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EVALUATION OF JACKFRUIT GENOTYPES FOR YIELD AND QUALITY ATTRIBUTES UNDER EASTERN INDIAN CONDITION

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Abstract

Evaluation of twenty one genotypes of jackfruit was carried out for two consecutive years during 2000-01 and 2001-02. Genotypes varied in their tree morphological characters, bearingg behavior, fruit and flake characters, maturity period and yield potential. Based on overall performance with respect to bearing potential, maturity period, fruit and flake characters, the genotypes HPJS-5/8 and HPJS-3/10 have been found promising for table purpose, whereas, HPJS-4/5 and HPJS-2/6 have been found suitable for culinary purpose. These genotypes have been recommended for release by the Institute Varietal Release Committee. The genotypes HPJS-3/10, HPJS-5/8, HPJS-8/9, HPJS-9/5 and HPJS-11/9 have also been indentified for pleasant aroma in the ripe flakes.

INTRODUCTION

Jackfruit (*Atrocarpus heterophyllus* Lam.) is native and being grown all over the country up to the elevation of 1500m above msl (Bose and Mitra, 1996). However, the major areas of cultivation in India lie in the eastern and southern parts of the country. This includes the states of Jharkhand, Bihar, West Bengal, Uttar Pradesh, Orissa, Chhatisgarh, Andhra Pradesh, Tamil Nadu, Kerala and Karnataka. Apart from India, it is also grown in East Indies and other warmer areas of both hemispheres (Morton, 1965). The jackfruit trees are highly productive and regular bearer. A well grown up healthy plant produces 300-500 kg fruits every year. The individual fruit weight generally varies from 0.98-57.80kg at maturity (Vishal Nath *et al.* 2001). It is a hardy plant species that can be grown under a wide variety of well drained soils of warm humid plains and hill slopes. The sub humid plateau region of eastern India enjoys the mild climate endowed with well drained light soil and sloppy topography which is best suited for jackfruit. The continuous propagation by seeds has resulted in rich genetic diversity. Visualizing the potentiality for commercial cultivation of jackfruit in the region, the effort was made to collect and evaluate the genotypes for high yield and better quality fruits.

MATERIALS AND METHODS

The major jackfruit growing areas of Bihar, West Bengal and Uttar Pradesh were surveyed and genotypes possessing desirable horticultural traits were collected during 1985. Seedlings of these genotypes are being maintained in Field Gene Bank of Horticulture and Agro Forestry Research Programme (HARP), Ranchi. Since 1986, a total of 101 germplasms have been augmented and maintained in germplasm repository out of which 21 genotypes having uniform age and vigour have been evaluated for yield and yield atrributing parameters for two consecutive years (2000-01 and 2001-02). These genotypes were planted at 10 x 10m spacing during 1986. After the age of 14 years few genotypes have attended economical bearing stage. Individual plant has been marked as genotype. The observations were recorded on vegetative growth, fruiting performance, fruit and flake characters from these promising genotypes. The quantitative and qualitative characters were recorded as described in IPGRI jackfruit descriptor (IPGRI, 2000). The weight of 20 flakes with seed and without seed was taken and average value was calculated. The fruit quality was judged by Hedonic ratings test (Amerine *et al.* 1965). Tree volume was calculated by using the formula.

Tree volume (m^3) = 4.3 x π x spread (East-West x North- South/ 4 x height/2.

RESULTS AND DISCUSSION

Tree Characters:

Data regarding the tree characters of different jackfruit genotypes have been presented in Table 1. It is evident from the Table that the plant height of different genotypes ranged from 5.6 to 9.05 m with minimm in HPJS-8/9 and maximum in HPJS-8/3. The trunk circumference at 30 cm height in different genotypes ranged from 83 cm in HPJS-3/10 to 161.0 cm in HPJS-11/9. The minimum Est-West plant canopy spread was recorded in HPJS-8/9 (5.05m) whereas, the North-South plant canopy spread was the minimum in genotypes HPJS-9/1 (4.85m). The maximum canopy spread (E-W) and (N-S) was recorded in HPJS-5/8 (9.30 m and 10.50 m, respectively). The genotype HPJS-5/8 also

Table 1: Growth and fruiting characters of jackfruit genotypes.

