MORPHOLOGICAL AND BIOCHEMICAL CHARACTERIZATION OF MANGO GENOTYPES

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Received: 12 July 2023, Revised: 10 August 2023, Accepted: 14 August 2023

Abstract

The present investigation was carried out during 2021-23 in the Department of Fruit Science, Horticultural College and Research Institute, Periyakulam. Sixty mango genotypes were taken for the experiment with the objective to study the morphological and Biochemical behavior of mango genotypes. Wide variability was recorded for different phenological traits. Maximum leaf area, hermaphrodite flower per cent, TSS was recorded by Sindhu (272.95 cm^2, 37.11%, 22.70^{0}Brix). Maximum male flower per cent was recorded by Pedharasam (79.60%). The Highest acidity and ascorbic acid content was observed by Sothuparai local (1.20%), Mallika(52.08mg100 g^{-1}).Hence,it could be concluded that the cultivar Sindhu, Pedharasam ,Sothuparai local, Mallika can be used in breeding programme to getting maximum leaf area, hermaphrodite flower per cent, TSS, male flower per cent, acidity and ascorbic acid content.

Keywords: Male flower, Leaf area, TSS, Phonological traits

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DOI: 10.48047/ecb/2023.12.si10.00352

Introduction

Mango (*Mangifera indica* L.) belongs to the family, Anacardiaceae is the most important fruits of the tropical and subtropical part of the world. It has the chromosome number 2n = 4x = 40.The Indo-Burma region is the main centre of origin of mango**.** Mukherjee (1951) reported that the existence of the wild form of *Mangifera indica*, it's associated species which supports its Indian origin and the cultivated nature,is apparently due to allopolyploidy, likely amphidiploidy. Mango is a nutritionally complete fruit and the nutrient benefit of mango varies from varieties and the period of growth.It is an excellent source of vitamin A (4800 IU 100 g-1). It also contains 8.8 per cent fat, 0.01 per cent starch and several other nutrients. Mango is India's award-winning summer popular fruit with over 1000 recognized varieties eaten as fresh. Besides, it also has good demand in the processing industries for the preparation of various processed products including squash, nectar, jam, leather, pickles and amchoor, etc.

Mango is evergreen trees of semi vigorous to vigorous growth and can grow to a height of 25 metres in optimal conditions. India is the world's largest mango producer contributing for around 50 percent of overall global production.It is the national fruit of India commonly cultivated for its unique features such as high nutritious values with pleasant taste. It is a well adopted crop under the climate condition of Tamilnadu. In tamilnadu, the annual production of mango is 6.39 lakh tons from an area coverage of 1.46 lakh hectare (NHB Database, 2022).

Due to the wide range of diversity in the cultivated mango varieties throughout the countries, the morpho-phenological attributes of different mango cultivars are also varied significantly among the cultivars (Joshi *et al.,* 2014**).** Phenology is the advancement of any plants demonstrating the recognizable stages of growth. It depends on the environmental factors and the adaptation capacity of the plants to a particular environment. Under subtropical environments, vegetative growth flushes develop at mild temperatures of about 25ºC or higher (Nunez-Eliséa *et al*., 1996),while flower induction process initiated at 5–15ºC.The amount of flushes emerging depends on the cultivar, the size of the tree and the growth environment (Davenport, 2000).

Mango plant does not develop flowers uniformly in both directions of the tree canopy and at least two different flushes are observed. The panicles on the eastern and south-eastern sides of the tree begin to bloom. The number of flowers in a single panicle ranges between 1000-6000, depending on the variety and the maturity of the shoots. Floral initiation in mango is the transient engagement of buds to invoke a specific direction of development (i.e. vegetative shoots, generative shoots or mixed shoots) when growth is stimulated (Davenport, 2009). Tightly correlated with the initiation of a shoot, induction happens on the basis of circumstances at the moment of initiation.

Based on the phenological condition plant growth and development behavior significant various it can be indirectly affect by plant yield. Hence, it is very important to study the diversity of the existing mango cultivars for morpho-phenological traits. Keeping these views in mind, the present research work was formulated to characterize the morphological and biochemical attributes in different mango genotype.

Materials and Methods

The present investigation was carried out in the central block of the Department of Fruit Science, Horicultural College and Research Institute, Periyakulam situated at 10.13^{O}N latitude and 77.59^{O}E longitudes and at an altitude of 289 m above mean sea level. The mean maximum and minimum temperature were 31.80^{O}C and 23.06^{O}C respectively with mean relative humidity of 77.10 percent and the mean rainfall of 62.03 mm per annum. The nature of soil of the experimental plot is sandy loam with the pH of 7.5 and EC of 0.42 dsm-1.

