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GENETIC VARIABILITY AND HERITABILITY STUDIES OF MANGO CULTIVARS

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ABSTRACT
The present study was carried out to assess the genetic variability, heritability and genetic advance for different characters in 34 diverse cultivars of mango. The study was conducted at Horticultural research station, Venkataramannagudem for evaluating the variability of mango cultivars in Randomized block design. All the characters showed very small difference between genotypic coefficient of variation (GCV) and respective phenotypic coefficient of variation (PCV), indicated that all the characters were least affected by environment. The high phenotypic coefficient of variation and genotypic coefficient of variation were observed for fruit length, fruit diameter, fruit weight, fruit skin thickness, peel weight, pulp to stone ratio, pulp to peel ratio, pulp weight, edible to non-edible ratio, stone weight, stone per cent, stone length, embryo weight, total sugars, reducing sugars, non-reducing sugars, titratable acidity, ascorbic acid, TSS: acid ratio, β- carotone and total phenols. High heritability coupled with high genetic advance were observed for all characters studied indicating these characters are governed by additive gene action and phenotypic selection may be more fruitful. Hence, direct selection may be followed for the improvement of mango for these characters.

KEYWORDS: Genetic advance, mango, genotypic coefficient of variation, phenotypic coefficient of variation.

INTRODUCTION

Mango (*Mangifera indica* L.) is an important member of the family Anacardiaceae in order Sapindales and is the most important fruit crop in India having a great cultural, socio-economic and religious significance since ancient times. By virtue of its excellent flavor, delicious taste, attractive color, delicious fruit quality with richness in vitamins and minerals, accessibility to common man, liking by the masses, mango has been assigned the status of the 'King of the fruits' in the tropical world and it is the 'National Fruit of India'. Mango is considered to be an allopolyploid, most probably amphidiploid and outbreeding species having chromosome number 2n=40 (Mukherjee, 1950). It is highly heterozygous as performance varies with the climate which resulted in a high level of genetic diversity. Further, confusion exists in the nomenclature of mangoes due to different local names for the same variety. Characterization and assessment of diversity is essential to utilize these unique cultivars in crop improvement programmes and also for better conservation of genetic resources, it especially benefits a plant breeder in choosing proper parental materials. To improve yield potentials in an existing crop, an understanding of the variability is necessary to formulate and accelerate breeding program. The genotypic and phenotypic coefficient of variation within a crop will facilitate in selection of superior genotypes which is proportional to the amount of genetic variability present and the extent to which the characters are inherited. Since, many economic traits are quantitative in nature and highly influenced by the environment, the progress of breeding is governed by the nature of genetic and non-genetic variations; it will be useful to partition the overall variability into its heritable and non-heritable components to know whether superiority of selection is inherited by the progenies. Effective selection of genotypes for desirable traits is determined by the estimates of heritability along with genetic advance. The progress in breeding programme depends on magnitude of genetic variability present in breeding material. Selection is also effective when there is high degree of genetic variability among the individuals in a population. Therefore, the present investigation was undertaken to estimate the variability, heritability and genetic advance among different traits in mango cultivars.

MATERIALS & METHODS

The present study was conducted to study the performance of mango cultivars of coastal districts in Andhra Pradesh at Horticultural Research Station, Venkataramannagudem during the period of 2012 to 2014. A well- planned germplasm collection survey based on diversity richness was conducted in coastal districts of Andhra Pradesh which includes Horticultural Research Station and private owned mango orchards. Random sampling strategy was followed for collection of samples. Three trees in each cultivar were taken as sample size. The experimental material consists of 34 indigenous mango cultivars and variants within them obtained from the coastal districts of Andhra Pradesh. The indigenous mango cultivars used are:

1. Banganapalli – 1
2. Banganapalli – 2
3. Banganapalli - 3
4. Banglora - 1

5. Banglora - 2
6. Baramasi
7. Cherukurasam
8. Chinnarasam
9. Chinna Suvarnarekha
10. Elamandala
11. Hyder
12. Imampasand
13. Jalal
14. Jehangir
15. Kolanka Goa
16. Kottapalli Kobbari
17. Kowsuri Pasand
18. Nalla Andrews
19. Nalla Rasalu
20. Navaneetam
21. Nuzividu Tiyya Mamidi
22. Nuzividu Rasalu
23. Panchadara Kalasa
24. Pandurivari Mamidi
25. Paparao Goa
26. Peddarasam
27. Panukula Mamidi
28. Royal Special
29. Rajamanu
30. Sora Mamidi
31. Suvarnarekha
32. Tella Gulabi
33. Tella Rasalu
34. Rajamamidi

