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Variability of Fruit Characters of Jackfruit in Rongram Block of West Garo Hills of Meghalaya

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Abstract A survey was conducted in Rongram block of West Garo Hills district of Meghalaya to study the fruit and seed characters of different jackfruit trees.The information was collected as per the descriptors prescribed by International Plant Genetic Resources Institute, Rome, Italy. Out of the 20 trees observed, Type 4, Type 6, Type 15, Type 19 and Type 20 produced very juicy pulp, which are suitable for juice processing. Type 1, Type 11 and Type 17 produced fruits with firm textured, thick flakes which are suitable for chips making. Type 4, Type 9, and Type 12 produced fruits with soft and sweet flakes which can be used for processing into products like jam, jelly, halwa. Fruits of Type 11 and Type 18 exhibited a total soluble solids (TSS) content of 25°Brix which may be used for table purpose.

Keywords Jackfruit, Fruit characters, Seed characters, Meghalaya, Variability.

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Introduction

The jackfruit tree (*Artocarpus heterophyllus* Lam.) is a tropical evergreen tree belonging to family Moraceae bearing a dicotyledonous compound fruit. Jackfruit, locally known as Tebrong is a very popular fruit among Garo tribe. The fruits are good source of vitamin A, B, C, potassium, calcium, iron, proteins, minerals and carbohydrate (Chadha 2009). Jackfruits are highly nutritive and a rich source of pectin, carotene, ascorbic acid and contain substantial amount of fiber (Sharma et al. 2009). The seeds are very rich in protein and contain high amount of starch. Jackfruit can be used as a food supplement in times of scarcity owing to its high nutritive value. Most of the jackfruit trees grown in Garo Hills are of seedling origin and do not bear true-to-type. As a result, considerable variations are observed in morphological characters, fruit bearing, fruit size and fruit quality. These variations may be suitably utilized for improvement of this fruit crop and also for collection and conservation of germplasm suitable for various processing purposes. Jackfruit has a wide range of genetic variation, in particular, in South and South-east Asia, which aids in selection of

Table 1. Fruit characters (quantitative) of different types of jackfruit in Rongram block of West Garo Hills.

Tree type	Stalk length (mm)	Stalk diameter (mm)	Average fruit weight (kg)	Number of flakes per kg fruit	Weight of flakes per kg fruit (g)	Avg/ weight of fresh flake with seed (g)	Avg/ weight of fresh flake without seed (g)	Flake/ fruit ratio	Flake length (cm)	Flake width (cm)	Rachis length (cm)	Rachis diameter (cm)	TSS (°Brix)
Type 1	43.21	37.12	11.9	7.31	341.42	46.7	39.42	0.34	6.0	4.1	33.0	5.6	20
Type 2	68.0	18.5	3.25	32.61	369.23	11.3	6.6	0.36	3.6	2.5	18.2	4.4	20
Type 3	49.23	17.36	3.0	29.33	483.33	16.48	11.9	0.48	5.3	3.4	16.9	5.3	22
Type 4	55.0	36.35	6.55	14.19	389.31	27.42	21.18	0.38	6.5	4.3	38.7	4.4	19
Type 5	51.35	14.86	3.5	18.85	428.57	22.73	16.67	0.42	4.0	3.6	12.08	4.6	15
Type 6	75.85	30.08	8.55	10.29	380.11	36.93	26.7	0.38	6.4	3.9	32.5	8.3	19
Type 7	75.85	30.08	2.3	35.21	478.26	13.38	9.88	0.47	3.4	2.3	12.9	4.3	24
Type 8	79.44	17.74	2.5	9.6	340.0	35.42	27.08	0.34	4.9	3.8	13.9	3.4	21
Type 9	39.34	21.98	3.9	14.87	358.97	24.14	18.1	0.35	4.2	3.5	18.0	5.5	20
Type 10	66.17	16.87	3.8	11.31	315.78	27.91	30.93	0.31	4.8	3.8	17.6	3.9	19
Type 11	80.28	20.08	5.7	11.4	429.82	37.69	30.0	0.43	4.6	3.9	21.0	5.8	25
Type 12	78.25	21.23	4.2	19.52	607.14	31.09	23.78	0.61	4.9	3.6	17.8	4.6	22
Type 13	67.26	19.17	2.95	21.02	372.88	17.74	11.29	0.37	4.6	3.2	11.6	3.7	15
Type 14	33.8	23.11	9.85	10.65	639.59	43.52	36.57	0.46	6.5	3.9	23.6	11.3	17
Type 15	28.32	20.39	6.1	34.43	450.81	13.09	7.86	0.45	4.8	2.4	22.5	7.9	14
Type 16	50.23	16.19	12.1	16.3	586.95	36.0	27.33	0.59	5.6	3.6	34.5	4.9	20
Type 17	118.18	21.92	10.1	15.15	495.04	32.68	22.87	0.49	5.9	3.2	5.8	3.9	17
Type 18	47.51	18.1	3.4	22.5	376.81	16.88	12.99	0.38	5.2	2.6	15.5	3.5	25
Type 19	32.03	23.47	2.0	32.5	225.0	6.92	3.08	0.22	2.1	2.8	15.0	4.7	10
Type 20	49.23	24.18	4.5	28.89	377.77	13.08	9.23	0.38	5.7	2.4	4.9	2.4	18
Mean	59.41	22.44	5.51	19.80	422.34	25.57	19.17	0.41	4.95	3.34	19.30	5.12	19.1
SD	21.67	6.33	3.25	9.25	102.94	11.65	10.13	0.09	1.13	0.63	9.23	2.02	3.77
SEm ±	4.85	1.42	0.73	2.07	23.02	2.60	2.26	0.02	0.25	0.14	2.06	0.45	0.84
CV (%)	36.47	28.23	59.03	46.74	24.37	45.55	52.82	22.29	22.79	18.85	47.83	39.41	19.73

