

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.711.349>

Morphological Variations among Different Jackfruit Genotypes

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ABSTRACT

Keywords

Plant characters, Leaf characters and PCA (Principle component Analysis)

Article Info

Accepted:

22 October 2018

Available Online:

10 November 2018

Jackfruit (*Artocarpus heterophyllus* Lam.), being a cross pollinated crop shows high variations in plant and leaf characters. Thus, present study was under taken to assess the morphological variations of plant and leaf characters among twenty genotypes under AICRP on Fruits, B.C.K.V., Mohanpur centre as per the descriptor developed by Bioversity International (IPGRI). Variations were noticed with respect to shape of crown (elliptic, pyramidal, broadly pyramidal, semicircular and irregular), leaf shape (elliptic, oblong, obovate, narrowly elliptic and broadly elliptic) and also in terms of biometric characters of fruit like plant height (5.9-9.1m), trunk circumference (0.61-1.17m), crown diameter (5.1-10.2 m), leaf blade length (7.5-13.4 cm), leaf blade diameter (4.1-7.6 cm), petiole length (0.7-2.7 cm).

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.), is a tetraploid ($4n=56$) and is the one of the most significant trees in tropical homegardens and perhaps the most widespread and useful tree in the important genus *Artocarpus*, of family *Moraceae*. The jackfruit species reportedly originated in the rainforests of the Western Ghats of India (Chandler, 1958) and in Malaysia (Brown, 1941). Jackfruit is a national fruit of Bangladesh and state fruit of Kerala and Tamilnadu; where it is commonly referred to as “poor man’s food” as it is cheap and plentiful during the season. In India, it has wide distribution in Assam, Tripura, Bihar, Uttar Pradesh, the foothills of the Himalayas and South Indian States of Kerala, Tamil Nadu and Karnataka.

Jackfruit is a multipurpose tree and all parts of the plant are equally important. Fruits are rich in several nutrients. It can act as source of complete nutrition to the consumer. Fruits of jackfruit are compared to avocado and olive in terms of the healthier mix of nutrients for human dietary needs, almost having the exact nutrient equivalent of mother's milk. It is rich in vit-B and C, potassium, calcium, iron, proteins and high level of carbohydrates, affordable and readily available supplement to our staple food. Its seeds are rich in proteins and can be relished as a nutritious nut. The fruit is also the source of chemical 'Jacalin' useful in preventing colon cancer, AIDS (Priya *et al.*, 2014). Tree is known for its durable anti-termite timber. Jackfruit trees are suitable for growing in wide agro-climatic regions owing to its versatile adaptability,

hardy nature, low maintenance cost and high yield. The trees help in amelioration of soils and prevention of the soil erosion. The leaves and fruit waste provide valuable fodder for cattle, pigs and goats.

Jackfruit, being cross-pollinated and mostly seed propagated, jackfruit has innumerable types or forms in terms of fruit characteristics. The types differ widely among themselves and many types available in India under various local names have originated in this way. However, distinct cultivars are not available. Selection of superior genotypes for the fresh market and the processing industry, as well as for high yield, better quality and tolerance to abiotic and biotic stresses, would be of great value for commercialization of this underutilized nutritive fruit. Thus, present study was undertaken to assess the morphological variations among twenty genotypes under AICRP on Fruits, B.C.K.V., Mohanpur centre as per the descriptor developed by Bioversity International (IPGRI)

Materials and Methods

A study entitled “Morphological variations among different jackfruit genotypes” was conducted at AICRP on Fruits, B.C.K.V., Mohanpur centre during 2015-2017. Various morphological characters of jackfruit plant and leaf were observed in twenty different genotypes (serially numbered as G-1 to G-20) as per the descriptor developed by Bioversity International (IPGRI). The plants were healthy, about 14 years of age and received similar cultural treatments.

