International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 1465-1468

Received: 25-07-2019
Accepted: 27-08-2019

Sayali Jadhav
M.Sc. (Agri), Department of Soil Science and Agril. Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra, India

VG Salvi
Head, Department of Soil Science and Agril. Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra, India

Utkarsha Deshmukh
M.Sc. (Agri), Department of Soil Science and Agril. Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra, India

SC Jadhav
Ph.D. (Scholar), Department of Soil Science and Agril. Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra, India

Correspondence
VG Salvi
Head, Department of Soil Science and Agril. Chemistry, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra, India

Effect of foliar application of nutrients on flowering, fruit set and yield of alphonso mango in lateritic soil

Sayali Jadhav, VG Salvi, Utkarsha Deshmukh and SC Jadhav

Abstract
In order to study the effect of foliar application of nutrients on flowering, fruit set and yield of mango, an experiment was conducted during 2016-17 at Mango Orchard of Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth in lateritic soil of coastal region in Maharashtra. The results of the experiment showed that the induction of vegetative flush, flowering, fruit set and yield of mango increased with foliar application of nutrients. Among the various treatments, the treatment receiving foliar spray of 3 per cent Amrashakti multinutrient solution recorded significantly maximum induction of vegetative flush with increased flowering and fruiting as well as maximum yield of mango. In the present investigation, the foliar application of nutrients showed their beneficial effect over control treatment.

Keywords: Urea, potassium nitrate, amrashakti multinutrient solution, alphonso mango

Introduction
Mango (*Mangifera indica* L.) belonging to the family *Anacardiaceae* is the most important commercially grown fruit crop of Indian subcontinent and is believed to have originated from south east Asia. In India, about 19686.9 MT of mango produced over an area 2262.8 ha with 8.7 tons ha^{-1} productivity (Anonymous, 2017) [2]. In Maharashtra state, approximately 0.46 million tons of mango is produced over an area of about 0.162 million ha (Anonymous, 2014 a) [1]. The Konkan region in the state is famous for mango production with an area of about 0.11 million ha under mango cultivation. However, the production is only 0.35 million tons with a productivity of about 3.16 tons ha^{-1}. Unique characteristics like sugar-acid blend, attractive colour, shape, pleasant aroma, highly appreciable flavour, taste and distinct long keeping quality all offer the fruit its matchless status. Due to this status, the fruit enjoys virtual dominance both in domestic as well as international market. The share of Alphonso alone is 30 per cent in total mango export of the country (Burondkar and Jadhav, 2009) [5].

Nitrogen is one of the important nutrient for the growth of mango and it has a relevant role in the production and quality of the fruits. Phosphorus favous root system development, production of a strong stem/trunk and retention and maturation of fruits. Potassium increases the ability of the plant to withstand stress conditions such as drought, cold, salinity and attack of diseases and pests (Samra and Arora, 1997) [11]. Calcium, magnesium and sulphur are important in the assimilation of N and transport of carbohydrates and amino acids. They also maintain pulp consistency (Silva, 1997) [12]. Various characteristics like fruit size, colour, shape, taste, shelf life, processing ease etc. essentially depend on supply of micronutrients (Ganeshamurthy *et al.*, 2013) [6]. Boron, copper, zinc and ferrous are beneficial for improvement of fruit growth, retention, weight, volume, firmness and yield (Nehete *et al.*, 2011) [9].

In general, three flowering flushes are observed in Alphonso mango under the Konkan conditions. However, often an additional fourth flush with fruit set in March also observed which though contributed more to the total crop yield but with low market value. Flushes emerging earlier than January end generally produce significant crop with high market value. Emergence of fourth flowering flush is a consequence of insufficient crop load of the earlier three flushes in some locations. The shoot phenology changed because of the negligible fruit set in the earlier flushes leading to emergence of fourth flush.

However, there is need to understand physiology of flowering, fruit set and development under the dynamics of climate change and to develop mitigation technologies with increase in yield of mango. The present investigation was therefore undertaken, to study the effect of foliar application of nutrients on flowering, fruit set and yield of mango cv. Alphonso in lateritic soil of Konkan region.

Material and Methods

An experiment was conducted during 2016-17 at Mango Orchard of Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth with mango cv. Alphonso. The experimental soil was moderately acidic in reaction with low electrical conductivity and very high in organic carbon content. However, the status of major nutrient content of soil showed medium content of available nitrogen, low content of available phosphorus and high content of available potassium. In general, soil properties of experimental site showed a typical lateritic soil of Konkan region.