Materials

Sixty mango genotypes of nearly similar age namely were chosen for the experiment Details of sixty mango genotype listed **(Table 1)**

Observation recorded:

1. Leaf area (cm^2)

Average leaf area of randomly selected 15 leaves from five shoots were taken from third and fourth positions from the tip of bearing shoots was measured by Graphical and LBK method and expressed in cm^2.

2. Hermaphrodite flowers (%)
The percentage of hermaphrodite flowers was calculated by using the following formula.

$$\text{Per cent of hermaphrodite flowers} = \frac{\text{Number of hermaphrodite flowers per panicle} \times 100}{\text{Total number of flowers per panicle}}$$

3. Male flower (%)
The percentage of male flowers was calculated as follows. (Keeping the perfect flowers as constant one).

$$\text{Per cent of male flowers} = \frac{\text{Number of male flowers per panicle} \times 100}{\text{Total number of flowers per panicle}}$$

4. TSS (^{O} Brix)
The total soluble solids was measured with the help of digital refractometer (HI 96801) at three different points of fruits, i.e. shoulder, middle and distal end portion on individual fruits (total 15 fruits) from all genotypes. The average was then calculated for each genotypes. The values were expressed in degree Brix (Ranganna,1986).

5. Titrable acidity (%)
Titrable acidity was determined by titrating the sample extracted in water against 0.1N NaOH using phenolphthalein as indicator. The acidity was calculated by using the following formula and expressed in per cent (Ranganna, 1979).

$$\text{Titrable acidity (\%)} = \frac{1\times \text{Equivalent weight of acid} \times \text{Normality of NaOH} \times \text{Titer value} \times 100}{10 \times \text{Weight of the sample}}$$

6. Ascorbic acid (mg 100g^{-1})
Ascorbic acid content (Vitamin C) was determined by oxalic acid titration method (Ranganna, 1977). The juice was extracted with four per cent oxalic acid and the volume was made up to 100ml. From this 5mi of extract was taken and titrated against 2,6 – dichloro indophenol dye. Ascorbic acid was calculated by using the following formula and expressed in mg 100g-1 (Bala *et al.*, 2013).

$$\text{Ascorbic acid content (mg 100g}^{-1}) = \frac{1\text{mg} \times \text{Vol. of dye used for standard} \times 100 \text{ ml} \times 100 \text{ g}}{\text{Vol. of dye used for sample} \times 5 \text{ ml} \times \text{Weight of sample}}$$

Statistical analysis
The observation were subjected to statistical analysis by using randomized block design (RBD) Were two replication mean difference were tested by 'F' Test at five per cent level of significant (LOS). Critical difference (CD) at 5 per cent level of significant was used for comparison among treatments. Data were analyzed using statistical analysis software (OPSTAT).

Result and discussion:
1. Leaf area (cm^2)
The experimental result revealed that leaf area of different mango genotypes ranged between (51.68- 272.95 cm^2) (Table 2) (Grap1). Maximum leaf area was recorded by genotypes Sindhu (MI-13) (272.95 cm^2) followed by Arka Aruna (MI-23) (272.95 cm^2). Minimum Leaf area was recorded by Samba Kooja (MI-37) (51.68 cm^2). This variation might be to due to presence of the large size of leaves, variation in leaf size and genetic nature of the particular accession (Abirami *et al*.,2004).Environment also play a major role for leaf characteristics. this study are harmony with finding of Singh *et al*.(2006), Majundar *et al* .(2011).

2. Hermaphrodite flower (%)
Hermaphrodite flower percentage was highest recorded by genotypes Sindhu (MI-13) (37.11%) followed by Malpacharichi (MI-12) (36.55%) .Lowest Hermaphrodite flower percentage was recorded by Pachathani (MI-20) (20.40 %) (Table 2) (Grap1).The development of perfect flowers required more reserves from the tree than staminate flowers. The variation in sex ratio of different mango cultivars is due to control by physiological and environmental conditions. The similar finding was found by Chandra *et al*., (2001) and Hoda *et al*.,(2003).

3. Male flower (%)

The result revealed that male flower percentage of different mango genotypes ranged between (79.60-62.89%) (Table 2) (Grap1). Highest Male flower percentage was recorded by genotypes Pedhrasam (MI-19) (79.60 %) followed by Neelashwari (MI-47) (79.52 %). Lowest male flower percentage was recorded by Sindhu (MI-13) (62.89 %).This variation might be to genetic variation and environmental effects. The similar finding was found by Majumdar (2011), Sridar *et al*.,(2016), Veena and Dinesh (2018).