Plant characters viz., age of the tree, tree height (m), trunk circumference (cm), trunk surface, trunk growth habit, crown diameter (m) and crown shape were recorded on unpruned plants. Leaf characters viz., leaf blade length (cm), leaf blade width (cm), leaf blade shape, leaf apex shape, leaf base shape,

leaf blade margin, leaf upper surface pubescence, leaf lower surface pubescence, leaf midrib pubescence, petiole length (mm) and grooves on petiole were recorded by collecting five leaves from each genotype from all sides crown.

Principal components were computed from the correlation matrix and genotypic scores obtained for the first component and succeeding components with latent roots greater than unity (Jager *et al.*, 1983).

Results and Discussion

All 20 genotypes plants selected for present study were of same age i.e. fourteen (14) years old. Even with the same age of the genotypes, differences with regard to plant height were observed among the genotypes (Table 1). The maximum plant height of 9.1m was observed in G-20, followed by G-12 (8.9m) and G-16 (8.8m). The least height of 5.9m was observed in G-4. Differences in plant height was also observed by Gaithoiliu *et al.*, (2017) and found height of different genotypes ranges from 6.5 m to 16 m.

The results of trunk circumference varied among the genotypes (Table 1), maximum trunk circumference (1.17m) was recorded in G-10. The least trunk circumference (0.61m) was observed in G-4. Grand mean of crown diameter recorded was 7.42m and showing variation from 5.1m (G-18) to 10.2m (G-14).

Semi-erect plant growth habit recorded in G-3, G-5, G-6, G-7, G-8, G-9, G-10, G-11, G-13, G-14, G-15, G-17, G-18 and G-20 whereas spreading growth habit observed in G-1, G-2, G-4, G-12, G-16 and G-19. Two types of trunk surface (rough and very rough). Among them 16 showed rough surface (G-1, G-3, G-4, G-5, G-6, G-8, G-9, G-11, G-12, G-13, G-14, G-15, G-17, G-18, G-19 and G-20) and 4 recorded very rough (G-2, G-7, G-10 and G-

16). Five crown shapes were noted i.e. elliptic in G-3, G-4, G-5, G-17; pyramidal in G-1, G-9, G-11; broadly pyramidal in G-2, G-6; G-8, 10, G-12, G-13, G-14, G-15, G-16, G-20; semicircular in G-7 and irregular in G-18 and G-19. Terminal (2012) also reported the varied plant crown shape like irregular, oblong, pyramidal, obovate, semicircular, elliptical and broadly pyramidal in both clonal and seedling progenies.

The genotypes differed in leaf length and ranged from 7.5 cm to 13.4 cm for the various jackfruit genotypes studied (Table 2). The grand mean leaf length for the genotypes studied was 10.6 cm. The maximum leaf length of 13.40 cm was recorded in genotypes G-13 and G-15 followed by G-11 (12.00cm), while lowest leaf length (7.5 cm) was recorded in G-10. Grand mean leaf width was observed to be 5.7 cm for the jackfruit genotypes studied, while the leaf width ranged from 4.1 cm to 7.6 cm. The maximum leaf width of 7.6 cm was recorded in G-14, while lowest leaf width of 4.1 cm was recorded in G-20. Variation in leaf blade length and width was also reported in the study of Ruby Khan *et al.*, (2010). Five different leaf blade shapes were noted as elliptic in G-1, G-4, G-6, G-9, G-18, G-19; oblong in G-8, G-12, G-14, G-17; obovate in G-3, G-7; narrowly elliptic in G-5, G-11, G-13, G-15, G-16, G-20 and broadly elliptic in G-2 and G-10. Similar observations in conformity to this finding were also reported by Chandan (2001) with elliptic, narrowly elliptic, broadly elliptic, obovate, oblong and lyrate. The shape of the leaf apex were noted as acute (G-2, G-6, G-7, G-11, G-13, G-16 and G-20), acuminate (G-1, G-3, G-4, G-5, G-9, G-15, G-18 and G-19) and obtuse (G-8, G-10, G-12, G-14 and G-17). Whereas, four different shape of the leaf apex were noted as cuneate (G-2, G-3, G-5, G-11, G-13, G-14, G-15, G-16, G-19 and G-20), shortly attenuate (G-1, G-7, G-9, G-10, G-12, G-17 and G-18), oblique (G-4 and G-6) and rounded

