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Manjula GS
Department of Postharvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Vasudeva KR
Department of Postharvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Sadananda GK
Department of Postharvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Krishna HC
Department of Postharvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Suresha GJ
Department of Post-Harvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Shankarappa TS
Department of Microbiology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Corresponding Author:
Manjula GS
Department of Postharvest Technology, College of Horticulture, Bengaluru UHS Campus, Karnataka, India

Jackfruit (*Artocarpus heterophyllus* L.) germplasm evaluation for fruit and flake characteristics

Manjula GS, Vasudeva KR, Sadananda GK, Krishna HC, Suresh GJ and Shankarappa TS

Abstract
An investigation was carried out to characterize and evaluate Jackfruit (*Artocarpus heterophyllus* L.) germplasm at Jack garden, Kolar for fruit and fruit characters was carried out under Department of Postharvest Technology, College of Horticulture, Bengaluru. Results revealed that the genotypes had significant variations for fruit physical parameters. The number of flakes per kg of fruit ranged from 15.67 in Tamaka-5 to 58.00 in Tamaka-28. The weight of flakes per kg of fruit ranged from 346.02 gm in Tamaka-47 to 697.43 gm in Byrachandra variety. The weight of fresh flake with seed ranged from 8.5 g in Tamaka-28 to 46.73 g in Tamaka-5. Weight of fresh flake with seed and without seed varied significantly among the fifty jackfruit genotypes. Flake/Fruit ratio varied from 0.5 per cent in Tamaka-38 (Flake: Seed ratio 0.97) to 0.88 in Byrachandra variety (Flake: Seed ratio 7.66). Highest flake length was observed in Tamaka-5 (83.52 mm) while, lowest was in Tamaka-37 (20.23 mm). Broadest flake was obtained in Tamaka-6 (46.48 mm) and lowest flake width was in Tamaka-37 (16.03 mm). Flake thickness varied from a minimum of 1.14 mm in Tamaka-47 to a maximum of 7.57 mm in Tamaka-5.

Keywords: Jackfruit, genotypes, flake, physical parameters, quality

Introduction
Jackfruit (*Artocarpus heterophyllus* L.) is a tropical evergreen tree, belongs to the family Moraceae which also includes fruit crops such as fig and mulberry. Moraceae family comprises of 55 genera and 900 to 1000 species of mostly topical herbs, shrubs, trees and sometimes vines. The genus *Artocarpus* contains about 50 species; most are native to Asia and of which 15 bear edible fruits. The three most important species are bread fruit *A. altilis* (syn. *A. communis; A. incisus*), jackfruit *A. heterophyllus* (syn. *A. integer; A. integrifolius*).
It is an evergreen, monoecious, latex producing tree, 20-30 m in height with a dense canopy. It is believed to be native of Western Ghats of southern Asia and it is widely cultivated in India, Bangladesh, Myanmar, Malaysia, Sri Lanka, and other tropical countries. India is the largest producer of jackfruit, producing 1857000 MT of fruits with a cultivated area of around 1.56 lakh hectares (Anon., 2019) [4].
Jackfruit is hardly recognized as a commercial fruit crop in India, though it is widely grown in the country. It is quite popular in eastern and southern India and widely cultivated in the states like Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, West Bengal, Maharashtra, Assam and union territories like Andaman and Nicobar Islands. In Karnataka it is cultivated in an area of about 5360 hectares, with an annual production of about 1.65 lakh tons. The productivity is about 35 tons ha^{-1}. The value of the produce is about 187 crores per year (Hittalmani, 2016) [5].
Jackfruit is reputed both for its exceptionally big size (up to 50 kg in weight and 60-90 cm in length) as well as for the large crop weight per tree is said to produce more food per acre than any other fruit in South India. It grows from sea-level to about 5,000 feet elevation in the South, and into the foothills of the Himalayas, but trees grown above 4,000 feet elevation are generally considered to produce fruit of inferior quality. Because of seed propagation, the existing population of jack comprises innumerable trees differing from each other. Though no varieties as such can be recognized, it is possible to divide the cultivated jack, broadly into two groups, one characterized by firm flesh which is highly flavoured and relished and other by mushy or soft flesh (Singh *et al*., 1963) [6]. Rudrakshi, with fruit size of an ordinary pummelo, smoother and less spiny was recognized by Naik (1949) [7].
Jackfruit is a highly heterozygous, cross pollinated fruit and as such seedlings exhibit a wide range of variations which aids in the selection of the superior desirable types. Due to predominant cross pollination and seed propagation over a large period of time genetic