4. TSS (^{0}Brix)

TSS was highest recorded by genotypes Sindhu (MI-13) (22.70 ^{0}Brix) followed by kuruvi neelum (MI-11) (21.00^{0}Brix). Lowest TSS was recorded by Pachathani (MI-06) (13.20^{0}Brix) (Table 3) (Grap2).Slight variation in TSS was observed which could be attributed to seasonal variation or variation due to soil and climatic conditions. Higher TSS is a good phenomenon of mango fruits.TSS of fruit is a genetic character, which might be affected by the date of harvesting in mango (Kumar, 1998).

5. Titrable acidity (%)

The result revealed that Titrable acidity of different mango genotypes ranged between (0.20-1.20%)(Table3) (Grap2).Maximum Acidity was recorded by genotypes Sothuparai local (MI-51) (1.20 %) followed by P.S.Bangalora (MI-50) (0.46 %).Minimum titrable acidity was recorded by Neelashan (MI-32) (0.20 %). These findings are in line with Prem *et al*. (2012).Rodriguez *et al*. (2012) noticed that the highest acidity (0.22 %) was observed in cv.Valencia Pride.

6. Ascorbic acid (mg 100 g-1)

Ascorbic acid was highest recorded by genotypes Mallika (MI-07) (52.08 mg 100g-1) followed by Thothapuri Imam Pasand (MI-25) (51.95 mg 100g-1). Lowest Ascorbic acid was recorded by Mohandas (MI-17) (16.85 mg 100g-1) (Table 3) (Grap2).The result of quality parameters in present study was close to Ubwa *et al*. (2014). They determined the proximate composition and some physico-chemical parameters of three mango fruit varieties. The variation in ascorbic acid content among mango cultivars is also reported by Rajwana *et al*. (2010).

Conclusion:

Based on finding it concluded that the morpho-phenological behavior of different cultivar are different significant. The genotypes of Sindhu, Pedharasam, Sothuparai Local and Mallika was recorded at maximum leaf area, hermaphrodite flower per cent,TSS, male flowers per panicle, acidity and ascorbic acid content will be effective for future breeding programme.

Table 1. Details of the genotypes used in the present study Treatments

S.No	Accession number	Genotypes	S.No	Accession number	Genotypes
1	MI-1	Au-Rumani	31	MI-31	Mulgoa
2	MI-2	Amarapalli	32	MI-32	Neelashan
3	MI-3	PKM-1	33	MI-33	Neeluthin
4	MI-4	PKM-2	34	MI-34	Kuthukal Valasai Naddu
5	MI-5	Pathiri	35	MI-35	Manjeera
6	MI-6	Swarna Jahanhir	36	MI-36	Era Neelum
7	MI-7	Mallika	37	MI-37	Samba Kooja
8	MI-8	Neelphonso	38	MI-38	Vallam Naddu
9	MI-9	Kovan Kanchi	39	MI-39	Dill Pasanth
10	MI-10	Gundur Pacharichi	40	MI-40	Neelum
11	MI-11	Kuruvi Neelum	41	MI-41	Neelgoa
12	MI-12	Malpacharichi	42	MI-42	Peter Pasand
13	MI-13	Sindhu	43	MI-43	Sajahan
14	MI-14	Pondy Neelum	44	MI-44	Panchavarnam
15	MI-15	Senbaga Thoophu Karupatti	45	MI-45	Rumani
16	MI-16	Arka Anmol	46	MI-46	Badomi
17	MI-17	Mohandhas	47	MI-47	Neelashwari
18	MI-18	P.K.Patti	48	MI-48	Komangai
19	MI-19	Pedhrasam	49	MI-49	Arka Puneet
20	MI-20	Pachathani	50	MI-50	P.S.Bangalora
21	MI-21	Ratna	51	MI-51	Sothuparai Local
22	MI-22	Sundar Langra	52	MI-52	Alphonso
23	MI-23	Arka Aruna	53	MI-53	Kalaipad
24	MI-24	Banganapalli	54	MI-54	Kalkachi
25	MI-25	Thothapuri Imam Pasand	55	MI-55	Iswarya
26	MI-26	Senthuram	56	MI-56	Javari

