International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 2783-2786

Received: 17-01-2018
Accepted: 18-02-2018

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Effect of post flowering foliar application of nutrients on fruit retention and yield of mango (*Mangifera indica* L.) CV. Alphonso

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Abstract
A trial was conducted to study the effects of foliar application of nutrients on fruit retention and yield of Alphonso mango. Fruit retention was maximum with Urea 2% at pea stage, MPP 0.5% each at marble and egg stages. Fruit weight maximum with Urea 2% at pea stage, MPP 0.5% each at marble and egg stages and yield was highest in terms of kg/tree (47.77) was noticed in treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages.

Keywords: Foliar application, nutrients, fruit retention, yield

Introduction
Mango (*Mangifera indica* L.) belongs to family Anacardiaceae, is universally accepted as the finest tropical fruit of the world and has been called, in the orient, "King of the fruits". This fruit is rightly known as 'National fruit of India', owing to its nutritional richness, unique taste and flavour, religious and medicinal importance. Mango is the main commercial fruit crop of our country. It has originated from South East Asia, the Indo-Burma region, in the foothills of the Himalayans (Mukherjee, 1951) [17].

Alphonso mango enjoys virtual dominance both in domestic as well as in international markets due to its typical sugar-acid blend, pleasant aroma, highly appreciable flavour and taste. Production of Alphonso mango is confronted with problem like fruit drop. It has been reported in many researches that fruit drop is as natural phenomenon occurs during different fruit growth and development stages and foliar sprays of nutrient reduce the fruit drop in most of the commercial fruit crops (Singh and Bal, 2006; Jadhav, 2007) [23, 12]. In Alphonso mango, foliar application of 1% potassium nitrate at pea, marble and egg stages, 2% urea after fruit set from third or fourth to sixth plant protection spraying and 20 ppm Naphthalene Acetic Acid (NAA) at pea and marble stage are recommended by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (Anonymous, 2010d) [1]. Foliar application of urea and potassium nitrate are reported to increase physical quality attributes and yield of mango (Baghel *et al*., 1987) [2]. Further to reduce the fruit drop at various stages of growth and development and to find out the feasibility of various nutrients through foliar sprays to reduce the fruit drop. Hence, the research project was conducted entitled, 'Effect of post flowering foliar application of nutrients on fruit retention, yield and quality of mango (*Mangifera indica* L.) CV. Alphonso.

Materials and Methods
The trial was conducted in the mango orchard, plot No. 28, Department of Horticulture, College of Agriculture, Dapoli (M.S.) from December, 2010 to June, 2011 and December, 2011 to June 2012 on 25 years old uniform and healthy plants. The experiment was laid out under Randomized Block Design with three replications and 14 treatments. 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)

Number of fruits on 10 tagged panicles on three trees of each replication was counted and average fruit retention per panicle was calculated at harvest stage. Fruit retention per panicle at harvest stage was recorded on number of fruit at pea stage.Final observation of fruit length and fruit weight were recorded on randomly sampled five fruits from each replication.Total numbers of fruits harvested from each tree were weighed by using monopan electronic balance and yield of fruits was expressed in Kg per tree.