diversity within the existing population increased. Wide variations were observed in sweetness, flavour, taste, size, shape and bearing habit. Depending on the type or clone or genotype, the fruit is consumed fresh, or as canned slices, fruit juice and dried chips. For fresh consumption, the fruit is commonly sold as whole fruit, sections/quarters and minimally processed produce.

Considering its high productivity and nutritive value selection of superior elite trees for vegetable, table and processing purposes, trees possessing high yield potential with better quality, tolerance to biotic and abiotic stresses will be of great value for commercialization of jackfruit cultivation. Champion trees are available and majority of them are of seedling origin. As a preliminary step in crop improvement as well as for commercial exploitation, it is desirable to investigate the nature of divergence in terms of vegetative, fruiting and biochemical characters. Characterization have to be made to identify the elite trees having good agronomic and economic traits with commercial and industrial uses for further colonal multiplication.

College of Horticulture, Tamaka farm is having a huge collection of jackfruit germplasm which are suitable for both fresh consumption as well as processing into different products. Systematic work regarding characterization of jackfruit germplasm and study of genetic diversity for different traits of importance has not been carried out and there is a scope for jackfruit for specific purpose and this study is aiming to address those issues of categorizing the jackfruit germplasm for processing a research was undertaken at college of horticulture, Bengaluru.

Material and Methods

Jackfruits required for the experiment were obtained from the Jack garden, College of Horticulture, Tamaka, Kolar – 563101. Jack garden, Kolar is located at 13° 08′ north latitude and 78° 10′ 32″ east longitude at an altitude of 752.15 m above mean sea level and evaluated for fruit quality traits. The experimental field was having red loamy soil with good fertility and minimum undulations and slopes with less than five per cent.

Genotypes having different in morphology and good fruit characters were selected by taking opinion from the local working person. Selected genotypes are named as Tamaka-1 to Tamaka-49 and they are marked. In each genotype, five flowers were tagged at the time of flower emergence from November 2017. Byrachandra variety from Hitakari nursery was taken as standard and same procedures were followed. Genotypes having different in morphology and good fruit characters were selected by taking opinion from the local working person. Selected genotypes are named as Tamaka-1 to Tamaka-49 and they are marked. In each genotype, five flowers were tagged at the time of flower emergence from November 2017. Byrachandra variety from Hitakari nursery was taken as standard and same procedures were followed.

Timely and periodical observations were recorded in the field starting from 2017- 2018 for various characters. The harvested fruits were brought to the laboratory and the morphological observations were taken as per the descriptor for jackfruit (given in Annexure II) developed by IPGRI (2000) [8]. A number of observations consisting of some morphological and quantitative characters of trees like bearing habit, fruit bearing position, season of fruit availability, fruit clustering habit, fruit shape, shape of spine, fruit attractiveness, rachis cooking quality, Weight of flake with seed, weight of flake without seed, flake/fruit ratio, flake/seed ratio, number of flakes per kg of fruit, flake weight per kg fruit, flake width and flake thickness.

Results and Discussion

Table 1: Fruiting season, bearing habit, bearing position, clustering habit, fruit shape, rachis cooking quality, shape of spine and fruit attractiveness of selected jackfruit genotypes of Jack garden, Kolar.

