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Morphological Characterization of Jackfruit (*Artocarpus heterophyllus* Lam.) of Assam, India

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A B S T R A C T

Evaluation of 24 local genotypes from six different agroclimatic zones of Assam was conducted during 2016-2018. Wide variability was observed among the selected jackfruit accessions for morphological characters. Variability in crown shapes like irregular, elliptical, oblong and spherical were observed. Wide variations in leaf blade shape i.e. elliptic, obovate, oblong, broadly elliptic and narrowly elliptic were recorded in the selected jackfruits. Different fruit shapes like ellipsoid, spheroid, oblong, clavate, oblong and irregular were recorded in the selected accessions. Flake texture and flake flesh colour also showed wide variation. In seeds, different seed shapes such as ellipsoid, irregular, reniform, spheroid and oblong were recorded.

Introduction

The jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae and is believed to have originated in the rain forests of Western Ghats of India (Rowe-Dutton, 1985). It is cultivated throughout the tropical lowlands in South and South East Asia, parts of Central and Eastern Africa and Brazil. In India it is widely distributed in the states of Assam, Bihar, Tripura, West Bengal, Uttar Pradesh, the foot hills of the Himalayas and South Indian states of Kerala, Tamil Nadu and Karnataka. The region comprising of Assam, Tripura and West Bengal produces major share of jackfruit in India (APAARI, 2012).

The area under jackfruit cultivation in India is 1.85 lakh hectares with a production of 18.30 lakh MT. In Assam, the total area under jackfruit cultivation is estimated to be 22 thousand hectares with an annual production of 1.97 lakh MT (NHB, 2015-16).

Jackfruit shows a considerable range of variations in morpho-agronomic characters

and this may be because jackfruit trees are cross-pollinated and are mostly propagated by seeds. A considerable variation between trees has been observed for the traits such as growth habit, canopy structure, leaf size, fruit shape, size, colour, fruit bearing (age and seasonality) and maturity. Variations also exist in density, size and shape of spines on rind, fruit bearing, sensory quality, flesh type, sweetness, flavour and taste.

Jackfruit trees found in Assam exhibit wide range of phenotypic variations as they are cross pollinated and mostly propagated by seeds. So, the present investigation was undertaken to morphologically characterize the selected jackfruit germplasm of Assam.

The characterization of the jackfruit germplasm will help in selection of superior elite trees possessing high yield potential with better quality, tolerance to biotic and abiotic stresses. This will further lead to the development of good varieties resulting in commercialization of the under-utilized fruit.

Materials and Methods

The investigation was carried out with an objective to study the morphological variations among different jackfruit trees of Assam during the period from 2016 to 2018. The experiment was conducted in six districts, representing six agro-climatic zones of Assam viz Cachar under Barak Valley Zone, Goalpara under Lower Brahmaputra Valley Zone, Nagaon under Central Brahmaputra Valley Zone, Sonitpur under North Bank Plain Zone, Karbi Anglong under Hill Zone and Jorhat under Upper Brahmaputra Valley Zone. The selected jackfruit trees were identified in the farmer's field in six different locations. However, this fruit being an underutilized crop were grown in backyard without any management practice, mixed with other forest or fruit trees. Four healthy jackfruit trees between 10 to 20 years of age were selected in each district comprising of twenty four (24) numbers of trees in six districts. Each tree (accession) was given an accession number for future identification. The accession number consisted of initials of the district e.g CAC for Cachar, GLP for Goalpara, NAG for Nagaon, SON for Sonitpur, KA for Karbi Anglong and JRT for Jorhat and the numerical 1 to 4 for tree number.

Data on morphological parameters of trees, leaves, fruits, seeds of the selected jackfruit trees were recorded based on Jackfruit descriptor (IPGRI, 2000).

Results and Discussion

In the present investigation, an attempt was made to characterize the jackfruit accessions of Assam with respect to morphological characters of trees, leaves, fruits and seeds. The results obtained from the study are discussed hereunder.

