

1 **Studies on the sex ratio of different mango varieties under the northern dry zone of**  
2 **Karnataka**

3  
4  
5 **Abstract**

6 An investigation was carried out to evaluate different cultivars of mango for their  
7 performance, growth, and flowering under the northern dry zone of Karnataka. Tree height,  
8 canopy volume and trunk girth were maximum in Baneshan, while Kadar recorded maximum  
9 tree spared. Baneshan were the first to come into fall bloom, and Dashehari were recorded  
10 maximum panicle per plant. The maximum number of fruits per panicle at harvest was found in  
11 Kesar. The maximum fruit set percent was observed in Totapuri.

12 **Keywords:** Mango, Dashehari, flowering, varieties

13 **Introduction**

14 Mango is a tropical fruit that belongs to the cashew family (Anacardiaceae) and has  
15 hundreds of cultivars. It is native to southern Asia, especially Myanmar, Bangladesh, and  
16 northeastern India, and has been cultivated there since ancient times. Mango trees are evergreen  
17 and can grow up to 40 meters (131 feet) tall, with a crown radius of 15 meters (49 feet). The  
18 mango is a tropical fruit tree that usually flowers in spring and produces attractive fruits. Mango  
19 inflorescence is a branched terminal panicle, up to 0.6 m long and a hundred to several thousand  
20 flowers per panicle. Mango inflorescence is a flowering shoot called panicles and bears 2 types of  
21 flowers male and hermaphrodite flowers. Sex ratio is a variable component within a panicle,  
22 trees and among the cultivars. The initial fruit set is directly related to the proportion of perfect  
23 flowers (Singh *et al.*, 2015). A tree can have 200 to 3000 panicles with the potential to produce a  
24 tremendous number of flowers (Barui and Ghosh, 2002).

25 Mango fruit develops rapidly after fruit set and is ready for harvesting within 13 to 20  
26 weeks, depending on variety and climate. Mango is essentially a tropical fruit. It generally does  
27 well within the temperature range of 24 to 27 °C but also can tolerate temperatures as high as 48  
28 °C. The requirement for water depends on the type of soil and climate, planting distance,  
29 cultivars, age of the plants, developmental stages, NPK applications and weather conditions  
30 (Malik and Mitra, 2001; Reddy *et al.*, 2001; Gawanker *et al.*, 2010; Dhake *et al.*, 2011). The

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31 productivity of mango is low due to several factors such as alternate bearing, fruit drop, disease  
32 and pests, most of the north Indian varieties viz. Dashehari, langar, Chousa and Bombay Green  
33 are alternate bearers while most of the south Indian varieties are regular bearers (Pandey and  
34 Dinesh, 2010). Low productivity is the resultant effect of alternate bearing, inadequate fruit set,  
35 followed by heavy fruit drop. In Mango, flowering is influenced by weather conditions and  
36 varietal genotypes.

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37 Mango belongs to the group of plants, in which an antagonism between vegetative vigor  
38 and flowering intensity is observed. Therefore, any factor that reduces the vegetative vigour  
39 without altering the metabolic activity, favours flowering. Mango trees are generally induced to  
40 flower between October to December in the northern hemisphere and from June to August in the  
41 southern hemisphere. However, irregularity of flowering in mangoes, which varies in time and  
42 intensity of flowering from year to year almost completely biannual (alternate bearing habit), is  
43 not an uncommon phenomenon. Accordingly, the unravelling of the nature of flower triggering  
44 and signalling elements is of utmost importance (Narvariya et al., 2015).

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45 Even in the same region, different environmental conditions at different years can affect  
46 the maturity and quality of fruits (Develliers, 1998). Therefore, the evaluation of different  
47 promising mango cultivars for a given set of ecology is one of the prerequisites for successful  
48 mango cultivation.

