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Study on flowering behaviour of mango cv. Langra in Kymore Plateaue and Satpura hills of Madhya Pradesh

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Abstract
Forty clones of Langra variety of mango were selected for study the flowering behavior at Fruit Research Station, Imalia, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). Significant variation was observed among of clones with respect to date of floral bud initiation, panicle length, number of peniclets, sex ratio. Maximum panicle length (21.16 cm), number of paniclets (41.24 panicle^{-1}), flower shoot length (53.51cm), number of malformed panicle (15.53 m^{-2}), number of healthy panicle (45.43 m^{-2}), total number of flowers (582.54), total number of hermaphrodite flowers (371.23), total number of male flower (261.41) and sex ratio (0.60%) was recorded with clone L-60, L-22, L-24, L-21,L-14, L-61, L-66, L-62 and L-22, respectively.

Keywords: Mango cv. Langra, flowering behavior, Paniclets, hermaphrodite flower, sex ratio

Introduction
Mango (*Mangifera indica* L.) belonging to family Anacardiaceae is one of the commercially important fruit crops and is having wider adaptability with respect to soil, climate and altitude for its successful cultivation and it is universally considered as one of the most important fruit crops in tropical and subtropical areas of the world (Sharma *et al.* 2015) [7]. It is now widely spread throughout the tropics and sub tropics which comprises of 73 genera and about 830 species and its origin in the north foothills of India-Myanmar region (Yamanaka *et al*., 2006) [8]. Excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and hurtful value recognize mango as one of the best fruits in the world markets. Mango tree usually flowers in spring and produces attractive fruits. Mango inflorescence is a branched terminal panicle, up to 0.6 m long and has several hundred to several thousand flowers. It bears two types of flowers, male and hermaphrodite flowers. Sex ratio is a variable component within panicles, tree and among cultivars. The initial fruit set is directly related to the proportion of perfect flowers (Singh *et al*., 2015) [5].

Mango belongs to the group of plants, in which an antagonism between vegetative vigour and flowering intensity is observed. Mango trees are generally induced to flower between October to December in northern hemisphere and during June to August in southern hemisphere. However, irregularity of flowering in mango, which varies in time and intensity of flowering from year to year to almost complete biennial, is not an uncommon phenomenon. Moreover, at several occasions, due to lack of information on flowering behaviour of parental cultivar, breeding efforts is under-performed. The information pertaining to initiation of flowering, flowering duration, sex ratio, pollen viability etc. has significant implications on success of breeding efforts. In order to have a scheme of mango hybridization employing diverse parental cultivars, flowering behaviour of potential parental cultivars need to be investigated. Several studies have been made on characterization of intra-varietal variability of many different cultivars of mango. However, clonal variability studies in ‘Langra’ mango are limited. In the light of aim present study was initiated to study the extent of clonal variability exists in cv ‘Langra’ mango in flowering behavior.

Materials and Methods

The experiment was carried out during 2018-2019 and 2019-2020 at Fruit Research Farm, Imalia, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) which is situated at 22°49' and 20°80' North latitude and 78°21' and 80°58' East longitude at an attitude of 411.78 meter above the mean sea level. The average rainfall ranges from 1350 mm, winter rains are also received usually. The soil of experimental site was clayey in texture (58.4% clay, 22.5% silt and 20.1% sand) having pH 7.2, medium available N (302 kg ha^{-1}), high in P (22.6 kg ha^{-1}) and K (430.7 kg ha^{-1}) with medium organic carbon (0.70%). Healthy and vigorous forty superior clones from 50 year old plantation of Langra were selected for the collection of data and the data was analyzed in Randomized Block Design (RBD). The observations were made on a daily basis to determine the time of first floral bud initiation from December to January. Panicle length was measured using a measuring scale from shoot apex to panicle apex. An average of nine panicles was taken for calculating mean value for panicle length. The number of paniclets per panicle was counted at full bloom stage of nine panicles of the individual clone of mango tree and average number of paniclets was worked out. Branches from all directions were tagged and malformed and healthy panicles were counted. Day to 50% bloom was calculated on the basis of number of days taken for emergence of 50 per cent panicles on individual tree. These panicles were marked to determine the number of total flower, male and hermaphrodite flowers. Sex ratio was calculated by dividing number of male flowers with number of hermaphrodite. This indicates the presence of male flowers per hermaphrodite flowers.