Sl No.	Name of Genotype	Fruiting season	Bearing habit	Bearing position	Clustering habit	Fruit shape	Rachis cooking quality	Shape of spine	Fruit attractiveness
1.	Tamaka-1	Mid-season	Regular	Primary	Solitary	Clavate	Poor	Intermediate	Good
2.	Tamaka-2	Early	Irregular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
3.	Tamaka-3	Early	Regular	Primary	Cluster	Oblong	Poor	Intermediate	Intermediate
4.	Tamaka-4	Mid-Season	Regular	Primary	Solitary	Oblong	Good	Intermediate	Good
5.	Tamaka-5	Mid-Season	Regular	Tertiary	Solitary	Oblong	Good	Sharp	Intermediate
6.	Tamaka-6	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Good	Sharp	Good
7.	Tamaka-7	Mid-Season	Regular	Primary	Cluster	Irregular	Good	Sharp	Good
8.	Tamaka-8	Mid-Season	Regular	Primary	Cluster	Irregular	Good	Intermediate	Intermediate
9.	Tamaka-9	Mid-Season	Regular	Primary	Cluster	Irregular	Good	Intermediate	Poor
10.	Tamaka-10	Mid-Season	Regular	Primary	Cluster	Oblong	Poor	Intermediate	Good
11.	Tamaka-11	Mid-Season	Regular	Primary	Cluster	Irregular	Poor	Sharp	Intermediate
12.	Tamaka-12	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Poor
13.	Tamaka-13	Late	Regular	Primary	Solitary	Oblong	Good	Intermediate	Good
14.	Tamaka-14	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Good	Intermediate	Good
15.	Tamaka-15	Late	Regular	Primary	Cluster	Spheroid	Good	Sharp	Good
16.	Tamaka-16	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
17.	Tamaka-17	Mid-Season	Regular	Primary	Solitary	Clavate	Good	Intermediate	Intermediate
18.	Tamaka-18	Mid-Season	Regular	Primary	Cluster	Oblong	Good	Intermediate	Good
19.	Tamaka-19	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Good	Intermediate	Good
20.	Tamaka-20	Mid-Season	Regular	Primary	Cluster	Oblong	Good	Intermediate	Excellent
21.	Tamaka-21	Mid-Season	Regular	Trunk	Cluster	Oblong	Good	Intermediate	Good
22.	Tamaka-22	Early	Regular	Primary	Solitary	Ellipsoid	Good	Intermediate	Good
23.	Tamaka-23	Mid-Season	Regular	Primary	Cluster	Irregular	Good	Intermediate	Good
24.	Tamaka-24	Early	Irregular	Primary	Cluster	Ellipsoid	Good	Intermediate	Poor
25.	Tamaka-25	Early	Regular	Trunk	Cluster	Spheroid	Poor	Intermediate	Intermediate
26.	Tamaka-26	Mid-Season	Regular	Primary	Cluster	Irregular	Good	Intermediate	Good

27.	Tamaka-27	Mid-Season	Regular	Primary	Cluster	Irregular	Poor	Intermediate	Intermediate
28.	Tamaka-28	Mid-Season	Regular	Primary	Solitary	Ellipsoid	Good	Sharp	Good
29.	Tamaka-29	Mid-Season	Regular	Trunk	Cluster	Irregular	Poor	Intermediate	Good
30.	Tamaka-30	Mid-Season	Irregular	Primary	Cluster	Oblong	Poor	Flat	Intermediate
31.	Tamaka-31	Mid-season	Regular	Primary	Cluster	Spheroid	Good	Intermediate	Good
32.	Tamaka-32	Early	Regular	Primary	Cluster	Ellipsoid	Good	Intermediate	Good
33.	Tamaka-33	Mid-Season	Regular	Trunk	Cluster	Irregular	Good	Intermediate	Good
34.	Tamaka-34	Mid-Season	Regular	Trunk	Cluster	Ellipsoid	Good	Intermediate	Good
35.	Tamaka-35	Mid-Season	Irregular	Trunk	Cluster	Ellipsoid	Good	Sharp	Poor
36.	Tamaka-36	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Intermediate
37.	Tamaka-37	Late	Regular	Secondary	Solitary	Irregular	Good	Sharp	Poor
38.	Tamaka-38	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
39.	Tamaka-39	Mid-Season	Regular	Primary	Cluster	Oblong	Poor	Intermediate	Good
40.	Tamaka-40	Mid-season	Regular	Trunk	Cluster	Ellipsoid	Poor	Intermediate	Intermediate
41.	Tamaka-41	Mid-season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
42.	Tamaka-42	Early	Regular	Primary	Cluster	Ellipsoid	Good	Intermediate	Good
43.	Tamaka-43	Late	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
44.	Tamaka-44	Mid-Season	Regular	Trunk	Cluster	Oblong	Poor	Intermediate	Good
45.	Tamaka-45	Mid-Season	Regular	Trunk	Cluster	Ellipsoid	Good	Intermediate	Intermediate
46.	Tamaka-46	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Good	Intermediate	Good
47.	Tamaka-47	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
48.	Tamaka-48	Mid-Season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Good
49.	Tamaka-49	Mid-Season	Irregular	Primary	Solitary	Ellipsoid	Good	Intermediate	Excellent
50.	Byrachandra	All season	Regular	Primary	Cluster	Ellipsoid	Poor	Intermediate	Excellent