Genotypes	Plant height (m)	Trunk girth (cm)	Canopy spread (m)		Tree (m^3)	Date of		No. of fruits per plant	Yield per tree (kg)
			E-W	N-S		Fruit set	Fruit maturity		
HPJS-1/4	8.10	101.0	5.80	6.30	155.01	6th Feb.	15th June	26	239.2
HPJS-1/9	8.10	106.0	6.10	7.00	181.14	25th Jan.	8th June	35	262.5
HPJS-2/1	7.45	98.0	7.30	5.75	163.78	1st Mar.	10th June	26	366.6
HPJS-2/6	8.65	130.0	8.90	8.60	346.75	1st Mar.	25th June	25	250.0
HPJS-3/2	7.30	100.0	5.70	6.25	136.20	18th Mar.	17th June	18	88.2
HPJS-3/10	6.40	83.0	6.80	6.00	136.76	8th Feb.	19th June	28	252.0
HPJS-4/5	8.10	112.0	8.30	6.30	221.83	2nd Mar.	30th June	52	374.4
HPJS-5/1	6.30	102.0	8.30	6.70	183.49	12th Feb.	17th June	31	145.7
HPJS-5/8	8.05	128.	9.30	10.50	411.71	11th Feb.	12th June	40	548.0
HPJS-6/1	8.05	112.0	7.40	7.50	234.00	18th Jan.	5th June	18	248.4
HPJS-7/1	7.65	98.0	6.85	6.90	179.38	11th Feb.	14th June	29	371.2
HPJS-8/3	9.05	108.0	6.20	6.80	199.84	8th Feb.	16th June	7	98.0
HPJS-8/9	5.60	79.0	5.05	5.70	84.43	28th Feb.	8th June	18	192.6
HPJS-9/1	6.65	79.0	5.5	4.85	93.75	18th Mar.	12th June	5	50.0
HPJS-9/2	8.05	141.0	7.90	7.95	264.79	16th Mar.	14th June	4	36.0
HPJS-9/3	6.45	106.0	5.90	6.30	125.75	16th Feb.	17th June	27	297.0
HPJS-9/5	7.10	123.0	7.00	7.20	187.42	12th Mar.	16th June	22	176.0
HPJS-9/6	8.10	110.0	7.40	7.60	238.59	28th Feb.	15th June	19	167.2
HPJS-10/1	5.90	100.0	5.90	5.90	107.56	2nd Mar.	17th June	6	90.0
HPJS-10/8	6.60	107.0	5.35	5.40	99.86	15th Mar.	20th June	5	82.5
HPJS-11/9	6.65	161.0	9.20	8.70	278.77	21st Feb.	18th June	42	378.0

Table 2 : Fruit characters of different jackfruit genotypes.

