujala (1%)	Sujala (1%)
T_9	KNO_3 (1%)	KNO_3 (1%)	Sujala (1%)
T_{10}	KNO_3 (1%)	Sujala (1%)	Sujala (1%)
T_{11}	NAA 20 ppm	NAA 20 ppm	–
T_{12}	K_2SO_4 (0.5 %)	K_2SO_4 (0.5 %)	K_2SO_4 (0.5 %)
T_{13}	KNO_3 (1.5%)	K_2SO_4 (1.5 %)	K_2SO_4 (1.5 %)
T_{14}	Control (No foliar spray)		

Where,

- KNO_3 : Potassium Nitrate (13:00:45)
- MPP : Monopotassium Phosphate (00:52:34)
- Urea : 46:00:00
- Sujala :19:19:19
- NAA : Naphthalene Acetic Acid
- K_2SO_4 : Potassium Sulphate (00:00:50)

* Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (MH) India, 415712.

Yield of fruit per plant was recorded on the basis of number of total fruit harvested from three tree of each replication and average total number of fruits was estimated. Final observation of TSS, Total sugar and titratable acidity were recorded on randomly sampled five fruits from each replication.The TSS was recorded by using hand refractometer and expressed in ^{0}Brix. Total sugar and titratable acidity were estimated by using the A.O.A.C.(1980) method.

RESULT AND DISCUSSION

The data pertaining to the effect of foliar sprays on yield of Alphonso mango are presented in Table 2 indicated that there was significant effect of different foliar sprays on yield of Alphonso mango fruits. During first year (2011), significantly the highest number of fruits was obtained in the treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages), i.e. 168.66 fruits per tree and was superior over rest of the treatments except T_1 (161.91), T_5 (161.31) and T_2 (159.87). The lowest number of fruits i.e. 93.71 fruits per tree was recorded in treatment T_{14} (control).Similarly, in the second year (2012), significantly the highest number of fruits was obtained in the same treatment i.e. T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages) i.e. 199.68 fruits per tree and was at par with the treatments T_5 (195.12), T_1 (190.52) and T_2 (189.22). The lowest number of fruits i.e. 117.65 fruits pert tree was recorded in treatment T_{14} (control).Thus the pooled analysis showed that, significantly the highest number of fruits in the treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages), i.e. 184.17 fruits per tree and was at par with the treatments T_5 (179.22), T_1 (176.22) and T_2 (174.55) only the lowest number of fruits i.e. 105.68 fruits per tree was recorded in treatment T_{14} (control).

The application of 2% urea at pea stage, 0.5% MPP each at marble and egg stages had beneficial effect on yield. This might be due to the combination effect of urea and monopotassium phosphate, as the three major nutrient supplied through foliar sprays at different critical stages. The increase in yield due to urea and potassium was also reported by Shinde *et al*., (2007), Somavashi (2010) in Kokum, Brahmachari (1997), Vijayalakshmi and Srinivasan (1998), Burondkar *et al*., (2002), Gupta and Brahmachari (2004), Kumari *et al*., (2007), Stino *et al*., (2011) and Bansode (2012) in mango.

Fruit TSS increased significantly by various treatments. Similarly, at ripe stage, in the first year (2011), the variation was significant. The highest (20.57 ^{0}B) TSS was found in treatment T_1 (KNO_3 1% each at pea, marble and egg stages) and was at par with T_2 (20.47 ^{0}B) and T_3 (19.68 ^{0}B). The lowest (16.94 ^{0}B) TSS was recorded in control.During second year (2012), the treatment T_1 (KNO_3 1% each at pea, marble and egg stages) was found to give highest (21.38 ^{0}B) TSS of mango fruit which was superior over all the other treatments except T_3 (21.35 ^{0}B). The lowest (17.26 ^{0}B) TSS of mango fruit was found in control. The data regarding pooled analysis it was indicated that highest (20.97 ^{0}B) TSS was found in T_1 (KNO_3 1% each at pea, marble and egg stages) and was at par with T_3 (20.51 ^{0}B). The lowest (17.10 ^{0}B) TSS of mango fruit was observed in control.

