

Original Research Article

Effect of Fertilizer Levels on Flowering Behaviour and Yield of Fruits in Mango Cv. Alphonso

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ABSTRACT

In India, Alphonso is supposed to be the best commercial mango variety for its excellent flavour and sub acidic taste, long shelf life and early bearing. In mango the total number of flowers in panicle may vary from 1000-6000 depending upon cultivar. Types of flowers, fruit set and fruit development are important factors which decide ultimate yield of tree. It is particularly important in mango where proportion of male and hermaphrodite flowers varies greatly. Hence, the present study was carried out. The study revealed that there was no significant effect of different fertilizer levels on production of male and hermaphrodite flowers. However, direction of the tree exerted significant influence on induction of male and hermaphrodite flowers in Alphonso mango. North side bears minimum number of male flowers and maximum number of hermaphrodite flowers. While East sides' bears maximum number of male flowers and West sides bears minimum number of hermaphrodite flowers which is at par with East. The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits were higher than the interior fruits in terms of total fruits or number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T₄) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tends to produce more vegetative growth than the reproductive growth.

Keywords

Fertilizer levels,
Flowering behaviour,
Sex-ratio,
Yield of fruits,
Alphonso
Mango

Introduction

In India, Alphonso is supposed to be the best commercial mango variety for its excellent flavour and sub acidic taste, long shelf life and early bearing. Every year India exports about 30,000 tonnes of mango fruits. Out of which, more than 85 percent share is of 'Alphonso' mango. Generally mango produces cymose type of inflorescence which is primarily terminal but axillary and multiple panicles may also arise from axillary bud quite frequently. The panicle consists of main axis bearing many branched secondary or tertiary axis which may bear flowers. They are either male or

hermaphrodite. The total number of flowers in panicle may vary from 1000-6000 depending upon cultivar (Mukherjee, 1953). Types of flowers, fruit set, fruit drop and fruit development are important factors which decide ultimate yield of tree. It is particularly important in mango where proportion of male and hermaphrodite flowers varies greatly. Time and peak period of flowering, sex-ratio, incidence of pest and diseases, prevailing temperature and weather conditions greatly influence the fruit set and fruit development. Hence, the present investigation was carried out with objective

to study the effect of fertilizer levels on flowering behaviour in Alphonso mango trees.

Materials and Methods

The experiment was conducted at the Department of Horticulture, College of Agriculture, Dapoli, Dist.-Ratnagiri, Maharashtra. The seventy two Alphonso trees of 20 years age having uniform growth and vigour constituted the experimental material. The experiment was conducted in a Randomized Block Design with three replications. The treatment details are as given below.

T₁= No fertilizers (control)

T₂= Recommended dose of NPK*

T₃= Recommended dose of NPK + ½ Recommended dose of NPK

T₄= Double Recommended dose of NPK

T₅= 4.5 kg N + Recommended dose of P and K

T₆= 1.5 kg P₂O₅ + Recommended dose of N and K

T₇= 2 kg K₂O + Recommended dose of N and P

T₈= Micro-nutrient complex (i.e. Ormichem 2 kg/tree) + Recommended dose of NPK

T₉= Soil application of lime (Calcium carbonate i.e. 10 kg/tree) + Recommended dose of NPK

T₁₀= Foliar application of KH₂PO₄ (2% spray) + Recommended dose of NPK

T₁₁= Organic manures only (50 kg/tree)

T₁₂= Foliar application of multi-nutrient complex (2% spray) + Recommended dose of NPK

*Recommended dose of NPK = 1.5 kg N, 0.5 kg P₂O₅ and 0.6 kg K₂O/tree/year i.e. 3 kg Urea + 3 kg Single Super Phosphate + 1 kg Muriate of Potash

The manures and fertilizers as per treatments were applied 1st fortnight of July in the trenches (30 cm wide and 15 cm deep) which were dug half the distance of the canopy of the tree from its trunk. Farm yard manure 50 kg/tree was commonly applied. Further paclobutrazol (cultar) 5 g a. i. /tree was also applied by soil drenching in the first fortnight of August.

In each tree flowering panicles were selected from four directions. The flowers were removed by forceps which were opened at each counting. Total number of flowers were counted on the selected panicles and recorded.

Number of male flowers present on each panicle were counted and their percentage to total number of flowers was calculated which represented percent male flowers per panicle. Total number of hermaphrodite flowers were counted and recorded and their percentage to total number of flowers was calculated which represented percent hermaphrodite flowers per panicle.

