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Analysis of intra-varietal variability in mango (*Mangifera indica* L.) cv. Dashehari

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ABSTRACT

Dashehari is an important export variety of mango for its attractive appearance, excellent taste and pleasing flavour which is cultivated on a commercial level and propagated through vegetative means to ensure multiplication of true to type plants. Despite this, intra-varietal variability is reported in certain varieties although limited. In the present study, 45 Dashehari trees, 25-30 years in age from 15 different orchards in 2 blocks viz. Malihabad and Mall from Agri-Export Zone for mango of Uttar Pradesh, India were selected for study. The significant intra-varietal variability in trunk girth was observed to range from 102.50 to 151.33, number of secondary branches per plant 12 to 29, leaf length 17.45 to 22.55 cm, leaf width 3.95 to 5.62 cm, leaf thickness 0.21 to 0.38 mm and petiole length 2.42 to 4.35 cm. Among panicle characters panicle length ranged from 27.70 to 37.08 cm, panicle width 15.80 to 25.25 cm, number of florets per panicle 38.83 to 66.17 and number of flowers per panicle 1932.83 to 2979.33. The extent of intra-varietal variability was determined in terms of PCV and GCV. However, the highest PCV 22.46, GCV 21.69 and genetic advance as per cent of mean (GAM %) (88.87%) were recorded for number of secondary branches while the maximum value of heritability (100) and genetic advance (1205.90) was recorded for number of flowers per panicle. Dendrogram clusters developed on the basis of tree and leaf parameters the morphotypes under study are grouped into only two major clusters (cluster I and II) with additional sub-clusters, differentiating the morphotypes collected from different areas.

Key words: Clusters, dashehari, dendrogram, heritability, intra-varietal, variability

INTRODUCTION

Mango (*Mangifera indica* L.) under family Anacardiaceae has originated from Indo-Malaya region. It is a highly cross-pollinated and heterozygous plant, performance of which varies with the climate resulting in a high level of genetic diversity. Most cultivars have arisen through selection of desirable types from naturally produced seedlings (Karihaloo *et al.,* 2003) where each cultivar is identified by the characteristic combination of properties such as plant architecture, fruit size, color, taste, flavor etc. (Anu *et al.,* 2015). In north India Dashehari is an important export variety of mango for its attractive appearance, excellent taste and pleasing flavour which is cultivated on a commercial level and they have been established through vegetative propagation to ensure multiplication of true to type plants. Despite this intra-varietal variability in certain varieties of mango from India and other countries have also been characterized based on morphological traits as well as genetic markers (De Souza and Lima, 2004; Rocha *et al.,* 2012). Until recently, morphology-based methods have been used for the characterization of intra-varietal variability in mango where significant variation among the trees of the same variety in an orchard with regard to fruit shape, size, color and quality of the fruits has been observed which was ascribed to bud mutations (Gan *et al.,* 1981; Pandey, 1998). Flowering behaviour, sex expression, yield and physico-chemical attributes of mango varieties are important determinants of assessing their performance. Flowering is a decisive factor in the productivity of mango. The process associated with mango flowering involves shoot initiation followed by floral differentiation, and panicle emergence (Murti and Upreti, 2000). All these developmental events occur in most of the mango cultivars during October-December under tropical as well as subtropical conditions. The induction of floral bud formation is correlated with the prevailing environmental conditions as well as age of terminal resting shoots (Davenport, 2007). However, phenological and physiological models of vegetative growth and flowering in mango have been proposed by a number of workers (Kulkarni, 1991; Davenport, 1993).

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Variability is important source for identifying inherent character which was responsible for further crop improvement. High heritability generally enables the breeder to select plants on the basis of the phenotypic expression (Johnson *et al.*, 1955). As the heritability estimates are often subjected to genotype-environment interaction, estimation of genetic advance is required for expected genotypic progress of a particular character. Studies on the variability using genetic parameters are essential for initiating an efficient breeding programme. The present study was attempt to gather information on genetic variability, heritability, and genetic advance among the important traits of mango cv. Dashehari.

