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Response of foliar spray of different chemicals on flowering and fruit retention of dashehari mango under ultrahigh density plantation

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Abstract
The present experiment entitled "Response of foliar spray of different chemicals on flowering and fruit retention in Dashehari mango under ultra high density plantation" was conducted during the year 2015-16 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari. The experiment was laid out in Randomized Block Design and replicated thrice. Nine treatments comprising urea (1, 1.5 and 2 %), KNO_3 (1 and 2 %), novel organic liquid fertilizer (1 and 2 %) and ethephon 200 mgl^{-1} along with one control and they were sprayed twice, first fortnight of October and November. The effect of these treatments on different parameters of flowering and fruit retention were recorded and analyzed statistically. Results of present investigation revealed that among all the treatments, foliar application of KNO_3 @ 2 % treatment gave minimum vegetative shoot and maximum flowering shoot per terminal, minimum vegetative shoot (%), maximum flowering shoot (%), maximum length of panicle and minimum days for full bloom. Fruit setting percentage at pea, marble and maturity stage were significantly the maximum in same treatment. The yield (kg/tree) was significantly the maximum in KNO_3 @ 2% treatment.

Keywords: Flowering, fruit retention, yield, Dashehari and KNO_3

Introduction
Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae is universally accepted as the finest tropical fruit of the world and has been called, in the orient, "King of fruits". Mango is rightly known as 'National Fruit of India', owing to it's nutritional richness, unique taste and flavour, religious and medicinal importance. It is third widely produced fruit crop of the tropics after banana and citrus. It possesses good nutritive and medicinal values. It is internationally known as the fruit ambassador of India. It is because of its excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and high nutritive value.

The flowering, fruit set and fruit yield of mango are the most critical events and it's depend upon many biotic and abiotic factors, amongst them foliar spray of growth regulators and growth retardants play very important role in regulating them in mango. Potassium is major nutrient attributed to the stimulating effect of K on photosynthesis, phloem loading and translocation as well as synthesis of large molecular weight in the developing fruits (Rabeh and Sweelam, 1990) [10]. Further sulphur increase the absorption of potassium or it react with nitrogen and potassium (Farrag *et al*., 1990) [4]. It helps in energy transformation and activation of enzymes in carbohydrate metabolism which subsequently partitioning of photosynthates to the developing fruits.

Potassium nitrate (KNO_3), also known as saltpeter or nitric acid is considered a special fertilizer. It is a colorless transparent crystal or white powder with 13 % nitrogen (N) and 45 % potassium (K). KNO_3 is one of the chemical inducing substances that have shown some potential for inducing flowering in mango by increasing the activity of nitrate reductase and stimulating the production of ethylene. (Beevers and Hageman, 1969) [3]. The use of KNO_3 has been employed in various countries, like Mexico, United States (Hawaii) and Malaysia for off season flowering and yield improvement. (Afiqah *et al*., 2014) [2].

Material and Methods
A Field experiment was conducted on Ultra High Density plantation. About eight year old mango trees planted at 3 m x 1.5 m spacing. All the trees under the experiment was given uniform cultural practices during the course of investigations.

The experiment was laid out in Randomized Block Design (RBD). All the treatments were replicated thrice and a double tree served as a unit. Nine treatments comprising urea (1, 1.5 and 2 %), KNO_3 (1 and 2 %), novel organic liquid fertilizer (1 and 2 %) and ethephon 200 mgl^{-1} along with one control and they were sprayed twice, first fortnight of October and November. The effect of these treatments on different parameters of flowering and fruit retention were recorded. The data collected were subjected to statistical analysis suggested by Panse and Sukhatme (1985) [9].

Foliar spray of prepared solution of chemicals were done at first fortnight of October and November as per the treatments. The spray was done by using tractor operated sprayer. According to the treatments, the freshly prepared solutions were sprayed on the trees till they were thoroughly wet.

Results and Discussion

The data presented in Table-1 clearly revealed that foliar application of different chemical treatments at first fortnight of October and November, foliar application of KNO_3 @ 2% (T_5) treatment gave lower vegetative shoot and vegetative shoot (%) with higher number of flowering shoot and flowering shoot percentage. It might be due to the KNO_3 induced flowering. The mechanism of action of KNO_3 involves a biochemical process where the reduction of nitrate to ammonia takes place. Ammonia got metabolised to different amino acids that also includes methionine. Methionine is further converted to S-adenosylmethionine (SAM) and then to 1-aminocyclo-propane-1-carboxylic acid (ACC) and is finally converted to ethylene. Ethylene might be an important second messenger in plant development and is also capable of promoting flowering (Maloba *et al*. 2014) [6]. Some previous studies suggested that KNO_3 may be a stimulus for flower initiation. KNO_3 does not induce flowering, but helped in sensitizing buds to the floral stimulus when KNO_3 is sprayed on the terminal bud of mango shoots. (Kulkarni, 1988) [5]. Stated that the floral stimulus was already present in the shoots at the time the buds responded to KNO_3.

Table 1: Effect of foliar spray of different chemicals on flowring and fruit retention in Dashehari mango under ultra high density plantation.