Yield of each tree was recorded by counting the total number of fruits per tree in direction wise. The fruits were harvested at the 'C' stage of maturity described as Cheema and Dani (1934).

Results and Discussion

Generally, Alphonso mango produces 3 to 4 vegetative flushes under Konkan conditions

in the 'off' year, while 1 or 2 vegetative flushes and 1 reproductive flush in 'on' year. The first flush is produced in February to March, second in March to April or in the beginning of monsoon and the last one is in October and November. Effect of fertilizer levels on occurrence of male and hermaphrodite flowers in Alphonso mango are presented in Table 1 and 2.

There was no significant effect of fertilizer levels on induction of male and hermaphrodite flowers. However, direction plays a key role. It was observed that the East side bears maximum male flowers, which is significantly superior over rest of the directions. While minimum number of male flowers was noticed on West sides which is at par with North and South directions. The direction and treatment also has significant role. The highest number of male flowers (2135.67) was observed on the trees receiving the foliar spray of KH_2PO_4 along with recommended dose (T_{10}) treatment. The lowest one (1319.83) was noticed on North sides of the trees receiving higher doses of potash along with recommended doses of N and P (T_7) treatment.

The North side of the tree, bears maximum number of hermaphrodite flowers (139.21) and it is significantly superior to the West side which is at par with the East and South sides.

The different doses of fertilizers and their combinations did not produce any significant influence on flowering in Alphonso mango.

In general, the study in mango, the hermaphrodite flowers after pollination and fertilization set fruit. Therefore, the number of hermaphrodite flowers in panicles having important criteria for the yield.

The present study indicates that, the North sides produce more number of hermaphrodite flowers. This is possibly due to low light intensity and low temperature. This is in agreement with the work done by Desai *et al.*, (1985) and Jahuri *et al.*, (1968). While further work indicated that the more number of male flowers was observed on East side than rest of the directions. This is due to profuse light and higher temperatures on Eastern side. However, there is no significant difference among fertilizer levels and their combinations on production of male flowers. Probably, the phytohormones and photoperiodism must have played a key role in production of male and hermaphrodite flowers.

Percentage of male and hermaphrodite flowers and sex-ratio

The data pertaining to the effect of fertilizer levels on per cent male and hermaphrodite flowers and sex-ratio in Alphonso mango trees are presented in Table 3.

The data indicate that there was no significant difference among fertilizer levels with respect to male and hermaphrodite flowers in Alphonso mango trees. However, the percentage of male and hermaphrodite flowers showed significant difference. The trees which received foliar spray of KH_2PO_4 along with recommended dose of fertilizers (T_{10}) produced significantly more number of male flowers (1858.08) and percentage of male flowers (9.67%) followed by the rest of the treatments. While, the double recommended dose of fertilizers (T_4), higher nitrogen along with recommended P and K (T_5) and the organic manures only (T_{11}) and the trees supplied with foliar spray of multi-nutrient complex along with recommended dose of fertilizers (T_{12}) showed less percentage of male flowers than the control (T_1) i.e. 9.65 percent.

The most important part is the percentage of hermaphrodite flowers born on panicle in mango trees which have direct relationship with yield level. The trees received double dose of recommended fertilizers (T₄) bore maximum percentage of hermaphrodite flowers (2.83%) which was found to be at par with the higher nitrogen along with recommended P and K (T₅), one and half times extra recommended dose (T₃), T₂, T₆, T₇, T₈, T₉, T₁₁ and T₁₂ treatments. The lowest percentage of hermaphrodite flowers (2.65%) were produced on the trees sprayed with KH₂PO₄ along with recommended dose of fertilizers (T₁₀) followed by control (T₁) 2.72 per cent which are significantly less than any other treatments.

As far as the sex-ratio is concerned, the trees sprayed with KH₂PO₄ along with recommended dose of fertilizers (T₁₀) and control (T₁) produce more male: hermaphrodite flowers ratio than rest of the treatments under study.

Effect of fertilizer levels on yield of fruits

The data pertaining to the effect of fertilizer levels and foliar spray of nutrients on yield of Alphonso mango are presented in Table 4.

