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Review article

Genetic resource management of jackfruit (*Artocarpus heterophyllus* Lam.)

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ABSTRACT

Jackfruit (Artocarpus heterophyllus Lam.), a giant and unique tropical composite fruit, is widely distributed in equatorial countries. Jackfruit shows a significant range of genetic diversity, especially within South and South East Asia, which aids in the selection of superior desirable types.Genetic resource management includes exploration, collection, evolution, characterization, conservation and exchange.The importance of conservation of genetic resources is very much essential to avoid the genetic erosion. Jackfruit genotypes have been collected in tropics for conservation, study, and improvement, but limited collections exist in India, Indonesia, Thailand, Nepal, Malaysia, Philippines, Vietnam, Sri Lanka, and Bangladesh. Mitra and Maity were initiated in 1990 for the collection and evaluation of over 1460 jackfruit trees in West Bengal. In situ conservation is crucial for the effective management and maintenance of agroecosystems, as farmers with deep crop knowledge are likely to understand their type and variation. Jackfruit germplasm is mainly stored in field gene banks or orchards, despite potential threats like disease, insect infestation, and natural disasters.Identification of the diverse germplasm for higher yield to develop improved cultivars suited for changing climate can help achieve nutritional and food security demands of the increasing global population. The present paper elaborated the status of different Artocarpus species, genetic diversity and in situ and ex situ conservation of species and, varieties for utilizing the gene pool for crop improvement.

***Keywords*:** Genetic diversity, genetic resource, heterozygous jackfruit

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to the family Moraceae and is a tetraploid with a somatic chromosome number of 56 (2n=4x=56). This family contains 55 genera and 900 to 1000 species along with fig, mulberry and hedge apple. Jackfruit is one of the most important fruits of this family. The genus *Artocarpus*, the third largest genus in the Moraceae family, includes about 50 species with milky latex of which 15 bear only edible fruit (Chandrashekar *et al*., 2018). Jackfruit is known as "Poor man's food" and it is the largest tree-borne fruit in the world (Choudhury *et al*., 2017). Immature jackfruits are commonly used in cooking, salads, and curries as a vegetable source. Ripe jackfruit can be consumed in different ways, including raw, cooked, jackfruit candy, and jackfruit leather. In India, jackfruit seeds are used to make a dessert by boiling them in sugar (Jagdale *et al*., 2021). Nowadays, jackfruit is also called as "Superfood" for its nutritional value and health benefits. The average nutritional composition of ripe jackfruit pulp (per 100 g) contains carbohydrate (16–25.4 g), protein (1.2–1.9 g), fat (0.1–0.4 g), energy (88–410 kJ), fibre (1.0–1.5 g), and water (72–94 g). The protein and carbohydrate content of different jackfruit seed species varies from 5.3 to 6.8% and 37.4 to 42.5 per cent, respectively (Jagdale *et al*., 2021).

Jackfruit is highly cross-pollinated and mostly propagated through seeds. As it is heterozygous in nature, exhibits high genetic diversity in a seedling population. Species diversity and genetic diversity within the species have been increased as a result of cross-pollination and predomination of seed propagation over a long period of time due to their influence on the evolutionary process of extinction, selection, gene drift, gene flow, and mutation

(Chandrasekhar *et al*., 2018). Gaining knowledge of individual variability and relatedness among individuals allows for the detection of duplicates and the selection of superior genotypes or genotype combinations to produce desired traits. Thus, selections made from naturally occurring open-pollinated seedlings by man have played the most significant role in the development of new jackfruit.

