

EVALUATION OF JACKFRUIT GERMPLASM FOR YIELD AND YIELD CONTRIBUTING CHARACTERS

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Abstract

Twenty germplasm of jackfruit grown in the Fruit Research Farm of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI) were evaluated for growth, yield and yield parameter along with qualitative characters from July 2012 to June 2015. All the germplasm varied for most of the parameters evaluated. The tallest plant was recorded in AH Joy-079(6.75m) and shortest plant in AH Joy-075 (3.50 m) among the germplasm. Base girth ranged from 42.50 cm to 80.20 cm in AH Joy-075 and AH Joy-085, respectively. Maximum plant spreading with North-South and East-West canopy (5.50 m and 6.00 m, respectively) was recorded in AH Joy-079 and minimum (3.00 m and 3.50m) in both AH Joy-075 and AH Joy-090 germplasm. The fruit number varied from 02 to 11 among the germplasm. Individual fruit weight ranged from 2.27 kg to 11.33 kg where AH Joy-034 had the lowest and AH Joy-092 noted the highest fruit weight. Maximum bulb (184) was recorded in AH Joy-092 and minimum (45) in AH Joy-085. Maximum TSS (25.0) was recorded in AH Joy-029 and minimum (14.0) in AH Joy-067 and the edible portion was noted the highest in AH Joy-036 (48.60%) where it was lowest in AH Joy-078 (32.10%). Bulb texture was soft to hard. Maximum germplasm were juicy to medium juicy having yellow to light yellow Pulp. Therefore, The germplasm AH Joy-089, AH Joy-017 and AH Joy-092 may be selected for higher yielder. The germplasm AH Joy-034, AH Joy-067, AH Joy-078, AH Joy-085 and AH Joy-098 should be selected for family size jackfruit as their individual fruit weight ranges between 2 to 4 kg including yellow bulb colour containing good juiciness and soft bulb texture.

Keywords: Jackfruit, qualitative characters, quantitative characters, family size fruit and yield.

Introduction

Jackfruit (*Artocarpus heterophyllus* L.) is a tree species of the family Moraceae which is native to Southeast Asia. It is the largest edible fruit in the world (Naik, 1949 and Sturrock, 1959). Jackfruit locally called “kathal” has gained the position of national fruit of Bangladesh due to its popularity and diversified use and other features. Every part of either the jackfruit tree or fruit has great economic importance. The poor people of jackfruit growing area used to eat this fruit instead of rice for one of their daily meals, in this regard it is commonly referred to as “the poor man’s food” (Rahman *et al.*, 1994). It is a cross-

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pollinated fruit tree and is mainly propagated by seeds in Bangladesh. As a result, wide range of variation is exhibited in morpho-agronomic characteristics. Narasimham (1990) and Hossain (1996) reported different types of jackfruit, which vary widely in size, shape, bearing habit and quality. Azad (1999) noted the vast genetic diversity in jackfruit on the basis of morpho-agronomic traits and using isozyme marker. Jackfruit is identified as deserving priority attention in Bangladesh because of its importance and diversity (Azad *et al.*, 2007; Hossain, 1996; Saha *et al.*, 1996), and Bangladesh is considered as a secondary center of jackfruit diversity (Arora, 1998; Dhar, 1998 and Hossain, 1996). Jackfruit rips mostly in May-July and there is an abundance of fruit in the market in this period. Every year a lot of fruits get rotten at that time. If the farmers can produce jackfruit early, they can get more benefit. It is a large monoecious tree producing fruit up to 50×100 cm size and weighing 50 kg (Jagadeesh *et al.*, 2006). The development of jackfruit varieties through hybridization is cumbersome and more time consuming. Therefore, selection of superior chance seedling has been suggested for the varietal development of jackfruit. The field population of jackfruit is composed of a large number of variable genotypes providing ample scope of selecting the superior ones. Bangladesh Agricultural Research Institute has already released two jackfruit varieties, but still there are opportunities to develop jackfruit varieties that farmers can cultivate for better yield and quality. Keeping this view in mind, the study was therefore, carried out to find out suitable line(s) for the development of a variety.