Table 2: Weight of flake with seed, weight of flake without seed, flake/fruit ratio, flake/seed ratio, number of flakes per kg of fruit, flake weight per kg fruit, flake width and flake thickness of the selected jackfruit genotypes of Jack garden, Kolar.

Sl. No.	Name of Genotype	Weight of flake with seed (gms)	Weight of flake without seed (gms)	Flake/fruit ratio	Flake/seed ratio	Number of flakes per kg of fruit	Flake length (mm)	Flake weight per kg fruit (gm)	Flake width (mm)	Flake thickness (mm)
1.	Tamaka-1	20.82	14.93	0.73	2.55	26.00	39.70	439.80	32.17	2.73
2.	Tamaka-2	17.18	9.45	0.56	1.23	26.33	48.01	417.87	27.36	2.85
3.	Tamaka-3	18.94	12.73	0.68	2.06	31.67	56.28	425.04	30.26	2.51
4.	Tamaka-4	13.57	10.70	0.80	3.76	34.33	53.38	600.37	24.30	3.81
5.	Tamaka-5	46.73	36.04	0.78	3.39	15.67	83.52	625.42	44.48	7.57
6.	Tamaka-6	20.72	13.82	0.68	2.02	19.33	68.74	453.91	46.48	2.88
7.	Tamaka-7	22.07	13.04	0.60	1.45	25.00	52.34	446.13	33.32	2.51
8.	Tamaka-8	30.73	24.04	0.79	3.61	39.33	35.94	477.42	18.84	3.57
9.	Tamaka-9	24.40	18.04	0.75	2.85	24.33	51.70	522.93	29.28	3.44
10.	Tamaka-10	27.72	18.80	0.69	2.12	26.00	42.64	510.82	36.47	5.04
11.	Tamaka-11	20.73	12.04	0.59	1.40	33.67	50.19	561.37	28.87	3.13
12.	Tamaka-12	34.07	23.04	0.69	2.10	24.67	52.59	693.37	35.81	3.53
13.	Tamaka-13	43.50	36.80	0.86	5.52	22.00	74.39	575.91	30.97	6.36
14.	Tamaka-14	22.07	15.04	0.69	2.15	31.67	57.91	574.37	25.20	3.51
15.	Tamaka-15	14.63	9.01	0.63	1.61	46.33	58.61	457.37	32.40	3.02
16.	Tamaka-16	20.73	13.07	0.64	1.71	31.33	52.58	537.80	32.66	3.31
17.	Tamaka-17	16.73	13.04	0.79	3.56	41.33	42.87	563.37	26.83	4.44
18.	Tamaka-18	16.74	12.05	0.73	2.58	43.67	36.05	587.13	33.65	3.79
19.	Tamaka-19	13.40	11.04	0.84	4.72	48.33	41.38	536.10	24.81	1.26
20.	Tamaka-20	32.75	23.71	0.73	2.64	24.00	52.28	679.80	42.36	2.13
21.	Tamaka-21	22.75	16.25	0.72	2.52	34.67	49.70	543.69	28.33	3.21
22.	Tamaka-22	26.52	21.01	0.80	3.84	23.33	52.73	672.37	22.29	3.22
23.	Tamaka-23	28.82	21.54	0.76	2.98	29.67	55.99	530.87	28.19	3.66
24.	Tamaka-24	14.58	9.53	0.66	1.90	27.33	45.65	409.93	28.18	2.94
25.	Tamaka-25	19.05	10.68	0.57	1.29	40.00	40.67	498.02	29.92	1.42
26.	Tamaka-26	38.73	29.69	0.78	3.30	16.33	66.92	537.71	36.89	3.72
27.	Tamaka-27	29.57	18.64	0.64	1.72	29.00	48.03	568.37	37.28	3.11
28.	Tamaka-28	8.50	4.49	0.54	1.13	58.00	44.33	452.69	23.48	1.51
29.	Tamaka-29	26.57	21.54	0.82	4.31	24.67	53.90	493.87	38.73	0.51
30.	Tamaka-30	24.07	17.38	0.73	2.61	31.33	47.28	567.37	29.68	3.13
31.	Tamaka-31	15.75	10.02	0.65	1.76	37.33	64.68	641.37	25.80	2.57
32.	Tamaka-32	36.64	29.35	0.81	4.05	33.67	52.32	565.04	27.00	2.46
33.	Tamaka-33	42.07	36.04	0.87	6.01	16.00	68.50	563.77	42.50	0.56
34.	Tamaka-34	31.30	23.82	0.77	3.20	22.33	65.39	512.82	33.47	4.53
35.	Tamaka-35	27.63	19.99	0.73	2.63	24.67	51.84	550.02	38.70	0.47
36.	Tamaka-36	33.50	24.71	0.75	2.83	23.67	56.50	586.99	25.37	3.63
37.	Tamaka-37	12.09	7.86	0.66	1.87	31.67	20.23	432.90	15.61	1.22