MATERIALS AND METHODS

The present study was conducted to analyze Intra-varietal variability in 45 Dashehari morphotypes during 2016-2017. Three plants each, 25-30 years old from 15 different orchards were selected for study from Agri-Export Zone for mango in Uttar Pradesh, India. The 5-7 month old leaves of uniform age and physiological maturity as per leaf sampling technique for mango (Poffley, 2005) and panicle was collected about 5 fit above ground level from three directions of the plants. Observations were recorded *viz.* leaf length (cm), leaf width (cm), petiole length (cm), panicle length (cm) and panicle width (cm) by using measuring scale while leaf thickness was measured by vernier calipers (Mitutoyo, Japan). However, number of florets per panicle and number of flowers per panicle was counted by manually. Analysis of variance using a randomized block design was done for all the characters by ICAR-SPAR (Statistical Package for Agricultural Research). The GCV, PCV, heritability, GA and GAM% were calculated as per the procedure (Falconer, 1989; Singh and Chaudhury, 1985 and Allard, 1960). A dendrogram was prepared on the basis of tree and leaf parameters using SPSS software for genetic relationships among the morphotypes.

RESULTS AND DISCUSSION

Wide range of variation was observed in tree, leaf and flowering characters of mango cv. Dashehari which indicated the presence of intra-varietal variability in the sample population (Table 1 and Table 2). The significant variability in trunk girth was observed to range from 102.50 to 151.33, number of secondary branches per plant 12 to 29, leaf length 17.45 to 22.55 cm, leaf width 3.95 to 5.62 cm, leaf thickness 0.21 to 0.38 mm and petiole length 2.42 to 4.35 cm. Among panicle characters, panicle length ranged from 27.70 to 37.08 cm, panicle width 15.80 to 25.25 cm, number of florets per panicle 38.83to 66.17 and number of flowers per panicle 1932.83to 2979.33.

Table 2: Average range of panicle parameters for intra-varietal variability in mango (*Mangifera indica* L.) cv. Dashehari

Source of morphotypes	Panicle length (cm)	Panicle width (cm)	Number of florets/panicle	Number of flowers/ panicle
Orchard-1	29.17-31.22	17.58-20.83	41.83-44.67	2212.50-2164.33
Orchard-2	28.85-29.58	17.83-19.93	47.50-51.17	2312.83-2496.67
Orchard-3	28.83-36.33	19.50-25.15	45.33-59.00	2067.67-2890.67
Orchard-4	33.00-37.08	19.92-22.00	39.17-66.17	1941.00-2979.33
Orchard-5	28.50-30.58	16.13-17.75	44.67-49.83	2307.17-2451.67
Orchard-6	31.83-35.00	20.25-22.83	51.83-56.33	2066.67-2658.83
Orchard-7	28.50-35.83	18.32-18.98	53.17-57.83	2397.00-2540.00
Orchard-8	29.67-31.20	17.75-18.70	44.83-49.33	1932.83-2867.50
Orchard-9	27.70-35.92	18.00-24.00	50.00-60.67	2484.50-2675.17
Orchard-10	29.75-35.30	21.83-23.17	38.83-48.17	2378.00-2458.50
Orchard-11	29.53-32.07	23.38-24.87	41.50-44.50	2694.00-2818.17
Orchard-12	32.98-36.25	19.42-20.25	42.17-50.00	2676.17-2821.67
Orchard-13	29.50-35.50	20.00-24.33	42.67-47.17	2725.83-2819.17
Orchard-14	28.50-30.58	19.97-21.97	41.17-42.00	2725.00-2887.50
Orchard-15	29.00-30.00	15.80-18.00	48.17-51.67	2143.33-2307.67
SE(m)±	1.03	0.66	0.79	2.41
CD (P=0.05)	2.04	1.31	1.57	4.77

**Critical difference between mean values of all Morphotypes*

Table 1: Average range of tree and leaf parameters for intra-varietal variability in mango (Mangifera indica L.) cv. Dashehari