Tree characters

Tree height (m)

Tree height of different jackfruit trees selected from various locations is given in Table 2. Maximum tree height was recorded in accession number SON2 (18 m) and the minimum was recorded in accession number CAC3 (7 m). The mean height of selected jackfruit accession was found to be 11.75 m. The variation reported in tree height may be due to the difference in age of the tree, plant physiological and soil nutrient status. Similar variations in tree height were reported by Chandrashekar *et al.,* (2018) and Phaomei *et al.,* (2017) among jackfruit trees who recorded that the tree height ranged from 10.94 to 23.64m and 6.5 to 16m respectively. The coefficient of variation of tree height was 23.17%.

Trunk circumference (cm)

Trunk circumference of jackfruit accessions are presented in Table 2. Maximum trunk circumference was recorded in SON 2 (198 cm) and the minimum was recorded in CAC3 (120 cm). Mean trunk circumference of jackfruit trees recorded was 153.83 cm. The present results conform to the findings of Chandrashekar *et al.,* (2018) and Phaomei *et al.,* (2017). The coefficient of variation of tree circumference was 13.65%.

Tree growth habit

The observations on tree growth habit of selected jackfruit accessions are presented in Table 1. Considerable variations in tree growth habit were recorded among the accessions. Erect growth habit was recorded in 11 jackfruit accessions (45.83%) followed by spreading in 10 accessions (41.66) whereas 3 accessions (12.50%) recorded semi-erect growth habit. Similar findings of variations in tree growth habit from erect, semi-erect and spreading were also recorded by Wangchu (2005).

Branching density

Branching density of the jackfruit accessions varied from sparse, medium and dense (Table 1). Medium branching density was recorded in 14 accessions (58.33%) followed by sparse in 9 accessions (37.50%) and dense in only one accession (4.16%).

The results are fairly consistent with the observation of Wann (2012) who recorded 'dense' branching density in five clonal progenies, 'medium' in four clonal progenies and two had 'sparse' branching density. This variation in branching density may be due to the growing condition, microclimate and genetic factors.

Branching pattern

The observations on branching pattern of jackfruit accession are presented in Table 1. 'Erect' branching pattern was recorded in 10 accessions (41.66%) followed by 'verticillate' branching pattern in 6 accessions (25%), 'opposite' branching pattern in 4 accessions (16.66%), 'horizontal' branching pattern in 2 accessions (8.33%) and 'irregular' branching pattern in 2 accessions (8.33%). A similar variation in branching pattern was recorded by Chandrashekar *et al.,* (2018) in 34 jackfruit accessions in Tamil Nadu.

Crown shape

Considerable variation in crown shape was recorded among the selected jackfruit accessions from different locations of Assam (Table 1). 11 accessions (45.83%) recorded 'irregular' crown shape followed by 'elliptical' in 10 accessions (41.66%), 'oblong' in 2 accessions (8.33%) and one accession (4.16%) recorded 'spherical' shape.

DeGraaf and Sendak (2006) reported that young trees tend to have a narrow crown, which spreads with ageing, trees grown on fertile soil with moist climate exhibit faster growth rate than those grown on poor soil and dry climate. These factor along with trees individual genetic makeup, contribute to the variation in tree size and growth form within species.

Fruit bearing position

The results of fruit bearing position of jackfruit accessions are presented in Table 1. Eighteen accessions (75%) reported 'main trunk' as the major fruit bearing position whereas six accessions (25%) reported 'primary branch' as the major fruit bearing position.

Wangchu (2005) observed variation in fruit bearing position where maximum fruits were borne either on 'trunk' or 'trunk and primary branches'. It was generally observed that fruit drop was more on higher order branches. It may be due to the action of strong sink at trunk/primary branches. Further this may be a natural adaptation of the tree wherein the higher order branches cannot hold all the developing fruits to maturity.

