Mysore J. Agric. Sci., 57 (1) : 270-279 (2023)

Studies on Effect of Age and Management Practices on Flowering Behaviour and Fruit Set in Mango (*Mangifera indica* L.) Cv. Alphonso

B. R. Premalatha, H. S. Shivaramu, M. N. Thimmegowda, S. V. Patil, A. P. Mallikarjuna Gowda, M. Murali Mohan and M. K. Prasanna Kumar
Department of Agronomy, College of Agriculture, UAS, GKVK, Bengaluru - 560 065
e-Mail : premalathabr@gmail.com

Authors Contribution

B. R. Premalatha : Investigation, orginal draft preparation, analysis;
H. S. Shivaramu : Conceptualization;
M. N. Thimmegowda & S. V. Patil : Data curation and draft correction;
A. P. Mallikarjuna Gowda, M. Murali Mohan & M. K. Prasanna Kumar : Conceptualization and suggestions.

Corresponding Author **:**
B. R. Premalatha
Department of Agronomy, College of Agriculture, UAS, GKVK, Bengaluru

Received : July 2022
Accepted : December 2022

Abstract

Alphonso is one of the most important commercial mango variety in India known for its typical sugar acid blend, pleasant flavour, good taste, soft, firm, fibreless, bearing habit long keeping quality and early bearing habit. In mango, the proportion of male and hermaphrodite flowers vary greatly but it is one of the factor which decides the fruit set and development. Hence, the present study was undertaken to study the effect of age and management practices on flowering behaviour and fruit set in Mango (*Mangifera indica* L.) Cv. Alphonso at Regional Horticultural Research and Extension Centre, UHS Campus, GKVK, Bengaluru and at Dryland Agriculture, UAS, GKVK, Bengaluru during 2018-19 and 2019-20 with two age groups (10 and 25 years old plantation) and two management practices (control and PPC spray). The results indicated that, there was significant difference among different age groups, trees sprayed with plant protection chemicals and also direction of the tree. Young aged trees of 10 years recorded significantly lower male flowers per tree (1776.01), higher hermaphrodite flowers (196.12), lower sex ratio (9.06) and higher fruit set percentage (4.64 %). Among the management practices, the trees sprayed with plant protection chemicals recorded significantly lower male flowers (1694.06), higher hermaphrodite flowers (196.30), lower sex ratio (8.63) and higher fruit set percentage (4.63 %). North side of the tree bears minimum number of male flowers (1707.22) and maximum number of hermaphrodite flowers (206.33) while, higher fruit set percentage (4.89 %) was recorded in east direction.

Keywords : Flowering behaviour, Fruit set, Direction, Mango

Mango (*Mangifera indica* L.) is the most popular tropical fruit, on account of its nutritive value, taste, attractive fragrance and health promoting qualities it is also known as the 'king of fruits' (Dutta *et al.,* 2013) and also known as 'Ambassador Fruit of India'. It's cultivation and usage are deep-rooted in Indian culture and tradition. It has been grown in Indian sub - continent for 4000 years (De Candolle, 1904) or more. Indian subcontinent has rich diversity of mango having about thousands of varieties and hence, India is considered to be the centre of origin of mango (Ravishankar *et al.,* 1979). India is the largest producer of mango contributing to 55 per cent of the world's total production. In India, it is cultivated in an area of 2.26 m ha, with a production of 21.8 mt (Anonymous, 2018b). The leading mango producing states in India are Uttar Pradesh producing 45.52 lakh MT from an area of 2.66 lakh hectares followed by Andhra Pradesh producing 43.74 lakh MT from an area of 3.63 lakh hectares (Anonymous, 2018). Though, India is the largest producer of mango, the average

national productivity is around 9.7 t/ha, which is much lower compared to Brazil (15.83 t/ha), Pakistan (10.62 t/ha) and Indonesia (9.78 t/ha).

