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Morphological Characterization of Different Jamun (*Syzigium cuminii* Skeels) Genotypes

P. R. Arpitha, M. K. Honnabyraiah, Gangadhara Narabenchi, S. Mohan Kumar and K. R. Vasudeva

RHREC, UHS Campus, GKVK, Bengaluru, Karnataka, India

**Corresponding author*

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A B S T R A C T

Jamun (*Syzygium cumini* Skeels) is an important underutilized tropical fruit crop of India possessing high nutraceutical value belongs to the family Myrtaceae. Totally, fifteen jamun genotypes were studied for morphological and for flower, fruit, seed, biochemical and physiological characters during 2019-2020 at Regional Horticultural Research and Extension centre, University of Horticultural Sciences Campus, Gandhi Krishi Vignana Kendra, Bengaluru. A significant differences were observed in morphological and physico-chemical characteristics among the various genotypes of jamun. The genotype GKVK-1 recorded the highest tree height (718 cm), highest east-west (653 cm) as well as north- south (612 cm) canopy spread whereas lowest tree was height recorded in the genotype Mysuru (408 cm), the genotype Bahadoli showed lowest canopy spread. The genotype GKVK-1 recorded highest leaf length (16.24 cm) followed by the genotype GKVK-2 (13.20 cm) as well as the leaf breadth of 6.64 cm whereas the lowest leaf length was noticed in the genotype Kallahalli (10.80 cm). The petiole length of the genotype Seedless recorded the highest value of 3.06 cm. The genotype Dhoopdal recorded the highestintermodal length. Cluster analysis revealed that genotypes in the cluster IV (NO. -58, GKVK-2) were more vigorous and cluster III (Mysuru, Seedless) were least vigorous. Among the physiological parameters highest stomatal frequency was found in the genotype No. 20 (60.80), relative water content was found in the genotype Bahdoli (88.33 %), total chlorophyll content was found in genotypes Mysuru and seedless (1.09 mg/cm^2).

Introduction

Jamun (*Syzygium cumini* Skeels) synonymly known as *Eugenia jambolana*, *Eugenia cumini* and *Syzygium jambolana*. It is a polyembryonic species belongs to family Myrtaceae, it is commonly known as Jambul, Black Plum, Java Plum, Indian Blackberry, Jamblang and Jamun. Jamun was originated in India (Singh, 1969) and scattered almost throughout the country. India ranks 2nd in production of the jamun in the world. In India, Major producing states are Maharashtra, Uttar Pradesh, Tamil Nadu, Gujarat. The jamun has successfully introduced into many other subtropical regions including Florida, California, Madagascar, West Indies, Algeria, Israel, etc. The tree grows to a

height of 8 to 15 m with oblong, opposite leaves that are smooth and glossy with turpentine smell. The bark is scaly grey and trunk is forked and which has fragrant white flowers in branched clusters with hermaphrodite nature at stem tips and purplish-black oval edible berries with single seed. Jamun flowering occurs during February and March, and bearing occurs from May to July. In some jamun genotypes bearing occurs in October. Jamun is highly cross pollinated crop, flower and fruit drop is the major problem which leads to considerable yield loss.

Jamun has promising theraupeutic value due to its various phyto- chemical constituents and pharmacological properties. It is a good source of iron apart from being the source of other minerals, sugars and phyto-chemicals (Singh *et al.,* 1969). The fruit is a loaded source of anthocyanins, pectin, phenols and protein. Seed contains an alkaloid jambosin and a glycoside, jambolin or antimallin, which reduces or stop the conversion of starch into sugars. High tannins responsible for the astringency and three esters viz., dihydrocarvyl acetate, geranyl butyrate and terpenyl valerate are responsible for flavor of the fruit. (Vijayananda *et al.,* 2001) The antioxidant activity of jamun fruit has been attributed to its total phenolic compounds including anthocyanins. The principal sugars glucose and fructose are present in the ripe fruits. In recent years, jamun fruits are becoming popular due to their rich medicinal properties particularly for the anti-diabetic properties.