Number of fruits per tree

The number of fruits per tree exhibited wide variations among jackfruit accessions (Table 2). The highest number of fruits per tree was recorded in accession number JRT3 (68.00) and the lowest number of fruits per tree was recorded in accession number CAC3 (9.00). The average number of fruits per tree was recorded to be 26.25. The coefficient of variation for number of fruits per tree was 54.26%.

Leaf characters

Leaf blade shape

Five different types of leaf blade shape were observed in different selected accessions of jackfruit trees (Table 1). Eleven number of jackfruit accessions (45.83%) recorded 'elliptic' leaf blade shape. Five accessions (20.83%) recorded 'obovate' leaf blade shape while four accessions (16.66%) recorded 'oblong' leaf blade shape. Two accessions each (8.33%) recorded 'broadly elliptic' and 'narrowly elliptic' leaf blade shape. Similar observations on leaf blade shape were also recorded by Chandrasekhar (2014).

Leaf length

Length of leaves showed significant variations among jackfruit accessions selected from different locations (Table 2). The highest leaf length of 17.94 cm was recorded in accession number GLP4 followed by CAC4 (17.92 cm) and the lowest was recorded in KA4 (10.34 cm). The mean leaf length of accessions was recorded to be 15.19 cm. Similar variation in leaf length was observed by Chandrashekar *et al.*, (2018), where a range of 12.36 to 22.47cm was recorded among the 34 genotypes surveyed. The variation in leaf length might be a genetic character among the jackfruit accessions and may also be attributed to varying microclimate. The coefficient of variation of leaf length was 12.62%.

Leaf width

The data on leaf width recorded in Table 2 showed significant variation of leaf width among the jackfruit accessions. The highest leaf width (10.36 cm) was recorded in accession number CAC4. The lowest leaf width (5.20 cm) was recorded in accession number KA4. The mean leaf width among the accessions was 8.58 cm. The results are in conformity with the findings of Chandrashekar *et al.*, (2018), who reported that the leaf width of accessions ranged from 5.62 to 10.58 cm. The variation in leaf width might be due to different genetic makeup of the jackfruit accessions. The coefficient of variation of leaf width was 13.81%.

Fruit characters

Fruit shape

The observation on fruit shape presented in Table 1 reveals wide variation among the jackfruit accessions. Of the twenty accessions studied eight accessions (33.33%) were ellipsoid in shape, seven accessions (29.16%) were spheroid, four accessions (16.66%) were oblong, three accessions (12.50%) were clavate and one each (4.16) were obloid and irregular. Wann (2012) also reported wide variations in fruit shape of jackfruit ranging

from ellipsoid, oblong, spheroid and irregular. Variation in fruit shape may be due to the combined effect of genetic traits and the nature of pollination. Uniform pollination results in definite shape whereas inadequate pollination gives irregular shape of fruits.

Flake texture

Wide variation in flake texture was observed among the jackfruit accessions (Table 1). Seven accessions (29.16%) recorded 'melting' texture, six accessions (25%) recorded 'firm' texture, five accessions (20.83%) recorded 'soft' texture, four accessions (16.66%) recorded 'fibrous' texture and two accessions (8.33%) recorded 'coarse' texture.

Variation in jackfruit flake texture was also reported by Akter and Rahman (2018) as 'very soft', 'medium firm' and 'firm'.

Flake flesh colour

The observation on flake flesh colour revealed wide variation in flake flesh colour ranging from creamy white to deep yellow (Table 1) in the jackfruit accessions. Eleven accessions (45.83%) recorded yellow flake flesh colour, six accessions (25%) recorded light yellow flake flesh colour, five accessions (20.83%) recorded deep yellow flake flesh colour and two accessions (8.33%) recorded creamy white flake flesh colour.

Jagadeesh *et al.*, (2007) observed that the intensity of colour of flakes, as revealed visually, was directly related to the amount of carotenoids found in each jackfruit type. So, the factors that influence carotenoids synthesis may be the factors controlling the flake flesh colour.