Results and Discussions

Studies taken up in orchard Table 1 ascertained, there were difference in the mango clones that the date of first floral bud initiations was earliest in L-11 followed by L-15, L-31, L-34, L-42, L-46, L-56 clones on 24th December. However, remaining other clones was late floral bud initiation. Flowering in mango is commonly related with dormancy of the terminal growth which is controlled by low temperature in subtropics (Chacko *et al*., 1971) [1]. The seasonal cyclic change of growth, flower, fruit and their development differ between cultivars and location. The variation observed in terms of panicle initiation might be due to the differences in genetic composition of parental mango genotypes. Phenology pattern is strongly under environmental control in mango. The maximum length of panicle (21.16 cm) was found in clone L-60 while the minimum length of panicle was found in L-29 (4.20 cm). Maximum number of paniclets were recorded in L-22 (41.24) and minimum was recorded in L-29 (4.16) followed by L-37. The total number of panicle in a cultivar greatly depends on the genetic potential of the cultivar, its interaction with the environment and varies with place and season. Mango is a terminal bearer and is polygamous in nature bearing both perfect and staminate flower. Both types of flowers are born on same inflorescence i.e. andromonocious (Mukherjee and Litz, 2009) [2]. Maximum flower shoot length was observed in L-24 (53.51 cm) while, Minimum flower shoot length in L-46 (3.83 cm). Maximum malformed panicles were found in L-21 (15.53) while minimum in L-40 (0.48). Maximum healthy panicles were found in L-14 (45.43) while, minimum L-21 (3.30).

Table 1: Flowering behaviour of forty mango clones cv. Langra

S. No.	Clones	Date of first Floral bud initiation	Panicle length (cm)	Number of paniclets panicle $^{-1}$	Flower shoot length (cm)	Number of malformed panicle (m^2)	Number of healthy panicle (m^2)
1.	L-11	4th week of Dec.	13.68	36.44	16.20	2.46	41.57
2.	L-12	1st week of Jan.	14.71	36.62	14.06	2.33	30.28
3.	L-13	1st week of Jan.	14.33	35.25	17.34	3.67	30.44
4.	L-14	1st week of Jan.	15.17	36.46	13.12	2.27	45.43
5.	L-70	1st week of Jan.	11.66	31.82	14.12	1.46	28.54
6.	L-15	4th week of Dec.	16.42	35.43	12.38	5.25	32.62
7.	L-16	1st week of Jan.	13.16	35.33	15.83	2.47	21.52
8.	L-17	1st week of Jan.	13.74	29.06	20.10	8.04	29.23
9.	L-68	1st week of Jan.	14.27	39.20	17.26	5.14	31.61
10.	L-69	1st week of Jan.	13.75	32.10	13.60	1.52	28.60
11.	L-18	1st week of Jan.	20.04	30.26	12.87	6.23	29.46
12.	L-20	1st week of Jan.	20.03	31.63	32.68	5.27	27.45
13.	L-22	1st week of Jan.	15.64	41.24	28.60	2.50	14.43
14.	L-21	1st week of Jan.	14.30	36.34	19.75	15.53	13.30
15.	L-26	1st week of Jan.	14.77	32.64	10.58	5.16	26.19
16.	L-25	1st week of Jan.	12.73	32.62	39.11	5.60	24.56
17.	L-24	1st week of Jan.	13.41	30.39	53.51	6.20	18.36
18.	L-27	1st week of Jan.	15.07	39.34	16.73	11.58	20.67
19.	L-28	1st week of Jan.	11.66	26.66	20.16	7.13	31.46
20.	L-29	1st week of Jan.	4.20	4.16	15.19	4.66	33.64
21.	L-31	4th week of Dec.	12.32	37.07	8.96	3.59	23.45
22.	L-32	1st week of Jan.	9.60	29.81	12.91	2.33	29.37
23.	L-37	1st week of Jan.	14.33	4.16	11.75	5.45	35.38
24.	L-35	1st week of Jan.	13.77	41.01	12.18	0.79	36.27
25.	L-34	4th week of Dec.	16.64	37.23	13.22	0.63	35.59
26.	L-38	1st week of Jan.	12.21	9.30	12.55	1.66	38.46
27.	L-40	1st week of Jan.	14.18	31.35	12.37	0.48	35.46
28.	L-43	4th week of Dec.	15.17	32.42	12.61	0.56	44.57
29.	L-42	4th week of Dec.	15.23	33.60	8.37	2.56	42.54
30.	L-41	1st week of Jan.	14.33	38.72	11.30	3.20	28.49
31.	L-46	4th week of Dec.	15.46	27.18	3.83	7.59	24.60
32.	L-54	1st week of Jan.	14.23	32.13	13.15	4.57	30.28

33.	L-59	1st week of Jan.	14.84	27.73	4.61	1.60	43.55
34.	L-57	4th week of Dec.	13.25	33.26	11.79	3.55	31.38
35.	L-60	1st week of Jan.	21.16	34.75	12.25	2.54	38.03
36.	L-62	1st week of Jan.	17.96	37.47	13.71	1.60	28.56
37.	L-61	1st week of Jan.	15.96	32.39	8.79	6.37	26.58
38.	L-63	1st week of Jan.	15.50	31.48	7.25	5.20	25.41
39.	L-66	2th week of Jan	16.96	40.50	7.35	8.66	25.60
40.	L-72	1st week of Jan.	15.26	36.57	6.38	2.24	35.60
C.D. (at 5%)		-	1.52	0.32	0.20	0.33	0.20
S.E.(m)		-	0.54	0.11	0.07	0.12	0.72
S.E.(d)		-	0.76	0.16	0.10	0.17	0.10