India has about thousands of mango varieties, among them about 30 are grown commercially and most of them have eco-geographical requirements for optimum growth and yield. 'Alphonso' is one of the leading commercial cultivar mainly grown in Karnataka, Maharastra, Tamilnadu, Gujarat and Andra Pradesh. The fruits of this variety are medium in size, ovate oblique in shape and orange yellow in colour. The pulp is yellow to orange in colour. Due to its typical sugar acid blend, it has pleasant flavour, good taste, soft, firm, fibreless and has got longer keeping quality. However, the variety suffers from serious drawbacks like irregular and shy bearing habit and eventually lower fruit set and poor yield. The average productivity of 'Alphonso' mango is around 4.5 t/ha which is very low compared to other commercial cultivars. Flowers, fruit set, fruit drop and fruit development are important factors that finally decides the 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, flowering behaviour, insect pests, diseases and weather parameters like temperature and relative humidity influences flowering and fruit set in Alphonso mango (Vidya *et* al., 2014, Sudha and Narendrappa, 2015 and Anonmous., 2017). Hence, the present investigation was carried out with the objective to study the effect of different age groups and use of plant protection chemicals on flowering behaviour in Alphonso mango.

Material and Methods

The experiment was carried out in two plantations of different age group with two management levels comprising plant protection spray at UHS campus and Dryland Agriculture Project, GKVK, Bengaluru with a sample size of 9 trees in each location during 2018-19 and 2019-20. The experimental design adopted was factorial RBD (FRBD) comprising of 2 age group (10 years at UHS campus and 25 years at Dryland Agriculture Project) and two management practices (Control and PPC spray) with 9 replications using Alphonso variety planted at a spacing of 10 m X 10 m.

Daily meteorological data recorded at the observatory at AICRP on Agrometeorology unit, Zonal Agricultural Research Station (ZARS), University of Agricultural Sciences, GKVK, Bengaluru during the crop growth period of 2018-19 and 2019-20 was collected. The normal and actual realized weather parameters *viz.,* rainfall, mean temperature (maximum and minimum), relative humidity, bright sunshine hours and wind speed were collected. The plantations were cleaned in the beginning of the mango season to avoid contamination from the host plants in and around the orchard trees and basins were made for each tree to conserve rainwater. To control the major diseases and pests like powdery mildew, anthracnose, fruit fly and mango hoppers, two sprays comprising Hexaconazole 5 per cent SC @ 1 ml/litre, Lambda-cyhalothrin 5 per cent EC @ 0.5 ml/litre and Wettable Sulphur 80 per cent WP @ 2 gm/litre were given at the time of flower bud initiation and fruiting stage for PPC spray treatment and the control treatment was maintained without any spray.

Nine trees were selected in each treatment and in each tree, five flowering panicles were selected from four directions totalling to 20 panicles for observations on flowering and fruiting behaviour. Panicle initiation data was noted with the emergence of first panicle on the tree. Male and hermaphrodite flowers was counted on panicles tagged during the flowering season. Number of total flowers was counted on the selected panicles. Number of male and hermaphrodite flowers was counted and their percentage to total number of flowers was worked out.

$$\% \text{ of male flowers} = \frac{\text{No. of male flowers}}{\text{Total no. of flowers}} \times 100$$

Male flowers percent : The percentage of male flowers was calculated by employing the following formula and expressed in percentage.

$$\% \text{ of hermaphrodite flowers} = \frac{\text{No. of hermaphrodite flowers}}{\text{Total no. of flowers}} \times 100$$

Hermaphrodite flowers per cent : The percentage of hermaphrodite flowers was calculated by employing the following formula and expressed in percentage

$$\text{Sex ratio} = \frac{\text{No. of male flowers per panicle}}{\text{No. of hermaphrodite flowers per panicle}}$$

Sex ratio (Perfect to male flowers) : The ratio of male flowers to hermaphrodite flowers was calculated as follows

$$\%\ \text{of Fruit set} = \frac{\text{Mean no. of fruits at pea stage}}{\text{Mean no. of hermaphrodite flowers}} \times 100$$

The collected data on different parameters was analysed by using analysis of variance (ANOVA) based on Factorial randomized block design (FRBD) concept.

Results and Discussion

The nature of flower production in mango is a very complex one related to the mechanism of controlling the balance between vegetative and reproductive development and of course, the climatic condition which play vital role in the condition growth and flowering. Phenomena of flowering in mango trees is especially challenging for physiologists, breeders and growers (Rani, 2018). The inflorescence of mango bears mainly two types of flowers male and hermaphrodite. It is only perfect or hermaphrodite flowers, which after proper pollination and fertilization, sets fruits.