Materials and Methods

The study was conducted at the Fruit Research Farm of Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI) during June 2012–June 2015 at Gazipur (24°06'N; 90° 21' E), Bangladesh. Earlier a survey was carried out in the central region of Bangladesh using questionnaire developed as per descriptor of jackfruit published by International Plant Genetic Resources Institute (IPGRI, 2000). Fruits of 20 germplasm were collected and five fruits from each accession were analyzed in the laboratory to study the fruit characteristics. Seedlings of each accession were planted following single row plantation in the Fruit Research Farm of HRC on 01 July 2001. The age of plants was 10 years at the time of study. Subsequently three fruiting years of each accession are included under this study. The climate of the experimental area was under subtropical zone which was characterized by high temperature and high rain during April to November and little or no rain during October to March. The soil of the experimental site was clay loam belonging to the Modhupur tract under Agro Ecological Zone 28 (Ahmed *et al.*, 2016). Planting distance was maintained 6 m x 3 m. A fertilizer dose of 300g Urea, 300g TSP, 250g MOP and 20 kg cowdung per plant and subsequent irrigation were applied on August 2012 after harvesting of fruits. The experimental plot was ploughed with power tiller just before applying fertilizer. Weeding was performed in the month March and April 2013. Unwanted branches were pruned off in September 2012. Data on

plant height, base girth, canopy spreading (north-south and east-west spread), number of fruits per plant, fruit length and diameter, spine number per 5 square cm, rind weight, rachis weight, bulb length and width, TSS, number of bulb and edible portion were recorded and analyzed statistically. Tree volume was calculated using the formula of Westwood *et al.* (1963), i.e., tree volume (m^3) = $4/3\pi a^2b$, where a = average of east-west and north-south spread, b = half of plant height and π (constant) = 3.14.

Results and Discussion

Growth characteristics of jackfruit germplasm

Plant and fruit characteristics of 20 accessions of jackfruit are presented in Table 1. The highest plant height (6.75 m) was found in AH Joy-079 closely followed by AH Joy-086 (6.50 m) and AH Joy-059 (6.25 m), while it was noted the lowest (3.50 m) in AH Joy-075.

Table 1. Growth characteristics of 20 jackfruit germplasm (average of 3 years)

Acc. no.	Plant height (m)	Base girth (cm)	Canopy Spreading		Tree volume (m^3)
			N-S	E-W	
AH Joy-017	5.50	75.00	4.50	4.75	16.96
AH Joy-029	6.00	60.00	4.00	5.25	18.50
AH Joy-032	6.00	62.50	3.75	4.00	15.50
AH Joy-034	5.67	60.00	3.00	4.33	13.85
AH Joy-036	5.55	55.60	3.10	4.00	13.14
AH Joy-059	6.25	72.00	4.75	5.00	20.31
AH Joy-067	5.50	66.00	3.50	4.25	14.21
AH Joy-075	3.50	42.50	3.00	3.50	18.90
AH Joy-078	5.30	65.00	5.70	5.00	7.58
AH Joy-079	6.75	55.80	5.50	6.00	25.88
AH Joy-080	5.67	45.50	4.70	4.00	16.44
AH Joy-081	4.75	68.30	5.00	4.85	15.60
AH Joy-085	5.33	80.20	4.65	5.20	17.50
AH Joy-086	6.50	50.50	4.50	5.33	21.30
AH Joy-087	3.75	58.00	3.75	4.25	10.00
AH Joy-089	5.75	75.50	5.50	5.80	21.66
AH Joy-090	4.30	45.00	3.00	3.50	9.32
AH Joy-092	4.50	55.00	4.00	3.75	11.63
AH Joy-098	5.20	65.00	3.50	4.30	13.52
AH Joy-097	4.33	58.00	4.00	4.55	12.34
Mean	5.30	60.77	4.18	4.58	15.71
SD	0.87	10.43	0.85	0.72	4.23
CV (%)	16.51	17.16	20.30	15.63	12.43