An increase in TSS during fruit ripening could be due to hydrolysis of starch into sugars. The results obtained indicated that all the foliar nutrient sprays improved the TSS than control. The treatment T_1 (KNO_3 1% each at pea, marble and egg stages) had significantly highest TSS in both the years. Among all treatments, the potassium shows the highest TSS. The increase in TSS may be accounted to the hydrolysis of the polysaccharides, conversion of organic acids into soluble sugars and enhanced solubilisation of insoluble starch and pectin present in cell wall and middle lamella (Gupta and Brahmachari, 2004). The foliar 'K' application favors the conversion of starch into simple sugar during ripening by activating the sucrose synthase enzyme (Dutta *et al*., 2011). Besides this, 'K' is also involved in phloem loading and unloading of sucrose and amino acids and storage in the form of starch in developing fruits by activating the enzyme starch synthase (Mengel and Kirk by,1987).These results are in line with those of Singh (1983), Vijayalakshmi and Shrinivasan (1998), Gupta and Brahmachari (2004),Yeshitela (2004),Burondkar (2005) and Stino *et al*., (2011) in mango and Ahalwat *et al*., (2010) in grape.

The titratable acidity of mango fruits decreased by application of different nutrients. Similarly, in the first year (2011), at ripe stage the variation was significant. The acidity of mango fruit was found in the treatment T_{14} (control) was the highest (0.46%). It was at par with T_{12} (0.45%), T_8 (0.44) and T_7, T_{10} and T_{11} (0.42%). The lowest (0.35%) acidity of mango fruit was found in T_1 (KNO_3 1% each at pea, marble and egg stages). During second year (2012), the maximum (0.47%) acidity of mango fruit was observed in the treatment T_{14} i.e. control, which was superior over T_{13} (0.42%), T_2 (0.41%) and T_1 (0.40%) whereas the lowest (0.39%) acidity of mango fruit was found in T_1 (KNO_3 1% each at pea, marble and egg stages). The pooled

Table 2
Influnce of Post Flowering Foliar Sprays on Fruit Yield (Number of fruits/tree) and Quality Parameters in Alphonso Mango

Treatments	*Ripe stage*											
	Yield (No. of fruits) at Harvest stage			*TSS*			*Titratable acidity*			*Total sugar*		
	2011	*2012*	*Pooled*	*2011*	*2012*	*Pooled*	*2011*	*2012*	*Pooled*	*2011*	*2012*	*Pooled*
T_1	161.91	190.52	176.22	20.57	21.38	20.97	0.35	0.39	0.37	15.61	15.81	15.71
T_2	159.87	189.22	174.55	20.47	19.14	19.81	0.36	0.41	0.39	15.34	15.52	15.43
T_3	154.20	178.90	166.55	19.68	21.35	20.51	0.37	0.40	0.38	15.31	15.46	15.39
T_4	143.67	169.56	156.62	17.87	17.89	17.88	0.39	0.44	0.42	15.04	15.10	15.07
T_5	161.31	195.12	179.22	17.30	17.33	17.32	0.40	0.45	0.43	14.90	14.92	14.91
T_6	144.67	170.34	157.50	18.79	18.82	18.81	0.41	0.46	0.44	15.02	15.04	15.03
T_7	168.66	199.68	184.17	17.92	17.86	17.89	0.42	0.43	0.43	15.02	15.04	15.03
T_8	104.11	130.90	117.51	18.42	18.62	18.52	0.44	0.46	0.45	14.83	14.85	14.84
T_9	140.87	161.49	151.18	19.42	19.45	19.44	0.38	0.45	0.41	14.87	14.90	14.88
T_{10}	114.89	140.12	127.51	17.45	17.48	17.47	0.42	0.47	0.45	15.05	15.10	15.08
T_{11}	134.89	158.01	146.45	19.10	19.14	19.12	0.42	0.43	0.43	15.16	15.19	15.17
T_{12}	112.78	138.46	125.62	19.06	19.21	19.14	0.45	0.44	0.44	14.95	15.00	14.98
T_{13}	113.33	141.12	127.23	18.98	18.95	18.97	0.39	0.42	0.40	15.03	15.07	15.05
T_{14}	93.71	117.65	105.68	16.94	17.26	17.10	0.46	0.47	0.46	14.54	14.63	14.59
Range	93.71-168.66	117.65-199.68	105.68-184.17	16.94-20.57	17.26-21.38	17.10-20.97	0.35-0.46	0.39-0.47	0.37-0.46	14.54-15.61	14.63-15.81	14.59-15.71
Mean	136.35	162.94	149.64	18.71	18.85	18.78	0.40	0.44	0.42	15.05	15.12	15.08
S. Em ±	4.65	6.54	3.65	0.329	0.213	0.232	0.017	0.016	0.014	0.175	0.128	0.142
C. D. at 5%	13.52	19.01	10.60	0.956	0.618	0.674	0.049	0.046	0.042	0.510	0.371	0.413