Fruit weight

The observations on fruit weight revealed significant variation in fruit weight among the jackfruit accessions (Table 3). The highest fruit weight was recorded in accession number GLP3 (10.89 kg) and the lowest was recorded in accession number CAC4 (1.19kg). The mean fruit weight was recorded at 4.61 kg. The coefficient of variation of fruit weight was 51.76%.

Fruit length

Significant variation in fruit length was observed among different jackfruit accessions (Table 3). The highest fruit length was recorded in SON1 (46.67 cm) followed by GLP3 (43.33 cm) and the lowest was recorded in KA4 (20.33 cm). Mean fruit length of 28.67 cm was recorded among the accessions.

Similar findings were reported by Akter and Rahman (2018) who recorded fruit length ranging from 20 cm to 47 cm and a mean of 31.40 cm among different jackfruit accessions. The variations in fruit length might be due to genetic and environmental factors. The coefficient of variation of fruit length was 24.32%.

Fruit diameter

The observations on fruit diameter presented in Table 3 revealed significant variation in fruit diameter among the jackfruit accessions. The highest fruit diameter of 74.00 cm was recorded in accession GLP3 followed by accession CAC2 (67.00cm) which was at par with SON1 and CAC1. The lowest fruit diameter was recorded in accession CAC4 (40.67 cm).

Table.1 Frequency distribution of polymorphic qualitative characters

Character	Frequency	Frequency percentage
Crown shape		
Spherical	1	4.16
Oblong	2	8.33
Elliptical	10	41.66
Irregular	11	45.83
Tree growth habit		
Erect	11	45.83
Semi-erect	3	12.50
Spreading	10	41.66
Branching density		
Sparse	9	37.50
Medium	14	58.33
Dense	1	4.16
Branching Pattern		
Erect	10	41.66
Opposite	4	16.66
Verticillate	6	25
Horizontal	2	8.33
Irregular	2	8.33
Fruit bearing position		
Main trunk	18	75.00
Primary branch	6	25.00
Fruit Shape		
Obloid	1	4.16
Spheroid	7	29.16
Ellipsoid	8	33.33
Clavate	3	12.50
Oblong	4	16.66
Irregular	1	4.16
Flake texture		
Soft	5	20.83
Firm	6	25.00
Coarse	2	8.33
Fibrous	4	16.66
Melting	7	29.16
Flake flesh colour		
Deep yellow	5	20.83
Yellow	11	45.83
Light yellow	6	25.00
Creamy white	2	8.33
Seed Shape		
Spheroid	2	8.33
Ellipsoid	8	33.33
Oblong	2	8.33
Reniform	5	20.83
Irregular	7	29.16

Table.2 Tree and leaf quantitative characters of jackfruit accessions

Location/ District	Plant No.	Accession No.	Tree height (m)	Trunk circumference (cm)	Fruits / tree	Leaf length (cm)	Leaf width (cm)
Cachar	1	CAC1	9	150	16	16.66	9.12
	2	CAC2	10	143	14	13.68	8.38
	3	CAC3	7	120	9	17.04	9.96
	4	CAC4	11	155	12	17.92	10.36
Goalpara	5	GLP1	12	116	36	16.12	7.92
	6	GLP2	14	153	15	17.16	8.94
	7	GLP3	13	156	42	13.16	6.42
	8	GLP4	16	176	28	17.94	8.02
Nagaon	9	NAG1	10	146	52	15.20	8.08
	10	NAG2	12	168	41	15.30	8.60
	11	NAG3	11	154	26	16.66	10.04
	12	NAG4	9	132	18	15.90	8.16
Sonitpur	13	SON1	17	182	28	16.08	9.94
	14	SON2	18	198	25	13.36	8.84
	15	SON3	14	196	34	13.90	9.06
	16	SON4	13	155	13	13.80	7.90
Karbi Anglong	17	KA1	9	128	18	13.16	7.32
	18	KA2	10	133	22	16.32	7.70
	19	KA3	14	172	28	15.14	9.00
	20	KA4	11	151	35	10.34	5.20
Jorhat	21	JRT1	12	156	12	15.30	8.88
	22	JRT2	10	148	23	11.88	8.96
	23	JRT3	11	162	68	16.32	9.80
	24	JRT4	9	142	15	16.30	9.28
Mean			11.75	153.83	26.25	15.19	8.58
SEd±						0.23	0.21
$CD_{(0.05)}$						0.45	0.41
CV(%)			23.17	13.65	54.26	12.62	13.81