superior and desirable types (Sidhu 2012). Although jackfruit is grown extensively in West Garo Hills, it is still an underutilized fruit crop and very less research has been done in this region. Therefore, a survey was conducted to study the fruiting behavior, fruit characters, flake characters and seed characters of jackfruit tree grown in different locations of Rongram block of West Garo Hills district of Meghalaya.

Materials and Methods

A survey was carried out in Rongram block of West Garo Hills district of Meghalaya during 2014–2015. The West Garo Hills district lies approximately between 90° 30´ and 89°40´ E longitudes and 26° and 25° 20´ N latitudes. Twenty trees were selected randomly from different locations within the district for observing the fruiting behavior, fruit characters, flake characters and seed characters. The data were collected as per the descriptors prescribed by IPGRI (International Plant Genetic Resources Institute, 2000), Rome, Italy, Statistical tools such as mean, standard deviation, standard error mean were used. The variation were determined by calculating the coefficient of variation.

Results anf Discussion

Among the 20 jackfruit trees studied under Rongram block, wide variations were observed among the fruit and seed characters. The fruiting season of the selected trees started from March to May and ended

Table 2. Flake qualitative characters of different types of jackfruit.

Tree type	Flake shape	Flake thickness	Flake texture	Pulp taste	Pulp consistency	Pulp flavor	Pulp juiciness	Pulp color
Type 1	Irregular	Thick	Firm	Sweet	Medium	Intermediate	Not juicy	Yellow
Type 2	Irregular	Medium	Coarse	Sweet	Medium	Weak	Not juicy	Creamy white
Type 3	Twisted	Medium	Firm	Sweet	Slimy	Intermediate	Juicy	Deep yellow
Type 4	Irregular	Thin	Soft	Sweet	Soft	Strong	Very juicy	Yellow
Type 5	Cordate	Medium	Soft	Insipid	Slimy	Intermediate	Not juicy	Creamy white
Type 6	Rectangular	Thick	Soft	Insipid	Slimy	Intermediate	Very juicy	Light yellow
Type 7	Twisted	Medium	Soft	Sweet	Medium	Strong	Not juicy	Light yellow
Type 8	Irregular	Medium	Firm	Sweet	Firm	Weak	Not juicy	Deep yellow
Type 9	Cordate	Medium	Soft	Sweet	Slimy	Strong	Not juicy	Yellow
Type 10	Spheroid	Medium	Soft	Insipid	Soft	Intermediate	Juicy	Light yellow
Type 11	Spheroid	Thick	Firm	Sweet	Firm	Intermediate	Juicy	Yellow
Type 12	Cordate	Medium	Soft	Sweet	Slimy	Intermediate	Juicy	Yellow
Type 13	Twisted	Medium	Firm	Acid	Firm	Weak	Juicy	White
Type 14	Twisted	Thick	Soft	Insipid	Soft	Intermediate	Juicy	Light yellow
Type 15	Rectangular	Thin	Fibrous	Insipid	Slimy	Weak	Very juicy	Creamy white
Type 16	Obovate	Medium	Fibrous	Sweet	Slimy	Strong	Juicy	Yellow
Type 17	Rectangular	Thick	Firm	insipid	Firm	Weak	Juicy	Light yellow
Type 18	Rectangular	Thin	Fibrous	Sweet	Slimy	Intermediate	Juicy	Yellow
Type 19	Rectangular	Thin	Soft	Acid	Slimy	Strong	Very Juicy	Creamy white
Type 20	Rectangular	Medium	Firm	Insipid	Firm	Weak	Very juicy	Creamy white

during June–September. All trees showed a regular bearing habit. It was observed that fruits of Type 4, Type 6, Type 7, Type 8, Type 9, Type 15, Type 17 and Type 20 were borne on primary branches. Type 5 and Type 16 produced fruits on secondary branches, while Type 13 and Type 14 bore fruits on main trunk. The remaining types produced fruits on primary, secondary and tertiary branches. Type 5, Type 9, Type 15, Type 16, Type 17, Type 19 and Type 20 showed solitary bearing habit. Type 11 and Type 8 showed cluster as well as solitary bearing habit. The remaining types bore fruits in clusters varied fruit shapes were observed like ellipsoid, oblong, spheriod, clavate, obloid and irregular.