Maximum base girth (80.20 cm) was obtained from AH Joy-085 followed by AH Joy-089 (75.50 cm) and AH Joy-017 (75.00 cm). Minimum base girth (42.50 cm) was found in AH Joy-075. North-South (5.50 m) and east-west (6.00 m) plant spreading were exhibited maximum in AH Joy-079 and those were demonstrated minimum (3.00 m and 3.50 m, respectively) in AH Joy-090. More or less similar physico-morphological variation has been reported in jackfruit by Reddy *et al.*, 2004; Shyamamma *et al.*, 2008; Ullah and Haque, 2008. Maximum tree volume was yielded by the germplasm AH Joy-079 (25.88 m³) where it was minimum (7.58m³) in AH Joy-078.

Fruit characteristics of jackfruit germplasm

a. Quantitative characteristics

A wide variation in physico-morphological fruit characteristics of jackfruit was observed among the 20 jackfruit germplasm (Table 2). The harvesting time showed that first harvesting was done in all the germplasm from mid-May to late May in three consecutive study years. The earliest first harvest (12-16 May) was recorded in AH Joy-098 which was late (26-31 May) in the germplasm AH Joy-017. Duration of harvest was carried out 24.67 to 48.67 days (in the germplasm AH Joy-087 and AH Joy-080 respectively) which is supported by the result of karim *et al.* (2008). Maximum coefficient of variation was observed for number of bulbs/fruit (50.41%) followed by number of fruits per plant (44.81%). Bulb is the economically important part of jackfruit as it comprises the edible part known as flake. Hence these characters can be considered for selection of elite type jackfruit. There are a few published reports which indicated variation for bulb characters in jackfruit clones (Muralidharan *et al.*, 1997; Mitra and Mani, 2000; Reddy *et al.*, 2004 and Jagadeesh *et al.*, 2010). Total soluble solids in the genotypes recorded comparatively low values for coefficient of variation (14.75%) signifying that this trait is conserved in nature. This result agreed with findings of Jagadeesh *et al.* (2010). However, a slight variation in this parameter can cause considerable impact on taste. Maximum number of fruits per plant (10.67) was produced by the accession AH Joy-067 followed by AH Joy-017 (8.33) and AH Joy-089 (7.67) whereas minimum number (02) was found in AH Joy-081 and AH Joy-087. The biggest fruit (11.33 kg) with maximum fruit length (39.00 cm) and diameter (25.20 cm) was harvested from the germplasm AH Joy-092 followed by AH Joy-090 (8.63 kg).

The smallest fruit (2.27 kg) having minimum fruit length (23.50 cm) and diameter (13.80 cm) was observed in AH Joy-034. Very dense spine (per five square centimeter) was found in AH Joy-090 (151) followed by AH Joy-089 (134) and minimum in AH Joy-017 (38).

Table 2. Fruit characteristics of 20 jackfruit germplasm (average of 3 years)