27	MI-27	Selambhu Naddu	57	MI-57	Gudadath
28	MI-28	Imam Pasand	58	MI-58	Kuthoos
29	MI-29	Bangalora	59	MI-59	Panchathara Kalasa
30	MI-30	Selambhualaghu pathai Naddu	60	MI-60	Manjallani Naddu

Table 2: Leaf and flower morphology of different mango genotypes

Genotypes	Leaf area (cm^2)	Hermaphrodite percentage (%)	Male flower Percentage (%)
MI-01	75.21	33.68	66.32
MI-02	197.08	32.82	67.18
MI-03	159.13	33.80	66.20
MI-04	128.34	26.50	73.50
MI-05	116.46	30.97	69.03
MI-06	118.97	26.81	73.19
MI-07	166.58	29.97	70.03
MI-08	129.94	25.98	74.02
MI-09	100.65	31.07	68.93
MI-10	123.06	25.77	74.23
MI-11	77.36	30.25	69.75
MI-12	172.72	36.55	63.45
MI-13	272.95	37.11	62.89
MI-14	140.89	28.65	71.35
MI-15	78.73	29.80	70.20
MI-16	64.03	24.70	75.30
MI-17	136.36	23.80	76.20
MI-18	153.15	24.22	75.78
MI-19	177.63	27.40	63.60
MI-20	116.71	20.40	79.60
MI-21	159.17	29.05	70.95
MI-22	117.86	33.42	66.58
MI-23	211.99	29.89	70.11
MI-24	134.50	28.19	71.81
MI-25	135.62	28.94	71.06
MI-26	108.50	29.69	70.31
MI-27	117.75	22.08	77.92
MI-28	171.98	25.60	74.40
MI-29	113.77	28.08	71.92
MI-30	138.10	29.87	70.13
MI-31	157.42	29.15	70.85
MI-32	130.86	33.47	66.53
MI-33	111.96	29.34	70.66
MI-34	114.17	29.51	70.49
MI-35	155.75	27.35	72.65
MI-36	150.33	24.81	75.19
MI-37	51.68	21.40	78.60
MI-38	114.19	29.78	70.22
MI-39	135.68	21.11	78.89
MI-40	140.52	33.94	66.06
MI-41	147.59	33.16	66.84
MI-42	114.37	32.74	67.26
MI-43	98.58	31.76	68.24
MI-44	91.92	24.00	76.00
MI-45	146.23	28.21	71.79
MI-46	119.96	24.46	75.54

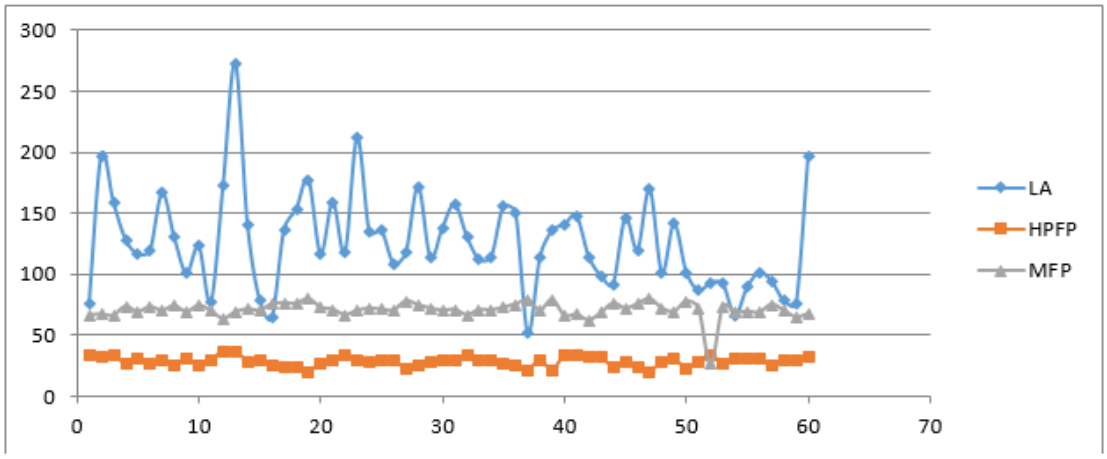
MI-47	169.78	20.48	79.52
MI-48	101.23	28.04	71.96
MI-49	141.36	30.73	69.27
MI-50	101.79	22.39	77.61
MI-51	86.64	28.19	71.81
MI-52	92.95	33.69	26.31
MI-53	92.11	26.69	73.31
MI-54	66.48	31.21	68.79
MI-55	89.33	30.65	69.35
MI-56	101.45	31.33	68.67
MI-57	94.38	24.97	75.03
MI-58	78.17	29.88	70.12
MI-59	75.21	30.26	64.74
MI-60	197.18	32.53	67.47
Grand mean	**126.40**	**28.67**	**70.42**
SED	**2.87**	**0.89**	**1.98**
CD(0.05)	**5.75**	**1.78**	**3.96**
CD(0.01)	**7.65**	**2.36**	**5.27**
CV%	**2.27**	**3.03**	**2.81**