(G-8). Variation in leaf base shape and apex shape were also reported in the study of Chandrasekhar (2014). The leaf margin observed was undulated (G-1, G-2, G-3, G-4, G-5, G-7, G-8, G-10, G-12, G-13, G-14, G-15, G-17, G-18 and G-19) and entire (G-6, G-9, G-11, G-16 and G-20). From the data represented in Table 2 revealed that leaf upper surface pubescence showing both sparse (G-1, G-2, G-3, G-4, G-5, G-8, G-10, G-11, G-12, G-13, G-14, G-15, G-17, G-18, G-19) and glabrous (G-6, G-7, G-9, G-16 and G-20).

Leaf lower surface pubescence also showed both sparse (G-1, G-2, G-3, G-4, G-5, G-7, G-8, G-9, G-10, G-11, G-12, G-13, G-14, G-15, G-17, G-18, G-19) and glabrous (G-6, G-16 and G-20). Gaithoilu *et al.*, (2017) also reported varied intensity of leaf upper and surface pubescence. leaf midrib pubescence showing sparsely pubescence (G-1, G-2, G-3, G-4, G-5, G-7, G-8, G-10, G-11, G-12, G-13, G-14, G-15, G-17, G-18, G-19) and glabrous (G-6, G-16 and G-20). The genotypes differed in petiole length and the average petiole length ranged from 0.7 cm to 2.70 cm for the various jackfruit genotypes studied. The grand mean petiole length for the genotypes studied was 1.7 cm. Maximum petiole length of 2.70 cm was recorded in genotype G-14 followed by G-19 (2.20 cm) and G-15 (2.20 cm), while lowest petiole length of 0.7 cm was recorded in G-5. Variation in leaf blade length was also reported in the study of Wangchu (2005) ranging 0.08cm (T-4) to 2.50cm (T-27). Presence of groove, acute crotch angle and rounded leaf petiole shape was recorded in all twenty genotypes.

An overall perusal of results revealed that medium plant height genotypes G-2 (7.8m), G-5 (7.5m) and G-18 (6.0m) with higher number of fruits per plant was noted 27, 68 and 30 fruits respectively, which gives opportunity to grow as homestead plants with good fruit quality fruits.

