

Evaluation of eleven genotypes jackfruit in Egypt Morphologically, Physiologically

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ABSTRACT

Artocarpus heterophyllus Lam. is an average tree, commonly known as jackfruit, and belongs to the family Moraceae. Jackfruit was found native to central and eastern Africa. This work conducted on matured seedling trees growing under Aswan governorate condition on two Locations at both botanical Garden Island at Aswan and tropical farm at Kom Ombo Research Station and El Qalyobia Governorate at El-Kanater Horticulture Research station, for three successive years during 2020 to 2022 seasons. The tree Genotype JF 7, produced the highest yield, fruits number and TTS Ratio (151 kg/plant, 82 fruit/plant and 22% respectively). In addition, it has the best branching characteristics as Semi Erect Considering the trees also could use as shade trees with Circumference 1.25m Semi Erect tree shape That is lead us to advises to multiply it and spread it in all the fields, allover of Egypt as an over loading load crop. And as micro climate modifying tree. Using RAPD analysis. The overall frequencies of polymorphic loci ranged from 324 to 2900 bp. Two loci were found at 900 bp in both of the genotype (JF-7 and JF-8) while absent in other genotypes. Two other loci. At 400 and 1200 were found at a similar frequency in (JF-9 and JF-10) and (JF-4 and JF-5) genotypes, respectively. Reveal that genetic variation in Jackfruit could be used as a baseline study in estimation of genetic diversity in different Jackfruit genotypes in Egypt., this might allow breeders to develop improved varieties with new genetic combinations through selection.

Keywords: Jackfruit, Featured Strains.

INTRODUCTION

The jackfruit (*Artocarpus heterophyllus* Lam.) belongs to family Moraceae and it is believed to contains at least 39 genera and approximately 1100 species (Zerega *et al.*, 2010 and Zerega and Gardner, 2019). Williams *et al.* (2017) stated diversity of the family is primarily centered in the tropics with variation in inflorescence structures, pollination forms, breeding systems, and growth forms Within the Moraceae family, the genus *Artocarpus* is comprised of approximately 70 species. The most recent evidence indicates that Borneo was the center of diversification of the *Artocarpus* genus and that species diversified throughout South and Southeast Asia. All members of the genus have unisexual flowers and produce exudates from laticifers. Inflorescences consist of up to thousands of tiny flowers, tightly packed and condensed on a receptacle Williams *et al.* (2017). In most species, the perianth of adjacent female flowers are partially to completely fused together and develop into a highly specialized multiple fruit called a syncarp, which is formed by the enlargement of the entire female head. Syncarps of this species range in size from a few centimeters in diameter to over half a meter long in the case of jackfruit (Jarrett 1976). Jackfruit as it is native to the

Western Ghats of India, and the rain forest of Malaysia. It is also found in central and eastern Africa, south eastern Asia, the Caribbean, Florida, Brazil, Australia, Puerto Rico, and many Pacific Islands. Rahman *et al.* (1999). *Artocarpus heterophyllus* is a bisexual plant. Both male and female flowers are found on the same plant. At the early stage the male flower is green in color, at maturity it becomes yellowish. The pollen grains, yellow in color, get dispersed widely. The female flower is an aggregate of small flowers later develop in fruit. Many *Artocarpus* species are the national fruit of Bangladesh. Jackfruit serves as a food for millions of hunger people in the countryside during the season, where there is a scarcity of food. Therefore, this fruit is regarded as “poor man's food” in Eastern and Southern parts of India. (Hossain *et al.*, 2014). Jackfruit is rich in protein, digestible starch, minerals and vitamins. Each 100 g of ripe flakes contains 287 to 323 mg potassium, 30 to 73 mg calcium and 11 to 19 g carbohydrates. (Prakash *et al.*, 2009). It is an energy-rich fruit suitable for the treatment of physical or mental fatigue, stress and muscle weakness and also for athletes. It has been found to exhibit antimicrobial, anti-diabetic, anti-inflammatory, antioxidant and anti-helminthic-properties (Shanmugapriya *et al.*, 2011). Jackfruit is the richest source of protein (1.72 g) when compared to other fruits, followed by banana (1.09 g), mango (0.82 g), fig (0.75 g) and pineapple (0.54 g). It is also an abundant source of potassium, with 448 mg per 100 g, and provides a plentiful supply of thiamine, niacin, calcium, sodium, Jackfruit valued for its heavy yields of nutritious fruits and durable timber. It is one of the potential new crops, that have attracted increased interest in the world. Jackfruit is widely cultivated in India, Vietnam, Malaysia, Myanmar, Indonesia, Bangladesh, Sri Lanka, Brazil, West Indies, Pakistan and lead to identification of superior ones with the objectives of characterization, screening for yield and quality. (USDA, 2016).