In India good varieties for yield is lacking, however, several area specific local selections have been identified by scientists and farmers. These selections are based on size, shape, taste, fruiting period and maturity of fruits. 'Ra Jamun' is one of those selection from north India, widely grown in India. Similarly in Maharastra Konkan Bahdoli is the ruling cultivar. Apart from these, some local selections growing in Haryana and Uttarpradesh are Kaatha, Badama, Jathi, Ashada, and Bhado. Central Institute of Sub tropical Horticulture, Lucknow has released one variety CISH J-42 which is seedless with good taste. There are three genotypes which have been identified for overall performance in Gujarat those are GJ-2, GJ-3 and GJ-8. The jamun fruit demand is increasing day by day because of its nutritive value and that will require selected plants of superior quality with high yield potential. As majority of jamun trees are of seedling origin, they show tremendous variation in their morphology and physico-chemical attributes. Lack of improved high yielding varieties with dwarf stature and good keeping quality are the major bottlenecks for the commercial cultivation of jamun in India. Hence, the present study aimed at characterizing the elite jamun genotypes to know the variability existing among them.

Materials and Methods

The present investigation on morphological characterization of different jamun genotypes was carried out during 2019-20 at Regional Horticulture Research and Extension Centre, University of Horticultural Sciences, GKVK campus, Bengaluru, Karnataka-560 065. 15 jamun genotypes used in the study planted at spacing of 5x5m.

All the Jamun genotypes were evaluated for various vegetative parameters. The genotypes were characterized for their tree vegetative characters like age of tree, shape of the canopy, tree height, circumference of tree, canopy spread, foliage type, leaf length and breadth, petiole length and internodal length. Physiological parameters like stomatal frequency, relative water content and cholorophyll content. Data were subjected to multivariate analysis utilizing cluster analysis using SAS v9.3 software and according to the cluster analysis done dendrogram was constructed for vegetative parameters.

Results and Discussion

The collections showed significant variation for the tree vegetative characters. The data pertaining to these characters were presented in Table 1, 2, 3 and 4. Grouping of genotypes resulted in four non-

overlapping clusters (Fig. 1). Cluster wise grouping of genotypes according to tree characters are given in Table 5. Cluster-II had maximum number of genotypes 7 (K-45, Chintamani, Hogalgere, Krishnagiri, Bahdoli, GKVK-1, No.-20) and Cluster III and IV had the minimum number of genotypes 2 (Mysuru, Seedless) and (NO. -58, GKVK-2). Cluster wise summary mean of tree characters will indicate the mean range of different traits and the genotypes were grouped based on similar parameters (Table 6).

The cluster wise mean of age of the tree was in the range of 6.5 years to 7 years. Cluster III recorded the lowest plant age (6.5 years) whereas the Cluster IV recorded the maximum plant age (7 years) (Table 6).The cluster wise mean value of tree height ranged from 469.00 cm to 518.00 cm. The cluster IV recorded the highest tree height (518.00 cm) and the Cluster III (469.00 cm) recorded the lowest tree height. Maximum tree height is because the trees in cluster IV were highly vigorous in nature. Similar results were noticed in by Deepika *et al.,* (2017). The cluster wise mean value of east-west canopy spread ranged from 486 cm to 529 cm. The Cluster II has the maximum east-west direction of 529 cm and the minimum of 486 cm was recorded in Cluster III, the cluster wise mean value of north-south canopy spread was ranged from 408 cm to 536 cm. The Cluster IV has the maximum N-S canopy spread of 536 cm and the minimum of 408 cm was recorded in Cluster I. The cluster wise mean value of tree circumference ranged from 49 cm to 65.5 cm. The Cluster IV has the maximum circumference of 65.5 cm and the minimum circumference of 49 cm was recorded in Cluster I. Maximum tree circumference was influenced by accumulation of carbohydrates as well as the tree height.

As per jamun DUS guide lines plant showed three types of spreading nature, *i.e.* Spreading, Semi-spreading and Upright. The genotypes Hogalgere, Hadonahalli, Kallahalli, Krishnagiri and GKVK – 2 were recorded spreading. The genotype seedless recorded semi spreading and the genotypes Mysuru, Chintamani, Bahadoli, No- 58, K-45, No.- 20, AJ-85, GKVK- 1 and Dhoopdal recorded upright (Table 1). In jamun two types of foliage was observed, *i.e*. sparse foliage and dense foliage. The genotypes comes under Sparse foliage type are Bahadoli, No.-58, K-45, No.-20, Hadonahalli, Kallahalli and Seedless. The genotypes comes under dense foliage type are Mysuru, Chintamani, AJ-85, Hogalagere, Krishnagiri, GKVK-1, GKVK-2 and Dhoopdal. In jamun two types of canopy shapes were found, *i.e*. round and oval (Table 1). The genotypes comes under the round shaped canopy are Mysuru, Chintamani, Bahadoli. The genotypes comes under the oval shaped canopy were No.-58, K-45, No.-20, Hadonahalli, Kallahalli, AJ-85, Hogalagere, Krishnagiri, GKVK-1, GKVK-2, Dhoopdal and Seedless.