Table 3: Biochemical parameters of different mango genotypes

Genotypes	TSS (^{0}Brix)	Acidity (%)	Ascorbic acid (mg 100g-1)
MI-01	17.50	0.28	28.31
MI-02	17.85	0.35	36.90
MI-03	17.25	0.18	44.17
MI-04	18.80	0.22	39.82
MI-05	17.50	0.37	45.10
MI-06	13.20	0.28	20.19
MI-07	18.30	0.33	52.08
MI-08	14.50	0.25	33.50
MI-09	17.60	0.23	29.74
MI-10	18.50	0.30	40.40
MI-11	21.00	0.26	23.46
MI-12	16.90	0.18	37.55
MI-13	22.70	0.23	48.30
MI-14	17.50	0.36	38.52
MI-15	14.50	0.39	28.60
MI-16	18.40	0.32	22.63
MI-17	19.30	0.18	16.85
MI-18	15.70	0.22	49.82
MI-19	16.42	0.46	26.30
MI-20	14.23	0.33	30.17
MI-21	21.50	0.42	29.44
MI-22	17.78	0.21	43.70
MI-23	19.50	0.28	20.49
MI-24	20.40	0.32	32.06
MI-25	16.20	0.29	51.95
MI-26	18.90	0.25	40.35
MI-27	18.70	0.27	26.81
MI-28	20.20	0.24	36.83
MI-29	18.32	0.17	39.50
MI-30	17.30	0.35	50.11
MI-31	20.00	0.24	49.53
MI-32	14.70	0.20	27.08

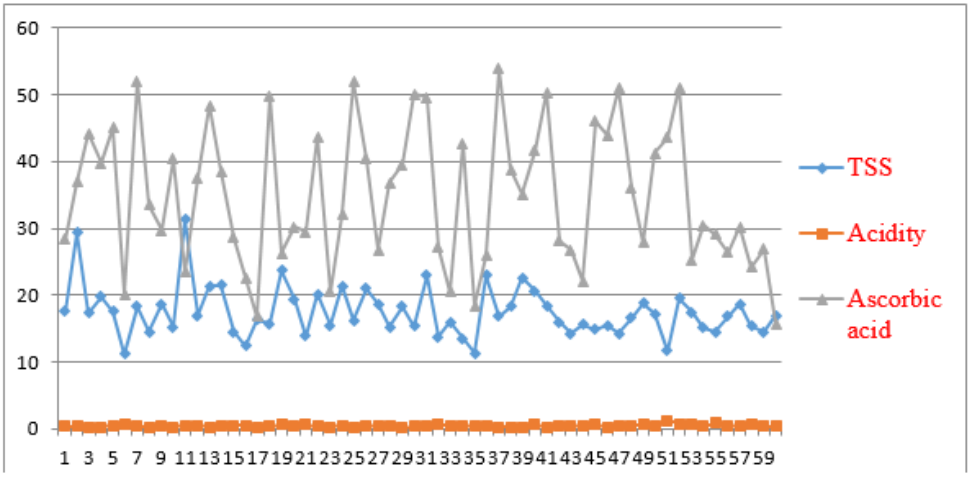
MI-33	16.00	0.25	20.52
MI-34	13.50	0.37	42.74
MI-35	16.32	0.32	18.42
MI-36	17.00	0.42	25.85
MI-37	14.80	0.25	45.86
MI-38	15.30	0.28	38.83
MI-39	20.60	0.34	35.06
MI-40	18.60	0.42	41.60
MI-41	15.40	0.32	50.30
MI-42	16.30	0.40	28.09
MI-43	14.70	0.39	26.71
MI-44	15.60	0.46	22.04
MI-45	14.80	0.38	46.00
MI-46	15.50	0.24	43.94
MI-47	16.30	0.36	50.88
MI-48	16.60	0.29	36.08
MI-49	18.80	0.35	27.92
MI-50	17.20	0.46	41.19
MI-51	11.72	1.20	43.51
MI-52	19.50	0.35	51.04
MI-53	17.40	0.32	25.30
MI-54	15.08	0.38	30.45
MI-55	18.45	0.29	29.10
MI-56	16.76	0.19	26.40
MI-57	14.70	0.43	30.25
MI-58	15.38	0.34	24.18
MI-59	14.44	0.42	26.83
MI-60	16.92	0.32	25.72
Grand mean	**17.08**	**0.32**	**34.91**
SED	**0.4**	**0.009**	**0.90**
CD(0.05)	**0.82**	**0.018**	**1.81**
CD(0.01)	**1.05**	**0.024**	**2.41**
CV%	**2.37**	**2.86**	**2.60**