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#### 49 **Material and Methods**

50 The investigation was carried out at the Main Horticultural Research and Extension  
51 Center (MHREC) UHS, Bagalkot (Karnataka) from August to June 2020. Bagalkot is situated in  
52 the north-eastern part of Karnataka at latitude 16° 10' 48.00" N longitude 75° 42' 0.00" E and altitude  
53 of 559 meters above the mean sea level. Bagalkot enjoys a subtropical climate, hot and dry  
54 summers and cold winters are the main characteristic features of this region. In general, the  
55 highest and lowest temperature goes above 45°C and below 15°C, respectively. The annual  
56 rainfall varies from 550 to 700 mm which is received mainly from July to September. The  
57 experimental material consisted of eight varieties of mango viz., Langra, Malgoa, Khadar,  
58 Dashehari, Pairi, Kesar, Totapari and Alphonso and free from the attack of insect pests and  
59 diseases. Healthy and vigorous eight-year-old plants were selected for the present study. During  
60 the investigation, all the experimental plants received the same cultural practices and treatments.  
61 The observations recorded growth parameters like plant height, plant-bearing habit, canopy

62 spread, canopy spread, plant canopy, trunk girth, number of primary and secondary branches, leaf  
63 area and reproductive parameters like number of panicles per plant, time of panicle emergence,  
64 panicle length, number of staminate and hermaphrodite flowers, number of fruits per panicle at  
65 harvest and fruit set percentage.

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## 66 Results and discussion

67 The height of the plant is one of the most important morphological parameters that reflect the  
68 growth quality of the tree. Among the cultivars the maximum tree height was recorded in  
69 Baneshan (3.82 m), however the minimum tree height was recorded in Pairi (2.50 m). The  
70 variation in plant height characters among the varieties might be due to variations in genetic  
71 makeup under the present set of environmental and edaphic conditions. The high variability in  
72 plant height among the mango varieties has also been determined by Majumdar *et al.*, 2011 and  
73 Joshi *et al.*, 2013. The maximum tree spread (north-south and east-west) was found in Khadar  
74 (4.40 m and 4.79 respectively) while the minimum was found in Dashehari (3.11 m and 3.0  
75 respectively). This variation concerning plant spread among the different cultivars may be due to  
76 the spreading and intermediate spreading habit of the cultivar. Similar results have also been  
77 reported by Reddy *et al.*, 2001; Sharma and Sing, 1970. The maximum tree canopy was recorded  
78 in Baneshan (14.74 m<sup>3</sup>) while the minimum tree canopy was recorded in Malgoa (7.26  
79 m<sup>3</sup>). Kobra *et al.*, 2012 reported that the tree canopy ranged from 21.92 m<sup>3</sup> (Lata Bombai) to  
80 79.78 m<sup>3</sup> (Khirsapat). The stem girth for different mango varieties indicated that Baneshan,  
81 Malgoa and Dashehari gave significantly higher stem girth as compared to other varieties. A  
82 greater number of primary and secondary branches were noticed in Dashehari followed by Kesar  
83 and Kadar similar observations were also noted by Vasanthrao 2009 and Mahesh 2018.

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84 The variation in vegetative traits concerning stem girth among the varieties might be due to  
85 variation in genetic makeup more or less similar results have been reported by Reddy *et al.*,  
86 2003; Dalal *et al.*, 2005. Significant differences were observed among the mango cultivars  
87 concerning the date and time of panicle emergence. The date of panicle emergence is earliest in  
88 Baneshan (24th to 29th October) followed by Totapuri (14th to 19th November) and Alphonso  
89 (14th to 29th November). While late panicle emergence was noticed in varieties Dashehari (12th to  
90 16th February) followed by Khadar (2nd to 8th December). The seasonal cyclic change of  
91 growth, flower, fruit and their development differ between cultivars and geographical location.  
92 The variation observed in terms of panicle initiation might be due to the difference in the genetic

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93 composition of parental mango cultivars. The phenology pattern is strongly under environmental  
94 control in mangoes.

95 Kadar, Pairi and Totapuri were found to have regular bearing habits. Whereas the rest of the  
96 cultivars showed irregular bearing habits. A maximum number of panicles per tree was observed  
97 in Dashehari (329.67) followed by Kesar (321.44) and Pairi (229.44). The minimum number of  
98 panicles per tree was observed in Malgoa (156.44). Chandra *et al.*, 2001, observed 1236 (Kesar)  
99 to 10,377 (Mallika) panicles per tree. Similar results were also reported by Dalal *et al.*, 2005;  
100 Bakshi *et al.*, 2012 in mango.