Type 16 exhibited the highest average fruit weight of 12.1 kg followed by 11.9 kg in Type 1 and 10.1 kg in Type 17. The highest number of flakes per kg fruit (35.21) was recorded in Type 7. Highest flake weight per kg fruit (225 g) was recorded in Type 19. Weight of fresh flake with seed was recorded highest (46.7 g) in Type 1, which also recorded the highest weight of fresh flake without seed (39.42 g). Highest flake: fruit ratio of 0.61 was noted in Type 12 followed by 0.59 in Type 16. Flake length was highest (6.5 cm) in Type 4 and 14. Flake width was highest (4. 3 cm) in Type 4. The longest rachis of 38.7 cm was noticed in Type 4 while diameter of the rachis was highest in Type 14 (11.3 cm). Type 11 and Type 18 recorded the highest TSS of 25°Brix (Table 1).

Varied flake shapes like spheroid, obovate, rect-

Table 3. Seed quantitative characters of different types of jackfruit.

Tree type	Seed length (cm)	Seed width (cm)	Number of seeds per kg fruit	100-seed weight (g)	Flake/ seed ratio
Type 1	3.5	2.0	6.89	771.95	6.44
Type 2	2.6	1.8	32.61	471.69	2.5
Type 3	2.3	1.6	28.66	465.11	3.62
Type 4	2.9	2.0	13.28	666.66	4.3
Type 5	2.8	1.7	18.85	606.06	1.07
Type 6	3.2	2.2	9.71	1084.33	3.61
Type 7	2.4	1.5	35.21	370.37	3.66
Type 8	2.9	2.4	9.2	869.56	4.25
Type 9	2.7	1.9	14.87	603.44	4.0
Type 10	3.2	2.4	11.31	697.67	4.0
Type 11	2.7	2.5	11.23	781.25	4.9
Type 12	3.1	2.3	19.05	750.0	4.25
Type 13	2.8	2.7	21.02	645.16	2.75

Table 3. Continued.

Tree type	Seed length (cm)	Seed width (cm)	Number of seeds per kg fruit	100-seed weight (g)	Flake/ seed ratio
Type 14	3.2	2.1	10.65	697.14	6.24
Type 15	3.6	1.6	33.61	600.0	2.39
Type 16	3.3	1.9	16.19	800.0	4.15
Type 17	3.5	2.0	13.96	1063.82	3.33
Type 18	2.8	1.7	20.87	416.66	4.33
Type 19	2.1	1.6	32.5	384.61	1.8
Type 20	3.2	1.6	28.89	384.61	3.4
Mean	2.94	1.98	19.43	656.50	3.75
SD	0.41	0.35	9.29	208.09	1.30
SEm±	0.09	0.08	2.08	46.53	0.29
CV (%)	13.93	17.68	47.82	31.70	34.57

angular, cordate, twisted and irregular were observed among the 20 trees. Type 1, Type 6, Type 11, Type 14 and Type 17 had thick flake. The flake texture was observed to be firm, soft, coarse and fibrous among the 20 trees, Type 1, Type 3, Type 8, Type 11, Type 13, Type 17 and Type 20 exhibited firm flake texture, pulp taste was sweet in Type 1, Type 2, Type 3, Type 4, Type 7, Type 8, Type 9, Type 11, Type 12, Type 16, and Type 18; insipid in Type 5, Type 6, Type 10, Type 14, Type 15, Type 17 and Type 20; acidic in Type 13 and Type 19. Pulp consistency was found to be soft, firm, medium and slimy. Some types exhibited a very strong pulp flavor, while some had weak and intermediate flavor. Fruits of Type 4, Type 6, Type 15, Type 19 and Type 20 were very juicy. Pulp color varied from light to deep yellow and white to creamy white (Table 2).