As a matter of fact, that the jack fruit trees successively grown in Upper Egypt at Aswan Governorate where temperature ranged from (23 °C) during flowering period to (41°C) at full maturity of fruits to El-Kanater El-Khyrya, El-Qalyobia Governorate, and for the volubility of the tree as a promising fruit crop that mentioned by Chandrashekar *et al.* (2018). Jackfruit valued for its heavy yields of nutritious fruits and durable timber. It is one of the potential new crops that have attracted increased interest in the world.

Jackfruit is considered remarkable fruit tree crop should be used to diversify the global food supply, enhance agricultural productivity and eradicate malnutrition, it is necessary to focus on crop improvement of plants that are utilized in rural societies as a local source of nutrition and sustenance. Chang *et al.* (2018) and Hendre *et al.* (2019) parted in a study for the African Orphan Crops Consortium (AOCC), an international public-private partnership. That goal of this global initiative is to sequence, assemble, and annotate the genomes of 101 traditional African food crops [Both breadfruit and jackfruit are nutritious and have the potential to increase food security, especially in tropical areas. Until now limited genomic information has been available for the *Artocarpus* genus as a whole. Microsatellite markers have been used to characterize cultivars and wild relatives of breadfruit, and other *Artocarpus* crop species Jackfruit, being cross-pollinated and mostly seed propagated, exhibits great variation in economic traits, which is considered as a pre- requisite for any crop improvement program. Thus, there is a need to identify and locate areas of rich genetic diversity of jackfruit (Haq, 2006). In this background, in the Dindigul district of Tamil Nadu, genetic variants are available in larger number, particularly in the lower Pulney hills, which are grown as shade trees in the coffee plantation. A systematic investigation on these types may lead to identification of superior ones with the objectives of characterization, screening for yield and quality.

MATERIALS AND METHODS

This study initiated during 2020 to 2022 seasons for “Evaluation of Eleven local jackfruit (*Artocarpus heterophyllus* Lam.) seedling trees genotypes ten of them growing under Aswan governorate condition at both botanical Garden Island at Aswan and tropical farm at Kom Ombo Research Station, on the east bank of the Nile; latitude 24° 6' north at Aswan governorate which Coordinates: 23.59°N 32.82°E. While the remaining genotype tree is growing under El Qalyobia Governorate at El Kanater Horticulture Research station. Located at various morphological metric and quality characters were identified in all the 11 genotypes.

Tropical farm at Kom Ombo with a relative humidity of 60-90 %, maximum and minimum temperature range from 30-40°C and 15-25°C, respectively. The descriptor developed for *Artocarpus heterophyllus* Lam. (Jackfruit) compiled by Diversity international was used in this study for characterizing the studied genotypes during 2020 to 2022. The genotypes were marked and observations were made for morphological, yield and quality parameters. Trees of 25 to 45 years old age group were scrutinized for this study.

Morphological data:

Leaf measurements:

The leaf morphological parameters, *i.e.* petiole length, leaf length, width, thickness, surface area, number of veins and leaf tip length were measured from ten leaves of each tree. The surface area of the leaf was measured by placing it over a 1cm grid-sheet. The grids capturing less than 50% of the leaf parts were disregarded in calculating the surface area. From each leaf, the angles between mid-rib and top most side vein (top angle), mid-rib and the central side vein (middle angle) and midrib and basal side vein (bottom angle) were measured using a Key of the shapes of the leaf and leaf base, margin, presence of hairs, texture of the leaf, venation pattern and arrangement of the leaves were recorded according to the key given in Norton- Brown (2016). The leaf tip shape was recorded according to modified from the key given by Norton-Brown (2016).