Acc. no.	First harvesting time	Duration of harvest (days)	Fruit length (cm)	Fruit dia (cm)	Spine no/5sq. cm of fruit	No of bulbs/fruit	TSS (%)	Edible portion (%)
AH Joy-017	26-31 May	41.00	25.0	24.4	38	75	20.0	42.50
AH Joy-029	20-25 May	39.33	30.4	23.0	63	181	25.0	43.20
AH Joy-032	22-27 May	40.33	25.0	20.2	59	60	20.0	39.20
AH Joy-034	16-20 May	28.67	23.5	13.8	103	94	21.0	44.70
AH Joy-036	15-20 May	36.33	28.1	23.0	64	104	16.0	48.60
AH Joy-059	15-20 May	42.00	26.1	21.8	64	73	15.5	48.20
AH Joy-067	18-24 May	37.67	26.3	16.2	87	74	14.0	41.40
AH Joy-075	15-22 May	46.33	26.1	24.1	47	165	18.0	44.60
AH Joy-078	18-22 May	34.67	29.7	17.0	64	52	14.0	32.10
AH Joy-079	15-20 May	46.33	33.2	20.1	108	55	16.5	45.50
AH Joy-080	16-22 May	48.67	26.5	21.8	100	182	18.0	40.00
AH Joy-081	20-25 May	30.67	30.3	24.0	102	130	16.0	41.80
AH Joy-085	24-30 May	46.00	34.3	19.3	69	45	17.0	37.20
AH Joy-086	20-27 May	40.67	33.7	18.7	49	175	20.0	39.70
AH Joy-087	22-28 May	24.67	35.2	18.2	60	45	16.0	32.00
AH Joy-089	15-20 May	45.67	32.0	20.7	134	56	16.5	44.20
AH Joy-090	15-22 May	49.33	37.5	23.0	151	157	18.0	43.90
AH Joy-092	20-27 May	26.33	39.0	25.2	57	184	20.0	45.10
AH Joy-098	12-16 May	36.33	23.7	17.0	66	63	18.5	47.90
AH Joy-097	18-25 May	42.67	26.6	22.5	48	165	20.0	42.60
Mean	-	39.18	29.36	20.70	76.65	106.75	18.00	42.22
SD	-	7.29	4.24	3.13	31.51	53.81	2.66	4.60
CV (%)	-	18.59	14.44	15.11	41.10	50.41	14.75	10.90

TSS= Total Soluble Solid

Maximum TSS (25.0) was recorded in AH Joy-029 and minimum (14.0) in AH Joy-067 with a mean value of 18.0 which is agreed with the findings of Rahman *et al.* (1994). The edible portion was recorded the highest in AH Joy-036 (48.6%) followed by AH Joy-059 (48.2%) and the lowest in AH Joy-078 (32.1%). The findings of the study partially similar to the results of Ullah and Haque (2008) where the authors reported 37.3 to 52.8% edible portion in their studied germplasm. Maximum bulb was counted in AH Joy-092 (184) followed by AH Joy-080 (182) and minimum in AH Joy-085 (45).

Table 2. Continued

Acc. no.	Individual fruit wt (kg)				Fruits/ plant (no.)				Rind wt (kg)	Rachis wt (g)
	2012-13	2013-14	2014-15	Average	2012-13	2013-14	2014-15	Average		
AH Joy-017	4.60	5.50	5.90	5.33	7	10	8	8.33	3.40	225
AH Joy-029	6.65	7.40	8.60	7.55	4	4	5	4.33	4.00	260
AH Joy-032	4.40	5.80	5.00	5.07	6	5	7	6.00	2.80	240
AH Joy-034	2.20	2.20	2.40	2.27	4	6	5	5.00	1.10	150
AH Joy-036	7.00	7.10	7.00	7.03	3	4	5	4.00	3.10	500
AH Joy-059	5.30	5.00	6.25	5.52	7	6	6	6.33	2.60	200
AH Joy-067	3.00	2.60	3.20	2.93	11	11	10	10.67	1.40	300
AH Joy-075	6.45	6.50	6.70	6.55	3	4	3	3.33	3.30	300
AH Joy-078	3.00	3.30	3.10	3.13	6	7	7	6.67	1.90	185
AH Joy-079	6.40	7.30	8.00	7.23	3	2	4	3.00	3.80	165
AH Joy-080	6.00	6.50	6.50	6.33	3	5	4	4.00	3.50	280
AH Joy-081	6.00	6.30	6.20	6.17	2	2	3	2.33	3.20	350
AH Joy-085	4.00	4.50	4.20	4.23	7	7	8	7.33	2.50	170
AH Joy-086	4.90	5.40	5.20	5.17	4	6	6	5.33	2.80	250
AH Joy-087	4.50	5.00	5.00	4.83	3	2	2	2.33	3.00	300
AH Joy-089	5.40	6.10	6.00	5.83	8	8	7	7.67	3.00	275
AH Joy-090	8.50	8.80	8.60	8.63	4	3	5	4.00	4.20	550
AH Joy-092	11.00	11.50	11.50	11.33	3	3	4	3.33	5.80	500
AH Joy-098	3.50	3.85	3.55	3.63	6	5	7	6.00	1.60	250
AH Joy-097	6.50	7.00	7.00	6.83	4	6	5	5.00	3.70	200
Mean	5.465	5.882	5.995	5.78	4.9	5.3	5.55	5.25	3.04	282.50
SD	2.040	2.141	2.197	2.108	2.27	2.49	1.99	2.16	1.06	113.92
CV (%)	37.33	36.39	36.64	36.47	46.30	47.06	35.79	41.09	34.96	40.33