Result and Discussion

The data on number of fruits per panicle as affected by different post flowering foliar sprays revealed that there was significant differences in number of fruits per panicle at harvest stage. Significantly the pooled analysis noticed highest number of fruits (0.372) in the treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages) and was at par with the treatments T_5 (0.361), T_1 (0.354) and T_2(0.347). The lowest number of fruits (0.147) was observed in the treatment T_{14} (control). Further, it was observed that irrespective of treatments, fruit retention was decreased from pea stage to harvest. The fruit drop in mango continued from fruit set up to harvesting. Generally maximum fruit drop occurs at early stage i.e. peanut stage and later on the drop was minimum at egg stage and at harvest in most of mango varieties (Desai, 1980) [9]. The present investigation also indicated similar trend. However, nutrition play key role to reduce the fruit drop. The data indicated that the all post flowering nutrient sprays improved fruit retention than control at all the stages of fruit growth. The treatment T_7 (Urea 2% at pea stage and MPP 0.5% each at marble and egg stages) had significantly highest fruit retention in both the years of study and was at par with T_5, T_1, T_2 and T_3. The fruit retention in all urea, phosphorus and potassium treatments was also remarkable. This could be attributed to enhanced carbohydrate metabolism. In foliar feeding, the nutrients are applied directly to the site of metabolism. Nitrogen is essential for rapid growth, increased vigour and retention of fruits. Nitrogen, phosphorus and potassium are three major elements which play pivotal role in growth and development of plants (Tisdale *et al*., 1993) [29]. Potash acts as a catalyst, which is used as an accelerator of reactions. It influences many physiological processes like cell division, photosynthesis and respiration (Jones, 1979) [13]. The results obtained in present investigation are in association with Rajput and Singh (1989) [18], Bhuyan and Irabgon (1993) [6], Ghosh and Chattopadhyay (1999) [10], Rani and and Brahmachari (2004) [19], Singh *et al*., (2005) [24] and Stino *et al*., (2011) [28] in mango and Shinde (2007) [21] in kokum.

Fruit length increased significantly by various treatments. The pooled data on mango length showed that highest (10.19cm) fruit length was noticed in treatment T_4 (Urea 2% each at pea, marble and egg stages) and was at par with T_5 (10.06cm), T_6 (9.96cm), T_7 (9.90cm), T_8 (9.76cm), T_{11} (9.66cm) and T_3 (9.63cm). The lowest (8.64cm) length was found in control, which was significantly inferior than rest of the treatments. The data indicated that the all foliar nutrient sprays improved fruit length than control. The treatment T_4 (Urea 2% each at pea, marble and egg stages) had significantly highest fruit length in both the years. The increase in fruit length with the application of urea might had resulted due to an accumulation of more materialand led to an efficient utilization for the development of the fruits. Potassium is general metabolic activator, increasing the respiration and photosynthetic rate. The increase in length of fruit could be due to accelerated rate of cell enlargement and formation of larger intracellular spaces during latter part of fruit growth (Gupta and Brahmachari, 2004) [11]. A similar increase in fruit length has been reported by Baghel *et al*., (1987) [2], Singh *et al*., (1991) [26], Sharath (2001) [20], Gupta and Brahmachari (2004) [11], Kumar *et al*., (2005) [14] and Singh *et al*., (2005) [24] in mango, Meena *et al*., (2005) [16] in guava, Barun and Kumar (2003) [5] in litchi.

The weight of mango fruit was increased by application of different foliar nutrients. The pooled analysis indicated that the lowest (218.55g) fruit weight at harvest was recorded in T_{14} (control) and was significantly inferior to all other treatments. The highest (288.14g) fruit weight was recorded in T_4 (Urea 2% each at pea, marble and egg stages) which was at par with T_5 (266.07g).The data indicate that the all foliar nutrient sprays improved fruit weight than control. The treatment T_4 (Urea 2% each at pea stage, marble and egg stages) recorded significantly highest fruit weight during both the years, which was at par with T_5. The increase in fruit weight could be due to rapid multiplication and enlargement of cells and greater accumulation of sugars and water in expanded cells (Gupta and Brahmachari, 2004) [11]. The nitrogen is supposed to give impetus to the formation of new cells and therefore growth in mass is associated with nitrogen.'K' increase the capacity to formation of starch (Singh, 2006) [23], thus this could be the reasons increase in fruit has been reported by Singh *et al*., (1983) [25], Singh *et al*., (1991) [26], Vijayalaksmi and Srinivasan (1998) [30], Gupta and Brahmachari (2004) [11] and Kumari *et al*., (2007) [15] in mango, Barun and Kumar (2003) [5] in litchi.