Number of male flowers : Statistical analysis of individual years and the pooled data showed that the trees of different age groups, management levels and direction varied significantly ($P > 0.05$) among each other with respect to the number of male flowers (Table 1). Among the different age group of trees, the trees of older age showed significantly higher number of male flowers (1885.58, 1768.96 and 1827.27) during 2018-19, 2019-20 and pooled data, respectively. Among the management levels, the control treatment without PPC spray showed significantly higher number of male flowers (2046.63, 1771.80 and 1909.22) during 2018-19, 2019-20 and pooled data, respectively. Direction also plays a key role in flowering behaviour. It was observed that the East side bears significantly maximum number of male flowers (2026.58,

Table 1

Number of male flowers as influenced by different ages, management practices and directions of Alphonso mango

2018-19	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2- With PPC	M_1 - Control	M_2- With PPC	
D_1 - North	1926.16	1556.67	1875.36	1614.27	1743.11
D_2 - South	2089.09	1676.24	2089.62	1745.69	1900.16
D_3 - East	2187.58	1801.88	2277.84	1839.03	2026.58
D_4- West	1949.20	1585.76	1978.22	1664.62	1794.45
A - Mean	A_1	1846.57	A_2	1885.58	
M - Mean	M_1	2046.63	M_2	1685.52	
	A		M		D
F - test	*		*		*
S.Em.±	13.14		13.14		18.59
CD at 5%	36.80		36.80		52.05

continued…

The Mysore Journal of Agricultural Sciences

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	18.59	26.29	26.29	37.18
CD at 5%	NS	NS	NS	NS

2018-19	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2- With PPC	M_1 - Control	M_2- With PPC	
D1 - North	1669.16	1629.30	1721.70	1665.20	1671.34
D2 - South	1796.56	1700.30	1828.10	1789.09	1778.51
D3 - East	1808.78	1750.71	1888.10	1826.47	1818.51
D4- West	1705.11	1583.63	1756.90	1676.16	1680.45
A - Mean	A1	1705.44	A2	1768.96	
M - Mean	M1	1771.80	M2	1702.61	

	A	M	D
F - test	*	*	*
S.Em.+	11.12	11.12	15.73
CD at 5%	31.14	31.14	44.04

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.+	15.73	22.24	22.24	31.46
CD at 5%	NS	NS	NS	NS

Pooled	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2- With PPC	M_1 - Control	M_2- With PPC	
D_1 - North	1797.66	1592.98	1798.53	1639.73	1707.22
D_2 - South	1942.82	1688.27	1958.86	1767.39	1839.34
D_3 - East	1998.18	1776.29	2082.97	1832.75	1922.55
D_4 - West	1827.16	1584.69	1867.56	1670.39	1737.45
A - Mean	A1	1776.01	A2	1827.27	
M - Mean	M1	1909.22	M2	1694.06	

	A	M	D
F - test	*	*	*
S.Em.+	8.79	8.79	12.43
CD at 5%	24.60	24.60	34.79

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.+	12.43	17.57	17.57	24.85
CD at 5%	NS	NS	NS	NS

Note : * Significant at 5 % level, NS : Non significant, PPC : Plant protection chemicals

1818.51and 1922.55 in 2018-19, 2019-20 and pooled data, respectively) compared to other directions and lowest number of male flowers was recorded in North direction during both the years. This might be due to profuse light and higher temperatures on Eastern side. However, non-significant differences were observed among the interactions.

Number of hermaphrodite flowers : The hermaphrodite flowers have an important criterion in determining the yield as these flowers after pollination and fertilization sets the fruit. Highly significant difference among the different ages, management levels and direction were observed for hermaphrodite flowers (Table 2). Among the different age groups, the trees of younger age showed significantly higher number of hermaphrodite flowers (196.71, 195.54 and 196.12) during 2018-19, 2019-20 and pooled data, respectively. Among the management levels, the trees with plant protection chemicals spray recorded significantly higher number of hermaphrodite flowers (196.14, 196.45 and 196.30) during 2018-19, 2019-20 and pooled, respectively. On the other hand, hermaphrodite flower number was significantly higher on the panicles of North side (205.08, 207.57 and 206.33 in 2018-19, 2019-20 and pooled data, respectively) followed by south direction. The findings are in confirmation with the findings of Majumdar and Mukherjee (1961), Desai *et al*. (1985), Asif *et al.* (2002), Anonmous., 2018a and Manjarekar *et al*., (2018) who also observed highest percentage of perfect flowers on the north and lowest on the eastern side.