Five fruits of each cultivar were taken per replication for evaluating fruit morphological and bio-chemical characters. Genotypic and phenotypic coefficients of variation were computed according to Burton (1952) based on the estimate of genotypic and phenotypic variance. Heritability in broad sense refers to the proportion of genetic variance to the total observed variance in the population. It has been estimated as per the formula given by Lush (1940). Genetic advance as per cent mean was worked out for each character adopting the formula given by Johnson *et al*. (1955b).

RESULTS & DISCUSSION

The phenotypic coefficient of variation ranged from 6.36 to 75.81 among the fruit morphological characters while it ranged from 13.54 to 62.16 among the bio-chemical characters, while the genotypic coefficient of variation ranged from 6.24 to 75.66 among the fruit morphological characters while it ranged from 13.03 to 61.61 among the bio-chemical characters (Table 1 and Table 2). In the present investigation, phenotypic coefficient of variation (PCV) was greater than the corresponding genotypic coefficient of variation (GCV) for all the characters indicating the importance of environment in expression of characters. However, the differences between the GCV and PCV for all the characters were narrow suggesting that the characters were less affected by environment. The range of PCV and GCV were classified as suggested by Sivasubramanian and Madhavamenon (1973) i.e., 0 - 10% as low, 10 – 20% as moderate and more than 20% as high. High values of PCV with corresponding high values of GCV were recorded for fruit length, fruit diameter, fruit weight, fruit skin thickness, peel weight, pulp to stone ratio, pulp to peel ratio, pulp weight, edible to non-edible ratio, stone weight, stone per cent, stone length, embryo weight, total sugars, reducing sugars, non-reducing sugars, titratable acidity, ascorbic acid, TSS: acid ratio, β-carotone and total phenols which indicates that there exists high genetic variability and better scope for improvement of these characters through selection. Similar results were obtained for fruit length, fruit diameter, fruit weight and stone per cent by Attri *et al.* (1999), Singh (2002) and Simi (2006), peel weight, pulp to stone ratio, pulp weight, stone weight and stone length by Rajan *et al.* (2009) and total sugars, reducing sugars, non-reducing sugars, titratable acidity, ascorbic acid by Karibasappa *et al.* (1999) and Rathod (2007) in mango. From the foregoing discussions, it is clear that these characters offer good scope for selection in mango. The genotypic coefficient of variation does not offer full scope to estimate the variation that is heritable and therefore, estimation of heritability becomes necessary. The variability existing in a population is the sum total of heritable and non-heritable components. A high value of heritability indicates that the phenotype of that trait strongly reflects its genotype. Heritability estimates for characters under study is given in Table 1 and Table 2. Heritability values are useful in predicting the expected progress to be achieved through the process of selection. Heritability values ranged from 71.90 to 99.61 among the fruit morphological characters while it ranged from 89.96 to 98.86 among the bio-chemical characters. Further, the range of heritability in broad sense was classified as suggested by Johnson *et al*. (1955a) i.e., less than 30% as low, 30 – 60% as moderate and more than 60% as high. Heritability estimates were high for all the characters studied. Further, similar to the present results, high heritability for pulp per cent, total sugars and β- carotene was reported by Attri *et al.* (1999), Singh (2002) and Simi (2006) in mango. This indicates that selection will be best step for selecting genotypes having traits with high heritability. This is because there would be a close correspondence between the cultivars and the phenotype due to relative small contribution of the environment to the total variability. The genetic advance as per cent mean ranged from 12.6 to 155.55 (Table 1) among the fruit morphological characters while it ranged from 25.83 to 125.82 among the bio-chemical characters (Table 2). High values of genetic advance as percentage of mean (> 20 %) were obtained in the present study for all the characters studied.

CONCLUSION

High heritability estimates coupled with high genetic advance were observed for all the characters were indicative of additive gene action and selection based on these characters would be more reliable. The characters with high heritability coupled with high genetic advance further indicated the possibility of making selections in earlier generations.