Source of morphotypes	Trunk girth (cm)	Number of secondary branches/plant	Leaf length (cm)	Leaf width (cm)	Leaf thickness (mm)	Petiole length (cm)
Orchard-1	126.17 - 132.0	12.0 - 20.67	19.52 - 21.62	4.50 - 5.22	0.29 - 0.38	2.67 - 3.72
Orchard-2	122.17 - 136.33	14.0 - 17.67	20.21 - 22.32	4.93 - 5.62	0.26 - 0.29	2.62 - 3.52
Orchard-3	102.50 - 120.17	12.0 - 18.0	19.95 - 22.27	4.68 - 4.82	0.25 - 0.38	2.83 - 3.18
Orchard-4	139.17 - 147.67	13.33 - 21.0	19.50 - 21.72	4.67 - 5.03	0.27 - 0.29	2.90 - 3.93
Orchard-5	132.17 - 150.00	20.0 - 29.0	20.33 - 21.38	3.95 - 5.23	0.25 - 0.27	3.07 - 3.38
Orchard-6	125.50 - 132 .67	15.0 - 19.0	17.45 - 21.77	4.52 - 5.47	0.25 - 0.28	2.42 - 3.22
Orchard-7	116.50 - 141.38	15.33 - 26.0	20.47 - 21.37	4.65 - 5.05	0.24 - 0.27	3.53 - 4.18
Orchard-8	138.17 - 141.67	12.0 - 24.33	20.50 - 21.08	4.47 - 5.05	0.24 - 0.30	2.97 - 3.78
Orchard-9	132.00 - 151.33	17.67 - 20.67	18.82 - 20.70	4.77 - 5.08	0.25 - 0.29	2.78 - 3.68
Orchard-10	132.67 - 125.50	14.0 - 20.33	20.02 - 22.55	4.95 - 5.43	0.25 - 0.26	2.93 - 3.22
Orchard-11	140.67 - 130.83	20.33 - 29.0	20.84 - 21.17	4.88 - 4.92	0.24 - 0.29	3.02 - 3.20
Orchard-12	140.17 - 145.50	18.0 - 22.67	18.80 - 22.22	4.75 - 5.08	0.22 - 0.26	2.68 - 3.35
Orchard-13	132.33 - 144.67	14.0 - 18.0	22.78 - 19.80	4.80 - 5.08	0.24 - 0.25	2.67 - 4.35
Orchard-14	133.33 - 147.50	14.67 - 17.33	20.25 - 21.30	4.55 - 5.17	0.23 - 0.25	2.48 - 3.13
Orchard-15	132.0 - 145.67	20.0 - 22.0	20.03 - 22.13	4.47 - 5.42	0.21 - 0.25	3.52 - 3.57
SE(m)±	0.89	0.71	1.14	0.34	0.02	0.39
CD (P=0.05)	1.76	1.41	2.25	0.67	0.04	0.78

