

Study of Different Variants of Cv. Langra (*Mangifera indica* L.) Based on Morphological and Yield Characters

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AA, RK and BDP designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AA, RK and BDP managed the analyses of the study. All the authors managed the literature searches, read and approved the final manuscript.

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ABSTRACT

Study of morphological and yield characters of different genotypes of mango are easy and convenient methods to identify promising and desired genotype during breeding programme. So, keeping in view, the trial was conducted under the experimental area of BAU, Sabour with objective of morphological and yields characterization of the variants of cv. Langra during the year 2012-13. The variants of cv. Langra significantly varied in respect of tree height(6.20 m to 11.40 m), trunk girth (95.00 cm to 280.00 cm), tree spread (East-West: 8.45 m to 17.40 m, North-South: 9.15 m to 17.05 m), duration of flowering (16.00 days to 20.00 days), fruit maturity (101.00 days to 123.00 days), fruit size(length: 8.58 to 13.66 cm, breadth: 6.39 to 10.87 cm), fruit weight (182.20 g to 843.90 g), fruit volume (171.40 ml to 699.40 ml), numbers of fruit per tree (32.50 to 1127.00 fruits) and fruit yield per tree (10.95 to 358.83 kg).

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These results shows the significant variations in genetic level of different variants of cv. Langra, which can be used for introduction of superior variant and further, it can also be used in breeding programs.

Keywords: Mango; morphology; variants; characters; yield.

1. INTRODUCTION

Mango (*Mangifera indica* L.) is an important member of the family Anacardiaceae and belongs to genus *Mangifera* order Sapindales. It is believed to have originated in Indo-Burma region [1,2,3] Mango is being cultivated for more than 4000 years in Eastern India and Burma [4]. Mango is the most popular fruit among millions of people in India and is also National fruit of India. Global production of mango is concentrated mainly in Asia and more precisely in India [5]. Mango is rich in vitamins as well as beta carotene, minerals and antioxidants etc. and also contains an enzyme with stomach soothing properties. The medicinal use of mango include protection against cancer, serves as astringents in case of diarrhoea, chronic dysentery, chronic arthritis, lowering blood cholesterol level etc. Raw mango fruits are used for making chutney, pickles and juices. The ripe fruit besides being used for dessert are also utilized for preparing several products like squash, syrup, nectar, jam, jelly etc. These excellent uses also bring a name to mango as "King of fruit" [6]. Domestication as well as shift to the commercial production has caused severe genetic erosion. At present, some released varieties as well as exotic/introduced varieties are cultivated commercially few of them are area specific. For continued improvement of mango through breeding to overcome threats from diseases, insect, pests or biotic stresses and to evolve varieties according to consumer preferences, a diver's gene pool is essential. This is important not only for the identification of species but also to determine their genetic divergence.

Langra is an important commercial mango cultivar of North India including Bihar also, it is biennial bearer and mid season maturity with having good keeping quality. It is more preferred cultivar because of having more pulp content, firm flesh, lemon yellow in colour, thin skinned, small size of stone, scarcely fibrous etc. [5]. It covers more area under cultivation than the any other cultivars of Bihar. Simultaneously, great variations are observed in this particular variety. The problem arises that which clone of Langra is true to type. There is apprehension of availability

of chance seedling of Langra that need to select for its evaluation & estimation variability among the available Langra clones. It was observed that significant variation exists among the tree of the same clone in an orchard with respect to fruit shape, size, colour and quality. This is ascribing to bud mutation. Asexual propagation enables us to preserve the accumulated mutation which would normally be sieved out by sexual propagation. There is need to varietal improvement programme for formulation with the main objectives to screen out the most promising clone of Langra for Bihar condition.

At present several mango cultivars have many synonyms in different regions which make identification difficult. The efficacy of a selection scheme or genetic analysis based on phenotype is a function of heritability of the trait. Factors like environment, traits of multiagency and quantitative inheritance or partial and complete dominance often compound the expression of genetic traits. Many of these complications of a phenotype-based assay can be overcome through direct identification of genotype with morphological and yield characters.

Keeping the view of above facts, the present investigation was undertaken to evaluate the genetic diversity in different variants of cv. Langra using morphological and yield characters.