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TABLE 1: Estimates of variability and genetic parameters for fruit morphological characters of mango

S.No	Character	Mean	Range	Phenotypic coefficient of variation	Genotypic coefficient of variation	Heritability (broad sense) (%)	Genetic advance as per cent mean (%)
1	Fruit Length (cm)	10.67	5.93 - 17.56	26.47	25.31	91.36	49.83
2	Fruit Diameter (cm)	7.69	4.47 - 12.20	22.72	21.82	92.24	43.18
3	Shape Index	1.3964	0.99 - 2.03	18.9	16.03	71.90	27.99
4	Fruit Weight (g)	400.74	131.43- 1395.45	68.78	68.60	99.52	141.01
5	Fruit skin Thickness (mm)	0.10	0.04 - 0.20	53.12	52.81	98.86	108.18
6	Peel Weight (g)	45.72	10.89 - 117.12	57.41	57.04	98.71	35.34
7	Peel Per cent	12.60	7.73 - 15.76	18.64	17.88	92.02	116.75
8	Fruit to Pulp Ratio	1.37	1.18 - 1.48	6.36	6.24	96.16	12.60
9	Pulp to Stone Ratio	5.82	3.00 - 12.87	36.63	35.30	92.91	70.10
10	Pulp to Peel Ratio	6.08	4.37 - 10.07	27.87	27.45	96.98	55.68
11	Pulp Weight (g)	303.39	89.12 - 1178.24	75.81	75.66	99.61	155.55
12	Pulp Per cent	73.74	67.33 - 84.43	6.38	6.31	97.58	12.83
13	Edible to Non-edible Ratio	2.93	2.00- 5.59	28.4	28.09	97.80	57.23
14	Stone Weight (g)	45.57	21.05 - 96.50	42.4	41.48	95.70	83.59
15	Stone Per cent	13.56	6.80 – 22.60	25.87	25.56	97.64	52.02
16	Stone Length (cm)	8.37	3.94 – 14.58	30.06	28.86	92.22	57.10
17	Stone Width (cm)	3.96	3.04 – 5.95	15.88	15.23	91.93	30.08
18	Stone Thickness (cm)	2.09	1.26 – 2.67	16.88	16.02	90.09	31.32
19	Embryo Length (cm)	6.19	2.95 – 7.73	17.65	17.13	94.18	34.25
20	Embryo Width (cm)	3.12	1.74 – 4.58	20.26	19.85	95.93	40.05
21	Embryo Weight (g)	22.10	9.90 – 38.22	29.66	28.68	93.39	57.12

Note: PCV, GCV and Genetic advance as per cent mean: Low = 0-10%; Medium = 10-20%; High = 20% above
Heritability: Low = Less than 30%; Medium = 30-60%; High = More than 60%

TABLE 2: Estimates of variability and genetic parameters for fruit bio-chemical characters

S. No	Character	Mean	Range	Phenotypic coefficient of variation	Genotypic coefficient of variation	Heritability (broad sense) (%)	Genetic advance as per cent mean (%)
1	TSS (°Brix)	18.27	15.05 - 25.44	13.54	13.03	92.58	25.83
2	Total Sugars (%)	12.27	8.82 - 21.51	22.6	21.88	93.65	43.61
3	Reducing Sugars (%)	4.34	2.63 - 6.44	22.38	21.22	89.96	41.46
4	Non-reducing Sugars (%)	7.94	5.80 - 15.39	24.75	23.8	92.41	47.13
5	Titratable Acidity (%)	0.30	0.14 - 0.19	62.16	61.61	98.26	125.82
6	Ascorbic Acid (mg/100g)	32.57	22.14 - 88.40	40.55	40.09	97.75	81.64
7	TSS: Acid Ratio	73.39	17.34 - 155.95	43.88	41.73	90.45	81.75
8	β- Carotene (µg/100g)	1111.49	623.71 - 1679.89	27.59	26.32	90.96	51.71
9	Total Phenols (mg of GA/100g)	46.78	19.90 - 98.04	45.98	45.71	98.86	93.63

Note: PCV, GCV and Genetic advance as per cent mean: Low = 0-10%; Medium = 10-20%; High = 20% above
Heritability: Low = Less than 30%; Medium = 30-60%; High = More than 60%

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