The direction plays a key role on the bearing of the trees. It was observed that irrespective dose of fertilizers, fruits bears on North side had significantly lesser number of fruits than any other direction. However, the inside i.e. interior part of the trees bears much more fruits which was significantly superior to all other direction. The study further indicated that there was non-significant difference on number of fruits present on East, West and South sides. However, little higher number of fruits present on Eastern sides. In general, though the total number of fruits at interior side was more than East, West, North and

South direction, the overall peripheral number of fruits is much more than total fruits in interior side.

The fertilizers also play significant role on bearing of mango trees. The recommended dose of fertilizers (T₂) produces highest number of fruits (137.66) than any other treatments which was significantly superior over the control and it was at par with the trees supplied with soil application of calcium carbonate along with recommended dose (T₉), the trees supplied with foliar spray of KH₂PO₄ along with recommended dose (T₁₀), organic manures only (T₁₁), trees supplied with higher phosphorus and recommended dose of N and K (T₆), higher potash and recommended dose of N and P (T₇) in that order.

The trees which received double dose of fertilizers (T₄) yielded poorly which was at par with the trees do not received fertilizer doses (T₁) and which receives higher doses of nitrogen and recommended P and K (T₅) and the trees supplied with ormichem and recommended dose (T₈) and foliar spray of multi-nutrient spray and recommended dose (T₁₂). The data cannot be compared as such study has not been conducted elsewhere, besides this is being one year data, it will very difficult to draw any valid conclusion. However, overall result indicates that high N favours more vegetative growth leading to poor crop yield.

There was no significant effect of different fertilizer levels on production of male and hermaphrodite flowers. However, direction of the tree exerted significant influence on induction of male and hermaphrodite flowers in Alphonso mango. North sides bear minimum number of male flowers and maximum number of hermaphrodite flowers. While East sides' bears maximum number of male flowers and West sides

bears minimum number of hermaphrodite flowers which is at par with East.

The production of fruits was more at interior side of the tree (155.500) than any other direction irrespective of fertilizers levels. However, total peripheral (East, West, North and South) fruits were higher than the interior fruits in terms of total fruits or

number of fruits per tree. Heavy doses of fertilizers may not prove beneficial as application of double dose of recommended fertilizers (T₄) treatment yielded poorly than rest of the treatments. Indicating heavily fertilized trees may tend to produce more vegetative growth than the reproductive growth.

Table.1 Number of male flowers per panicle at different directions as affected by different levels of fertilizers

Treatments	Directions				Mean
	East	West	North	South	
T ₁	1979.833	1499.833	1564.166	1738.000	1695.458
T ₂	1864.833	1761.333	1625.833	1855.333	1776.833
T ₃	1899.000	1374.833	1645.000	1619.666	1634.625
T ₄	1702.833	1470.000	1846.500	1743.000	1692.083
T ₅	1798.833	1652.833	1467.500	1568.666	1621.958
T ₆	1931.500	1658.000	1585.333	1453.000	1656.958
T ₇	1872.000	1466.500	1319.833	1550.333	1552.166
T ₈	1921.833	1640.500	1520.166	1855.666	1734.541
T ₉	2022.333	1473.000	1539.666	1593.333	1657.083
T ₁₀	2135.666	1969.333	1381.000	1946.333	1858.083
T ₁₁	1605.000	1614.833	1518.666	1850.000	1647.125
T ₁₂	1822.333	1418.666	2175.333	1660.666	1769.250
Mean	1879.666	1583.305	1599.083	1703.333	1691.347
	Direction		Treatment		Direction X Treatment
S.E. ±	57.316407		99.274928		198.549857
C.D. (5%)	160.941613		278.759051		557.518103
	Sig.		N.S.		Sig.

Table.2 Number of hermaphrodite flowers per panicle at different directions as affected by different levels of fertilizers

Treatments	Directions				Mean
	East	West	North	South	
T ₁	125.000	110.666	131.666	137.500	126.208
T ₂	132.666	132.333	141.000	148.833	138.708
T ₃	129.500	109.000	143.833	132.666	128.750
T ₄	124.500	115.833	168.666	138.666	136.916
T ₅	133.000	127.666	135.333	125.666	130.291
T ₆	130.833	123.666	136.500	111.500	125.500
T ₇	136.166	115.500	117.500	121.833	122.750
T ₈	128.666	129.000	134.333	144.000	134.000
T ₉	138.166	119.333	133.333	124.666	128.875
T ₁₀	136.000	130.666	117.666	127.666	128.000
T ₁₁	115.166	127.166	132.333	141.666	129.083
T ₁₂	142.333	112.666	178.333	130.000	140.833
Mean	131.000	121.083	139.208	132.013	130.826
	Direction		Treatment		Direction X Treatment
S.E. ±	4.059882		7.031921		14.063843
C.D. (5%)	11.396797		19.739831		39.479662
	Sig.		N.S.		N.S.