Treatments	Number of vegetative shoot per terminal	Number of flowering shoot per terminal	Vegetative shoot (%)	Flowering shoot (%)	Panicle length (cm)	Days require for full bloom (days)	Number of fruits set at pea size stage per panicle	Number of fruits set at marble stage per panicle	Fruit retention (%) at mature stage per panicle	Yield (kg / tree)
T_1 : Urea @ 1%	0.99	0.54	21.99	69.41	35.04	23.00	14.25	3.13	21.91	20.69
T_2 : Urea @ 2%	1.02	0.58	20.30	76.42	37.69	22.00	15.33	3.20	19.75	23.53
T_3 : KNO_3 @ 1%	1.26	0.60	22.42	79.52	41.38	21.33	17.00	3.93	23.70	24.48
T_4 : KNO_3 @ 1.5%	0.80	0.64	12.48	79.24	41.68	21.00	18.00	3.93	21.83	27.59
T_5 : KNO_3 @ 2%	0.70	0.86	6.67	93.38	45.36	20.00	19.00	4.47	23.59	32.49
T_6 : Ethephon @ 200mll^{-1}	0.89	0.66	15.05	71.38	35.37	22.00	15.00	3.09	20.72	24.09
T_7 : NOLF @ 1%	0.98	0.58	13.48	77.64	41.38	21.33	16.33	3.47	21.59	24.12
T_8: NOLF @ 2%	0.72	0.81	8.45	87.57	43.03	20.00	18.67	4.13	22.35	29.89
T_9 : Control	0.81	0.41	9.12	61.66	33.01	26.00	13.67	2.93	19.49	18.96
S. Em. ±	0.06	0.04	0.93	4.24	2.60	1.12	1.01	0.22	0.75	1.15
C. D. @ 5%	0.18	0.12	2.79	12.71	7.80	3.34	3.02	0.67	2.25	3.44
C.V. %	11.38	11.10	11.17	9.49	11.47	8.84	10.67	10.73	6.00	7.92

Spraying of chemicals and nutrient (Urea and KNO_3, KH_2PO_4) could induced early vegetative growth but into a lesser degree in Alphonso mango (Srihari and Rao, 1998) [12]. However, Sergent *et al.* (2000) [11] indicated that urea treatment (July) followed by KNO_3 (at first fortnight of October and November) induced better vegetative growth in Haden mango. It could be attributed to the nitrogen effect on plants during rainy season. This is in conformity with (Reddy and Kurian, 2012) pruning along with chemical sprays reduced percentage of vegetative shoots and increased percentage of flowering shoot in mango cv. Alphonso.

All the treatment showed remarkable improvement in flowering and length of panicle in mango over control. The highest percentage as well as length of panicle was recorded in treatment spray application of KNO_3 and novel organic liquid fertilizer (T_5 and T_8). The reason behind it was the foliar application of KNO_3 promotes ethylene biosynthesis which encourage floral induction and the favorable effect novel organic liquid fertilizer on plant growth and yield might be due to its bio regulatory effect chiefly through mobilization of dry matter and translocation of photosynthesis to sink. (Mishra *et al*., 2011) [17].

Significantly maximum number of fruit set at pea and marble stage per panicle and fruit retention (%) at mature stage were noted in KNO_3 @ 2 % (T_5) treatment followed by novel organic liquid fertilizer @ 2% (T_8) and KNO_3 @ 1% (T_5). While minimum number of fruit set at pea size and marble stage per panicle and fruit retention (%) at mature stage were noted in control (T_9) treatment. It might be due to potassium lowers osmotic potential thus reducing water stress and it essential constituent of carbohydrate synthesis. On the other hand, nitrogen in the experimental plants as a consequence of KNO_3 application enhanced carbohydrate reserves, which ensured better fruit set. All these reduce metabolites and water stress caused by competition among fruit lets, fruit setting and further development. It has been reported by different workers that nitrogen increases auxin content (Addicot, 1970) [1] and auxin plays a decisive role in enhancing fruit set and fruit retention by checking the abscission layer formation in fruit stalk. Nitrogen and potash promote the growth of settled fruit and boost up their retention on the tree till harvesting. Potassium nitrate and potassium di-hydrogen phosphate interacted positively with fruits, encouraged their favourable characters and their active implications increased fruit set and fruit retention**.**

Application of KNO_3 increased fruit retention because it contain nitrogen which increases auxin content which ultimately prevent abscission (Addicot, 1970) [1].

Foliar application of KNO_3 at different critical fruit development stages of mango, which content 13 % nitrogen and 45 % potassium had positive effect on fruit set and fruit development. This is might be due to foliar application of K

enhanced carbohydrate reserves, which ensured better fruit set. All these reduce metabolites and water stress caused by competition among fruitlets and fruit setting which leads to increased fruit set percentages and reduced fruit drop percentage. (Beevers and Hageman, 1969) [3].

Treatment T_5, Foliar application of KNO_3 @ 2 % at first fortnight of October and November gave maximum fruit yield. This might be due to KNO_3 induced flowering, the beneficial effect of nutrients in increasing the fruit yield seems to the increased of fruit retention per panicle, fruit length and fruit girth. Moreover, the applied nutrients (N and K) might have stimulated the functioning of a number of enzymes which in turn increased the translocation and mobilization of metabolites and photosynthetic towards the developing fruits, resulted in highest number of fruits and fruit yield (Sudha *et al*.,2012) [13]. The increased in the fruit yield in KNO_3 might be due to increased in fruit set and due to that synthesis of proteins from amino acids for which potassium is essential.

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