Over the past few decades, several jackfruit genotypes have been collected throughout the tropics for their conservation, study and improvement. In India, Indonesia, Nepal, Malaysia, Thailand, the Philippines, Sri Lanka, Vietnam, and Bangladesh, jackfruit collections for evaluation and selection are limited and therefore, the information available on the performance of the genotypes is also limited (IPGRI, 2000; Haq and Hughes, 2002). India and Bangladesh have reported a moderate level of jackfruit genetic diversity erosion (Dhakar *et al*., 2020). The most desirable varieties grown in India are low in productivity, storage, and processing quality. Despite being widely planted, jackfruit is rarely thought of as a commercial fruit crop (Bose and Mitra, 1990). This is because of a lack of improved varieties, a wide range of fruit quality, a long gestation period (8–10 years), and a high level of vulnerability to borer infestations. However, in recent years, jackfruit has gained commercial importance as a result of growing knowledge of its nutritional value in the human diet and its various uses. Here we provide a brief review on the genetic resources and management of jackfruit and its wild relatives in different jackfruit-growing areas of the world to identify the diverse germplasm for higher yield to develop cultivars suited for changing climate which can help to achieve food and nutritional security.

Origin and distribution

It originated in the evergreen rain forests of the Western Ghats of India (Haq, 2006). It is cultivated widely at low elevations throughout India, in many parts of Southeast Asia (Rahman *et al.,* 1999), in northern Australia as well (Azad *et al*., 2007), and in the evergreen forest zone of West Africa (Burkill, 1997). Major Jackfruit producers are India, Vietnam, Malaysia, Myanmar, Indonesia, Bangladesh, Sri Lanka, Brazil, West Indies, Pakistan and other tropical countries. India is the world's second-largest producer of jackfruit, just after Indonesia and India is known as the motherhood of the jackfruit **(**Sidhu**,** 2012). The area under jackfruit cultivation in India is 1.87 lakh hectares and the production is 17.39 lakh MT (NHB, 2019-20). Jackfruit is adapted to a wide range of habitats (Haq, 2006) and it can therefore help to mitigate the effects of environmental and climatic changes. Certainly, jackfruit's slow acceptance due to the large size fruit, weight more or less 30kg, strong aroma and unusual appearance.

The commercial cultivars of jackfruit are included in a single species *A. heterophyllus*. Moreover, *A. lakoocha* (Monkey jack), *A. altilis* or *A. communis* (Breadfruit), *A. hirsutus* (Wild jack), *A. camansi* (breadnut), *A. odoratissima* (marang) and *A. lingnanesis* (kwaimuk) are important species of the genus *Artocarpus* (Saxena *et al*., 2011).

Genetic diversity

Genetic diversity is the heritable materials that differ within a group of plants (Van Hintum, 1995). The genetic diversity of plant species is manipulated by plant breeding and made suitable for modern agricultural systems. In other words, it is the genetic stock for plant breeding. In recent years scientists have been studying the genetic diversity of different crop species for their efficient utilization and conservation.

Jackfruit exhibits a significant range of variation in its morpho-agronomic characteristics, which can be attributed to the fact that Jackfruit trees are primarily cross-pollinated and predominantly propagated through seeds. This variation encompasses traits such as tree growth habit (which can be open, spreading, low-spreading, or sparse upright), tree growth rate (ranging from fast to slow), canopy structure (often dense with a dome-shaped, slightly pyramidal, or flat top, ranging from 3.5 to 6.7 meters in height), leaf characteristics like shape (obovate, oblong, lanceolate, elliptic, elliptic-obovate, oval), leaf size (ranging from 4 to 25 cm in length and 2 to 12 cm in width), and fruit attributes such as shape (ellipsoid, oblong, spheroid, claviform, round), size, colour, fruit-bearing age, seasonality, and fruit maturity. Moreover, there are notable variations in the flesh types, sweetness, flavour, and taste, as well as in the density, size, and form of the spines on the rind, bearing, and sensory quality, as documented by Azad (2000).

Table 1: Diversity of important *Artocarpus* species.