* Three years average data of rind weight and rachis weight are shown in the table.

The highest rind weight (5.8 kg) was recorded in AH Joy-092 followed by AH Joy-090 (4.2 kg). The lowest rind weight was noticed in AH Joy-034 (1.1 kg). Maximum rachis weight (550 g) was observed in AH Joy-090 followed by AH Joy-036 and AH Joy-092 (500 g) while it was recorded minimum in AH Joy-034 (150g).

Table 3. Yield performance of 20 jackfruit germplasm

Acc. no.	Yield/ plant (kg)			
	2012-13	2013-14	2014-15	Average
AH Joy-017	32.20	55.00	47.20	44.44
AH Joy-029	26.60	29.60	43.00	32.72
AH Joy-032	26.40	29.00	35.00	30.40
AH Joy-034	8.80	13.20	12.00	11.33
AH Joy-036	21.00	28.40	35.00	28.13
AH Joy-059	37.10	30.00	37.50	34.94
AH Joy-067	33.00	28.60	32.00	31.29
AH Joy-075	19.35	26.00	20.10	21.83
AH Joy-078	18.00	23.10	21.70	20.89
AH Joy-079	19.20	14.60	32.00	21.70
AH Joy-080	18.00	32.50	26.00	25.33
AH Joy-081	12.00	12.60	18.60	14.39
AH Joy-085	28.00	31.50	33.60	31.04
AH Joy-086	19.60	32.40	31.20	27.56
AH Joy-087	13.50	10.00	10.00	11.28
AH Joy-089	43.20	48.80	42.00	44.72
AH Joy-090	34.00	26.40	43.00	34.53
AH Joy-092	33.00	34.50	46.00	37.78
AH Joy-098	21.00	19.25	24.85	21.80
AH Joy-097	26.00	42.00	35.00	34.17
Mean	24.50	28.37	31.29	28.01
SD	8.99	11.53	10.80	9.57
CV (%)	36.71	40.62	34.53	34.15

Number of fruit (10.67) was highest in AH Joy-067 followed by AH Joy-017 (8.33) and AH Joy-089 (7.67) but the highest yield per plant was calculated in AH Joy-089 (44.72 kg/plant) followed by AH Joy-017 (44.45 kg/plant) and the lowest yield per plant was in AH Joy-034 and Ah Joy-087 (11.28 kg/plant).

b. Qualitative characteristics

Out of twenty germplasm, maximum (9) gave ellipsoid shaped fruit and others were clavate, spheroid and oblong in shaped (Table-4). Fruit colour varied from

yellow to greenish yellow. Fruit surface of maximum germplasm was spiny except three (AH Joy-032, AH Joy-089, AH Joy-097) which showed smooth fruit surface. Spine shape was Intermediate to pointed. Regarding attractiveness of fruit four germplasm (AH Joy-029, AH Joy-032, AH Joy-059 and AH Joy-097) produced good fruits and others produced intermediate to poor fruits. Pulp were yellow to light yellow in colour. Bulb of maximum germplasm were juicy to medium juicy except AH Joy-089 and AH Joy-092 which were less juicy. Bulb texture was soft to hard and only two germplasm (AH Joy-017 and AH Joy-086) showed high fibrousness and others were medium and low. Most of the studied characters like fruit colour, fruit shape and pulp colour are similar to the research results of Azad *et al.* (2001) and Roy *et al.* (2012).