38.	Tamaka-38	14.63	7.16	0.50	0.97	40.33	50.41	530.04	23.89	2.31
39.	Tamaka-39	23.74	18.04	0.77	3.18	27.33	27.98	558.77	17.36	2.87
40.	Tamaka-40	9.57	5.79	0.62	1.54	47.33	39.72	478.87	23.28	1.41
41.	Tamaka-41	24.63	15.64	0.65	1.75	28.33	51.39	543.24	32.75	3.51
42.	Tamaka-42	35.74	29.13	0.83	4.43	16.00	55.13	599.26	38.68	4.22
43.	Tamaka-43	21.12	15.70	0.75	2.92	26.33	45.33	459.92	29.28	4.21
44.	Tamaka-44	21.07	11.04	0.53	1.11	33.00	51.68	594.37	20.26	2.02
45.	Tamaka-45	29.57	20.54	0.70	2.29	25.33	56.30	524.37	32.28	3.51
46.	Tamaka-46	17.73	10.70	0.61	1.53	42.00	57.73	612.92	28.49	3.57
47.	Tamaka-47	9.94	6.49	0.66	1.90	51.33	42.14	346.02	16.03	1.14
48.	Tamaka-48	24.74	17.91	0.73	2.64	29.33	54.97	583.93	34.69	4.38
49.	Tamaka-49	24.72	18.60	0.76	3.06	26.33	60.69	518.87	29.72	2.90
50.	Byrachandra	45.76	40.48	0.88	7.66	22.47	55.67	697.43	30.31	6.87
Mean		24.39	17.60	0.71	2.72	30.68	30.68	3.35	51.70	30.10
Range		8.5 - 46.73	4.49 - 40.48	0.5 -0.88	0.97 - 7.66	15.67-58.00	15.67-58.00	0.47-7.57	20.23-83.52	15.61-46.48
S.Em ±		0.46	0.56	0.01	0.07	0.85	0.85	0.08	0.61	0.57
C D @ 5%		1.29	1.56	0.04	0.21	2.40	2.40	0.24	1.71	1.61
CV (%)		3.27	5.47	3.68	4.87	4.84	4.84	4.45	2.04	3.30

The season of fruit availability or maturity of fruits showed variations among the selected genotypes. The 14 per cent of fruits of genotypes matures in early season (Feb–April); 76 per cent genotypes matures in mid-season (May –June) and 8 per cent genotypes matures in late season (July-September), while 2 per cent *i.e* Byrachandra is available throughout the year. Same results are obtained by Chandrashekar, 2014 [9] while surveying jackfruit genotypes in Andhra Pradesh regions and by Muthulakshmy (2003) [14] reported that there were three fruiting season for jackfruit in Thrissur district of Kerala. All season availability of Byrachandra variety is confirmed by Hittalamani *et al.*, 2016 [5].