***Artocarpus* sp.**	**Special Characteristics**	**Origin and distribution**	**Source**
A. altilis or A.communis (Breadfruit)	Evergreen in tropics and deciduous in monsoon countries. Principally important as carbohydrate food source and used more as a vegetable than as a fruit.	Native of Polynesia and important staple food in Polynesia.	Ragone (2018).
A. lakoocha (Monkey jack)	Deciduous tree, round or irregular small fruits, dull yellow colour with pink tinge. Fruits are sour and used as chutney or pickle	Native of sub-Himalayan region of India and grows up to an altitude of 1200 above MSL.	Bishnoi *et al*. (2017).
A. hirsutus (Wild jack)	It is commonly known as Wild jack, valued for its timber, smaller size of spherical fruits.	It is only endemic species of south western Ghats of peninsular India.	Solanki *et al.* (2020) and Gangaprasad *et al.* (2019).
A. integer or A. champedan (Champedak)	It is a monoecious, branched, evergreen, medium-sized, mid-canopy tree. The fruits are of smaller size and exhibit a waistline, a slight narrowing around the middle, resulting in a cylindrical shape. Taste is similar to jackfruit with a hint of durian.	Native to India, but cultivated in Malaysia, Indonesia, Thailand and Philippines.	De Almeida Lopes *et al.* (2018).
A. camansi (Breadnut)	It is very spiny fruits with numerous large, light brown seeds and little pulp.	Native to Indonesia, New Guinea and Philippines.	Ragone (2006).
A. odoratissimus (Marang)	It known as tarap or marang, tree cannot tolerate low temperatures (below 7^0C). It thrives within the latitude range of 15 degrees north to 15 degrees south.	Its primary found on the island of Borneo, specifically in regions including Brunei, Kalimantan (Indonesia), Sabah, and Sarawak (Malaysia).	Bakar and Bakar (2018).
A. annulatus	It is the nearest identified wild relative of two important but underutilized fruit tree species: jackfruit (*A. heterophyllus*) and cempedak (*A. integer*).	This is distributed on to the Padawan Limestone Area in Sarawak, Malaysia, where an endemic species is found.	Dickinson *et al*. (2020).
A.mariannensis	Diploid species, bears smaller fruit containing both seeds and starchy pulp.	Native to islands of western Micronesia	Ragone (2018).

Fig. 1 : *A. lakoocha*

Fig. 2 : *A. altilis*

Fig. 3 : *A. hirsutus*

Fig. 4 : *A. integer*

Table 2: Variationin plant morphologicalcharacters

Characteristics	Range
Tree growth rate	Fast, moderate, slow
Tree habit	Sparse upright, spreading, low spreading and open
Tree crown shape	Pyramidal, broadly pyramidal, spherical, elliptical and irregular
Canopy	Mostly dome-shaped, slightly pyramidal or flat toped. Canopy diameter ranges from 3.5m to 6.7 m
Leaf size	Leaf length 4 to 25 cm; leaf width2 to 12 cm
Leaf shape	Elliptical, broadly elliptic, narrowly elliptic, obovate and oblong
Leaf petiole	Petiole length: 1.2 to 4.0 cm
Fruit maturity	Variable
Fruit shape	Obloid, spheroid, ellipsoid, clavate, oblong and irregular
Fruit seasons	Variable
Number of fruits per plants	15 to 1450
Fruit thickness	Thin, thick and medium
Fruit weight (kg)	1.2 to 22.0
Fruit texture	Firm, fibrous, melting, course and crisp
Seed shape	Oblong,ellipsoid, irregular,spheroid,reniform, elongated
Seed weight (g)	250 to 1230

Source: Azad (2000); Mitra and Maity (2002)

Table 3: Variationinfruitcharacteristics

Characteristics	Range
Fruit weight (kg)	1.2 to 22.0
Fruit length (cm)	20.5 to 60
Fruit diameter (cm)	16.4 to 29.5
Fruit girth (cm)	50.5 to 95.8
No.of bulbs/fruit	24.2 to 580.2
Pulp (%)	18.3 to 60.9
Seed (%)	2.6 to 23.1
Rachis (%)	1.5 to 21.4
Rind (%)	20.6 to 72.0
Brix (°)	13.8 to 25.3

Source: Haq (2006)

Germplasm Resources

Cultivars

There aren't many trustworthy records on the actual jackfruit varieties that have been produced as a result of breeding initiatives throughout different nations. It appears that cultivars are generically categorised according to a few fruit-related traits. The categories were based on the aroma of the pulp, the tree productivity, and the seasonality of the fruit availability. As there are numerous other local names for jackfruit cultivars, some characteristics were left out of this classification (Azad, 2000; Haq, 2006).