101 The panicle length was observed highest in cultivar Totapuri (38.58 cm) followed by Khadar  
102 (35.45 cm) however minimum panicle length was found in Malgoa (27.69 cm). The variation in  
103 size and shape of the panicle in mango cultivars might be due to genetic composition and more  
104 specifically the physiological condition of the shoot on which the panicle arises. In the same line  
105 of work Chandra *et al.*, 2001 reported that the panicle length has distinct variation in eight mango  
106 cultivars and hybrids under agroclimatic conditions of Odisha. In the experiment, the earliest  
107 fruit set in Baneshan (4th to 10th November) followed by Totapuri (29th November to 5th  
108 December). The difference in the time of appearance of flowers in different cultivars might be  
109 due to the genetic constitution of a particular cultivar.

110 Among the various factors that influence fruitfulness in mangoes several hermaphrodite  
111 flowers per panicle is the most important as it decides fruit set per cent which in terms influences  
112 the productivity of the tree. **Verities** differed significantly concerning the number of  
113 hermaphrodite flowers per panicle.

114 Table 1. Morphological parameters of mango varieties under the Northern dry zone of Karnataka

Sl. No.	Treatment	Tree height (m)	Tree spread (m)		Tree canopy (m <sup>2</sup> )	Trunk girth (cm)	Number of primary branches	Number of secondary branches	Leaf area (cm <sup>2</sup> )
			N-S	E-W					
1	Khadar	3.41	4.40	4.79	13.27	40.67	4.89	13.22	48.26
2	Baneshan	3.82	3.72	3.59	14.74	53.44	4.00	9.89	41.32
3	Alphonso	3.49	3.75	3.10	13.24	35.61	3.44	8.22	42.06
4	Kesar	2.69	3.40	3.43	8.71	37.67	5.11	10.89	42.64
5	Dashehari	2.78	3.11	3.23	10.33	43.44	5.22	11.00	48.91

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6	Pairi	2.50	3.19	3.05	7.60	29.22	4.33	9.56	41.01
7	Totapuri	3.40	3.34	3.00	11.87	42.67	4.33	8.44	43.81
8	Malgoa	2.51	3.31	3.24	7.26	43.78	4.67	8.78	38.12
	<b>S.Em±</b>	<b>0.21</b>	<b>0.25</b>	<b>0.28</b>	<b>0.95</b>	<b>1.25</b>	<b>0.26</b>	<b>0.31</b>	<b>1.48</b>
	<b>CD at 5%</b>	<b>0.63</b>	<b>0.77</b>	<b>0.85</b>	<b>2.89</b>	<b>3.81</b>	<b>0.80</b>	<b>0.93</b>	<b>4.50</b>
	<b>CV (%)</b>	<b>11.74</b>	<b>12.39</b>	<b>14.13</b>	<b>15.19</b>	<b>5.33</b>	<b>10.18</b>	<b>5.32</b>	<b>5.94</b>