Table.3 Fruit quantitative characters of jackfruit accessions

Location/ District	Plant No.	Accession No.	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Weight of flake/kg of fruit (kg)
Cachar	1	CAC1	7.01	37.67	65.00	0.42
	2	CAC2	4.87	35.00	67.00	0.40
	3	CAC3	3.04	21.67	59.33	0.43
	4	CAC4	1.19	20.67	40.67	0.15
Goalpara	5	GLP1	5.11	34.00	58.67	0.47
	6	GLP2	5.18	32.33	56.67	0.36
	7	GLP3	10.89	43.33	74.00	0.46
	8	GLP4	1.89	23.67	45.00	0.27
Nagaon	9	NAG1	3.42	26.00	53.00	0.33
	10	NAG2	2.45	23.33	50.67	0.17
	11	NAG3	2.83	24.33	46.33	0.39
	12	NAG4	5.09	27.00	58.67	0.42
Sonitpur	13	SON1	10.11	46.67	64.67	0.54
	14	SON2	4.14	25.00	48.67	0.34
	15	SON3	7.43	33.00	68.67	0.34
	16	SON4	5.64	28.33	66.00	0.45
Karbi Anglong	17	KA1	3.92	26.33	53.67	0.15
	18	KA2	5.82	32.67	60.67	0.45
	19	KA3	4.90	31.00	60.00	0.48
	20	KA4	2.02	20.33	46.67	0.20
Jorhat	21	JRT1	3.85	25.00	57.33	0.39
	22	JRT2	3.49	24.00	57.67	0.37
	23	JRT3	3.33	23.00	54.00	0.44
	24	JRT4	3.05	23.67	55.00	0.46
Mean			4.61	28.67	57	0.37
SEd±			0.17	1.19	1.28	0.017
$CD_{(0.05)}$			0.35	2.38	2.55	0.034
CV(%)			51.76	24.32	14.37	29.52

Table.4 Fruit and seed quantitative characters of jackfruit accessions

Location/ District	Plant No.	Accession No.	Flake/seed ratio	Flake length (cm)	Flake width (cm)	100-seed weight (cm)
Cachar	1	CAC1	4.08	6.30	3.43	575
	2	CAC2	4.18	5.50	3.90	667
	3	CAC3	7.29	6.30	4.47	425
	4	CAC4	5.83	4.10	5.60	750
Goalpara	5	GLP1	3.48	6.17	3.83	775
	6	GLP2	3.83	5.10	3.87	625
	7	GLP3	3.71	6.23	3.80	700
	8	GLP4	4.59	5.00	3.70	550
Nagaon	9	NAG1	4.32	5.10	3.83	625
	10	NAG2	4.61	4.70	4.63	458
	11	NAG3	2.33	3.97	3.23	658
	12	NAG4	4.60	5.03	3.93	567
Sonitpur	13	SON1	4.53	4.93	3.17	375
	14	SON2	4.96	5.93	4.90	708
	15	SON3	4.91	6.60	4.53	575
	16	SON4	2.93	5.00	2.50	383
Karbi Anglong	17	KA1	2.82	4.73	2.97	417
	18	KA2	5.73	6.30	4.30	650
	19	KA3	4.29	6.70	4.13	767
	20	KA4	4.44	6.40	4.83	750
Jorhat	21	JRT1	5.10	6.00	4.67	742
	22	JRT2	4.25	6.23	4.50	900
	23	JRT3	4.58	4.73	4.03	592
	24	JRT4	5.57	7.37	4.83	642
Mean			4.46	5.6	4.07	619.83
SEd±			0.08	0.16	0.15	20.27
$CD_{(0.05)}$			0.17	0.32	0.29	40.33
CV(%)			23.59	15.83	17.36	21.96