The experiment was conducted in randomized block design with seven treatments which were replicated thrice. The treatments were T_1- control, T_2- 1 per cent urea, T_3- 1 per cent potassium nitrate, T_4- 1 per cent Amrashakti, T_5- 3 per cent urea, T_6- 3 per cent potassium nitrate and T_7- 3 per cent Amrashakti multinutrient solution. FYM, urea, single super phosphate and muriate of potash were applied at fertilizer ring periphery of each experimental tree. The days required for induction of vegetative shoot were recorded based on induction of new vegetative flush in summer from date of treatment. Per cent new vegetative shoots were calculated by 50 shoots tag per tree and the mean was calculated. Length of shoot (cm) was measured on ten shoots and the mean was expressed in centimetres. Number of leaves per shoot were counted per 10 shoot each tree and the mean was calculated. Average leaf area (cm^2) was measured by Leaf area meter. Flowering intensity (%) was measured by counting shoots flowered based on fifty new shoots tagged per tree. The length and breadth (cm) of panicle was measured on twenty shoots and the mean was expressed in centimetres. Hermaphrodite flowers (%) were counted in twenty panicles at four different side on the tree during flower opening and measured the male and hermaphrodite flowers. Fruit set was recorded at pea-berry stage on twenty randomly tagged panicles. Fruit retention (%) was recorded by counting the fruit set at different stages and expressed in per cent. Days required for harvesting from induction of vegetative flush and from flowering were recorded by count the days from treatment given to harvesting of fruits. Number of harvested fruits $tree^{-1}$ were counted and their total weight in kilograms (kg) per tree was recorded and expressed in the yield ha^{-1}.

Results and Discussion

Effect of foliar application of nutrients on induction of vegetative flush

The data regarding induction of vegetative shoot are presented in Table 1. The data indicated the days required for induction of vegetative flush, new vegetative shoot (%), length of shoot (cm), No. of leaves per shoot and average leaf area (cm^2).

Induction of vegetative shoot

The days required for induction of vegetative shoot ranged from 40.56 to 57.89 with a mean value of 45.67 days. Treatment T_7 receiving foliar spray of 3 per cent Amrashakti recorded significantly minimum days (41 days) required for induction of new vegetative shoot. However, maximum days (58 days) were required for induction of new vegetative shoot recorded by T_1 treatment i.e. control treatment. While, treatment T_4 consising foliar spray of Amrashakti 1 per cent recorded second position which requires 42 days for induction of new vegetative shoot. Both the treatments were at par with T_5 (42 days), T_6 (45 days), T_2 (46 days) and T_3 (47 days) treatments.

New vegetative shoot

The percent new vegetative shoot varied significantly from 9.70 to 16.88 per cent with a mean value of 12.79 per cent. The maximum percent of new vegetative shoot (16.88%) was recorded with treatment T_7 receiving foliar spray of 3 per cent Amrashakti multinutrient solution which was at par with treatment T_4 (14.10%) consisting foliar spray of 1 per cent Amrashakti multinutrient solution. Yeshitela *et al.* (2010) [15] also reported the increase in the per cent new vegetative shoot due to application of 3 per cent potassium nitrate.

Length of shoot

The data presented (Table 1) in respected of length of shoot indicated that the treatment T_7 receiving foliar spray of 3 per cent Amrashakti indicated significantly maximum length of shoot (12.62 cm) but it was at par with all other treatments except control (T_1) treatment. The increase in length of shoot due to application of foliar spray of nutrients that enhanced cell division of meristematic tissue of stem. Baiea *et al.* (2015) [3] reported that the trees sprayed with 200 ppm zinc sulphate combined with 2 per cent potassium nitrate recorded maximum length of shoot (14.20 cm) in *'Keitt'* mango.

Number of leaves per shoot and average leaf area

The maximum number of leaves per shoot and average leaf area (5.16 and 105.99 cm^2, respectively) was recorded with treatment T_7 comprising foliar spray of 3 per cent Amrashakti multinutrient solution which was at par with treatment T_4 consisting foliar spray of 1 per cent Amrashakti solution, foliar spray of 3 per cent urea i.e. T_5 treatment and T_6 treatment receiving foliar spray of 3 per cent potassium nitrate. The treatment T_1 i.e. control treatment recorded minimum number of leaves (4.48) per shoot and minimum leaf area (81.55 cm^2). Similar results were also reported by Nafees *et al.* (2013) [8] and Baiea *et al.* (2015) [3].