The cluster wise mean of leaf length ranged from 11.84 cm to 12.88 cm. The Cluster IV recorded the highest mean value of 12.88 cm whereas the Cluster I recorded the lowest mean value of 11.84 cm. The maximum leaf length was influenced by the maximum spread of canopy due to more number of primary, secondary and tertiary branches. Cluster mean value of leaf breadth ranged from 5.17 cm to 5.93 cm. Cluster II recorded the highest mean value of 5.17 cm and the Cluster III recorded the lowest value of 5.93 cm. The cluster wise mean value of internodal length ranged from 4.63 cm to 6.01 cm. The Cluster IV recorded lowest value of 4.63 cm and the Cluster I recorded the highest value of 6.01 cm (Table 6). Similar reports were obtained by Shamsher and Amarjeet (2016).

The mature leaves of jamun genotypes revealed three different colours i.e. Dark green, dark yellowish green, moderate olive green. The genotypes comes underdark green colour were Mysuru, Chintamani, Bahadoli, No.-58, K-45, No.-20, A-85, Hadonahalli, GKVK-1 and GKVK-2. The genotypes comes under dark yellowish green colour are No. – 20, Hogalagere and Dhoopdal.

Table.1 Variability in tree characteristics of jamun genotypes as per DUS guidelines

Genotypes	Tree habit	Foliage type	Shape of the canopy	New flush colour	Mature leaf colour
Mysuru	Upright	Dense	Round	178 A (Greyish red)	136A (Dark green)
Chintamani	Upright	Dense	Round	153B (greenish yellow)	136A (Dark green)
Bahdoli	Upright	Sparse	Round	152 A(Light olive)	136A (Dark green)
No. 58	Upright	Sparse	Oval	152 A(Light olive)	135A (Dark green)
K-45	Upright	Sparse	Oval	152 A(Light olive)	136A (Dark green)
No. 20	Upright	Sparse	Oval	178B (Dark reddish orange)	139A (Dark yellowish green)
AJ- 85	Upright	Dense	Oval	183B(Dark reddish)	132A(Dark green)
Hogalgere	Spreading	Dense	Oval	153A(Deep greenish yellow)	136B(Dark yellowish green)
Hadonahalli	Spreading	Sparse	Oval	153A (Deep greenish yellow)	135A(Dark green)
Kallahalli	Spreading	Sparse	Oval	153A(Deep greenish yellow)	147A(Moderate olive green)
Karishnagiri	Spreading	Dense	Oval	152 A(Light olive)	137A(Moderate olive green)
GKVK -1	Upright	Dense	Oval	183A (Dark red)	136A(Dark green)
GKVK -2	Spreading	Dense	Oval	178 A(Greyish red)	136A(Dark green)
Dhoopdal	Upright	Dense	Oval	187A(Dark red)	136B(dark green)
Seedless	Semi spreading	Sparse	Oval	178 A(Greyish red)	136A(Dark green)