115

116 Table 2. Reproductive parameters of mango varieties under the Northern dry zone of Karnataka

Sl. No.	Treatment	Bearing habit	Date of panicle emergence	Date of fruit set	Number of panicles per tree	Panicle length (cm)	Number of hermaphrodite flowers per panicle	Number of staminate flowers per panicle	Number of fruits per panicle at harvest	Fruit set percentage (%)
1	Khadar	Regular	Dec 2 - Dec 8	Dec 19 - Dec 26	170.00	35.45	327.78	1050.33	1.18	0.05
2	Baneshan	Irregular	Oct 24 - Oct 29	Nov 4 - Nov 10	213.89	31.36	252.40	433.78	1.51	0.04
3	Alphonso	Irregular	Nov 14 - Nov 29	Dec 5 - Dec 12	161.22	32.01	350.78	1316.89	1.29	0.04
4	Kesar	Irregular	Nov 15 - Nov 20	Nov 30 - Dec 6	321.44	29.95	440.33	1499.00	1.15	0.04
5	Dashehari	Irregular	Feb 12 - Feb 16	Feb 25 - March 2	329.67	31.56	554.89	3001.00	1.48	0.06
6	Pairi	Regular	Nov 21 - Nov 26	Dec 2 - Dec 9	229.44	29.91	233.67	1825.44	1.18	0.03
7	Totapuri	Regular	Nov 14 - Nov 19	Nov 29 - Dec 5	225.67	38.58	435.56	1256.89	1.26	0.08
8	Malgoa	Irregular	Nov 24 - Nov 29	Dec 9 - Dec 16	156.44	27.69	335.33	1310.44	1.29	0.04
	<b>S.Em±</b>	-	-	-	<b>14.95</b>	<b>1.02</b>	<b>139.21</b>	<b>7.43</b>	<b>0.06</b>	<b>0.01</b>
	<b>CD at 5%</b>	-	-	-	<b>45.35</b>	<b>3.09</b>	<b>422.18</b>	<b>22.54</b>	<b>0.19</b>	<b>0.02</b>
	<b>CV (%)</b>	-	-	-	<b>11.46</b>	<b>5.50</b>	<b>16.50</b>	<b>3.51</b>	<b>8.58</b>	<b>19.02</b>

117

118 The maximum number of hermaphrodite flowers per panicle was found in Dashehari (554.89)  
119 followed by Kesar (440.33). The minimum number of hermaphrodite flowers per panicle was  
120 found in Pairi (233.67). Mango is known to exhibit diverse types of flowers. From this study, it  
121 is clear that the productivity of mango is influenced by the number of hermaphrodite flowers  
122 which normally decides the per cent of fruit set. Hong and hui, 2001; Chandra *et al.*, 2001; Asif  
123 *et al.*, 2002 and Dalal *et al.*, 2005 in mango. The number of staminate flowers per panicle is  
124 considered to be one of the important factors towards the unfruitfulness of mango. Because  
125 enormous staminate flowers produced will drain out the nutrients from the tree, which are  
126 otherwise utilized for the growth and development of hermaphrodite flowers. Verities differ  
127 significantly among themselves for the number of staminate flowers per panicle. The maximum  
128 number of staminate flowers per panicle was found in Dashehari (3001.00) followed by Pairi  
129 (1825.44). This may be the reason for Pairi and Kesar being low-yielders due to a greater number  
130 of staminate flowers per panicle. The minimum number of staminate flowers per panicle was  
131 found in Baneshan (433.78). Similar results were reported by Kumar and Bramhachari *et al.*  
132 (2014) in Kumar and Bramhachari (Table 2).

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133 The maximum number of fruits per panicle at harvest was found in Baneshan (1.51)  
134 followed by Dashehari (1.48). The minimum number of fruits per panicle at harvest was found in  
135 Kesar (1.15). Bakshi *et al.* (2012) reported number of fruits per panicle at harvest ranged from  
136 0.81 to 1.67, these results were in agreement with the present investigation (Table 2).

137 In fruit crops like mango fruit set per cent Is the most relevant factor in deciding the fruitfulness  
138 of mango. Among the different cultivars, the maximum fruit set (%) was found in Totapuri (0.08  
139 %) The minimum fruit set (%) was found in Pairi (0.3 %). From these facts, it is obvious that the  
140 cultivar, that had a high fruitset percentage proved to have more potential with a greater number  
141 of fruits per tree, which referred to the highest percentage. These findings are in line with  
142 Vasantrao's (2009) observations of the study (Initial fruit set percentage ranged from 3.69 to  
143 8.68%). The variation may be due to the different cultivars used in this study and the number of  
144 hermaphrodite flowers per panicle (Table 2).

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145 There were distinct variations for different vegetative and flowering characters among the  
146 mango cultivars under study. Based on the results obtained, it may be concluded that the verities  
147 like Baneshan, Totapuri and Dashehari were superior in most of the characters. The information  
148 generated from this study will be useful for various breeders for the improvement of verities by

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149 selecting suitable parental material. This research work can be further validated by evaluating  
150 these **verities** with suitable molecular **markers**

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