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Research Article

THE EFFECT OF FOLIAR SPRAY OF CHEMICALS ON OFF SEASON FLOWERING, FRUIT SETTING AND YIELD OF FRUITS OF MANGO VARIETY BANGALORA

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Abstract: Effect of foliar application of various nitrogenous, phosphorus and ethylene chemicals on flowering, fruit set and yield of mango variety Bangalora was studied at the Santhur, Pochampalli, Krishnagiri District during 2012 - 2017. Seven foliar treatments comprised of T_1 as control T_2 and T_3 - KNO_3@ 2% spray with and without 1% Urea respectively.T_4-KH_2PO_4 @1% T_5-NH_4NO_3 @ 2%, T_6 and T_7 -Ethephon @ 400ppm and 800 ppm concentration respectively with three successive foliar sprays replicated thrice in twenty five year old 'Bangalora' mango orchard. Paclobutrazol (PBZ) is applied for all the trees @ 5ml/tree during the month of April. The experiment was laid out in Randomized Block Design with three replications, and a single tree was treated as a unit/treatment. The soil application of paclobutrazol @ 5ml/tree during April month and three successive foliar sprays of KH_2PO_4 @ 1% at an interval of 30 days during May, June and July months resulted in the highest number of fruits per tree (391.87), individual fruit weight (452g), the maximum yield per tree (198.45 kg/tree) during the off season followed by the spray of KNO_3 @ 2% with an yield of 186.22 kg/tree.

Keywords: *Mango, Bangalora, off season flowering, Paclobutrazol, Fruiting, KNO_3, KH_2PO_4, Ethephon*

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Introduction

India is the largest producer of mango occupying about 2.26 lakh thousand hectares, with production of 20.7 million tonnes and productivity about 9.1MT/ha as per the India Stat 2017-2018. The off season mango production is predominant in tropical countries *viz*., Thailand, Philippines, Indonesia and some parts of peninsular India especially, Kanyakumari and Courtallam of Tamil Nadu due to favourable temperature and relative humidity prevailing. Off season flowering is observed during September October months in Tirunelveli and Kanyakumari districts with the fruiting period during January and February - a very early start with good demand for the fruits. Several attempts on flowering induction show significant results in regulating off-season production of mango. The paclobutrazol soil application which is followed by the application of any dormancy breaking substance has forced tropical fruit trees to have off-season flowers hence it can be very well followed in mango trees to force flower practically at any time Poerwanto *et al*.[19]. Following such practices for off season production of mango can be best utilized during markets best prices. In mango, Paclobutrazol is one of the chemical growth regulators that's extensively used for artificial induction of flowering Nartvaranant *et al*. [15] The soil application of paclobutrazol followed by foliar application of a dormancy-breaking substances has forced mango, trees to produce flowers Poerwanto *et al*.[19]. An alternative to dependence on the environmental stimulus for flower initiation is evolving management strategies substitute for these signals. It has also been recognized that mango leaves absorb most of the nutrients within 24-72 hrs after spray and, thereafter, depletion of leaf nutrient content is seen owing to translocation of N, P and K to actively developing organs within the plant system Singh [20]. Hence, an attempt was made by us to improve flowering and fruit set in mango using various nitrogenous chemicals as foliar spray. Various studies have earlier reported that foliar spray of nutrients in different fruit crops cause significant response in improving flowering and yield parameters Hegde *et al*. [8].

As for physiological, flowering and fruit yield parameters, the earlier studies are restricted to the main season and information on off season is scanty. Hence, the present study was taken up to find out the effect of foliar spray of chemicals on off season flowering, fruiting and yield of fruits of mango variety Bangalora.

Material and Methods

The present investigation was conducted at Regional Research Station, Paiyur during the year 2012-2017. The study was conducted in a farmer's field, which was located at Santhur village, Pochampalli Taluk, Krishnagiri district. The experimental site is geographically located at latitude 11°09' N, longitude 76°57' E and altitude 426.76 m above MSL. The experiment was laid out in a Randomized Block Design (RBD), with seven treatments and replicated thrice. Twenty five years old uniform sized trees of mango cv. Bangalora spaced at 10m x 10 m were selected for this study. The treatments are - control (T_1) , KNO_3@ 2% +Urea @1%- (T_2) and KNO_3@ 2% (T_3) spray, KH_2PO_4 @1% (T_4), NH_4NO_3 @ 2% (T_5), Ethephon @ 400ppm (T_6), Ethephon @ 800 ppm concentration (T_7)- and respectively three successive foliar sprays at an interval of 30 days. The paclobutrazol concentration was calculated based on the diameter of the tree, and applied @ 5ml/tree which were done during the month of April for getting off season yield. Soil drenching of paclobutrazol was done as per the procedure reported by Burondkar & Gunjate [5]. The foliar spray of nutrients and growth regulators was imposed at three successive months *viz*., May, June and July for the period 2013-2017.Chlorophyll index was recorded using portable Chlorophyll Meter (Opti-science model, CCM-200 plus) and the average value was computed using method described by Monje & Bugbee [15]. Number of panicles were counted per square meter area at three different locations on a tree with help of wooden frame 1m x 1m dimension and the mean was expressed in numbers after spraying of chemicals.