Fig.1 Dendrogram for morphological characters of jamun genotypes

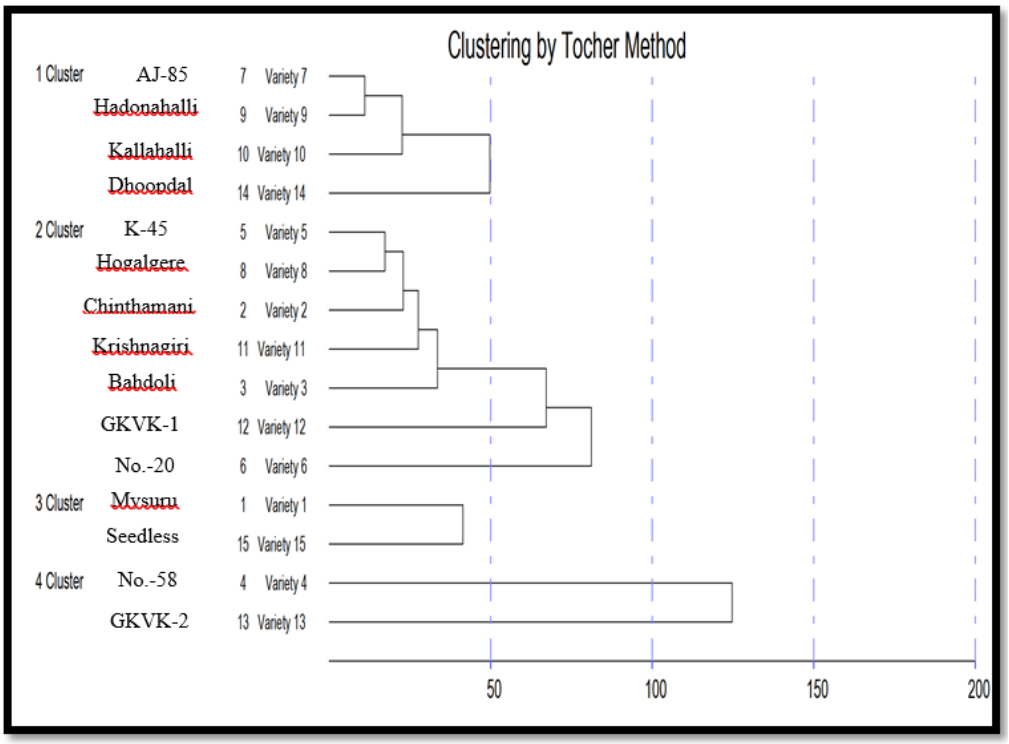

Table.2 Variability in tree characteristics of jamun genotypes

Genotypes	Age of the tree (years)	Tree Height (cm)	Plant spread east-west (cm)	Plant spread north-south (cm)	Tree circumference (cm)
Mysuru	7.00	408	490	486	63.60
Chintamani	7.00	474	518	460	72.20
Bahdoli	7.00	423	464	406	55.60
No. 58	7.00	518	586	542	53.00
K-45	7.00	494	528	546	57.30
No. 20	7.00	508	506	510	52.80
AJ- 85	7.00	500	546	494	58.50
Hogalgere	7.00	455	498	494	58.20
Hadonahalli	7.00	520	530	502	46.30
Kallahalli	7.00	424	516	474	42.10
Karishnagiri	7.00	434	506	510	51.10
GKVK -1	7.00	718	653	612	75.40
GKVK -2	7.00	520	516	518	53.50
Dhoopdal	6.00	542	542	470	50.80
Seedless	6.00	435	496	492	52.20
SEm±	0.00	0.11	0.19	0.20	2.30
C.D@5%	0.00	0.33	0.53	0.57	6.51

Table.3 Variability in leaf characteristics of jamun genotypes

Genotypes	Leaf length(cm)	Leaf breadth (cm)	Petiole length (cm)	Internodal length (cm)
Mysuru	12.10	6.04	2.72	4.32
Chintamani	11.30	5.06	2.12	5.08
Bahdoli	13.00	5.62	2.06	6.24
No.-58	11.90	4.64	2.00	4.56
K-45	11.90	4.90	2.62	4.28
No.- 20	11.20	4.26	1.74	4.58
AJ- 85	12.30	5.00	2.12	5.76
Hogalgere	11.70	5.00	1.88	5.22
Hadonahalli	11.68	5.66	2.1	5.08
Kallahalli	10.80	5.38	2.02	4.92
Karishnagiri	12.30	5.06	2.18	4.90
GKVK -1	16.24	6.64	2.38	6.72
GKVK -2	13.60	6.38	2.28	4.92
Dhoopdal	12.90	4.98	2.14	7.82
Seedless	11.96	5.68	3.06	5.82
SEm±	0.36	0.24	0.11	0.29
C.D@5%	1.02	0.67	0.32	0.81