Highest seed length (3.6 cm) was recorded in Type 15 while highest seed width was recorded in Type 13, Highest number of seeds per kg fruit (35.21) was noted in Type 7. Highest 100-seed weight (1084.33 g) was recorded in Type 6. Flake: Seed ratio was highest in Type 1 (6.44) followed by Type 14 (6.24), while lowest ratio (1.07) was observed in Type 5 (Table 3). Varied seed shapes were observed among the 20 types like reniform, spheroid, elongate and irregular. Seed coat color varied from brown to dull brown and cream to off-white. Seed coat was easily separable from kernel in Type 1, Type 5, Type 6, Type 10, Type 13 and Type 14. Viviparous seeds were observed in Type 1, Type 3, Type 5, Type 6, Type 8, Type 10, Type 13, Type 14, Type 16 and Type 17 (Table 4).

Characterization studies on jackfruit in South Karnataka showed enormous variability in qualita-

Table 4. Seed qualitative characters of different type of jackfruit.

Tree type	Seed shape	Seed surface sliminess	Seed surface pattern	Seed coat color	Adherence of seed coat to kernel	Vivipary
Type 1	Irregular	Highly slim	Uniform	Cream	Easily separable	Present
Type 2	Irregular	Intermediate	Uniform	Cream	Intermediate	Absent
Type 3	Irregular	Intermediate	Uniform	Cream	Difficult to separate	Present
Type 4	Irregular	Highly slim	Patches	Dull brown	Difficult to separate	Absent
Type 5	Irregular	Highly slim	Regular striations	Dull brown	Easily separable	Present
Type 6	Reniform	Intermediate	Uniform	Dull brown	Easily separable	Present
Type 7	Reniform	Slightly slimy	Uniform	Cream	Difficult to separate	Absent
Type 8	Irregular	Intermediate	Uniform	Off-white	Difficult to separate	Present
Type 9	Spheroid	Highly slim	Uniform	Dull brown	Difficult to separate	Absent
Type 10	Reniform	Intermediate	Uniform	Cream	Easily separable	Present
Type 11	Spheroid	Intermediate	Uniform	Brown	Difficult to separate	Absent
Type 12	Irregular	Intermediate	Uniform	Dull brown	Difficult to separate	Absent
Type 13	Irregular	Intermediate	Other (cracked)	Brown	Easily separable	Present
Type 14	Irregular	Slightly slim	Uniform	Brown	Easily separable	Present
Type 15	Elongate	Intermediate	Uniform	Dull brown	Intermediate	Absent
Type 16	Irregular	Intermediate	Uniform	Brown	Intermediate	Present
Type 17	Irregular	Slightly slim	Uniform	Dull brown	Difficult to separate	Present
Type 18	Irregular	Highly slim	Uniform	Brown	Difficult to separate	Absent
Type 19	Spheroid	Highly slim	Uniform	Dull brown	Difficult to separate	Absent
Type 20	Elongate	Intermediate	Uniform	Cream	Difficult to separate	Absent

tive and quantitative traits of fruits (Reddy et al. 2004). Twenty eight off-season jackfruit germplasm of South Western regions of Bangladesh were observed and significant variations were noted among the germplasm in relation to fruit characteristics (Mannan et al. 2005, Mannan et al. 2006). Nearly 1800 trees were observed in Eastern India over a period of 7 years and 2 types were identified with very juicy flakes as suitable for processing and some types exhibiting TSS more than 25 °Brix were identified as suitable for table purpose (Mitra and Mani 2000). Thirty four jackfruit types were observed in hilly region of Karnataka and 4 types were identified as suitable for chips making based on study of 9 flake characters (Jagadeesh et al. 2007). Forty four superior genotypes from three districts of West Bengal were observed and it was noted that characters like weight of fresh flakes without seed, weight of fresh flakes with seed, stalk length, fruit yield per tree, rachis diameter, rachis length, fruit length, shelf life, number of flakes per kg fruit, flake width, number of seeds per kg fruit, vitamin C, TSS/Acid ratio and sugar/acid ratio could be used as selection criteria for development of effective and productive plant types in jackfruit (Wangchu et al. 2013).

Conclusion

The sensory attributes of jackfruit flakes like appearance, color, flavor, texture and sweetness showed wide variation among the 20 types studied in Rongram block. Type 1, Type 11, and Type 17 produced fruits with firm textured, thick flakes suitable for chips making. Type 4, Type 9 and Type 12 produced fruits with soft and sweet flakes suitable for processed products like jam, jelly, halwa, candy. Fruits of Type 4, Type 6, Type 15, Type 19 and Type 20 produced very juicy pulp which may be suitable for juice processing. Type 11 and Type 18 produced fruits with total soluble solids (TSS) content of 25°Brix suitable for table purpose. The fruit and seed quantitative parameters also showed wide variations. Type 16 produced fruits of highest fruit weight which also exhibited the second highest flake: Fruit ratio. Type 1 produced fruits of second highest fruit weight which also showed the highest flake seed ratio. These germplasm may be considered for future crop improvement purpose.

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