However, Khan *et al.*, (2010) recorded a maximum mean of fruit diameter of 165.18 cm and a minimum mean of 66.61 cm in jackfruits collected from homesteads and fallows. The variation in fruit diameter among the accessions might be due to genetic factors as well as the soil and nutrient status of the location. The coefficient of variation of fruit diameter was 14.37%.

Weight of flake per kg of fruit

The data on weight of flake per kg of fruit presented in Table 3 showed significant variation among different jackfruit accessions in weight of flake per kg of fruit.

The highest weight of flake per kg of fruit was recorded in accession number SON1 (0.54 kg)

and the lowest weight of flake per kg of fruit of 0.15 kg was recorded in accession number CAC4 and KA1. The mean weight of flake per kg of fruit was 0.37. A significant positive correlation of 0.584 was found between weight of fruit and weight of flake per kg of fruit.

The present finding is in conformity with the findings of Wangchu *et al.*, (2013) who recorded weight of flake per kg of fruit in the range of 0.25 to 0.61 kg. The difference in weight of flake per kg of fruit might be due to the genetic difference among the accessions. The coefficient of variation of weight of flake per kg of fruit was 29.52%.

Flake seed ratio

The observations on flake seed ratio presented in Table 4 revealed significant variation among the jackfruit accessions. The highest flake seed ratio was recorded in accession number CAC3 (7.29) and the lowest flake seed ratio was recorded in accession number in NAG3 (2.33). The mean of flake seed ratio recorded was 4.46.

Similar variation in flake seed ratio that ranged from 1.07 to 6.44 was recorded by Phaomei *et al.,* (2018). The variation in flake seed ratio in jackfruit accession can be attributed to genetic factors. The higher the flake seed ratio could be a desirable character for identification of superior genotypes. The coefficient of variation of flake seed ratio was 23.59%.

Flake length

The data on flake length (Table 4) revealed that there was significant variation of flake length among the jackfruit accessions. The highest flake length of 7.37 cm was recorded in accession number JRT4 and the lowest flake length was recorded by NAG3 (3.97 cm). The mean flake length was recorded to be 5.6 cm.

Similar variations were also reported by Akter and Rahman (2018) and Wangchu *et al.*, (2013). The variation in flake length might be attributed as genetic character of the individual accessions.

Flake width

The observation on flake width (Table 4) reveals that there is significant variation in flake width among the jackfruit accessions. The broadest flake width was recorded in accession number CAC4 (5.60 cm) while the narrowest flake width was recorded in accession number KA1 (2.97 cm). The mean flake width was recorded at 4.07 cm.

Seed characters

Seed shape

Significant variation in seed shape was observed in the jackfruit accessions (Table 1). Eight accessions (33.33%) recorded ‘ellipsoid’ seed shape, seven accessions (29.16%) recorded ‘irregular’ seed shape, five accessions (20.83%) recorded ‘reniform’ seed shape, two accessions (8.33%) recorded ‘spheroid’ seed shape and two accessions (8.33%) recorded ‘oblong’ seed shape.

100-seed weight

Significant variation was observed in 100-seed weight among the jackfruit accessions selected from different locations (Table 4). The highest 100-seed weight of 900 g was recorded in accession number JRT2 and the lowest 100-seed weight was recorded in accession number SON1 (375 g). The mean 100-seed weight among the accessions was recorded to be 619.83 g.