Genotypes	Fruit shape	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (kg)	Fruit rind weight (kg)	Fruit attractiv-ness	Pulp aroma
HPJS-1/4	Ellipsoid	39.5	37.1	9.20	2.10	Good	Strong
HPJS-1/9	Oblong	37.8	33.0	7.50	2.00	Good	Intermediate
HPJS-2/1	Oblong	48.1	41.1	14.10	5.00	Good	Intermediate
HPJS-2/6	Spheroid	37.0	46.0	10.0	5.40	Excellent	Intermediate
HPJS-3/2	Ellipsoid	30.0	31.8	4.90	1.50	Poor	Intermediate
HPJS-3/10	Ellipsoid	40.0	40.1	9.00	2.40	Good	Pleasant
HPJS-4/5	Oblong	37.0	32.2	7.20	2.30	Excellent	Intermediate
HPJS-5/1	Oblong	30.1	29.8	4.70	1.50	Poor	Intermediate
HPJS-5/8	Oblong	49.0	37.5	13.70	3.70	Excellent	Pleasant
HPJS-6/1	Ellipsoid	46.1	42.0	13.80	5.00	Intermediate	Intermediate
HPJS-7/1	Ellipsoid	49.1	36.1	12.80	2.50	Intermediate	Intermediate
HPJS-8/3	Oblong	43.1	43.5	14.00	4.00	Excellent	Intermediate
HPJS-8/9	Clavate	46.4	30.1	10.70	2.80	Good	Pleasant
HPJS-9/1	Oblong	40.0	38.1	10.00	3.20	Poor	Intermediate
HPJS-9/2	Ellipsoid	31.0	37.9	9.00	2.00	Good	Intermediate
HPJS-9/3	Oblong	34.5	39.5	11.00	2.50	Good	Intermediate
HPJS-9/5	Clavate	33.0	32.0	8.00	2.00	Good	Pleasant
HPJS-9/6	Ellipsoid	48.7	43.0	8.80	2.50	Intermediate	Strong
HPJS-10/1	Oblong	43.0	38.0	15.00	5.50	Good	Intermediate
HPJS-10/8	Oblong	48.0	39.8	16.50	6.50	Good	Strong
HPJS-11/9	Ellipsoid	42.0	35.5	9.00	2.80	Good	Pleasant

recorded the maximum tree volume (411.71m³). The genotypes HPJS--5/8 and HPJS-2/6 are medium tall and spreading genotypes, whereas, HPJS-8/9 and HPJS-10/1 are dwarf types and HPJS--8/3 and HPJS-2/6 are tall gowing genotypes (Table 1)

Jackfruit genotypes enter in floriferous phase from 18th December and continue up to 11th March under Chotanagpur condition. In Jackfruit, the fruit is a sorosis where spikes are formed as small fruit. It is a monoecious tree in which about 96% male spikes (Samdar and Yadav, 1986) and 3-4% female spikes (Shadevan *et al.*, 1950) are found. The stigma with short style is present on the surface of the spike which remains receptive for 36 hrs. (sambanurty and Ramlingam, 1954). The wind pollination and fertilization of spike end within 3-6 days after anthesis. Sufficient and uniform pollination result in high fruit set per cent and

uniform fruit shape. Date of fruit set in different genotypes ranged from 18th January to 18th March. It was earliest in HPJS-6/1 and latest in HPJS-3/2 and HPJS-9/1 (Table 1) Accordingly genotypes can be categorized as early, mid season and late type depending upon the date of fruit set. Considering January fruit set as early, February set as mid season and March set as late, the genotypes HPJS-1/9 and HPJS-6/1 can be grouped as early, HPJS-1/4, 3/10, 5/1, 5/8, 7/1, 8/3, 8/9, 9/3, 9/6 and 11/9 as mid season and HPJS-2/1, 2/6, 3/2, 4/5, 9/1, 9/2, 9/5, 10/1 and 10/8 as late. Number of fruits in different genotypes depends upon the growth and health of the tree.

Table 3 : Flake characters of jackfruit genotypes.