data of acidity of mango fruit showed that the treatment T_{14} was recorded the highest (0.46%) acidity of mango fruit, which was superior over T_9 (0.41%), T_{13} (0.40%), T_2 (0.39%) and T_3 (0.38%) and other treatments at par with each other. The lowest (0.37%) acidity of mango fruit was noticed in T_1 (KNO_3 1% each at pea, marble and egg stages).

The data indicated that all foliar nutrients spray decreased the fruit acidity than control. The treatment T_1 (KNO_3 1% each at pea, marble and egg stages) had significantly minimum acidity in both the years. The treatments with 'K' and 'N' containing nutrients show the decrease in fruit acidity. The depletion in organic acids could be due to fast conversion of acids into sugars and their derivatives or their utilization in respiration or both (Gupta and Brahmachari, 2004). 'K' acts as a catalyst that accelerates the rate of reactions in plants (Jones, 1979). Similarly it has been reported by Venkatarayappa *et al*., (1976) in banana, Bariana and Dhaliwal (2002) in guava, Vijayalakshmi and Shrinivasan (1998), Gupta and Brahmachari (2004) and Stino *et al*., (2011) in mango.

Total sugars of mango fruits were appreciably increased by various foliar nutrients applied. Similarly, during the first year (2011), at ripe stage, the total sugars of mango fruit was highest (15.61%) and was significantly superior over all other treatments except T_2 (15.34%), T_3 (15.31%) and T_{10} (15.16%). The lowest (14.54%) total sugars of mango fruit were found in control. During the second year (2012), the highest (15.81%) total sugars of mango fruit was found in T_1 (KNO_3 1% each at pea, marble and egg stages) and was at par with T_2 (15.52%) and T_3 (15.46%) whereas lowest (14.63%) of total sugars of mango fruit was found in control. The pooled data of total sugars of mango fruit showed that the highest (15.71%) total sugars was observed in T_1 (KNO_3 1% each at pea, marble and egg stages) but it was at par with T_2 (15.43%) and T_3 (15.39%) while lowest (14.59 %) was recorded in control.

The treatment T_1 (KNO_3 1% each at pea, marble and egg stages) produced significantly higher total sugar at harvest and ripe stage in both the years which was at par with T_2. In foliar feeding the nutrients are applied directly to the site of metabolism. In present investigation, the total sugars in fruits of treated trees were significantly higher than control. This increase could be attributed to enhanced carbohydrate metabolism. Foliar application of P and K increases sugar content as K increases the capacity of production and translocation of sugar. (Dsouza, 2007).Similarly, it was reported by Kumar and Pathak

(1992) in grapes, Ali *et al*. (1991) and Dutta (2004) in guava Sharma *et al*., (1990), Singh *et al*., (1991) Brahmachari *et al*., (1997), Vijayalakshmi and Srinivasan (2000), Yeshitela (2004), Kumari *et al*., (2007) and Stino *et al*., (2011) in mango.

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