2. MATERIALS AND METHODS

The field experiment of this investigation was conducted under the experimental area of Department of Horticulture (Fruit and Fruit Technology), Bihar Agricultural College, Sabour a campus of Bihar Agricultural University, Sabour, Bhagalpur during the year 2012-13. The ten genotype namely T₁- Dholi KothiMaldah, T₂- Surajgarha Maldah, T₃- Kalkattia Maldah, T₄- Langra/Maldah, T₅- Seso Maldah, T₆- Safed Lucknow, T₇- Digha Maldah, T₈- Kala Maldah, T₉- Banarsi Langra and T₁₀- Dudhiya Maldah were selected for investigation.

2.1 Observation Recorded

The observations on different characters under study were recorded in a year. Detailed

procedures followed for recording of different observations were as follows:

2.1.1 Tree height

The tree height was measured by a measuring stick from ground level to tip of the highest shoot and average of the data was expressed in meter.

2.1.2 Trunk girth

The trunk girth was measured at 50 cm above from the ground level by measuring tape and average of the data was expressed in cm.

2.1.3 Tree spread

The tree spread was measured by a measuring tape as canopy diameter (average of East-West and North- South dimensions) and average of the data was expressed in meter.

2.1.4 Rachis colour

The rachis colour was recorded at peak flowering stage.

2.1.5 Inflorescence shape

The inflorescence shape was recorded at the time of peak flowering stage.

2.1.6 Foliage density

The foliage density of tree was recorded during the month of November.

2.1.7 Duration of flowering

Duration of flowering was recorded from first opened of flower to 85-90% flower buds have opened in panicle and it was calculated in days.

2.1.8 Days to maturity

It was recorded by counting the days taken from bud break to maturity attained by the fruit in individual trees.

2.1.9 Fruit characteristics

The ten fully matured fruits from each replication were selected randomly from each of the ten cultivars for the assessment of fruit characters.

2.1.10 Size of fruits

The fruits were harvested at full maturity. The ten fruits were selected randomly from each cultivar

of all replications and their ultimate length and breadth were recorded with the help of a vernier caliper in cm and average size was worked out.

2.1.11 Fruit weight

The ten fruits from each treatment of all replications, which were used for the measurement of fruits size. This fruits were weighted carefully with the help of electronic balance in gram and the average weight of fruits was calculated.

2.1.12 Volume of fruit

The volume of fruits was measured by water displacement method. The ten fruits under each treatment and each replication were taken out and mean volume was recorded replication wise.

2.1.13 Number of fruits per plants

The number of fruits per treatment and replication wise counted at the time of harvesting of fruits and their mean was calculated.

2.1.14 Fruit yield per plants

The number of fruits per treatment was multiply by fruit weight and their mean was calculated and expressed in kg per tree.

3. RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed under the following heads:

3.1 Tree Height, Trunk Girth, Plant Spread (East- West and North-South)

The data presented in Table 1, clearly showed that different variants of cv. Langra significantly varied in respect to plant height, plant girth and Plant spread (East- west and North-South).

3.1.1 Tree height

A critical examination of the Table 1 clearly exhibited the significant variation in tree height among the different variants of cv. Langra. The maximum tree height of 11.40 m was recorded in cv. Banarsi Langra which was found at par with cv. Dudhiya Maldah, Safed Lucknow and Digha Maldah with having value of 11.30 m, 11.10 m and 10.30 m respectively. The minimum plant height of 6.20 m was obtained in cv.

Langra/Maldah followed by cv. Kala Maldah (7.16 m), Surajgarha Maldah (7.20 m), Kalkattia Maldah (7.30 m) and Dholi Kothi Maldah (8.40 m). Tree height to canopy spread ratio was differed among the different cultivars of mango under Uttarakhand agro-climatic condition [7]. According some researcher mango trees are often leafy and varied in locality to locality from small to large size and reaching up to 30 meters [8]. But in modern plantations, however, the size and shape of the plant is determined by the density of planting and cultural practices, as the pruning system.

3.1.2 Trunk girth

The average of trunk girth during the experimental year has been given in Table 1. The variant Banarsi Langra produced maximum trunk girth of 280.00 cm and it was found statistically at par with cv. Digha Maldah (255.00 cm). On the other hand Kalkattia Maldah produced minimum trunk girth of 95.00 cm followed by cv. Langra/ Maldah (110.00 cm). This might be due to the varietal differences and/or the variation of environmental factors. Morphological characters like trunk girth variation were assessed in different accessions of mango as compared to other characters [9]. This result also agreed with the findings obtained by researcher [10].