Genotypes	No. of flakes per fruit	Average flake weight with seed (g)	Average flake weight without seed (g)	Flake length (cm)	Flake width (cm)	Total Sugar (%)	T.S.S. (°brix)	Acidity (%)	Pulp consistency
HPJS-1/4	169	21.5	16.5	5.8	2.7	7.46	18.0	0.14	Medium
HPJS-1/9	115	30.0	24.5	5.5	3.5	8.06	21.0	0.14	Medium
HPJS-2/1	230	30.0	25.0	6.1	2.5	6.32	17.5	0.12	Medium
HPJS-2/6	242	26.5	20.0	6.2	3.0	10.51	18.2	0.12	Medium
HPJS-3/2	90	32.0	25.5	5.5	3.1	7.17	17.9	0.04	Medium
HPJS-3/10	280	15.0	11.2	5.5	3.5	9.43	18.8	0.08	Medium
HPJS-4/5	210	26.5	22.5	6.5	3.4	11.63	16.2	0.04	Soft
HPJS-5/1	48	30.0	24.5	4.0	3.7	7.24	17.5	0.16	Medium
HPJS-5/8	276	25.1	19.6	6.5	4.3	8.33	18.0	0.09	Medium
HPJS-6/1	152	35.0	26.0	7.4	3.7	6.84	17.0	0.11	Medium
HPJS-7/1	240	34.0	26.0	6.5	3.8	8.24	16.5	0.16	Soft
HPJS-8/3	333	30.0	25.0	7.0	3.5	6.84	17.0	0.13	Medium
HPJS-8/9	230	34.0	28.0	6.0	3.0	13.15	18.0	0.04	Medium
HPJS-9/1	198	26.0	22.5	5.2	3.5	8.32	16.0	0.04	Medium
HPJS-9/2	180	20.0	16.0	6.5	3.5	8.47	18.0	0.04	Medium
HPJS-9/3	210	20	17.0	4.5	3.5	11.62	16.1	0.04	Soft
HPJS-9/5	178	40.0	32.5	6.0	4.0	11.62	18.2	0.05	Medium
HPJS-9/6	250	30.0	25.5	6.0	3.9	9.88	17.2	0.16	Medium
HPJS-10/1	298	32.5	25.5	6.5	3.0	13.51	16.2	0.06	Medium
HPJS-10/8	185	42.5	33.5	7.0	5.0	9.26	16.0	0.05	Medium
HPJS-11/9	251	25.3	10.3	5.6	3.4	9.23	25.0	0.04	Medium

Data presented in Table 1 revealed that during the period under study the number of fruits in jackfruit genotypes ranged from 4 (HPJS-9/2) to 52 (HPJS-4/5). The genotypes bearing on an average 25 or more fruits are considered to the the good bearer (Rai and Reddy, 2000). The yield per tree ranged from 36 kg (HPJS- 9/2) to 378 kg *HPJS-11/9) in different genotypes.

Fruit Characters:

Different jackfruit genotypes exhibited varying fruit characters. Data on fruit shape, fruit length, fruit diameter, fruit weight, fruit attractiveness and aroma have been presented in Table-2. Fruit shape is an important character for jackfruit. Fruits with uniform and oblong shape fetch high price in market and considered good for processing. The evaluated genotypes had ellipsoid, clavate, spheroid and oblong shapes. Genotypes HPJS-1/9, 2/1, 4/5, 5/1, 5/8, 8/3, 9/1, 9/3, 10/1 and 10/8 had oblong shape. Fruit length in different genotypes varied from 30.0 cm in HPJS-3/2 to 49.1 cm in HPJS-7/1. The minimum fruit diameter was recorded in genotype HPJS 5/1 (29.8cm), whereas, the maximum fruit diameter was recorded in genotype HPJS-2/6 (46.0 cm). The fruit weight in different genotypes varied greatly. The minimum fruit weight was recorded in HPJS-5/1 (470 kg/fruit), whereas, the maximum fruit weight was recorded in genotype HPJS-10/8 (16.5 kg/fruit). In the present study it has been noticed that the genotypes HPJS-10/8, HPJS-10/1 and HPJS-8/3 produced 5, 6 and 7 fruits with an average fruit weight of 16.0, 15.0 and 14.0 kg, respectively, whereas, the genotypes HPJS-5/4 having 52 fruits had a fruit weight of 7.2 kg. This shows that the number of fruit has inverse relation with the average fruit weight in jackfruit. However, genotype HPJS--5/8 produced 40 fruits with an average weight of 13.7 kg which may be due to the genetical character of the germplasm.

The rind of jackfruit comprises of fruit skin and placenta. Perusal of data presented in Table 2 revealed that the average rind weight in different genotypes varied from 1.5 kg to 6.5 kg/fruit. HPJS-3/2 and HPJS-5/1 recorded the minimum rind weight, whereas, the maximum value was recorded in genotype HPJS-10/8. Fruit attractiveness in different genotypes has also been presented in Table 2.