Table.3 Total flowers, percentage of male and hermaphrodite flowers in flowering panicle and sex-ratio as affected by different levels of fertilizers

Treat-ments	No. of flowers per flowering panicle			Percentage of flowers		Sex-ratio
	Male	Herma-phrodite	Total	Male	Herma-phrodite	Male : Herma-phrodite
T ₁	1695.46	126.21	1821.67	93.07 (9.65)	6.93 (2.72)	13.43:1
T ₂	1776.84	138.71	1915.55	92.76 (9.63)	7.26 (2.79)	12.81:1
T ₃	1634.63	128.75	1763.38	92.70 (9.63)	7.30 (2.80)	12.70:1
T ₄	1692.09	136.92	1829.01	92.51 (9.62)	7.49 (2.83)	12.35:1
T ₅	1621.96	130.30	1752.26	92.56 (9.62)	7.44 (2.82)	12.45:1
T ₆	1656.96	125.50	1782.46	92.96 (9.64)	7.04 (2.74)	13.20:1
T ₇	1552.17	122.75	1674.92	92.67 (9.63)	7.33 (2.80)	12.64:1
T ₈	1734.54	134.00	1868.54	92.83 (9.64)	7.17 (2.78)	12.95:1
T ₉	1657.09	128.88	1785.97	92.78 (9.63)	7.22 (2.78)	12.86:1
T ₁₀	1858.08	128.00	1986.08	93.56 (9.67)	6.44 (2.65)	14.53:1
T ₁₁	1647.13	129.09	1776.22	92.73 (9.63)	7.27 (2.79)	12.76:1
T ₁₂	1769.25	140.83	1910.08	92.63 (9.62)	7.37 (2.81)	12.57:1
S.E. ±	107.251	7.025	113.623	0.009	0.030	-
C.D. (5%)	N.S.	N.S.	N.S.	0.026	0.089	-

(Figures in parenthesis indicate the square root transformation values)

Table.4 Effect of fertilizer levels at different directions on yield of fruits (in nos.) in mango cv. Alphonso

Treatments	Direction wise Yield of fruits (in numbers)					Mean fruit yield
	East	West	North	South	Interior	
T ₁	87.000	95.500	63.000	93.666	156.666	99.166
T ₂	129.500	118.166	108.666	131.833	200.166	137.666
T ₃	104.666	96.833	75.833	105.500	145.500	105.666
T ₄	76.666	67.333	46.000	76.333	114.000	76.066
T ₅	106.500	92.000	62.666	77.000	147.666	97.166
T ₆	113.166	105.833	89.000	103.500	156.833	113.666
T ₇	117.666	95.500	79.666	91.333	152.166	107.266
T ₈	109.500	85.833	66.000	99.166	141.000	100.300
T ₉	136.666	135.500	94.833	138.333	162.333	133.533
T ₁₀	134.333	111.666	83.333	103.000	182.666	123.000
T ₁₁	96.666	132.500	84.166	115.666	163.000	118.400
T ₁₂	80.666	123.000	51.666	116.666	144.000	103.200
Mean	107.75	104.972	75.402	104.333	155.500	109.591
	Direction		Treatment		Direction X Treatment	
S.E. ±	7.139300		11.060155		24.731259	
C.D. (5%)	19.990231		30.968732		69.248191	
	Sig.		Sig.		N. S.	

References

- Cheema, G.S. and Dani, P.G. (1934). Report on the export of mangoes to Europe. Dept. Agric. Bombay, Bulletin No. 170, pp.17-18.
- Desai, A.G.; V.P. Limaye and R.T. Gunjate (1985). Floral biology of Alphonso, Goamankur and Kesar varieties of mango. *Journal of MAU*, 10 (2): 193-195.
- Jahuri, O.S.; S.S. Teotia, N.P. Upadhyay and D.S. Bana (1968). Sex distribution in mango (*Mangifera indica* L.) panicles as influenced by their position on the tree. *South Indian Hort.*, 16 (3&4): 31-34.
- Mukherjee, S.K. (1953). The mango it's botany, cultivation used and future improvements, especially observed in India, *Econ. Bot.*, 7: 130.