Effect of foliar application of nutrients on flowering and fruiting of mango.

The data pertaining to flowering and flowering characters as influenced by foliar application of nutrients with different treatments are recorded in Table 2.

Flowering intensity

Flowering intensity of mango ranged from 30.00 to 54.56 per cent with a mean value of 46.18 per cent due to different treatments of foliar application of nutrients. The maximum flowering intensity (54.56%) was recorded with the treatment T_6 receiving foliar spray of 3 per cent potassium nitrate which found to be at par with all other treatment except treatment T_1 i.e. control treatment which recorded minimum flowering intensity (30.00%). The maximum flowering intensity recorded with foliar spray of potassium nitrate may be due to universal rest breaking agent in deciduous trees which stimulated flowering of mango by inducing nitrate reductase, increase levels of endogenous ethylene and methionine promoting mango flowering. Yeshitela *et al.* (2004) [14]

reported maximum flowering intensity (52%) as compared with control (43%) treatment in *'Tommy Atkins'* mango.

Length of panicle

The length of panicle presented in Table 2 varied from 9.61 to 15.11 cm with a mean value of 12.34 cm. The maximum length of panicle (15.11 cm) was recorded with the treatment T_6 comprising of foliar spray of 3 per cent potassium nitrate which was found to be significantly superior over all other treatments except treatment T_7 receiving foliar application of 3 per cent Amrashakti multinutrient solution (14.05 cm). Both the treatments were at par with each other. The control treatment recorded minimum length of panicle (9.16 cm). The maximum length of panicle might be due to the combine effect of nutrients involved in activation of enzymes and protein synthesis as well as translocation for efficient cellular activity leading to increase the length of panicle through cell division and cell elongation in the shoot apex. These results corroborate the findings of Nehete *et al.* (2011) [9] who reported the increase in panicle length due to micronutrient spray in '*Kesar'* mango.

Hermaphrodite flowers

Significantly maximum hermaphrodite flowers (20.09%) of mango were recorded with the treatment T_6 receiving foliar spray of 3 per cent potassium nitrate which was at par with T_7 (18.81%) and T_5 (17.71%) treatments receiving foliar spray of 3 per cent Amrashakti and 3 per cent urea solution, respectively. The minimum hermaphrodite flowers 9.85 per cent were recorded by control treatment. These results are in conformity with the results reported by Nehete *et al.* (2011) [9] and Sudha *et al*. (2012) [13] who reported the minimum hermaphrodite flowers due to control treatment in *Alphonso* mango.

Fruit set per panicle

The data pertaining to fruit set per panicle revealed that the treatment T_7 receiving foliar spray of 3 per cent Amrashakti multinutrient solution recorded highest fruit set (12.23) and showed its superiority over all other treatments in respect of fruit set per panicle. The foliar spray of nutrients with its combination improves pollen germination and pollen tube growth which is associated with better pollination, fertilization with fruit setting and maximum auxin synthesis in the plant system might delayed the formation of abscission layer during early stages of fruit development. Sudha *et al.* (2012) [13] also reported the increase in fruit set due to 2 per cent potassium nitrate (16.5%) in Alphonso mango.

Fruit retention per panicle

It was observed from the data presented in Table 2 that the treatment T_7 recorded highest fruit retention 0.32 per cent and it was significantly superior over all other treatments. The application of nutrients in combination might have regulated fruit drop or retention in plants, which altered the control of fruit drop and increased the total number of fruits per tree. However, the minimum fruit retention 0.25 per cent was recorded with treatment T_1 i.e. control treatment. Gurjar *et al.* (2015) [7] also reported significantly maximum fruit retention due to the treatment consisting 1 per cent $ZnSO_4$ + 1 per cent $FeSO_4$ and 0.5 per cent borax as compared to control treatment.