Table-1 *Pooled mean for the foliar effect of nutrients on the flowering and fruit characters of off season mango variety Bangalora from 2012-2017*

SN	Treatment	Number of Inflorescence / m^2	Panicle Length (cm)	No of hermaphrodite flowers / panicle	No of fruits at marble stage	Leaf Nitrogen content %	Chlorophyll index	No. of fruits / tree	Individual fruit weight (g)	Fruit Length (cm)	Fruit yield per tree (kg)
1	Control	29.26	18.47	156.45	2.36	0.97	29.47	255.8	0.33	19.37	134.8
2	KNO_3@ 2%	33.04	26.34	196.88	3.78	1.33	43.39	341.91	0.358	20.26	186.22
3	KNO_3 @ 2% + 1% Urea	36.76	21.98	246.74	3.94	1.49	41.47	296.29	0.389	21.17	151.04
4	KH_2PO_4 @ 1%	42.78	30.27	284.2	4.77	1.26	42.2	391.87	0.452	22.8	198.45
5	NH_4NO_3@ 2%	37.04	26.32	193.76	4.08	1.36	34.5	362.89	0.436	24.46	179.14
6	Ethephon@ 400 ppm	31.45	22.95	213.63	3.4	1.03	29.9	328.19	0.39	20.27	145.96
7	Ethephon @ 800 ppm	34.03	23.57	226.62	3.71	1.13	32.56	286.3	0.405	20.76	170.91
	Mean	34.98	24.27	216.89	3.71	1.22	36.21	323.32	0.394	21.302	166.64
	SED	3.48	4.193	24.979	0.834	0.142	4.761	46.478	0.021	1.053	12.735
	CD 5%	7.583	9.136	54.429	1.817	0.309	10.374	101.277	0.0461	2.294	27.749

At the time of full bloom, number of hermaphrodite flowers was counted from the randomly selected three panicles per tree and the mean value was expressed in numbers. Length of panicle was measured at full bloom stage. Three panicles were tagged per tree and the mean value was expressed in centimetre. Statistical analysis of data was done by adopting statistical procedures as per the methods of by Panse & Sukhatme [17].