Table.1 Plant characters of different selected jackfruit genotypes

Genotype	Plant Height [m]	Trunk Circumference [m]	Crown Diameter [m] N-S	Crown Diameter [m] E-W	Mean Crown Diameter [m]	Trunk Growth Habit	Trunk Surface	Crown Shape	No. of Fruits/Plant	Fruit Weight (Kg)
G-1	7.5	0.72	6.5	6.4	6.45	Spreading	Rough	Pyramidal	11	9
G-2	7.8	0.68	8.2	6.2	7.2	Spreading	Very Rough	Broadly Pyramidal	27	9
G-3	7.1	0.86	6.9	7.6	7.25	Semi-Erect	Rough	Elliptical	12	10
G-4	5.9	0.61	5.2	5.3	5.25	Spreading	Rough	Elliptical	9	7
G-5	7.5	0.81	8.3	8.3	8.3	Semi-Erect	Rough	Elliptical	68	3
G-6	8.8	0.92	9.1	8.8	8.95	Spreading	Rough	Broadly Pyramidal	9	7
G-7	8.4	0.83	8.7	8.9	8.8	Semi Erect	Very Rough	Semicircular	13	11
G-8	8.6	0.89	8.9	9.1	9	Spreading	Rough	Broadly Pyramidal	8	6
G-9	7.5	0.70	7	6.6	6.8	Semi Erect	Rough	Pyramidal	9	7
G-10	8.7	1.17	8.7	8.9	8.8	Semi-Erect	Very Rough	Broadly Pyramidal	11	9
G-11	8.2	0.81	8.1	7.6	7.85	Semi Erect	Rough	Pyramidal	7	5
G-12	8.9	0.91	9.3	9.7	9.5	Spreading	Rough	Broadly Pyramidal	9	7
G-13	7.5	0.76	7.9	7.1	7.5	Semi Erect	Rough	Broadly Pyramidal	18	16
G-14	8.1	0.89	10.7	9.7	10.2	Semi-Erect	Rough	Broadly Pyramidal	9	7
G-15	7.5	0.70	7	6.6	6.8	Semi Erect	Rough	Broadly Pyramidal	7	5
G-16	8.8	1.10	9.2	8.5	8.85	Spreading	Very Rough	Broadly Pyramidal	6	5
G-17	7.3	0.86	7.7	7.5	7.6	Semi-Erect	Rough	Elliptical	7	5
G-18	6	0.64	5.1	5.1	5.1	Semi-Erect	Rough	Irregular	30	5
G-19	7.3	0.73	6.7	6.3	6.5	Semi-Erect	Rough	Irregular	7	5
G-20	9.1	0.93	7.9	8.4	8.15	Semi-Erect	Rough	Broadly Pyramidal	8	6
General Mean	7.57	0.82	7.53	7.31	7.42				14.3	7.2
Range	Max.	9.1 (G-20)	1.17 (G-10)	10.7 (G-14)	9.7 (G-12 & G-14)	10.2 (G-14)			68 (G-1)	16 (G-13)
	Min.	5.9 (G-4)	0.61 (G-4)	5.1 (G-18)	5.1 (G-18)	5.1 (G-18)			6 (G-16)	3 (G-5)

Table.2 Leaf characters of different selected jackfruit genotypes

Genotype	Leaf Blade Length (cm)	Leaf Blade Width (cm)	Leaf Blade Shape	Leaf Apex Shape	Leaf Base Shape	Leaf Blade Margin	Leaf Upper Surface Pubescence	Leaf Lower Surface Pubescence	Leaf Midrib Pubescence	Petiole Length (Cm)
G-1	9.4	5.1	Elliptic	Acuminate	Shortly Attenuate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.4
G-2	11.0	5.8	Broadly Elliptic	Acute	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.7
G-3	10.9	5.9	Obovate	Acuminate	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.8
G-4	9.6	5.0	Elliptic	Acuminate	Oblique	Undulate	Sparse	Sparse	Sparsely Puberulent	1.5
G-5	9.5	4.7	Narrowly Elliptic	Acuminate	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	0.7
G-6	11.2	6.2	Elliptic	Acute	Oblique	Entire	Glabrous	Glabrous	Glabrous	2.1
G-7	8.3	5.5	Obovate	Acute	Shortly Attenuate	Undulate	Glabrous	Sparse	Sparsely Puberulent	1.5
G-8	8.4	5.7	Oblong	Obtuse	Rounded	Undulate	Sparse	Sparse	Sparsely Puberulent	0.8
G-9	11.4	6.5	Elliptic	Acuminate	Shortly Attenuate	Entire	Glabrous	Sparse	Glabrous	1.7
G-10	7.5	5.9	Broadly Elliptic	Obtuse	Shortly Attenuate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.3
G-11	12.0	6.1	Narrowly Elliptic	Acute	Cuneate	Entire	Sparse	Sparse	Sparsely Puberulent	1.6
G-12	10.3	5.9	Oblong	Obtuse	Shortly Attenuate	Undulate	Sparse	Sparse	Sparsely Puberulent	2.0
G-13	13.4	5.8	Narrowly Elliptic	Acute	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.9
G-14	13.2	7.6	Oblong	Obtuse	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	2.7
G-15	13.4	5.8	Narrowly Elliptic	Acuminate	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	2.2
G-16	10.9	4.8	Narrowly Elliptic	Acute	Cuneate	Entire	Glabrous	Glabrous	Glabrous	1.3
G-17	10.9	6.3	Oblong	Obtuse	Shortly Attenuate	Undulate	Sparse	Sparse	Sparsely Puberulent	2.0
G-18	11.4	6.3	Elliptic	Acuminate	Shortly Attenuate	Undulate	Sparse	Sparse	Sparsely Puberulent	1.9
G-19	9.7	4.9	Elliptic	Acuminate	Cuneate	Undulate	Sparse	Sparse	Sparsely Puberulent	2.2
G-20	8.8	4.1	Narrowly Elliptic	Acute	Cuneate	Entire	Glabrous	Glabrous	Glabrous	1.3
Grand Mean	10.6	5.7								1.7
Range	Max	13.4 (G-13)	7.6 (G-14)							2.7 (G-14)
	Min	7.5 (G-10)	4.1 (G-20)							0.7 (G-5)