**Critical difference between mean values of all Morphotypes*

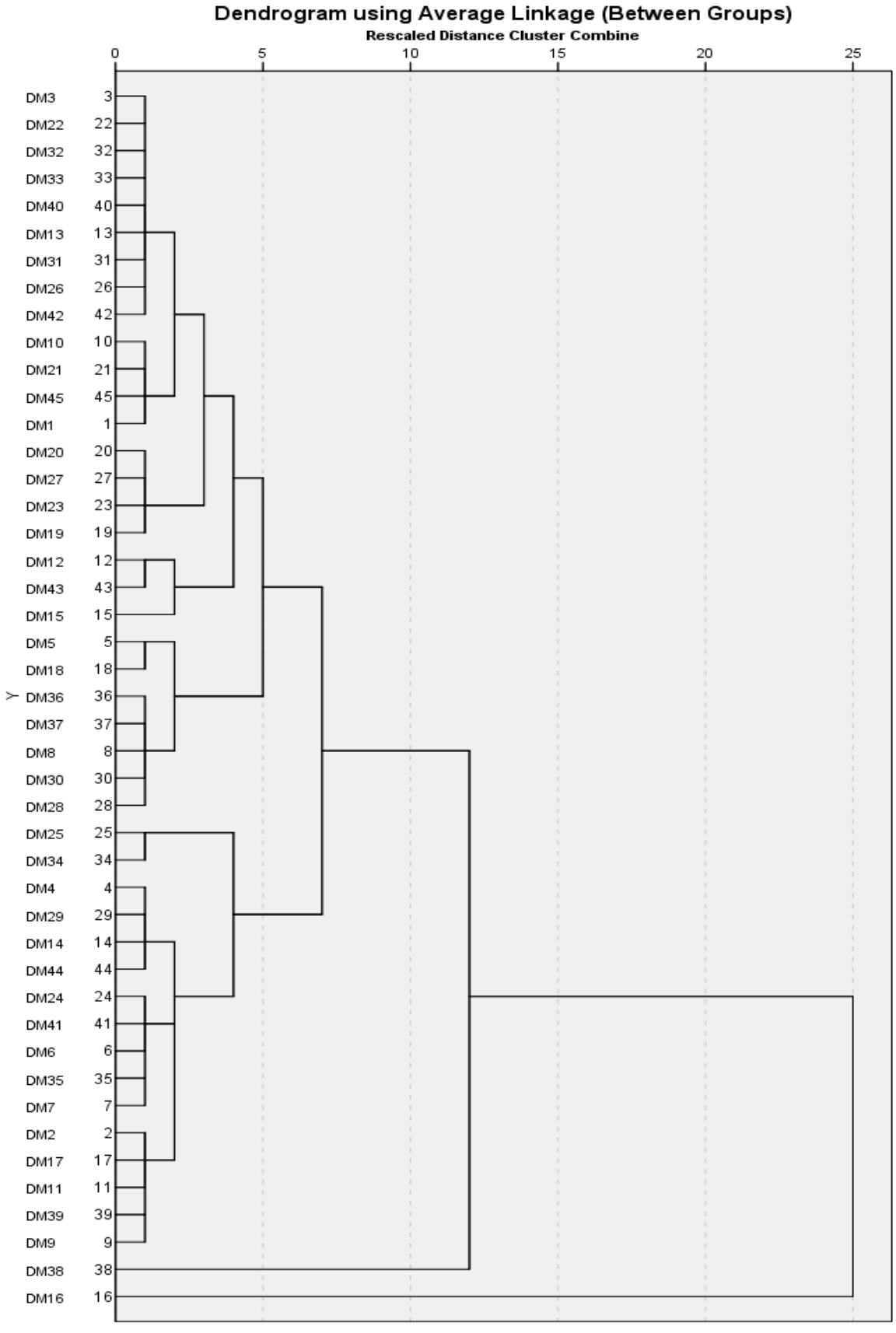

Fig. 1 Dendrogram of 45 Dashehari morphotypes on the basis of tree and leaf data

The present study was consonance with those of Singh *et al.* (2009) also detected prominent variation in the cultivar 'Banganapalli' based on morphological characters of tree, leaf and fruit. However, intra-cultivar heterogeneity in mango has been characterized mostly at the morphological level by several researchers (Kundu *et al*., 2018). Gan *et al.,* 1981 and Pandey, 1998 used morphology-based methods for the characterization of intra-varietal variability in mango where significant variation among the trees of the same variety in an orchard with regard to fruit shape, size, color and quality of the fruits has been observed which was ascribed to bud mutations. The genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as percent of mean (GAM%) of tree, leaf and panicle traits of mango are presented in (Table 3). The estimates of phenotypic coefficient of variation were higher than the genotypic coefficient of variation for all the characters studied. The results indicated the influence of environment on the expression of these characters under investigation (Majumder *et al.,* 2012). The higher estimates of genotypic and phenotypic coefficient of variation and close difference between PCV and GCV were obtained for number of secondary branches (22.46 and 21.69), number of florets per panicle (12.52 and 12.19), number of flowers per panicle (11.39 and 11.39), panicle width (11.04 and 9.45), panicle length (9.61 and 7.75), trunk girth (7.78 and 7.72) and leaf thickness (6.28 and 4.05), which indicates expression of these characters less influenced by environment effect and they have a wide scope for improvement through selection. However, leaf length, leaf width and petiole lengths showed wide difference between PCV and GCV which indicates expression of these characters influence by environmental effect thus, these characters not more reliable for crop improvement through selection (Ranpise and Desai, 2003) in lime.