Table.4 Variability in physiological parameters of jamun genotypes

Genotypes	Stomatal frequency (No. of stomata/mm^2)	Relative water content (%)	Chlorophyll a (mg/cm^2)	Chlorophyll b (mg/ cm^2)	Total Chlorophyll (mg/ cm^2)
Mysuru	30.60	79.99	1.06	0.03	1.09
Chintamani	42.40	85.71	0.49	0.06	0.55
Bahdoli	49.60	88.33	0.49	0.03	0.52
No. 58	43.60	78.49	0.65	0.19	0.84
K-45	32.80	47.47	0.43	0.11	0.54
No. 20	60.80	37.61	0.47	0.03	0.50
AJ- 85	43.60	56.60	0.62	0.07	0.63
Hogalgere	42.60	55.11	0.43	0.10	0.52
Hadonahalli	38.20	39.34	0.63	0.01	0.64
Kallahalli	35.40	34.59	0.68	0.02	0.70
Karishnagiri	46.20	76.85	0.50	0.07	0.57
GKVK -1	44.20	65.26	0.45	0.03	0.48
GKVK -2	40.00	50.33	0.80	0.14	0.94
Dhoopdal	37.60	65.78	0.53	0.10	0.63
Seedless	48.20	78.96	1.04	0.05	1.09
SEm±	0.76	3.04	0.00	0.01	0.00
C.D@5%	2.14	8.60	0.01	0.02	0.01

Table.5 Cluster wise grouping of jamun genotypes according to morphological characters

Clusters	Genotypes
Cluster-I	AJ-85, Hadonahalli, Kallahalli, Dhoopdal
Cluster-II	K-45, Chintamani, Hogalgere, Krishnagiri, Bahdoli, GKVK-1, No.-20
Cluster-III	Mysuru, Seedless
Cluster-IV	NO. -58, GKVK-2

Table.6 Cluster wise summary mean of morphological characters

Characters	Cluster I	Cluster II	Cluster III	Cluster IV
Age of the tree (Years)	6.75	7	6.5	7
Tree height(cm)	496.50	499.00	469.00	518.00
North-South(cm)	408	517	493	536
East-West (cm)	503	529	486	505
Circumference of tree (cm)	49	57.57	58.13	65.5
Leaf length(cm)	11.84	12.45	12.04	12.88
Leaf breadth (cm)	5.25	5.17	5.93	5.55
Petiole length(cm)	2.1	2.11	2.89	2.18
Internodal length(cm)	6.01	5.3	5.24	4.63
Stomatal frequency (No. of stomata / mm^2)	38.56	45.54	39.25	41.38
Relative water content (%)	46.96	64.69	77.3	64.55
Chlorophyll a (mg/cm^2)	0.62	0.47	1.05	0.73
Chlorophyll b (mg/cm^2)	0.05	0.06	0.04	0.16
Total chlorophyll (mg/cm^2)	0.65	0.53	1.09	0.89

The genotypes comes under moderate olive green colour were Kallahalli and Krishnagiri, similar results were obtained by Anushma *et al.,* (2018) and Deepika *et al.,* (2017)

The cluster wise mean value for stomatal frequency ranged from 38.56 to 45.54. The cluster I (AJ-85, Hadonahalli, Kallahalli, Dhoopdal) recorded the lowest cluster mean value 38.56 and the cluster II (K-45, Chintamani, Hogalgere, Krishnagiri, Bahdoli, GKVK-1, No.-20) recorded the highest mean value 45.54.

Leaf stomata are the principal means of gas exchange in vascular plants, the more number of stomata per unit area the more co_2 can be taken up, and the more water can be released. Thus higher stomatal frequency can greatly amplify the potential for behavioral control over water loss rate and co_2 uptake.

The leaf relative water content (RWC) is an important indicator of water status in plants; it reflects the balance between water supply to the leaf tissue and transpiration rate.The cluster wise mean value for relative water content ranged from 46.96 to 77.3. The cluster I (AJ-85, Hadonahalli, Kallahalli, Dhoopdal) recorded the lowest cluster mean value 38.56 per cent and the cluster III (Mysuru, Seedless) recorded the highest mean value 77.3 per cent. The cluster wise mean value for total cholorophyll ranged from 0.53 $mg/cm^2$to 1.09mg/cm^2.

The cluster III (Mysuru, Seedless) recorded the lowest mean value 0.53mg/cm^2 and the cluster IV (NO. -58, GKVK-2) recorded the highest mean value 1.09mg/cm^2.(Table 6). Chlorophyll content mainly determines the photosynthetic rate and primary productivity in plant and is widely used as a response to the environment stress and nitrogen fertilizer application. Therefore, chlorophyll content could be used as an important diagnostic indicator for plant growth study.

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