3.1.3 Plant spread

The data with respect to tree spread in East-West and North-South direction of different variants were measured and their values have been presented in Table 1. The maximum spread in East-West and North-South direction was

recorded in Safed Lucknow (17.40 m and 17.05 m respectively) followed by cv. Banarsi Langra with value of 13.85 m in East-West direction and cv. Digha Maldah showed at par value of 15.00 m in North –South direction. The minimum tree spread in East-West and North-South direction was recorded in Langra/ Maldah (8.45 m and 9.15 m). Plant spread variation in different variants may be due to the genetic characteristic of the genus *Mangifera*. The similar type of observation of broad morphologic diversity was also found in native mango genotype of Mexico [7]

3.2 Rachis Colour, Inflorescence Shape, Foliage Density, Duration of Flowering and Fruit Maturity

The variation in respect to rachis colour, inflorescence shape, foliage density, duration of flowering and fruit maturity was significantly varied among the different variants of cv. Langra and noted results from the present investigation are presented in Table 2.

3.2.1 Rachis colour and inflorescence shape

Data concern to rachis colour and inflorescence shape of different variants was presented in Table 2. The data pertaining to rachis colour was registered in yellowish green colour and inflorescence shape in the form of conical among the all variants of cv. Langra. The similarity in rachis colour and inflorescence shape was happen due to similarity in genetic constitution of different cultivar of cv. Langra which confirmed the earlier findings [11,12], and [7].

Table 1. Morphological characterization of different variants of cv. Langra

Treatment	Variants	Tree height (m)	Trunk girth (cm)	Plant spread (m)	
				East-West	North-South
T ₁	Dholi Kothi Maldah	8.40	165.00	12.25	10.70
T ₂	Surajgarha Maldah	7.20	155.00	11.00	11.80
T ₃	Kalkattia Maldah	7.30	95.00	9.50	9.25
T ₄	Langra/Maldah	6.20	110.00	8.45	9.15
T ₅	Seso Maldah	8.65	140.00	12.45	11.15
T ₆	Safed Lucknow	11.10	245.00	17.40	17.05
T ₇	Digha Maldah	10.30	255.00	13.75	15.00
T ₈	Kala Maldah	7.16	185.00	9.43	9.26
T ₉	Banarsi Langra	11.40	280.00	13.85	12.20
T ₁₀	Dudhiya Maldah	11.30	205.00	11.50	14.25
SEm (±)		0.42	8.76	0.66	0.71
CD(P=0. 5)		1.24	26.03	1.95	2.10
CV %		8.10	8.27	9.51	10.26

3.2.2 Foliage density

It is evident from the Table 2 that foliage density in all variants of cv. Langra were medium dense except Dholi Kothi Maldah, Seso Maldah and Dudhiya Maldah which showed the dense foliage density. This variation in foliage density might be due to diverse characteristics of different mango variants of cv. Langra in different climatic condition. This observation was similarity with the earlier finding of researcher [11] and [12].

3.2.3 Duration of flowering (days)

The duration of flowering (days) was recorded at 50 to 95 per cent of flowers were bloomed in a panicle under different variants. By observing the Table 2 it is clear that the minimum duration was taken in flowering by variant of Surajgarha Maldah (16 days) and it was found at par with Dholikothi Maldah (17.00 days), Safed Lucknow (18.00 days), Kala Maldah (17.00 days) and Dudhiya Maldah (18.00 days) whereas; maximum days was observed in the variants of Kalkattia Maldah (20.00 days), Langra/Maldah (20.00 days), Seso Maldah (20.00 days) and

Banarsi Langra (20.00 days). The duration of flowering (days) was differed in different variants of cv. Langra due to genetic differences based on different geographical origin and their genetic exchange in respective geographical region [13]. Further, it was found significant variation in flowering pattern in some *Mangifera* species [14].

3.2.4 Day to maturity (days)

The average time taken for maturity (days) of fruits during the experimental period was presented in Table 2. The variants Dholi Kothi Maldah took minimum of 101 days in maturity which was found at par with variants of Seso Maldah (110 days) and Digha Maldah (106 days). On the other hand the maximum time in fruit maturity of 123 days was spent by Langra/Maldah followed by Kala Maldah (121 days), Dudhiya Maldah (120 days), Banarsi Langra (117 days) and Kalkattia Maldah (116 days). This might be due to variations in fruit maturity from locality to locality of the cultivars. The similar observation was observed in previous workers [13,14,15], and [16].