Results and Discussion

The effect of different plant foliar nutrients on number of hermaphrodite flowers per panicle in the pooled data was highly significant in off season is presented in Table 1. Among the different treatments, the highest number of hermaphrodite flowers per panicle (284.20) was recorded in KH_2PO_4 1% (T_4). The lowest number of hermaphrodite flowers per panicle (156.45) was recorded in T_1, NH_4NO_3 @ 2% (193.76) was on par with KNO_3@1% (196.88) during the off season. Nutrients (KNO_3, NH_4NO_3) when used as a foliar spray are more effective in induction of post-harvest early and profuse vegetative growth as well as early induction of flowering with increase in yield Patil *et al*.[19]. KH_2PO_4 (1%) led to the production of highest number of hermaphrodite flowers. In general, a hermaphrodite flower has to go through several stages of sequential developments namely pollination, fertilization, fruit set, development and maturity. So, a tree which produces normally a higher number of hermaphrodite flowers must have greater reserves of carbohydrates. In this back ground, in the current experiment, paclobutrazol might have resulted in higher reserves of carbohydrates in shoots by its anti-gibberellin nature Subbaiah *et al*. [22] Number of shoots per terminal was found to be more in the application of KNO_3 @ 2% + 1% Urea with 3.67 number while the control recorded 1.67 Beevers and Hageman [4] and Filner *et al. [*8] reported ability of KNO_3 and other nitrate sources as inducing nitrate reductase in many species. Nitrate reductase is a key enzyme in nitrate assimilatory pathway for amino acids synthesis. Methionine has been reported to promote mango flowering and is a precursor of ethylene Maity, *et al*.[12] , Davenport and Nunez, [6] stated that KNO_3- stimulated flowering of mango is mediated by increased levels of endogenous ethylene. Length of the shoots was more with the KH_2PO_4 application 22.00cm while the control recorded 7.62 cm from the Table 1. The 'number of panicles per m^2 canopy area' is one of the major determinants of yield in mango. The effect of different foliar nutrients on number of panicles per m^2 canopy area which was highly significant in off season is presented in Table 1. Among the different treatments, in the off season trees the highest number of panicles per m^2 canopy area (42.78) was recorded in T_4 which was followed with T_5 (37.04) and T_3 (36.76). The lowest number of number of panicles per m^2 canopy area (29.26) was recorded in T_1. With respect to application of nutrients, PBZ + KH_2PO_4 (1%) led to the production of higher number of panicles per m^2 canopy area. As per the finding by Marschner, [13] due to a deficiency of the element Phosphorus the number of flowers formed in mango is reduced. This result also agrees with that reported by other tropical fruits, which reports that by the application of Phosphorus increased flowering Agusti, [2] and increase metabolism in the buds, absorption of Magnesium also promoted by phosphorus, Phosphorus promotes the synthesis of nucleic acids the element that is fundamental in the floral formation Feucht, [7]. Paclobutrazol could enhance the total phenolic content of terminal buds and altered the xylem to phloem ratio of the stem, which is important in restricting the vegetative growth and enhancing flowering by altering assimilates partitioning and patterns of nutrient supply for new growth Kurian and Iyer, [11].The effect of nutrients on panicle length which was highly significant in off seasons are presented in Table 1. Among the different treatments, the highest panicle length (30.27 cm) was recorded in T_4. The lowest length of panicle (18.47cm) was recorded in T_1 during the off season. In control there is no foliar spraying only soil application of PBZ. Hence, the Paclobutrazol reduces the panicle length by blocking gibberellin synthesis path way. This is why because gibberellins are responsible for cell elongation and in their reduced synthesis the elongation process gets diminished. Among these treatments, application of KH_2PO_4 (1%) led to the production of highest length of panicle. The increase in panicle length might be due to more availability of required nutrients. The effect of different nutrients on number of fruits per panicle at marble stage was highly significant in off seasons are furnished in Table 1. Among the different treatments, the highest number of fruits per panicle at marble stage (4.77) was recorded in T_4 KH_2PO_4 (1%). The lowest number of fruits per panicle at marble stage (2.36) was recorded in Control T_1 during the off season. Among the different treatments, the highest chlorophyll content was recorded by application of KNO_3 (1%) (43.39). Similar observations were reported by many workers earlier Subbaiah *et al*. [22] and Panjavarnam *et al*. [16] in mango. The plants treated with paclobutrazol synthesized more cytokinin, which in turn enhanced chloroplast differentiation, chlorophyll biosynthesis and prevented chlorophyll degradation. Xia *et al.* [25]. Application of paclobutrazol blocks the terpenoid pathway which normally leads to GA biosynthesis and an intermediate compound 'phytol' is produced which in turn leads to chlorophyll synthesis Bai *et al*. [3]. In the light of above theories, the higher chlorophyll content recorded by application of paclobutrazol can be understood. Potassium is responsible for energy production in the form of ATP and NADPH in chloroplasts by maintaining balanced electric charges in plants. Kumar and Kumar, [10], Sudha *et al*. [23] reported that maximum chlorophyll content was observed in KNO_3@ 2% (1.7mg g^{-1}) and minimum in control (1.3mg g^{-1}). The highest number of fruits per tree (391.87) was recorded in KH_2PO_4 (1%) T_4 followed by NH_4NO_3@ 2% T_5 (362.89) and KNO_3 @ 2% T_2 (341.91). The lowest number (255.80) was recorded in control during the off season. The highest fruit yield (198.45 kg/ tree) was recorded in the application KH_2PO_4 (1%) T_4 followed by the KNO_3@ 2% T_2 (186.22 kg/tree). The lowest number (134.80 kg/tree) was recorded in control during the off season. Potassium di-hydrogen phosphate has positively with set fruits, encouraged their favourable characters and their active implications increased fruit set and fruit retention. The foliar application of potash promotes the growth of settled fruit and boost up their retention on the tree till harvesting. Similar results were recorded by Sudha *et al*. [23] in mango while Srivastava *et al*. [21] in ber which are in agreement with the present investigation.

Conclusion

In the effect of foliar chemicals on mango off season flower induction studies conducted at Santhur, Pochampalli in the variety Bangalora.

the soil application of paclobutrazol @ 5ml/tree during April month and three successive foliar sprays of KH_2PO_4 @ 1% during May, June and July months resulted in the highest number of fruits per tree (391.87), individual fruit weight (452g), the maximum yield per tree (198.45 kg/tree) during the off season followed by the spray of KNO_3 @ 2% (186.22 kg/tree) when compared to the control with 134.80 kg/tree during the off season.

Application of Research: Foliar nutrition effect in mango will add to the improvement of off season flowering and fruiting research in mango which is of huge interest for the farming community as it has better market for the off season fruits.

Research Category: Fruit science

Abbreviations: KNO_3 - Potassium Nitrate, KH_2PO_4 – Potassium di hydrogen phosphate, NH_4NO_3 – Ammonium Nitrate, PBZ-Paclobutrazol.

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Research project name or number: 'Effect of different chemicals on off season flower induction of Mango'

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Study area / Sample Collection: Santhur, Pochampalli, Krishnagiri

Cultivar / Variety name: Mango, *Mangifera indica*: Bangalora

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