Table 4. Qualitative characteristics of jackfruit germplasm

Acc. no.	Fruit Shape	Fruit colour	Fruit surface	Spine shape	Attractiveness
AH Joy-017	Clavate	Greenish yellow	Spiny	Intermediate	Intermediate
AH Joy-029	Ellipsoid	Yellow	Spiny	Intermediate	Good
AH Joy-032	Oblong	Yellow	Smooth	Intermediate	Good
AH Joy-034	Oblong	Greenish yellow	Spiny	Intermediate	Poor
AH Joy-036	Spheroid	Yellow	Spiny	Intermediate	Intermediate
AH Joy-059	Spheroid	Greenish yellow	Spiny	Intermediate	Good
AH Joy-067	Ellipsoid	Yellow	Spiny	Pointed	Poor
AH Joy-075	Spheroid	Yellow	Spiny	Intermediate	Intermediate
AH Joy-078	Ellipsoid	Yellow	Spiny	Pointed	Intermediate
AH Joy-079	Oblong	Yellow	Spiny	Intermediate	Intermediate
AH Joy-080	Ellipsoid	Yellow	Spiny	Intermediate	Intermediate
AH Joy-081	Clavate	Greenish yellow	Spiny	Pointed	Intermediate
AH Joy-085	Ellipsoid	Yellow	Spiny	Pointed	Intermediate
AH Joy-086	Oblong	Yellow	Spiny	Intermediate	Intermediate
AH Joy-087	Oblong	Greenish yellow	Spiny	Intermediate	Poor
AH Joy-089	Ellipsoid	Yellow	Smooth	Intermediate	Intermediate
AH Joy-090	Ellipsoid	Yellow	Spiny	Intermediate	Intermediate
AH Joy-092	Ellipsoid	Greenish yellow	Spiny	Intermediate	Intermediate
AH Joy-098	Ellipsoid	Yellow	Spiny	Intermediate	Intermediate
AH Joy-097	Spheroid	Greenish yellow	Smooth	Intermediate	Good

Table 4. Continued

Acc. no.	Bulb color	Bulb Juiciness	Bulb fibrousness	Bulb texture
AH Joy-017	Yellow	Juicy	High	Hard
AH Joy-029	Yellow	Juicy	Low	Soft
AH Joy-032	Yellow	Juicy	Low	Soft
AH Joy-034	Yellow	M juicy	Medium	Soft
AH Joy-036	Yellow	Juicy	Low	Soft
AH Joy-059	Yellow	M juicy	Low	Soft
AH Joy-067	yellow	Juicy	Low	Soft
AH Joy-075	yellow	Juicy	Medium	Hard
AH Joy-078	L yellow	Juicy	Low	Semi hard
AH Joy-079	Yellow	Juicy	Medium	Hard
AH Joy-080	Yellow	Juicy	Low	Soft
AH Joy-081	L yellow	Juicy	Low	Soft
AH Joy-085	Yellow	Juicy	Low	Soft
AH Joy-086	Yellow	Juicy	High	Soft
AH Joy-087	L yellow	Juicy	Low	Soft
AH Joy-089	L yellow	L juicy	Medium	Hard
AH Joy-090	Yellow	Juicy	Low	Semi hard
AH Joy-092	Yellow	L juicy	Low	Soft
AH Joy-098	L yellow	M juicy	Low	Semi hard
AH Joy-097	Yellow	M juicy	Medium	Soft

*L Yellow=Light yellow; L Juicy=Less Juicy; M Juicy=Medium Juicy

Conclusion

Evaluation of available jackfruit germplasm helps to develop new varieties. Keeping this view in mind, the evaluation can be concluded with the selection of AH Joy-089, AH Joy-017 and AH Joy-092 for top yielder but AH Joy-034, AH Joy-067, AH Joy-078, AH Joy-085 and AH Joy-098 germplasm should be selected for the family size fruits.

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