At the University of Agricultural Sciences in Dharwad, India, a crop improvement initiative was launched (Jagadish *et al*., 2007). Thirty varieties from the coastal region and sixty types from the hilly region were evaluated and selected for the programme. With these chosen materials, additional breeding work is currently being done. In the Philippines, a variety, "EVIARC Sweet" was identified through selection and the variety has already been released

Table 4 : Selected Cultivars in different countries

Country	Cultivars
India	Champa, Gulabi, Hazari, Varika, Rudrakshi, Gulabi, Safeda, Khaja, Bhusila, T-Nagar jak, Bhadaiyan, Handia, Velipala, Kooli, Gerissal, Barica, Ghila, and Karcha
Bangladesh	Topa, Hazari, Chala, Goal, Koa, Khaja
Australia	Black gold, Honey gold, Lemon gold, Golden nugget, Cheena, Chompa Gob Coching, Galaxy, Fitzroy, Nahen, Kapa, Mutton and Varikkha
Mayanmar	Kala, Talaing
Malaysia	J-30, J-31, NS-1, Na 2, Na 29, Na 31
Indonesia	Mini, Kandel, Tabouey
Philippines	TVC, J-01, J-02, Torres, EVIARC Sweet
Srilanka	Varaka, Vela, Peniwaraka, Singapore Jak/Ceylon jak, Kuruwaraka
USA	NS-1, J-30, J-31, Black gold, Galaxy, Cheena, Golden Nugget, Lemon Gold, Honey Gold, Delightful, Tabouey
Thailand	Kun Wi Chan, Dang rasimi, Kha-numlamoud, Kha-numnang

Souce: Valavi *et al.*, 2011

Table 5: Characterization, evaluation and selection of promising lines of jackfruit

Country	Characterization, Evaluation	Selection
India	281	54
Sri Lanka	77	3
Pakistan	10	5
Nepal	350	47
Vietnam	202	8
Philippines	148	2
Bangladesh	70	10
Thailand	81	2
Indonesia	28	4

Source: Haq (2006)

Table 6: Jackfruit collection in different countries.

Country	No. of Accession
India	947
Bangladesh	130
Pakistan	10
Nepal	350
Indonesia	155
Philippines	178
Thailand	87
Sri Lanka	77
Vietnam	202
Brazil	45
Australia	14
China	76
Costa Rica	15
Malaysia	155
New Guinea	10
USA Florida & Hawaii	19
Other Pacific Islands	30

Source: Haq (2006)