Average of 5 leaves from each genotype

Table.3 Eigen value and variability of plant and leaf characters of jackfruit based on principal component analysis

COMPONENT	PC1	PC2	PC3	PC4	PC5
Eigen value	5.197	2.565	2.367	1.535	1.535
% Variance	32.481	16.033	14.793	9.594	6.837
CHARACTERS	EIGEN VECTORS				
Plant height (m)	-.822	.383	.306	-.013	-.016
Trunk circumference (cm)	-.648	.326	.471	.114	-.175
Crown diameter (m)	-.584	.615	.348	-.046	-.040
Plant habit	-.288	-.188	.094	-.673	.460
Trunk surface	-.381	-.090	.470	.388	.597
Crown shape	.556	-.455	.085	.187	-.216
Leaf blade length (cm)	.205	.500	-.735	-.029	.120
Leaf blade width (cm)	.268	.716	-.295	.172	.209
Leaf blade shape	-.153	.661	.179	-.427	-.303
Leaf apex shape	.660	.085	.210	-.106	-.402
Leaf base shape	.182	.258	.317	.691	-.101
Leaf blade margin	.763	.096	.473	-.077	.187
Leaf upper surface pubescence	.782	.271	.270	-.344	.030
Leaf lower surface pubescence	.846	.204	.268	.090	.131
Leaf midrib pubescence	.793	.202	.430	-.097	.205
Petiole length (cm)	.276	.493	-.580	.195	.176

Having medium plant height (7.5m), 18 fruits/plant/season with average weight of 10kg/fruit and good fruit quality characters of genotype G-13 gives an opportunity to grow as homestead plant. Easy handling small size fruit character (3kg average fruit weight) G-5 provides consumer acceptance and with the character of bearing highest number of fruit per plant among the genotypes fetching more income to farmer.

G-3, G-7 and G-13 having fruit weight greater than 10 kg with high TSS are highly beneficial for industries, street vendors and for home level processing units.

The result of the PCA for plant and leaf parameters of jackfruit showed the genetic diversity of the genotypes. Among the five principle component PC-1 accounted the highest variability, PC-2 and PC-3 accounted

for higher variability for most of the variability observed among the jackfruit genotypes from different locations (Table 1 and Fig. 1). Among the five principal components, the first principal component axes had Eigen value > 5, the second and third principle component axes had Eigen value > 2 and the remaining principle components had Eigen value > 1.5. PC-1, PC-2, PC-3, PC-4 and PC-5 accounted for 32.48%, 16.03%, 14.79 %, 9.59% and 6.83% respectively of the morphological variation in the jackfruit genotypes (Table 3). PC-1 explains for maximum percentage of variation and comprised of 10 characters with positive value and six characters with negative value.

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How to cite this article:

Pebbuli Avani and Bauri, F.K. 2018. Morphological Variations among Different Jackfruit Genotypes. *Int.J.Curr.Microbiol.App.Sci*. 7(11): 3042-3048.
doi: <https://doi.org/10.20546/ijcmas.2018.711.349>