Percentage of male and hermaphrodite flowers and sex ratio : The data indicated that, the percentage of male flowers and sex ratio was significantly higher in older aged trees (90.63 and 9.78, 90.16 and 9.23 and 90.43 and 9.51 during 2018-19, 2019-20 and pooled data of two years, respectively). While, the percentage of hermaphrodite flowers was significantly higher in young aged orchard (9.74, 10.33 and 10.01 during 2018-19, 2019-20 and pooled data of two years, respectively). This is due to higher panicle length and breadth in younger trees and also the younger trees are more vigorous compared to older ones.

Among the management levels, significantly higher percentage of hermaphrodite flowers (10.45, 10.38 and 10.40 per cent during 2018-19, 2019-20 and pooled data of two years respectively) and lower

TABLE 2

Number of hermaphrodite flowers as influenced by different ages, management practices and directions of Alphonso mango

2018-19	A_1 - 10 years of age		A_2 - 25 years of age		D - Mean
Treatments	M_1 - Control	M_2 - With PPC	M_1 - Control	M_2 - With PPC	
D_1 - North	205.29	207.93	202.13	204.98	205.08
D_2 - South	202.13	205.98	194.47	200.33	200.73
D_3 - East	190.22	193.22	188.22	186.20	189.47
D_4 - West	183.62	185.24	181.62	185.24	183.93
A - Mean	A1	196.71	A2	192.90	
M - Mean	M1	193.46	M2	196.14	
	A		M		D
F - test	*		*		*
S.Em.±	0.57		0.57		0.81
CD at 5 %	1.60		1.60		2.27

continued…

The Mysore Journal of Agricultural Sciences

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	0.81	1.15	1.15	1.62
CD at 5 %	NS	NS	NS	NS

2019-20	A_1 - 10 years of age		A_2 - 25 years of age		D - Mean
Treatments	M_1 - Control	M_2 - With PPC	M_1 - Control	M_2 - With PPC	
D_1 - North	209.47	212.27	200.27	208.29	207.57
D_2 - South	197.09	204.10	193.53	199.33	198.51
D_3 - East	186.13	191.30	182.47	190.40	187.58
D_4 - West	181.64	182.31	178.02	183.59	181.39
A - Mean	A1	195.54	A2	191.99	
M - Mean	M1	191.08	M2	196.45	

	A	M	D
F - test	*	*	*
S.Em.±	0.86	0.86	1.22
CD at 5 %	2.42	2.42	3.42

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	1.22	1.73	1.73	2.44
CD at 5 %	NS	NS	NS	NS

Pooled	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2 - With PPC	M_1 - Control	M_2 - With PPC	
D_1 - North	207.38	210.10	201.20	206.63	206.33
D_2 - South	199.61	205.04	194.00	199.83	199.62
D_3 - East	188.18	192.26	185.34	188.30	188.52
D_4 - West	182.63	183.78	179.82	184.42	182.66
A - Mean	A1	196.12	A2	192.44	
M - Mean	M1	192.27	M2	196.30	

	A	M	D
F - test	*	*	*
S.Em.±	0.51	0.51	0.73
CD at 5 %	1.44	1.44	2.03

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	0.73	1.03	1.03	1.45
CD at 5%	NS	NS	NS	NS

Note: * Significant at 5 % level, NS : Non significant PPC : Plant protection chemicals

TABLE 3

Percentage of male and hermaphrodite flowers in flowering panicle and sex ratio as influenced by different ages and management practices of Alphonso mango