Table 2. Morphological characterization of different variants of cv. Langra based on different characters

Treatment	Variants	Rachis colour	Inflorescence shape	Foliage Density	Duration of flowering (days)	Day to maturity (days)
T ₁	Dholi Kothi Maldah	Yellowish green	Conical	Dense	17	101
T ₂	Surajgarha Maldah	Yellowish green	Conical	Medium	16	115
T ₃	Kalkattia Maldah	Yellowish green	Conical	Medium	20	116
T ₄	Langra/Maldah	Yellowish green	Conical	Medium	20	123
T ₅	Seso Maldah	Yellowish green	Conical	Dense	20	110
T ₆	Safed Lucknow	Yellowish green	Conical	Medium	18	114
T ₇	Digha Maldah	Yellowish green	Conical	Medium	19	106
T ₈	Kala Maldah	Yellowish green	Conical	Medium	17	121
T ₉	Banarsi Langra	Yellowish green	Conical	Medium	20	117
T ₁₀	Dudhiya Maldah	Yellowish green	Conical	Dense	18	120
SEm (±)		-	-	-	0.74	3.88
CD (P=0. 5)		-	-	-	2.21	11.53
CV %		-	-	-	6.96	5.88

3.3 Fruit Size, Fruit Weight, Fruit Volume, Numbers of Fruit per Tree, Fruit Yield per Tree

The fruit characterization such as fruit size, fruit weight, fruit volume, numbers of fruit per tree, fruit yield per tree of different variants of cv. Langra are presented in Table 3.

3.3.1 Fruit size

3.3.1.1 Length of fruit (cm)

The data concern to fruit length of different variants of cv. Langra was significantly differed during the observation. It clearly indicates that the fruit length was registered maximum in cv. Seso Maldah (13.66 cm) and it was found statistically at par with cv. Dholi Kothi Maldah (13.35 cm) whereas; the minimum was observed in Dudhiya Maldah (8.58 cm) followed by Safed Lucknow (9.35 cm).

3.3.1.2 Fruit breadth (cm)

The maximum fruit breadth of 10.87 cm was noted in Dholi Kothi Maldah which was significantly followed by variants of Seso Maldah, Langra/Maldah and Digha Maldah with having fruit breadth of 8.76 cm, 7.59 cm and 7.58 cm respectively. The lower value of fruit breadth i.e. 6.39 cm was measured in Safed Lucknow followed by Dudhiya Maldah (7.41 cm), Surajgarha Maldah (7.45cm), Kalkattia Maldah (7.50 cm) and Kala Maldah (7.55 cm).

The variation of fruit size among the different variants of cv. Langra might be due to purely varietal character which is influenced by environments and locations also. This is the reason that when fruits of Mallika from the Abohar (Punjab) gave the more fruit size (16.80 x 12.10 cm) [17] and it was observed in reduced size (12.29 x 6.75 cm) at Sabour, Bihar [18], such variation in size of other cultivars from different localities were also reported by different researchers [19,20,21] and [16]. Further, it was observed the possible cause of differentiation in fruit size was due to the variation in characters of the pericarp like cell size, laticiferous canals, intercellular space etc. in different tissues of the fruits which contribute to increase in length, breadth and thickness of the fruits [15].

3.3.1.3 Weight of fruit (g)

A careful scrutiny of the data in Table 3 indicates that there was significant variation in fruit weight

among the different variants of cv. Langra was recorded. The maximum fruit weight of 843.90 g was produced by cv. Dholi Kothi Maldah and found out standing being significantly superior among the remaining variants; however, it was followed by Seso Maldah (492.4 g) and Kala Maldah (338.0 g). The minimum fruit weight of 182.20 g was noted in Dudhiya Maldah which was showed statistical equality with Safed Lucknow with having fruit weight of 202.30 g. Thus, it is clear that fruit weight is a varietal character which is influenced by environment also. In the present study a wide range of fruit weight from 182.20 to 843.90 g was recorded. More variations from 50 g to 640 g in mango fruit when 60 cultivars were studied under Punjab conditions [22]. More or less similar findings were observed under Sabour condition [18] and among 101 varieties of mango fruit weight was varied from 75 g to 545 g. Other workers had also reported variations from locality to locality of the cultivars [20,23,24] and [25].