Yield of mango fruits per tree was appreciably increased by various foliar nutrients applied. The pooled analysis showed that significantly the highest fruit yield 47.77 kg was obtained in the treatment T_7 (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages), which was at par with the treatment T_5 (47.50 kg), T_4 (45.13 kg) and T_1 (43.82 kg). Only the lowest fruit yield 23.10 kg was recorded in control (no foliar spray). The present investigation clearly indicated that the nutrient play a key role in fruit retention and further increase in the fruit weight. 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) [21], Somavashi (2010) [27] in Kokum, Brahmachari (1997) [7], Vijayalakshmi and Srinivasan (1998) [30], Burondkar *et al*., (2002) [8], Gupta and Brahmachari (2004) [11], Kumari*et al*., (2007) [5], Stino *et al*., (2011) [28] in mango.

Thus by considering fruit retention and fruit yield as an important characters, treatment T_7(Urea 2% at pea stage, MPP 0.5% each at marble and egg stages) found to be best among various treatments under study followed by T_5 (Urea 2% at pea stage, KNO_3 1% at marble stage and MPP 0.5% at egg stage), T_4(Urea 2% each at pea, marble and egg stages) and T_1 (KNO_3 1% each at pea, marble and egg stages) respectively.

Table 2: Effect of post flowering foliar sprays on fruit retention (Number of fruits/panicle), physical parameters and yield at harvest in Alphonso mango

Treatments	Harvest stage											
	Number of Fruits / Panicle (fruit retention)			Fruit length (cm)			Fruit weight (g)			Yield (Kg/tree)		
	2011	2011	Pooled	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
T_1	0.334	0.334	0.334	38.80	49.09	43.82	239.63	257.64	248.64	38.80	49.09	43.82
T_2	0.326	0.326	0.326	37.83	48.18	42.88	236.64	254.65	245.64	37.83	48.18	42.88
T_3	0.323	0.323	0.323	37.70	46.96	42.22	244.49	262.50	253.50	37.70	46.96	42.22
T_4	0.311	0.311	0.311	40.48	49.93	45.13	281.79	294.49	288.14	40.48	49.93	45.13
T_5	0.342	0.342	0.342	42.16	52.83	47.50	261.37	270.76	266.07	42.16	52.83	47.50
T_6	0.318	0.318	0.318	36.32	45.84	40.96	251.08	269.09	260.08	36.32	45.84	40.96
T_7	0.355	0.355	0.355	42.23	53.59	47.77	250.37	268.38	259.37	42.23	53.59	47.77
T_8	0.200	0.200	0.200	25.74	34.72	30.11	247.21	265.22	256.22	25.74	34.72	30.11
T_9	0.277	0.277	0.277	34.20	42.12	38.07	242.81	260.82	251.82	34.20	42.12	38.07
T_{10}	0.159	0.159	0.159	27.26	35.77	31.40	237.28	255.29	246.29	27.26	35.77	31.40
T_{11}	0.261	0.261	0.261	33.55	42.15	37.74	248.72	266.73	257.73	33.55	42.15	37.74
T_{12}	0.164	0.164	0.164	27.20	35.89	31.43	241.20	259.21	250.21	27.20	35.89	31.43
T_{13}	0.151	0.151	0.151	26.30	35.29	30.67	232.08	250.09	241.09	26.30	35.29	30.67
T_{14}	0.140	0.140	0.140	19.85	26.50	23.10	211.84	225.26	218.55	19.85	26.50	23.10
Range	0.140-0.355	0.140-0.355	0.140-0.355	19.85-42.23	26.50-53.59	23.10-47.77	211.84-281.79	225.26-294.49	218.55-288.14	19.85-42.23	26.50-53.59	23.10-47.77
Mean	0.262	0.262	0.262	33.54	42.78	38.16	244.75	261.44	253.09	33.54	42.78	38.16
S. Em ±	0.011	0.011	0.011	1.20	2.23	1.45	7.088	8.811	7.844	1.20	2.23	1.45
C. D. at 5%	0.031	0.031	0.031	3.47	6.48	4.21	20.603	25.613	22.803	3.47	6.48	4.21

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