Fig. 5 : Variation in tree crown shape

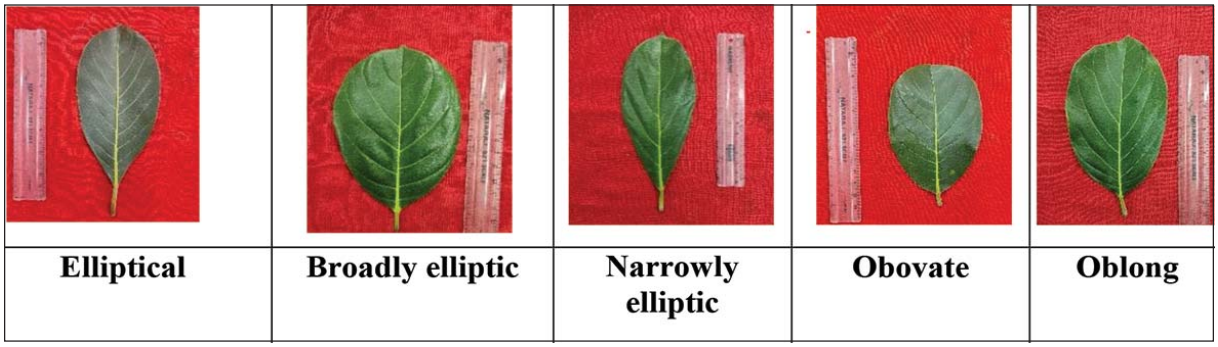


Fig. 6 : Variation in leaf shape

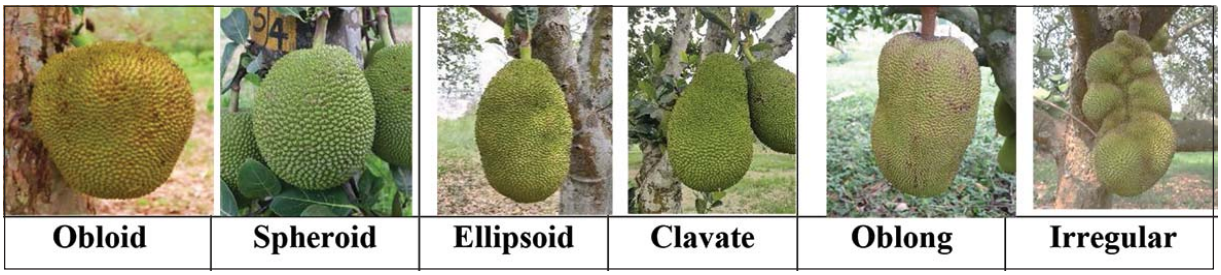


Fig. 7 : Variation in fruit shape

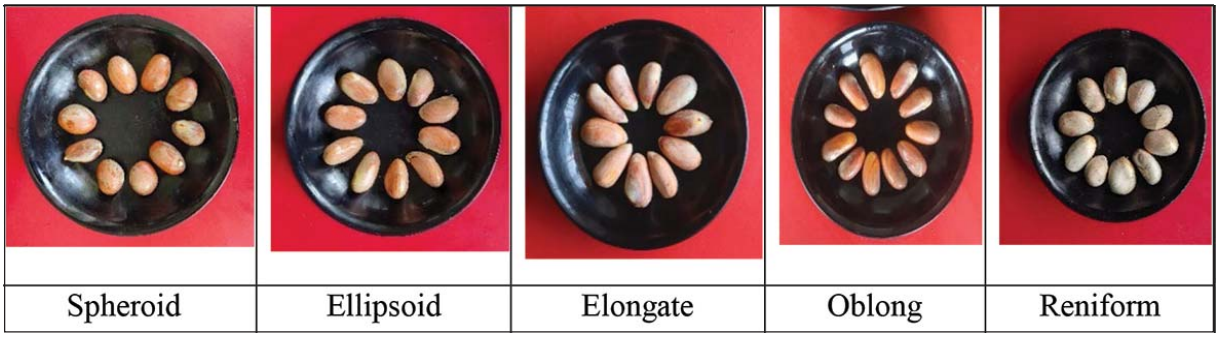


Fig. 8 : Variation in seed shape

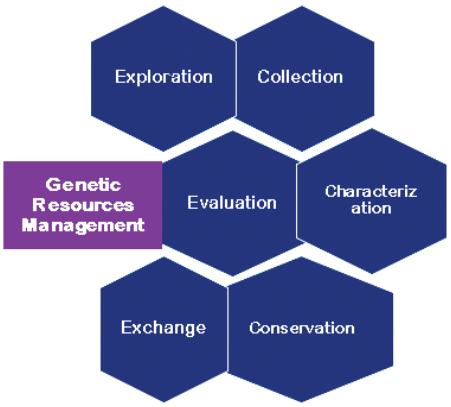
(<www.agribusinessweek.com/new-jackfruit-variety-food products-developed> accessed on 13.3.2009).