Most of the genotypes (90%) showed regular bearing habit and 10 per cent of the genotypes are irregular bearers. Same type of results was also found by Nimisha, 2014 [13] while identifying and characterizing of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasaragod district.78 per cent of the genotypes showed bearing position on primary branches, 18 per cent on the trunk, 2 per cent on the secondary branch and 2 per cent on tertiary branch. Similar results were obtained by Chandrashekar, 2014 [9] while surveying on Andhra Pradesh region for jackfruit genotypes. 82 per cent of the genotypes showed cluster bearing habit and 18 per cent of the genotypes showed solitary bearing habit. The cluster bearing habit was observed mainly on trunk and the solitary bearing habit on trunk, primary branches and secondary branches. These results are accordance with Jagadeesha *et al.*, 2007 [10] while studying on tree characters the jackfruit genotypes of coastal zone of Karnataka.

The fruit shape showed variations among the selected genotypes. The 48 per cent of the genotypes showed ellipsoid shape, 22 per cent of the genotypes showed oblong shape, 20 per cent of the genotypes showed irregular shape, 6 per cent of the genotypes showed spheroid and 4 per cent of the genotypes showed clavate shape. The 58 per cent of the genotypes showed good rachis cooking quality and 42 per cent of the genotypes showed poor rachis cooking quality. Similar results were obtained by Chandrashekar, 2014 [9] while surveying on Andhra Pradesh regions for jackfruit genotypes and by Jagadeesha *et al.*, 2007 [10] while studying on tree characters the jackfruit genotypes of coastal zone of Karnataka.

The variations in the fruit surface are represented in the table 1. The 82 per cent of the genotypes showed intermediate spine shape, 16 per cent of the genotypes showed sharp spine shape and only 2 per cent of the genotypes showed flat spine shape. The 6 per cent of the genotypes showed excellent fruit attractiveness, 62 per cent of the genotypes showed good fruit attractiveness, 22 per cent of the genotypes showed intermediate fruit attractiveness and 10 per cent of the genotypes showed fruit attractiveness. Similar results were obtained by Chandrashekar, 2014 [9] while surveying on Andhra Pradesh region for jackfruit genotypes and by Nimisha, 2014 [13] while evaluating genotypes of Wayanad district of Kerala.

Weight of fresh flake with seed varied significantly among the fifty jackfruit genotypes (Table 2). The weight of fresh flake with seed ranged from 8.5 gm in Tamaka-28 to 46.73 g in Tamaka-5. Rai *et al.* (2003) [15] observed highest weight of fresh flake with seed was 42.5 g which is in agreement with the present finding. Wangchu *et al.* (2013) [11] and Jagadeesh *et al.* (2007) [10] recorded maximum weight of fresh flake with seed to be 74.33 g and 59.04 g, respectively.

Weight of fresh flake without seed varied significantly among the fifty jackfruit genotypes (Table 2). It varied from 4.49 gm in Tamaka-28 to 40.48 gm in Byrachandra variety. The result is in agreement with the finding of Rai *et al.* (2003) [15] who observed maximum flake weight without seed was 33.75 g in HPJS-10/8 genotype. Reddy *et al.* (2004) reported a higher (49.25 g) flake weight without seed. The weight of the individual flake without seed contributes to the pulp content of the fruit. The fruit with the higher number of flakes and higher flake weight without seed will have higher pulp content.

Flake: Fruit ratio varied significantly among the fifty jackfruit genotypes (Table 2). It varied from in 0.5 in Tamaka-38 to 0.88 in Byrachandra variety. The result is in agreement with the findings of Jagadeesha *et al.*, 2007 [10] while working on dessert type jackfruits of hilly zone of Karnataka (India) where edible portion percentage varied from 19.49 to 47.52 per cent. Higher the flake: fruit ration higher the percent of pulp in the fruit, so more the edible portion in the fruit. Chandrashekar *et al.*, 2018 [3] also found similar results on flake: fruit ratio of minimum 0.35 to the maximum of 0.71 in 35 local genotypes of jackfruit under coffee ecosystem of lower pulney hills.