L-13, L-15, L-18 and L-31 clones of mango showed the appearance of 50% in 1st week of February. The differences observed in terms of time of appearance of 50% flower stage among parental mango cultivars might be attributed to the genetic differences and interaction of genetic- environmental factors (Singh *et al*. 2014) [6]. Total number of flowers ranged between 502.96 in L-18 to 382.54 in L-61. L-66 showed maximum total number hermaphrodite flower 371.23 while minimum total number of hermaphrodite flower was found in L-18 (302.31). The lesser number of hermaphrodite flowers in early emerged flowers may be attributed to the fact that cool weather during inflorescence contributes to the fewer perfect flowers (Naik and Rao, 1943, Singh *et al*., 1996) [3, 4]. L-62 showed maximum total number male flower 261.41 while minimum total number of male flower was found in L-13 (160.08). Sex ratio varied from 0.79 (L-62) to 0.42 (L-11, L-12).

Table 2: Flowering behaviour of forty mango clones cv. Langra

S. No.	Clones	Days to 50% flowering	Number of flowers	Number of hermaphrodite flowers	Number of male flower	Sex ratio %
1.	L-11	2nd week of Feb.	502.96	351.20	151.76	0.42
2.	L-12	2nd week of Feb.	510.76	356.75	154.01	0.42
3.	L-13	1st week of Feb.	521.20	361.12	160.08	0.43
4.	L-14	2nd week of Feb.	523.17	337.10	169.39	0.55
5.	L-70	2nd week of Feb.	503.46	330.38	173.08	0.52
6.	L-15	1st week of Feb.	522.24	333.96	191.61	0.57
7.	L-16	2nd week of Feb.	525.12	329.16	195.95	0.58
8.	L-17	2nd week of Feb.	507.18	330.47	176.69	0.53
9.	L-68	2nd week of Feb.	524.18	320.00	204.17	0.62
10.	L-69	2nd week of Feb.	527.95	311.16	216.79	0.70
11.	L-18	1st week of Feb.	526.07	302.31	223.76	0.73
12.	L-20	2nd week of Feb.	524.64	307.77	216.87	0.70
13.	L-22	2nd week of Feb.	530.24	331.95	198.28	0.60
14.	L-21	2nd week of Feb.	539.73	342.70	197.00	0.57
15.	L-26	2nd week of Feb.	556.60	322.36	234.23	0.73
16.	L-25	2nd week of Feb.	541.27	328.00	213.26	0.64
17.	L-24	2nd week of Feb.	543.23	344.00	199.23	0.57
18.	L-27	2nd week of Feb.	532.96	344.13	188.83	0.54
19.	L-28	2nd week of Feb.	531.16	352.43	178.73	0.50
20.	L-29	2nd week of Feb.	534.23	347.26	186.96	0.53
21.	L-31	1st week of Feb.	525.30	353.16	172.13	0.48
22.	L-32	2nd week of Feb.	528.40	357.26	171.13	0.47
23.	L-37	2nd week of Feb.	532.24	361.34	170.92	0.47
24.	L-35	2nd week of Feb.	518.30	333.11	185.18	0.55
25.	L-34	2nd week of Feb.	521.26	343.70	177.56	0.51
26.	L-38	2nd week of Feb.	522.48	351.52	170.95	0.48
27.	L-40	2nd week of Feb.	531.63	341.22	190.41	0.55
28.	L-43	2nd week of Feb.	532.31	324.56	207.74	0.62
29.	L-42	2nd week of Feb.	537.61	343.26	194.34	0.56
30.	L-41	2ndweek of Feb.	567.55	342.89	224.49	0.65
31.	L-46	2nd week of Feb.	521.22	322.63	198.55	0.61
32.	L-54	2nd week of Feb.	531.35	341.90	189.45	0.55
33.	L-59	2nd week of Feb.	563.37	341.86	221.51	0.64
34.	L-57	2nd week of Feb.	577.57	353.28	224.29	0.63
35.	L-60	2nd week of Feb.	581.73	362.60	219.13	0.60
36.	L-62	2nd week of Feb.	575.91	314.50	261.41	0.79
37.	L-61	2nd week of Feb.	582.54	352.96	229.57	0.65
38.	L-63	2nd week of Feb.	543.24	363.20	180.04	0.50
39.	L-66	2nd week of Feb.	536.67	371.23	165.44	0.44
40.	L-72	2nd week of Feb.	556.61	360.43	196.18	0.54
S Em±		-	0.54	1.00	2.83	0.007
C.D. (at 5%)		-	1.52	2.82	7.98	0.019

Conclusion

Based on the results, it may be concluded that flowering behaviour of mango cultivars differ significantly. Clone L-62 perform best with higher percentage of sex ratio. So it could be used as one of the parent in mango breeding programmes for enhancing yield. This study may also be useful for expanding the harvesting period and fulfilling other breeding objectives.

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