The results falls within the range of the findings of Chandrashekar *et al.*, (2018) and Wangchu *et al.*, (2013), where the range recorded by them were 291.88 to 739.54 g and 263.33 to 1133.33 g respectively.

From the present investigation, it can be concluded that the jackfruit types selected under different agro-climatic zones of Assam exhibit wide variations in morphological characters. The most notable variations in tree and leaf morphological characters of the jackfruit trees included crown shape, branching pattern, leaf shape and leaf dimensions. The fruit morphological parameters varied considerably but, among the many differences fruit weight, fruit shape, fruit bearing position, flake colour and flake texture were noteworthy.

References

Akter, A. and Rahman, H. 2018. Evaluation of Jackfruit (*Artocarpus heterophyllus* Lam.) Germplasm. *Research & Reviews: Journal of Botany*. 7(1): 38–53.

APAARI 2012. Jackfruit Improvement in the Asia-Pacific Region – A Status Report. Asia-Pacific Association of Agricultural Research Institutions, Bangkok, Thailand

Chandrasekhar, V. 2014. Survey and characterization of jackfruit (*Artocarpus heterophyllus* Lam.) germplasm available in Andhra Pradesh to identify elite trees. Ph.D. Thesis, Dr. Y.S.R. Horticultural University, Venkataramannagudem, Andhra Pradesh.

Chandrashekar, K.G., R.M. Vijayakumar, S. Subramanian, M. Kavino and John Joel, A. 2018. Morphological Characterization of Jackfruit (*Artocarpus hetrophyllus* Lam.) Local Genotypes under Coffee Ecosystem of Lower Pulney Hills. *Int.J.Curr.Microbiol.App.Sci.* 7(03): 2210-2224.

DeGraaf, R.M. and Sendak, P.E. 2006. Native and naturalized trees of New England and adjacent Canada. A field guide. University press of New England, London, p. 13.

IPGRI 2000. Descriptors for jackfruit (*Artocarpus heterophyllus* Lam), *Bioversity Int.* (formerly IPGRI), Rome, Italy.

Jagadeesh, S.L., Kirankumar, G., Laxminarayan, H.; Swamy, G.S.K., Reddy, B.S., Basavaraj, N., and Raghavan, G. S.V. 2007. Variability Studies in physico-chemical parameters in chips purpose jackfruit selections of hilly zone in Karnataka. Karnataka J. of Agri. Sci., 20(2):346-349.

Khan, R., Nyree, Z., Salma, H. and Zuberi, M.I. 2010. Jackfruit (*Artocarpus heterophyllus* Lam.) diversity in Bangladesh: Land use and artificial selection. *Econ. Botany* 64(2): 124-136.

NHB Data Base. 2015. Published by National Horticulture Board, Department of Agriculture and Co-operation, Government of India.

Phaomei, G.; Pereira, L.S. and Mathew, B. 2017. Diversity of jackfruit (*Artocarpus heterophyllus* Lam.) in Rongram block of West Garo Hills, Meghalaya. *Int.J.Sci. Envir.* 6(3):1940-1947.

Rowe-Dutton, P. 1985. *Artocarpus heterophyllus* Jackfruit. *In*: Garner JR and Chaudhury SA (eds.). The Propagation of Tropical Fruit Trees. FAO/CAB, London: 269-290.

Wangchu, L. 2005. Selection of superior jackfruit genotypes and their identification through electrophoretic banding patterns of isozymes. Ph.D

Thesis, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal.

Wangchu, L.; Dheeraj, S. and Mitra, S.K. 2013. Studies on the diversity and selection of superior types in jackfruit (*Artocarpus heterophyllus* Lam.). *Genet. Res. Crop Evol.* 60: 1749-1762.

Wann, T. 2012. Morphological and molecular assessment of variations clonal and seedling progenies of jackfruit (*Artocarpus heterophyllus* Lam.). M.Sc. Thesis, University of Agricultural Sciences, Bangalore, Karnataka.

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