Although the genotypic coefficient of variation and phenotypic coefficient of variation are the measures of genetic variability however, the amount of genetic gain can be estimated from genotypic coefficient of variation and phenotypic coefficient of variation along with heritability. Swarup and Chougule (1962) suggested that the estimates of genotypic coefficient of variation alone was not sufficient to quantify the amount of variation which is heritable while Burton (1952) inferred that genotypic coefficient of variation effects together with heritability estimates would furnish more reliable information. In the present study, heritability estimates were high for most of the characters *viz.,* trunk girth (98.40), number of secondary branches (93.20), panicle length (65.00), panicle width (73.30), number of florets per panicle (94.40) and number of flowers per panicle (100.00) and very low estimates for remaining characters. Higher heritability value indicates that these were inherited characters governed by major genes or additive gene effects and therefore, selection of these characters would be more effective for further crop improvement which was also suggested by Johnson *et al.* (1955). The genetic advance expressed in percent mean was very high for some of the characters, such as number of secondary branches (88.87), number of florets per panicle (50.56) and number of flowers per panicle (48.32).

Table 3: Estimates of genetic components for vegetative and floral characters in mango cv. Dashehari

Characters	PCV	GCV	h^2	GA	GAM%
Trunk girth (cm)	7.78	7.72	98.40	43.83	32.50
Number of secondary branches	22.46	21.69	93.20	16.70	88.87
Leaf length (cm)	6.74	0.15	0.10	0.00*	0.00*
Leaf width (cm)	4.27	0.64	2.30	0.02	0.40
Leaf thickness (mm)	6.28	4.05	14.50	0.02	7.69
Petiole lengths (cm)	6.07	0.99	2.70	0.02	0.62
Panicle length (cm)	9.61	7.75	65.00	8.36	31.50
Panicle width (cm)	11.04	9.45	73.30	6.90	34.29
Number of florets/panicle	12.52	12.19	94.40	24.26	50.36
Number of flowers/panicle	11.39	11.39	100.00	1205.90	48.32

**very negligible*

It might be due to high range of variation among the genotypes. The characters, such as plant height, percent perfect flowers, duration of flowering, fruit weight, fruit breadth, fruit thickness, percent edible portion, and percent non-edible portion expressed moderate genetic advance. Heritability and genetic gain (GA) in referring valuable conclusion for effective selection based on the phenotypic coefficient of variation (Johnson *et al*., 1955). The characters having high heritability as well as moderate to high genetic advance and narrow difference between GCV and PCV indicate predominance of additive gene action for these characters and these characters would have possibilities of selection towards desired direction.

Cluster analysis

The tree and leaf traits were controlled by additive and peliotropic gene effect hence a dendrogram was prepared on the basis of tree and leaf data (Fig. 1) of 45 Dashehari morphotypes in order to establish their relatedness to each other. Samples were found to be very closely related and grouped into only two major clusters (cluster I and II) with additional sub-clusters, differentiating the morphotypes collected from different areas. Cluster-I consisted of 44 morphotypes which further divided into five sub-groups (cluster IA, IB, IC, ID and IE) while cluster-II comprised only one morphotypes.

The present study concluded that intra-varietal variability has been established in the sample population of mango cv. Dashehari. Similar PCV and GCV values for tree, leaf and panicle characteristics indicate minimal influence of environment on the phenotypic expression of these characters. Highest heritability, genetic advance and genetic advance as percent of mean were recorded for tree and panicle characters indicating that these were simply inherited characters governed by a few major genes or additive gene effects even if they were under polygenic control and therefore, selection of these characters would be more effective for improvement. Cluster analysis performed on the basis of tree and leaf characters has revealed that sample population can be divided into two main clusters further into sub-cluster.

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