Days required for harvesting from induction of vegetative flush

From the data it was observed that the treatment T_7 receiving foliar spray of 3 per cent Amrashakti multinutrient solution recorded significantly minimum days (269 days) for harvesting from induction of vegetative flush and it was at par with treatment T_6 consisting foliar spray of 3 per cent potassium nitrate (272 days), followed by T_4 i.e. foliar spray of 1 per cent Amrashakti (275 days) multinutrient solution and T_5 treatment consisting foliar spray of 3 per cent urea solution (278 days). The maximum days (297 days) required for harvesting from induction of vegetative flush were recorded with treatment T_1 i.e. control treatment. The above results are in conformity with the results reported by Yeshitela *et al.* (2010) [15] who reported that the application of 3 per cent potassium nitrate and 500 ppm paclobutrazol recorded minimum days (291 days) for harvesting from induction of vegetative flush due to interaction effect of two cultivars viz. *'Tommy Atkins'* and *'Keitt'* mango (*Mangifera indica*) cultivars.

Days required for harvesting from flowering

The result revealed that the treatment T_7 comprising foliar spray of 3 per cent Amrashakti solution recorded minimum days (100 days) for harvesting from flowering which was at par with treatment T_4 (102 days), T_3 (103 days), and T_6 (104 days) treatments. Whereas, treatment T_1 i.e. control treatment recorded maximum days (118 days) required for harvesting from flowering. Bansode (2012) [4] reported the maximum days (105.33) and minimum days (100) required for harvesting due to foliar spray at pea stage, marble stage and at egg stage.

Effect of foliar application of nutrients on yield of mango

As far as the fruit yield of mango (Table 3) was concerned, it differed significantly between different treatments and it ranged from 2.93 to 5.39 t ha^{-1} with a mean value of 3.91 t ha^{-1}. Among the various treatments, the treatment T_7 consisting foliar spray of 3 per cent Amrashakti multinutrient solution produced significantly higher fruit yield (5.39 t ha^{-1}) of mango and showed its superiority over all other treatments. It was followed by treatment T_6 receiving foliar spray of 3 per cent potassium nitrate (4.59 t ha^{-1}), treatment T_4 consisting foliar spray of 1 per cent Amrashakti (4.44 t ha^{-1}) and treatment T_5 receiving foliar spray of 3 per cent urea (3.77 t ha^{-1}) showed individual effect of treatments on mango yield. The minimum yield of mango was recorded with treatment T_1 i.e. control treatment (2.93 t ha^{-1}). This indicated the single chemical or combination of low dose of chemical nutrient did not influence the fruit yield in mango. Patil *et al.* (2010) [10] also reported the increase in the yield of mango due to increasing doses of foliar nutrient spray on Alphonso.

Table 1: Effect of foliar application of nutrients on induction of vegetative flush.

Tr. No.	Treatments	Days required for induction of vegetative shoot	% New vegetative shoot	Length of shoot (cm)	No. of leaves per shoot	Average leaf area (cm^2)
T_1	Control	57.89	9.70	7.99	4.48	81.55
T_2	Urea 1%	46.11	11.60	10.79	4.60	90.39
T_3	Potassium nitrate 1%	46.67	11.51	9.27	4.55	87.35

T_4	Amrashakti 1%	41.56	14.10	12.45	5.15	103.67
T_5	Urea 3%	42.00	13.12	11.51	4.80	98.67
T_6	Potassium nitrate 3%	44.89	12.62	11.37	4.73	95.78
T_7	Amrashakti 3%	40.56	16.88	12.62	5.16	105.99
	Mean	45.67	12.79	10.86	4.78	94.77
	S.E.±	5.52	1.26	1.18	0.15	4.02
	CD (P=0.05)	17.02	3.88	3.63	0.46	12.40

Table 2: Effect of foliar application of nutrients on flowering and fruiting of mango.

Tr. No.	Treatments	Flowering intensity (%)	Length of panicle (cm)	Hermaph rodite flowers (%)	Fruit set per panicle	Fruit retention per panicle	Days req. for harvesting from induction of veg. shoot	Days req. for harvesting from flowering
T_1	Control	30.00	9.61	9.85	8.14	0.25	296.67	118.22
T_2	Urea 1%	43.33	10.48	12.23	10.85	0.27	291.67	109.89
T_3	Potassium nitrate 1%	48.28	12.51	16.34	10.95	0.29	284.33	107.33
T_4	Amrashakti 1%	46.44	11.56	13.94	11.57	0.30	275.33	102.67
T_5	Urea 3%	48.54	13.07	17.71	11.18	0.30	278.33	103.64
T_6	Potassium nitrate 3%	54.56	15.11	20.09	11.59	0.30	271.67	102.22
T_7	Amrashakti 3%	52.13	14.05	18.81	12.23	0.32	269.33	100.00
	Mean	46.18	12.34	15.57	10.93	0.29	281.05	106.28
	S.E.±	5.61	0.60	1.00	0.01	0.001	2.60	1.42
	CD (P=0.05)	17.29	1.94	3.08	0.04	0.004	8.11	4.37

Table 3: Effect of foliar application of nutrients on yield of mango.