Parameters / Treatments	2018-19			2019-20			Pooled		
	Percentage of flowers		Sex ratio	Percentage of flowers		Sex ratio	Percentage of flowers		Sex ratio
	Male	Hermaphrodite	Male: Hermaphrodite	Male	Hermaphrodite	Male: Hermaphrodite	Male	Hermaphrodite	Male: Hermaphrodite
Age (A)									
A_1 - 10 years	90.26	9.74	9.40	89.67	10.33	8.73	89.99	10.01	9.06
A_2 - 25 years	90.63	9.37	9.78	90.16	9.84	9.23	90.43	9.57	9.51
F - test	*	*	NS	*	*	*	*	*	*
S.Em.±	0.12	0.12	0.14	0.12	0.12	0.11	0.09	0.09	0.09
CD at 5 %	0.36	0.36	NS	0.34	0.34	0.32	0.26	0.26	0.27
Management (M)									
M_1 - Control	91.33	8.67	10.59	90.22	9.78	9.28	90.82	9.18	9.94
M_2 - With PPC	89.55	10.45	8.60	89.62	10.38	8.67	89.60	10.40	8.63
F - test	*	*	*	*	*	*	*	*	*
S.Em.±	0.12	0.12	0.14	0.12	0.12	0.11	0.09	0.09	0.09
CD at 5 %	0.36	0.36	0.41	0.34	0.34	0.32	0.26	0.26	0.27
Age x Management									
A_1M_1	91.23	8.77	10.44	89.97	10.03	9.02	90.65	9.35	9.73
A_1M_2	89.29	10.71	8.36	89.37	10.63	8.44	89.34	10.66	8.40
A_2M_1	91.44	8.56	10.73	90.47	9.53	9.55	91.00	9.00	10.14
A_2M_2	89.82	10.18	8.84	89.86	10.14	8.90	89.86	10.14	8.87
F - test	NS	NS	NS	NS	NS	NS	NS	NS	NS
S.Em.±	0.18	0.18	0.20	0.16	0.16	0.16	0.13	0.13	0.13
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: * Significant at 5 % level, NS : Non significant PPC : Plant protection chemicals

TABLE 4

Fruit set percentage as influenced by different ages, management practices and directions of Alphonso mango

2018-19	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2 - With PPC	M_1 - Control	M_2 - With PPC	
D_1 - North	4.20	4.39	3.68	4.16	4.11
D_2 - South	4.19	4.61	3.90	4.44	4.29
D_3 - East	4.99	5.85	4.43	5.03	5.07
D_4 - West	4.96	5.46	4.46	5.03	4.98
A - Mean	A1	4.83	A2	4.39	
M - Mean	M1	4.35	M2	4.87	

	A	M	D
F - test	*	*	*
S.Em.±	0.06	0.06	0.09
CD at 5%	0.17	0.17	0.24

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	0.09	0.12	0.12	0.17
CD at 5%	NS	NS	NS	NS

2019-20	A_1 - 10 years of age		A_2 - 25 years of age		D - Mean
Treatments	M_1 - Control	M_2 - With PPC	M_1 - Control	M_2 - With PPC	
D_1 - North	3.39	3.99	2.77	3.37	3.38
D_2 - South	3.90	4.45	3.36	3.75	3.87
D_3 - East	4.81	5.42	4.12	4.50	4.71
D_4- West	4.34	5.30	3.93	4.40	4.49
A - Mean	A1	4.45	A2	3.78	
M - Mean	M1	3.83	M2	4.40	

	A	M	D
F - test	*	*	*
S.Em.±	0.05	0.05	0.07
CD at 5%	0.15	0.15	0.21

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.±	0.07	0.11	0.11	0.15
CD at 5%	NS	NS	NS	NS

continued…

Pooled	A_1 – 10 years of age		A_2 – 25 years of age		D - Mean
Treatments	M_1 - Control	M_2- With PPC	M_1 - Control	M_2- With PPC	
D_1 - North	3.79	4.19	3.23	3.77	3.75
D_2 - South	4.04	4.53	3.63	4.10	4.08
D_3 - East	4.90	5.63	4.27	4.77	4.89
D_4 - West	4.65	5.38	4.19	4.71	4.73
A - Mean	A1	4.64	A2	4.08	
M - Mean	M1	4.09	M2	4.63	

	A	M	D
F - test	*	*	*
S.Em.+	0.04	0.04	0.06
CD at 5 %	0.11	0.11	0.16

	AM	AD	MD	AMD
F - test	NS	NS	NS	NS
S.Em.+	0.06	0.08	0.08	0.11
CD at 5 %	NS	NS	NS	NS

Note: * Significant at 5 % level, NS : Non significant PPC : Plant protection chemicals

sex ratio (8.60, 8.67 and 8.63) was observed in plant protection chemicals sprayed trees compared to the control during 2018-19, 2019-20 and average of both the years, respectively (Table 3).