Syncope measurements:

The length, breadth and weight of the syncarps (*i.e.* compound fruits) were measured at five different directions of the diameter to capture the variation caused by irregular shapes. The shape and diversity of jack fruit syncarp was recorded according to the key given in which was developed based on the Syncarp shapes indicated by Medagoda (2007) and Norton- Brown (2016).

Statistical analysis:

The obtained data were statistically analyzed using the analysis of variance method according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

Tree Height:

In the present investigation, an attempt was made to identify superior genotypes with respect to morphological features, inflorescence characters, yield and quality parameters for Aswan governorate, condition where local seedling-originated jackfruit trees are being grown as scattered fruiting trees on a limited scale. The results obtained from the study are discussed hereunder.

Among the eleven genotypes, trees height ranged from 7.2 to 14 m with the mean of 8.9 m. The tree trunk height was the lowest in genotypes trees J F-7 with (7.2 m.) followed by J F-8 (8.3 m) while highest trunk in genotype trees was observed with genotype JF10 (14 m) followed by a group of medium trunk height trees. (JF-9, JF-2, JF-5 with height (10.5, 10 and

12m, respectively) and finally the tallest-trunk genotype trees group were (JF-10, JF- 3, JF-6 and JF-4) with height (14, 13.6, 13.4 and 13.2 m, respectively).

Trunk Circumference (m):

The trunk circumference of eleven genotypes observed ranged from 1.25 to 1.96 m with a mean of 1.61 m. The trunk circumference was the lowest genotype tree J F-6(1.25 m) followed by genotype tree J F-11, genotype tree J F 4 and genotype tree J F 2(1.47, 1.52 and 1.58 m respectively) and it was the highest in genotype tree J F-7, J F-9, J F3, J F-8, J F-5 and J F-10 (1.96, 1.89, 1.86, 1.83, 1.81 and 1.70 m, respectively). More than the tree height, trunk circumference is another important character which has more bearing on productivity in jackfruit as it supports many scaffold branches, which in turn support secondary and tertiary branches, the main fruit bearing zones. Higher stem circumference gives better support for the main branches and reflects the vigour of trees indirectly, bearing more number of fruits lead to higher yield. Lesser the trunk height with spreading nature, greater will be the number of fruits per tree due to more primary and secondary branches. Similar variability was reported by Muthulakshmi (2003), Murugan (2007) and Aseef (2016) on jackfruit.

Tree Crown shape:

Tree Crown shape from (Table 1) showed diversity of canopy shapes observed among the genotypes. Out of the eleven genotypes, more than 54.28 per cent of genotypes had „irregular“ canopy shape, 28.57 per cent were elliptical“ and 17.14 per cent were spherical“. The presence of more number of trees with irregular canopy shape is a desirable factor from the point of fruit set and yield. Similar variability was reported by Muthulakshmi (2003), Murugan (2007) and Aseef (2016).

Table (1): Tree characters Tree height, Circumference and Crown shape

Characters	Trunk Height (m)	Trunk Circumference (m)	Crown Shape
Genotype JF1	11.70	1.72	Spreading
Genotype JF2	10.00	1.58	Spreading
Genotype JF 3	13.60	1.86	Semi-Erect
Genotype JF 4	13.20	1.52	Spreading
Genotype JF 5	12.00	1.81	Semi-Erect
Genotype JF 6	13.40	1.96	Spreading
Genotype JF7	7.20	1.25	SemiErect
Genotype JF 8	8.30	1.83	Spreading
Genotype JF9	10.50	1.89	SemiErect
Genotype JF10	14.00	1.70	Semi-Erect
Genotype JF11	10.10	1.47	SemiErect
LSD.0.05	1.03	0.21	Spreading 45.5% Semi-Erect 54.5 %

Leaf blade shape:

Three different types of leaf blade shapes were observed in different eleven local genotypes of jackfruit trees (Table 2). From the eleven number of jackfruit trees of them had

undulate blade shape (72.72%) and three genotype trees had 'obovate' leaf blade (27.3%) recorded and that's agree with Dey and Baruah (2019).