A modest breeding programme has also been initiated recently in South Florida (Cambell *et al*., 2004). According to superior qualities of precocity and yield as well as fruit quality traits of scent, edible percentage, flesh hardness, colour and flavour, eleven cultivars have so far been chosen for inclusion in its jackfruit development project. This evaluation was carried out over two years in a research field station and 3 progenies were selected which could hold promise as dwarf varieties. Because farmers are in the best position to understand consumer preferences, they can choose the best crop varieties using farmer-participatory techniques. The farmers are significant retailers at the neighbourhood market. As a result, because farmers are involved in the jackfruit industry as producers, consumers and merchants, it has become more acceptable for the selection process to take into account their tastes. Farmers, however, propagate trees using seeds from the mother trees, which do not remain true to type. As a result, there was little evidence that this selection had an impact on cultivar development. Only asexual ways of propagation from better mother trees will allow for selection to be successful. High plant output, a longer fruiting season, acceptable flesh colour and texture and fruit sweetness are what farmers seek.

Gunasena *et al*. (1996) stated that superior jackfruit mother trees (or plus trees as he called them) can be used for the improvement of the species as the population of the field is composed of variable genotypes. Furthermore, the breeding method using the hybridization of perennial trees is cumbersome, time-consuming and sometimes impossible. Therefore, the selection of superior mother trees is more convenient than other breeding methods. The jackfruit has a lengthy juvenile phase before it begins to develop fruit and may live for over a century. Therefore, the improvement of trees by hybridization is not suitable for jackfruit. Saving time, money, and effort is achieved by the process of choosing better mother trees from the current population. Superior fruiting cultivars with acceptable timber properties will need to be given more focus, especially for household gardens. Since good timber varieties are not always also prolific in fruit production, the use specifications can frequently be in conflict.

Genetic resources management

Plant genetic diversity that has direct or indirect significance to humans can be found both between and within plant species. It consists of weedy races, possible domesticates, other wild species, farmers' variations, outdated cultivars, current cultivars, breeding lines and genetic stocks. Plant Genetic Resource (PGR) diversity decreased as a result of the introduction of enhanced variety/hybrid monocultures (limited genetic base), changes to agroecosystems, industrialization and other developmental processes (extinction, genetic erosion). PGR make up a national heritage that requires effective management and preservation for future generations. When it comes to crop improvement, food security, and nutrition, it is the most essential raw ingredient. Genetic resource management includes exploration, collection, evolution, characterization, conservation and exchange.



Exploration, collection and characterization

Mitra and Maity were initiated in 1990 the collection and evaluation of more than 1460 jackfruit plants in West Bengal. The Faculty of Horticulture Research Station, Bidhan Chandra Krishi Viswa Vidyalaya, is preserving 35 varieties, out of more than 1460 jackfruit plants studied by Mitra and Maity (2002), that have been identified as excellent clones. Twenty-three superior genotypes were chosen by Akter and Rahman (2017) based on cultural and environmental adaption. Regarding fruit attributes such as fruit size, sweetness, bulb colour, hardness of bulb, total soluble solids, percentage of edible portion as well as yield, the germplasm AHJ-02, AHJ-03, AHJ-04, AHJ-05, AHJ-06, AHJ-07, AHJ-09, AHJ-11, AHJ-14, AHJ-16, AHJ-18, AHJ-19, AHJ-21 and AHJ-23 were discovered to be suited for jackfruit growing in Bangladesh's Jamalpur region**.**