Tr. No.	Treatments	No. of fruits (tree^{-1})	Fruits (kg tree^{-1})	Yield (t ha^{-1})
T_1	Control	115.00	29.45	2.93
T_2	Urea 1%	119.28	30.37	3.10
T_3	Potassium nitrate 1%	123.00	31.52	3.13
T_4	Amrashakti 1%	177.00	44.13	4.44
T_5	Urea 3%	151.00	40.24	3.77
T_6	Potassium nitrate 3%	178.33	46.97	4.59
T_7	Amrashakti 3%	209.00	53.30	5.39
	Mean	153.23	39.43	3.91
	S.E.±	4.72	2.68	0.03
	C.D. (P=0.05)	14.56	8.26	0.10

Conclusion

Among the different treatments tried during present investigation, it can be concluded that the use of foliar spray of 3 per cent Amrashakti multinutrient solution is essential to improve induction of vegetative flush, flowering and fruit set as well as yield of mango in lateritic soil of coastal region of Maharashtra.

References

1. Anonymous. Krishi Sandesh published by Government of Maharashtra, 2014a.
2. Anonymous. Indian Horticulture Database, published by National Horticulture Board, 2017.
3. Baiea MHM, El-Badawy HEM, El-Gioushy SF. Effect of potassium, zinc and boron on growth, yield and fruit quality of 'keitt' mango trees. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2015; 6(4):800-812.
4. Bansode G. Effect of post-flowering foliar spray on fruit retention, yield and quality of mango (*Mangifera indica*) cv. Alphonso. Unpublished M.Sc. (Agri.) Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra, 2012.
5. Burondkar MM, Jadhav BB. Post flowering Morpho-physiological behavior of Alphonso mango as influenced by plant growth regulators, polyamine and nutrients under rainfed conditions. Acta Horticulture. 2009; 820:425-432.
6. Ganeshamurthy AN, Kotur SC, Raghupathi HB, Satisha GC, Varalakshni LR. Indian Journal of Fertilizers. 2013; 9(4):138-148.
7. Gurjar TD, Patel NL, Panchal B, Chaudhary D. Effect of foliar spray of micronutrients on flowering and fruiting of Alphonso mango (*Mangifera indica*). International Journal of life sciences. 2015; 10(3):1053-1056.
8. Nafees M, Ahmad I, Ashraf I. Sustainable production of mango fruit by managing irregular bearing through foliar spray of urea at critical growth stages. World Applied Sciences Journal. 2013; 24(10):1368-1372.
9. Nehete DS, Padhiar BV, Shah NI, Bhalerao PP, Kolambe BB, Bhalerao RR. Influence of micronutrient spray on flowering, yield, quality and nutrient content in leaf of mango cv. Kesar. Asian Journal of Horticulture. 2011; 6(1):63-67.
10. Patil KD, Salvi BR, Chavan SA. Effect of Foliar Application of Nutrients to Alphonso Mango in Lateritic Soils of Konkan. Journal of Indian Society of Coastal Agricultural Research. 2010; 28(1):40-43.
11. Samra JS, Arora YK. Mineral Nutrition. In: R.E. Litz. The Mango, botany, production and uses. Cab International, New York, 1997.
12. Silva CR. Tropical Fruit, Production technology of mango. UFLA/FAEP, Lavras-MG, 1997.
13. Sudha T, Balamohan TN, Soorianathasundaram K. Effect of foliar spray of nitrogenous chemicals on flowering, fruit set and yield in mango (*Mangifera indica*) cv. Alphonso. Journal of Horticultural Science. 2012; 7(2):190-193.
14. Yeshitela T, Robbertse PJ, Stassen JC. Potassium nitrate and urea spray affect flowering and yield of 'Tommy Atkins' mango in Ethiopia. South African Journal of Plant and Soil. 2004; 22(1):28-32.
15. Yeshitela T, Robbertse PJ, Stassen JC. Effect of various Inductive periods and chemicals on flowering and vegetative growth of 'Tommy Atkins' and 'Keitt' mango (*Mangifera indica*). New Zealand Journal of Crop and Horticultural Sciences. 2010; 32:209-215.