Graph1: Leaf and flower morphology of different mango genotypes



LA = Leaf Area(cm^2) , HPFP = Hermaphrodite percentage (%), MFP = Male flower percentage (%),

Graph 2: Biochemical parameters of different mango genotypes



References:

1. Abirami, K., Nachegowda, V., & Reddy, Y. T. N. (2004). Physico-chemical attributes of certain polyembryonic varieties of mango. *South Indian Horticulture*, *52*(1/6), 291.
2. Bala, M., Gupta, S., & Gupta, N. K. (2013). *Practicals in plant physiology and biochemistry*. Scientific Publishers.
3. Chandra A,Roy DP and Lenka PC (2001). Studies on floral character of mango cultivar and hybrids under agro-climatic conditions of Orissa. *Orissa J.Hortic* .,29(1) : 29-33.
4. Davenport TL(2000).Processes influencing floral initiation and bloom: the role of phytohormones in a conceptual flowering model.*Hort Technol* .,10(4) : 733-739.
5. Davenport TL (2009). Reproductive physiology. In The mango botany, production and uses,2nd edition, CABI International, Wallingford, UK.,97-169.
6. Hoda, M. N., Sanjay Singh, and Jayan T. SINGH. "Evaluation of ecological groups of mango (Magnifera indica) cultivars for flowering and fruiting under Bihar conditions." *Indian journal of agricultural science* 73, no. 2 (2003): 101-105.
7. Joshi R, Kundu M,and Singh C (2014). Morphological characters efficient tool for identification on different mango cultivars.*Environ. Ecol* ., *31*(1A), 385-388.
8. Kumar, D. (1998). Effect of post-harvest treatment on shelf-life and quality of mango. *Indian Journal of Horticulture*, *55*(2), 134-138.
9. Mukherjee SK (1951). Origin of mango. *Indian J. Genet.Plant Breed* .,11: 49- 56.
10. Majumder DA,Hassan L,Rahim MA,Kabir MA (2011). Studies on physio-morphology,floral bology and fruit characteristics of Mango.J.Bangladesh Agric.univ., 9(2) :187-199.
11. Núñez-Eliséa R, Davenport TL (1994) Flowering of mango trees in containers as influenced by seasonal temperature and water stress. Sci. Hort. 58:57-66.
12. Ranganna,S.1997.Manual of analysis of fruit and vegetable products.
13. Rodríguez Pleguezuelo, C. R., Durán Zuazo, V. H., Muriel Fernández, J. L., & Franco Tarifa, D. (2012). Physico-chemical quality parameters of mango (Mangifera indica L.) fruits grown in a Mediterranean subtropical climate (SE Spain). *Journal of Agricultural Science and Technology*, *14*(2), 365-374.
14. Rajwana, I. A., Khan, I. A., Malik, A. U., Saleem, B. A., Khan, A. S., Ziaf, K., ... & Amin, M. (2011). Morphological and biochemical markers for varietal characterization and quality assessment of potential indigenous mango (Mangifera indica) germplasm. *Int. J. Agric. Biol*, *13*, 151-158.
15. Sridhar, D., B. Ghosh, S. Kundu, Md Abu Hasan, and N. C. Das. "Genetic variability and heritability studies of mango cultivars." *Int. J. Curr. Microbiol. Appl. Sci* 7 (2018): 752-756.
16. Ubwa, S. T., Ishu, M. O., Offem, J. O., Tyohemba, R. L., & Igbum, G. O. (2014). Proximate composition and some physical attributes of three mango (Mangifera indica L.) fruit varieties. *International Journal of Agronomy and Agricultural Research*, *4*(2), 21-29.
17. Veena, G. L., & Dinesh, M. R. (2018). Genetic Diversity in Appemidi (Unique Aromatic Pickle Mango) Genotypes from Western Ghats Regions of Chikmagalur (Karnataka), India. *Int. J. Curr. Microbiol. App. Sci*, *7*(7), 1010-1018.