Kavya and Shyamalamma (2019) characterized twenty jackfruit accessions with two distinct fruit shapes, *viz*. obolid and ellipsoid were collected from different jackfruit growing districts in Karnataka. They found that most of the trees were erect type, with medium to low branching density and the branching pattern was irregular. It was found that 50-60% accessions with obolid fruit, then ellipsoid fruits. Kumaraswamy, Allilugatta 5, Manipur Parmesh and Swarna accessions were obolid fruits and Ashoka Yellow, Byrachandra, Ashoka Red, Janagere and NSP were ellipsoid fruits have been identified for commercial purposes. Simon *et al*. (2007) used RAPD markers to estimate the genetic diversity of twelve high-yielding jackfruit. The genetic dissimilarity matrix was computed using Squared Euclidian Distances, revealing a minimum genetic distance of 5% between the genotypes ('M0') and 'Kerala', indicating their similar geographical origin, and a maximum genetic distance of 7.9% between a clone of 'Mottavarica' ('M0') and 'Chandrahalasu' from distant locations.

Collection, characterization, conservation, evaluation and utilization of jackfruit germplasm at different All India Centres Research Project

- **Mohanpur (West Bengal):**Out of the 58 genotypes that were maintained, evaluations and characterizations of 41 genotypes have been documented.
- **Jorhat (Assam):** In-situ characterization and evaluation were conducted on 18 local genotypes from three agro-climatic zones in four districts of Assam: Morigaon, Kamrup, Barpeta, and Darang.
- **Kannara (Kerala)**: In the field gene bank, 10 accessions were conserved, 16 genotypes were evaluated, 11 were collected, and 3 genotypes were characterized.
- **Kovvur (Andhra Pradesh):** In the reporting period, a newly discovered genotype with small, round fruits was obtained from Devarapalli village in the West Godavari District of Andhra Pradesh. Currently, there are 31 genotypes under conservation in the field gene bank, with 26 of them in the bearing stage and 5 in the pre-bearing stage.
- **Periyakulam (Tamil Nadu)**:Explorations were conducted in Kulasekarem, Thiruvaadanai, Sethaiyathoppu, Keeranur, Kudimiyanmalai, and Pudhukottai district. A total of 23 accessions were conserved, with 14 of them currently in the bearing stage and 9 genotypes in the pre-bearing stage.
- **Lembucherra (Tripura)**:In the reporting period, 20 local jackfruit accessions were identified and their physico-chemical characteristics were assessed.(Source: http://krishi.icar.gov.in/jspui/handle/123456789/75189)

Germplasm collection and conservation

The collection, characterization, and evaluation of jackfruit germplasm have only sometimes been tried by a few programmes at the national level throughout Asia. With the exception of two regional initiatives, neither regional nor international organisations, have made a systematic effort to gather and assess germplasm: Conservation and Use of Native Tropical Fruit species Biodiversity in Asia (Mal *et al*., 2001) and Underutilized Tropical Fruits in Asia Network (UTFANET) (Haq, 2003). It is necessary to gather germplasm from selected regions of the Indian subcontinent and Southeast Asia, specifically from the place of origin as well as centre of diversity. Haq (2006) mentioned that the Andaman Islands and the Western Ghat, which may contain wild jackfruit germplasm, need

to have their genetic material systematically collected.

Conservation of genetic diversity

There are some worries about the decline of genetic variety even while jackfruit germplasm resources are not in danger (Haq, 2002). Since the diversity of the jackfruit gene pool has not been extensively assessed, it is believed that attention must be paid to conserving its diversity. Many desirable traits may be lost if the key desired characteristics are not preserved. The conservation process may follow the methods below:

***1. In situ* conservation**

For the agro-ecosystems to be managed and maintained effectively, *in situ* conservation is crucial. Because they have a deep understanding of their trees, farmers are likely to be familiar with the type and degree of variation.

In situ conservation is an option but is hardly used because jackfruit is typically grown in backyard gardens. Because of their potential as wood, some farmers in Bangladesh favour and preserve "straight stem" varieties. For "on-farm" conservation to be successful, farmers must be persuaded of the importance of diversity and its utility to them. Whenever they're convinced, it will be possible to persuade them to keep growing trees in conventional agro-ecologies.