Flake: Seed ratio varied significantly among the fifty jackfruit genotypes (Table 2). It varied from in 0.97 in Tamaka-38 to 7.66 in Byrachandra variety. The result is in agreement with the findings of Chandrashekar *et al.*, 2018 [3] while working on Morphological Characterization of Jackfruit Local Genotypes under Coffee Ecosystem of Lower Pulney Hills

where flake: seed ratio varied from 1.56 to 5.70. Higher the flake: seed ration higher the percent of pulp in the flake, so more the edible portion in the fruit.

The number of flakes per fruit was 15.67 in Tamaka-5 to 58.00 in Tamaka-28 The number of flakes/kg of fruit indicate the edible portion of the ripe fruit. It depends on the size of the fruit and also on the genetical character of the plant (Rai *et al.*, 2003) [15]. The investigated result is also in line with the data obtained by Wangchu *et al.* (2013) [11]. More number of flakes was recorded in bigger sized fruits compared to smaller size. Asymmetrical fruits had lesser flake number when compared with symmetrical fruits of same size. The number of flakes was lesser in asymmetrical side of such fruits which was filled with perigone. The higher number of flakes in the fruit might not essentially mean the high pulp content in the fruits. Although, between the two different jackfruits of equal mass, being rind and cylinder parameters and seed size constant, the fruit with less number of flakes will have more flake thickness and vice-versa (Jagadeesh *et al.* 2007) [10].

The weight of flakes per kg of fruit ranged from 346.02 gm in Tamaka-47 to 697.43 gm in Byrachandra variety. Similar range of variability was reported by Akter and Rahman (2017) [2] in a study carried out on 23 jackfruit genotypes in Jamalpur, Bangladesh and by Wangchu *et al.* (2013) [11] while evaluating 44 genotypes of jackfruit from 3 districts of West Bengal state.

Flake length, width and thickness

Significant variation was observed for flake length, width and thickness (Table 2). Highest flake length was observed in Tamaka-5 (83.52 mm) while, lowest was in Tamaka-37 (20.23 mm). Even in a single fruit, the flake length varied. The length of the flakes at basal region was found to be shorter than middle and apex region of the fruit because the space available for flake growth is shorter in basal region than the other regions. The finding is in agreement with the work of Akter and Rahman (2017) [2]. They recorded the maximum and minimum bulb length of 6.47 cm and 1.58 cm respectively at Jamalpur region, Bangladesh. Significant variability was also observed by Wangchu *et al.* (2013) [11]. Rai *et al.* (2003) [15] recorded relatively higher flake length among the studied genotypes.

Highly significant variation was observed among the investigated genotypes in terms of flake width (Table 2). Broadest flake was obtained in Tamaka-6 (46.48 mm) and lowest flake width was in Tamaka-37 (16.03 mm). Similar finding was observed by Wangchu *et al.* (2013) [11]. Akter and Rahman (2017) [2] recorded maximum flake width of 3.02 cm and minimum of 1.58 cm among the twenty-three studied genotypes. Rai *et al.* (2003) [15] also observed flake width which ranged from 2.5 cm to 5.0 cm in different jackfruit genotypes.

The flake thickness varied from a minimum of 1.14 mm in Tamaka-47 to a maximum of 7.57 mm in Tamaka-5 among the various jackfruits studied. Jagadeesha *et al.* (2007) [10] recorded maximum flake thickness of 0.51 cm in cluster-E and minimum of 0.24 cm in cluster-D among n 95 dessert type jackfruit selections from Western Ghats region of Karnataka in India.

Conclusion

The physical parameters are the main primary characters need to be considering for the identification of elite germplasms from the pool. Each genotype exhibited different characteristics in terms of quantity and quality of fruit. Among the germplasms evaluated Tamaka-5, Tamaka-6, Tamaka-12, Tamaka-13, Tamaka-17, Tamaka-22, Tamaka-23, Tamaka-28, Tamaka-30, Tamaka-35, Tamaka-36, Tamaka-40, Tamaka-42, Tamaka-45, Tamaka-48 are found to be best. These can be further evaluated for the biochemical properties and can be released as a variety.

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