Fruit maturity:

The fruit maturity in jackfruit genotyopes ranged from 5th June (HPJS-6/1) to 30th June (HPJS-4/5). Considering the maturity up to 10th June as early, 20th June as mid season and 30th June as late. The genotypes has been grouped into tree major groups. The genotypes HPJS-1/9, HPJS-2/1, HPJS-6/1 and HPJS-8/9 are early maturing genotypes, whereas, the genotypes HPJS-2/6 and HPJS-4/5 are late maturing types (Table 1)

Flake Characters:

Flake is the most important part of ripe jackfruit. Superiority of any genotype for table purpose depends on the quality of flakes. Flake characters of different jack fruit genotypes have been presented in Table 3. Number of flakes and its average weight without seed directly indicate the edible portion of ripe jackfruit. Number of flakes per fruit depends upon the size of fruits and also the genetical characters of the plant. In present study, the number of flakes/ fruit varied from 48 (HPJS-5/1) to 333 (HPJS-8/3). The genotypes having higher number of big size flake with desirable appreance with superior quality and crispy pulp are considered good for table purpose. Flake weight (after removing the seeds) in different genotypes varied from 10.25 g (HPJS-11/9) to 33.75 g (HPJS-10/8). Length of flake in these genotypes vaired from 4.5 cm (HPJS-9/3) to 7.4 cm (HPJS-6/1). The flake width in jackfruit genotypes ranged from 2.5 cm (HPJS-2/1) to 5.0 cm (HPJS-10/8). Thick flakes are generally preferred for table purpose. Among the genotypes evaluated, HPJS-1/9, 2/6, 5/1, 5/8, 8/3, 9/1 and 10/8 had thick flakes.

Data on biochemical characters of flake have been furnished in Table 3. The TSS content in these genotypes ranged from 16.0 (HPJS--9/1) to 25.0 °brix (HPJS-11/9). The total sugar content in jackfruit genotypes ranged from 6.32 (HPJS-2/1) to 13.51 per cent (HPJS-10/1). The acidity content varied from 0.041 to 0.162 per cent. Rich variability was recorded for presence of flavour and

aroma in pulp at ripening stage which is one of the most important deciding character for its suitablity to be used for table purpose. The most and desirable aroma was observed in genotypes, HPJS-3/10, HPJS-5/8, HPJS-8/9, HPJS-9/5 and HPJS-11/9.

Based on overall performance with respect to bearing potential, maturity period, fruit and flake characters the genotypes HPJS-5/8 and HPJS-3/10 have been found promising for table purpose, whereas, HPJS-4/5 and HPJS-2/6 have been found suitable for culinary purpose and are recommended for release by institute varietal release committee. Large number of budded plants of these genotypes have also been raised for distribution and plantation.

REFERENCES

Amerine, N. A., R.M. Pangborn and E.B. Roessler (1965). Principal of sensory evaluation of food. *Academic Press, London.*

Bose, T.K. and S.K. Mitra (1996). Fruits- Tropical and Sub Tropical. Naya Prokash, Calcutta. pp. 638-649.

IPGRI (2000). Descreptors for Jackfruit (*Artocarpus heterophyllus*). International Plant Genetic Resources Institute, Rome, Italy.

Morton, J. (1965). Jackfruit (*Artocarpus heterophyllus*). *Proc. Fla. Sta. Hort. Sci. 78*:336-334.

Rai, M. and N.N. Reddy (2000). Jackfruit cultivation in India. Recent Trends in Horticultural Research (Eds. (Mathura Rai *et al.*) CHES, Ranchi. pp 144-152.

Sahadevan, P.C.; A. Abdul Samad and K.C.P. Menon (1950). Flowering studies in Jackfruit. *Madras agric Journal.* 37: 497-508.

Sambamurti, K. and V. Ramalingam (1954). Pollination studies in Jackfruit. *Indian J. Hort. 1: 24-29.*

Vishal Nath; B. Singh and M. Rai (2001). Horticultural biodiversity in Santhal Parganas. *Indian. J. Plant Genetic Resoruces. 14* (1): 92-98.

Samaddar, H.N. and P.S. Yadav (1982). Studies on floral biology of jackfruit. *The Hort. Journal.* 1: 54-60.