The leaf morphological parameters, i.e. petiole length, leaf length, width, thickness, surface area, number of veins and leaf tip length were measured from ten leaves of each tree. The surface area of the leaf was measured by placing it over a 1cm grid-sheet. The grids capturing less than 50% of the leaf parts were disregarded in calculating the surface area. From each leaf, the angles between mid-rib and top most side vein (top angle), mid-rib and the central side vein (middle angle) and midrib and basal side vein (bottom angle) were measured using a Key of the shapes of the leaf and leaf base, margin, presence of hairs, texture of the leaf, venation pattern and arrangement of the leaves were recorded according to the key given in Norton- Brown (2016). The leaf tip shape was recorded according to mod.

Table (2): Leaf characters of the eleven local jackfruit genotypes.

Characters	Leaf apex		Leaf blade	
	Margin	Shape	length (cm)	width (cm)
Genotype JF1	Undulate	Acuminate	9.40	5.10
Genotype JF2	Undulate	Acute	11.00	5.80
Genotype JF 3	Undulate	Acuminate	10.90	5.90
Genotype JF 4	Undulate	Acuminate	9.60	5.00
Genotype JF 5	Undulate	Acuminate	9.50	4.70
Genotype JF 6	Entire	Acute	11.20	6.20
Genotype JF7	Undulate	Acute	12.00	5.50
Genotype JF 8	Undulate	Obtuse	8.40	5.70
Genotype JF9	Entire	Acuminate	11.40	6.50
Genotype JF10	Undulate	Obtuse	7.50	5.90
Genotype JF11	Entire	Acute	8.30	6.10
LSD.0.05			0.33	0.56

Physical fruits characters:

Number of Fruit:

It was found to be ranged from 82 fruits in Genotype JF 7 which have the Highest production number of fruits to 13 for Genotype JF1 recorded the lowest production number of fruits with 13 fruits per plant (Table, 3).

Fruit shape and size:

Fruit shape was found, mostly Elongated which maybe mean there is a dominant gene controlling and expressing.

Yield kg/plant:

Fruits yield ranged from 151 kilograms per plant in Genotype JF 7 which have the highest fruit production as well as number of fruits to 41 kilograms for Genotype JF1 recorded the lowest total yield production (Table, 3)

Table (3): The Physical fruits characters for the eleven jackfruit genotypes.

Characters	Number of Fruit/ Plant	Fruit shape and size	Yield kg/plant
G'enotype JF1	13.00	Oval	41.00
Genotype JF2 JF2	23.00	Thin elongated	62.00
Genotype JF3	57.00	Elongated	110.00
Genotype JF 4	73.00	Bell	145.00
Genotype JF 5	67.00	Large Oval	112.00
Genotype JF 6	45.00	Round	116.00
Genotype JF 7	82.00	slight Elongated Oval	151.00
Genotype JF 8	35.00	Irregular Bell	110.00
Genotype JF9	22.00	Elongated	70.00
Genotype JF10	24.00	Elongated	115.00
Genotype J11	23.00	Elongated	120.00
LSD.0.05	4.5		22.03

Table (4): TSS % for the eleven jackfruit genotypes.

Characters	TSS (%)
G'enotype JF1	17.00
Genotype JF2 JF2	20.00
Genotype JF3	19.30
Genotype JF 4	19.60
Genotype JF 5	19.70
Genotype JF 6	20.00
Genotype JF 7	22.00
Genotype JF 8	19.30
Genotype JF9	18.30
Genotype JF10	20.00
Genotype J11	18.50
LSD.0.05	0.98

Total Soluble Solids (TSS):

The primary characteristic for jackfruit genotypes showing sweetness is TSS. Significant difference in the TSS parameter was found. TSS was 17.0% to 22%, with the average TSS for the genotypes being 17.72%. The maximum TSS% was recorded in Genotype JF 7 (22%), while the minimum TSS% in Genotype JF1 (17%). (Table, 4). These results agree with Akter and Rahman (2017).

Conclusion:

All of the studied jackfruit trees included in the study showed considerable diversity in their growth patterns, leaves, inflorescences, and fruiting behaviors. While the quantity of fruits per tree varied from 13 to 83, the average total fruit weight ranged from 41 to 151kg. The trees with the most fruits per tree were Genotype JF 7 and Genotype JF 4, Genotype. These genetic might be taken into consideration in upcoming breeding and agricultural development programs. And must be propagated and distributed as a microclimate modifier tool not only as a perfect production cultivar from the aria unit.

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