Based on the available information, the diversity of wild populations of *A. heterophyllus* in forest settings, including the Andaman Islands, the Western Ghats of India, and the South-Eastern region of India, does not provide enough data to identify specific areas of diversity. Once this information is accessible, such wild populations can be designated as biosphere reserves and included in the major natural ecosystem areas.

***2. Ex situ* conservation**

Jackfruit seeds are challenging to preserve because they quickly lose viability **(**Gawankar *et al*., 2020**).** At lower or ambient temperatures, it is impossible to dry and store the seeds for more than around 5 weeks (Sonwalker, 1951).

Cryogenic preservation of embryos of jackfruit was described by Haq (2006). Seeds must have a little moisture content (16–26%) to be stored cryogenically. Fu and Xia (1993) and Chandel *et al*. (1995) demonstrated that as seed maturity increased, embryonic axis' physiological features, susceptibility to desiccation and freezing thresholds changed. The jackfruit embryo size is not identical, which presented issues for these authors. The greatest embryos for survival and repeated regeneration are those that measure 4-5 mm and come from mature, ripened fruits. Before being treated with a mixture of dimethyl sulphoxide (DMSO) and 0.5% proline, the chosen fresh embryos must be slightly dehydrated (to 60% moisture content). It is necessary to freeze things gradually, thus they must first be pre-frozen at 1°C every minute until they reach -40°C before being immediately submerged in liquid nitrogen at -196°C.

Theoretically, seeds kept in cryogenic conditions are in a condition of suspended existence and ought to last forever. But further research is required to understand how performance would change over time after storage. Axes taken from jackfruit seeds that had been cryopreserved had a 50% survival rate, according to Thamsiri (1999).

Slow-growth strategies can be used to store vegetatively grown clonal material *in vitro* for medium-term preservation. Pathogens are also removed from samples using in vitro techniques, preserving healthy samples. To standardize procedures for jackfruit in vitro storage, Mandal (1997) proposed that a thorough examination is required.

3. Field gene banks

The majority of jackfruit germplasm is maintained within field gene banks or orchards, often referred to as repositories or collections of living plants. Disease, insect infestation and natural disaster concerns exist for them. Because evaluation may be done on the developing plants, field orchards have the benefit of having readily available germplasm. The expensive establishment and upkeep costs as well as the threats to sustainable existence are drawbacks. In Haq's (2006) article, several field gene banks that had been created at Horticultural research centres and Universities around Asia were mentioned. A sizable collection kept in the field of Florida's Fairchild Tropical Garden was described by Cambell *et al*. (2004).

Numerous other nations, including as Australia, Fiji and Hawaii preserve small collections in their fields. For the purposes of starting improvement projects or on-farm testing, these collections serve as the origin of genetic material.

Farmer participatory conservation

PlavuJayan, 54-year-old farmer from Kerala known as Jackfruit Man who has planted over 20,000 seedlings from over 23 native varieties of this tropical fruit tree. The remarkable thing is not just the number of trees, but the up to 23 native varieties of 'Plavu' he has planted and possibly helped revive. These include 'Thamara Chakka', 'Rudrakshi', 'Football Varikka', 'BaloonVarikka', 'Kashumanga Chakka', 'Then Varikka', 'MadalillaChakka', 'PadavalamVarikka', 'ThengaChakka' 'AthimadhuramKoozha' and 'VakathanamVarikk a'< https://indianexpress.com/article/india/genome-conservation-the-jackfruit-man-6106829/>.

Conclusion and future scope

Genetic resources are of fundamental importance in crop variety improvement programmes. This is required for developing improved crop cultivars, which could contribute to national development by acquiring productive as well as qualitative attributes. Therefore, the available germplasm of jackfruit must be protected. Ultimately, horticulturists and plant breeders can select germplasm following their requirements. These jackfruit germplasms may be used in the programme to generate new varieties in the future. On-site selection and evaluation directly done by breeders in the farms of jackfruit farmers and growers is the main approach in this collaborative breeding work.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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