Fruit set percentage : The data indicated that, the fruit set percentage varied significantly with respect to different age groups, management practices and direction. However, the interactions were non-significant. Significantly higher fruit set percentage was noticed in younger trees (4.83, 4.45 and 4.64 %) compared to older trees during both the years of study period. Among the management levels, PPC sprayed trees recorded significantly higher fruit set percentage (4.87, 4.40 and 4.63 per cent during 2018-19, 2019-20 and pooled data, respectively). East side of the tree recorded significantly higher fruit set percentage (5.07, 4.71 and 4.89% during 2018-19, 2019-20 and pooled data, respectively) compared to other directions (Table 4) followed by West direction. However, bees and other pollinators play an important role in orchards in providing this stimulus for fruit set.

The study revealed there was distinct variations in production of hermaphrodite flowers and fruit set percentage with respect to age, management practices and direction. The young trees of 10 years age, plant protection chemicals sprayed trees and north side of the tree produced significantly higher hermaphrodite flowers, while higher fruit set percentage was found on east side.

References

Anonymous, 2017, *Annual Report*, 2016-17, AICRP on Agro-meteorology, UAS, GKVK, Bengaluru.

Anonymous, 2018a, *Annual Report*, 2017-18, AICRP on Agro-meteorology, UAS, GKVK, Bengaluru.

Anonymous, 2018b, Horticultural Statistics at a Glance, horticulture statistics division department of agriculture, cooperation & farmers welfare ministry of agriculture & farmers welfare Government of India.

Asif, M., Usman, M., Jaskani, M. J. and Khan, M. M., 2002, Comparative study of flower sex ratio in different cultivars of mango (*Mangifera indica* L.), *Int. J. Agri. Biol.,* **4** (2) : 220 - 222.

De Condolle, A., 1904, Origin of cultivated plants. Kegan Paul, Trench, London.

DESAI, A. G., LIMAYE, V. P. AND GUNJATE, R. T., 1985, Floral biology of alphonso, goamankur and kesar varieties of mango. *J. Maharashtra Agri. Univ.,* **10** (2) : 193 - 195.

DUTTA, S. K., SHRIVASTAV, M., CHAUDHARY, R., LAL, K., PATIL, P., SINGH, S. K. AND SINGH, A. K., 2013, Low temperature storage of mango (*Mangifera indica* L.) pollen. *Scientia Hort.,* **161**: 193-197.

MAJUMDAR, P. K. AND MUKHERJEE, S. K., 1961, Studies on the variability of sex expression in mango (*Mangifera indica* L.). *Indian J. Hort.*, **18** : 12 - 19.

MANJAREKAR, R. G., KHANVILKAR, M. H., SHIRKE, G. D., KARLE, S. S. AND AHIRE, P. G., 2018, Effect of fertilizer levels on flowering behaviour and yield of fruits in mango Cv. Alphonso. *Int. J. Curr. Microbiol. App. Sci.,* Special Issue - **6** : 508 - 514.

RANI, 2018, Advances in crop regulation in mango (*Mangifera indica* L.). *Int. J. Curr. Microbiol. App. Sci*., **7** (9) : 35-42.

RAVISHANKAR, H., RAO, M. M. AND BOJAPPA, K. M., 1979, Fruit-bud differentiation in mango 'Alphonso' and 'Totapuri' under mild tropical rainy conditions. *Sci. Hort.,* **10** : 95 - 99.

SUDHA, S. AND NARENDRAPPA, T., 2015, *In-vitro* efficacy of bioagents against *Colletotrichum gloeos porioides* causing anthracnose of mango. *Mysore J. Agric. Sci*., **49** (2) : 355 - 358.

VIDYA, A., SWAMY, G. S. K., PRAKASH, N. B., JAGADEESH, R. C., JAGADESH, S. L., GANGADHARAPPA, P. M. AND MUKESH, L. C., 2014, Effect of pre-harvest sprays of nutrients on the physico-chemical characters in mango (*Mangifera indica*) cv. Mallika. *Mysore J. Agric. Sci*., **48** (4) : 529 - 533.