3.3.1.4 Volume of fruit (ml)

A perusal of the data in Table 3 indicates that significant differences existed in volume of fruit produced by different variants of cv. Langra. The cultivar Dholi Kothi Maldah produced highest fruit volume of 699.40 ml and proved its superiority over rest of the variants, however; it was significantly followed by the cultivar Seso Maldah (460.20 ml), Langra/Maldah (300.50 ml) and Surajgarha Maldah (295.50ml). The minimum fruit volume of 171.4 ml was noticed in cv. Dudhiya Maldah which was at par with Safed Lucknow (176.40 ml). This was happen due to the volume of fruit is directly proportional to size of fruits and it is a purely varietal character which influenced by environments and locations. Similar results were also reported by earlier workers [19,20] and [21].

3.3.2 Numbers of fruit per tree

The number of fruits per tree was harvested during the experimental year and presented in Table 3. The variant Digha Maldah produced the highest number of 1127.00 fruits per tree followed by Safed Lucknow (968.50 fruits/plant) and Dudhiya Maldah (921.00 fruits/plant). On the other hand Kala Maldah produced minimum number of 32.50 fruits per tree. It might be due to varietal differences. The findings of this study are supported by the idea that yield is highly variable factor depending upon the cultivars and age of plants, climatic conditions, incidence of pests and diseases [26] and [27]. Some researcher had

Table 3. Morphological characterization of different variants of cv. Langra mango using different fruit characters

Treatment	Variants	Fruit size (cm)		Fruit weight (g)	Fruit volume (ml)	Nos of fruit (per tree)	Yield (kg/plant)
		Fruit length (cm)	Fruit breadth (cm)				
T ₁	Dholi Kothi Maldah	13.35	10.87	843.90	699.40	53.50	45.14
T ₂	Surajgarha Maldah	10.37	7.45	305.20	295.50	347.50	106.05
T ₃	Kalkattia Maldah	11.01	7.50	307.00	270.80	527.50	162.94
T ₄	Langra/Maldah	10.64	7.59	330.30	300.50	360.00	118.90
T ₅	Seso Maldah	13.66	8.76	492.40	460.20	490.00	241.27
T ₆	Safed Lucknow	9.35	6.39	202.30	176.40	968.50	195.92
T ₇	Digha Maldah	10.11	7.58	318.00	240.00	1127.00	358.38
T ₈	Kala Maldah	11.28	7.55	338.00	261.30	32.50	10.98
T ₉	Banarsi Langra	10.32	7.56	303.60	275.20	780.50	236.95
T ₁₀	Dudhiya Maldah	8.58	7.41	182.20	171.40	921.00	167.80
SEm (±)		0.43	0.34	28.82	30.29	21.42	17.62
CD (P=0. 5)		0.97	0.76	64.21	67.49	47.73	39.27
CV %		4.00	4.32	7.95	9.61	3.82	10.76

some different opinion that the average fruit weight of an orchard varies from 45 to 729 fruits, irrespective of variety [28]. But majority of the workers had the idea that fruit weight of a cultivar potential is a varietal character.

3.3.3 Yield (kg)

A critical examination of data in Table 3 clearly shows that the significant difference with respect to fruit yield per plant under the different variants of cv. Langra. The variant Digha Maldah significantly produced the maximum fruit yield of 358.83 kg/plant followed by Seso Maldah (240.86 kg/plant) and Banarsi Langra (236.96 kg/plant) whereas; the minimum of 10.95 kg/plant fruit yield was recorded in cv. Kala Maldah. The number of fruit produced by the plant and the yield of mango variety greatly depending upon the variety, tree condition and agro climatic conditions of the growing region [15]. The similar findings were also observed as highest yield per tree (33.26 kg) from Hybrid-010 while the lowest (3.62 kg) was in Hybrid-012 [12].

4. CONCLUSION

The present study confirms that the wide variation that exist among different variants of cv. Langra in respect of morphological and yield characters. The morphological and yield variations obtained in this present investigation may be of help to breeders for various genetic breeding programs in mango cultivars and also

opportunity to select germplasms on the basis of desirable characters.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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