

**IDENTIFICATION AND CHARACTERIZATION OF JACKFRUIT TYPES**  
**(*Artocarpus heterophyllus* Lam.) IN KASARGOD DISTRICT**

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**(2014 - 12- 118)**

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**KERALA, INDIA**  
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(*Artocarpus heterophyllus* Lam.) IN KASARGOD DISTRICT**

by

**NIMISHA. C**

**(2014 - 12- 118)**

**THESIS**

**Submitted in partial fulfilment of the  
requirements for the degree of**

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**DEPARTMENT OF POMOLOGY AND FLORICULTURE**

**COLLEGE OF AGRICULTURE**

**PADANNAKKAD, KASARAGOAD – 671 314**

**KERALA, INDIA**

**2016**

### **DECLARATION**

I, hereby declare that this thesis entitled “**IDENTIFICATION AND CHARACTERIZATION OF JACKFRUIT TYPES (*Artocarpus heterophyllus* Lam.) IN KASARGOD DISTRICT**” is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Padannakkad

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**CERTIFICATE**

Certified that this thesis entitled “**IDENTIFICATION AND CHARACTERIZATION OF JACKFRUIT TYPES (*Artocarpus heterophyllus* Lam.) IN KASARGOD DISTRICT**” is a record of research work done independently by Ms. Nimisha. C under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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**EXTERNAL EXAMINER**

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### LIST OF ABBREVIATIONS

%	-	Per cent
Acc.	-	Accession
°B	-	Degree Brix
CV	-	Coefficient of Variation
<i>et al</i>	-	And others
Fig.	-	Figure
g	-	Gram
<i>ie.,</i>	-	That is
IPGRI	-	International Plant Genetic Resources Institute
kg	-	Kilogram
KJ	-	Kasargod Jackfruit
ml	-	Millilitre
MSL	-	Mean Sea Level
mm <sup>2</sup>	-	Square milli meter
MV	-	Muttam Varikka
N	-	Normality
NA	-	Not Applicable
NaOH	-	Sodium Hydroxide
No.	-	Number
SD	-	Standard Deviation
SJ	-	Singapore Jack
viz	-	Namely



# **INTRODUCTION**

## INTRODUCTION

Jackfruit (*Artocarpus heterophyllus* Lam.), is a popular evergreen tropical fruit indigenous to the rain forests of Western Ghats of India (Purseglove, 1968). It is the largest tree born fruit with unique size, shape, flavor and taste. Jackfruit is adaptable to wide range of agro-climatic conditions and extensively grown in South East Asian and tropical African countries. It is the national fruit of Bangladesh and Indonesia. It is a popular rice substitute in Sri Lanka and is traditionally known as rice tree.

In India, jackfruit is grown in Kerala, Tamil Nadu, Karnataka, Goa, Andhra Pradesh, Odisha, Tripura, Bihar, Uttar Pradesh, West Bengal and Assam. The annual production of jackfruit in Kerala is 294 million fruits ([www.ecostat.kerala.gov.in](http://www.ecostat.kerala.gov.in), 2013-14). It is an important component of the multicrop homestead farming system of Kerala.

Jackfruit is a rich source of carbohydrates, proteins, vitamins, minerals, and dietary fibre. Young fruit, unripe matured fruit, ripe fruit and seeds are used for culinary preparations. Jackfruit is a good source of pectin, which makes it suitable for the preparation of processed products. The wood is a valuable timber and a good source of yellow pigment which is used in dyeing industry. The leaves are used as fodder.

Jackfruit possesses anti-diabetic, anti-ulcer, anti-inflammatory, anti-hypertensive, anti-microbial and anti-cancerous properties. Jacalin present in the seed, inhibit Herpes Simplex Virus type 2 and is useful for the evaluation of immune status of HIV 1 infected patients. It is an important component of folk medicine.

In spite of such a vast potential and usefulness, jackfruit remains as an underutilized fruit crop without much cultural interventions. Recently, efforts are

being taken by research organizations to promote and commercialize jackfruit because of its evolving image as a naturally grown organic fruit with distinct medicinal properties.

Jackfruit is a highly cross pollinated crop and mainly propagated through seeds till recently which have resulted in tremendous diversity. Considerable range of variation has been observed in growth habit, canopy structure, bearing habit, fruit quality and seasonality (Azad *et al.*, 2007). This variation offers scope for crop improvement through selection of ideal superior genotypes.

The genetic diversity in jackfruit is a valuable resource which needs to be conserved and exploited. Hence there is a need to identify and locate ideal jackfruit types among the existing germplasm for conservation and effective utilization.

The most important forms of jackfruit are 'soft fleshed' and 'firm fleshed' types. The firm fleshed type is commercially important due to better fruit quality. In Kerala, the firm fleshed type of jackfruit is more predominant in Northern Kerala (Prasannakumariamamma and Kumaran, 2011).

Attempts have been made to identify and characterize superior jackfruit types in Thrissur, Alappuzha and Wayanad districts of Kerala. No such efforts have been made in other districts of Kerala. However, wide variability is noticed in jackfruit types in the homesteads of Kasargod district and promising types remain un-noticed.

For the identification of elite trees with desirable traits such as compact canopy architecture, early flowering, regular bearing habit, medium sized fruits with more number of fruits per tree, high TSS, acceptable flake colour, flavour and texture a detailed survey has to be made in the farmer's field and the promising types have to be characterized as per IPGRI (Biodiversity International) descriptors.

Therefore the present study entitled “Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district” was taken up with the following objectives:

1. To conduct a detailed survey of jackfruit in Kasargod district.
2. To identify the jackfruit types with earliness in bearing and high table quality and
3. To characterize the selected firm fleshed jackfruit types through morphological and biochemical analysis as per the IPGRI descriptor.

# **REVIEW OF LITERATURE**

## 2. REVIEW OF LITERATURE

*Artocarpus heterophyllus* Lam. is a monoecious species in the family Moraceae. The genus *Artocarpus* consists of 50 species of which 15 species produces edible fruits. *Artocarpus heterophyllus* is tetraploid with  $2n=56$ . Other common species coming under this genus are *Artocarpus altilis* (breadfruit), *Artocarpus integer* (Chempedak), *Artocarpus lakoocha* (monkey jack) and *Artocarpus hirsutus* (Anjily).

Jack is a large, evergreen tree growing to a height of 10 to 15 m and is indigenous to the evergreen rain forests of Western Ghats of India (CSIR, 1992). In the humid hill slopes, it flourishes up to an elevation of 1500 m (Sammadar, 2002). It is cultivated throughout the tropical areas in South and South East Asia, parts of central Eastern Africa and Brazil (Menon and Peter, 2011).

The scientific literature related to the present study are reviewed and presented in this chapter.

### 2.1 VARIABILITY IN JACKFRUIT

Being highly cross pollinated and seed propagated crop, jackfruit exhibit wide variability. Jackfruit differs widely in size, shape, period of maturity and quality parameters such as sweetness, flavor, taste and acidity (Mitra, 1998). The heterozygous nature of seedling population offers tremendous scope for the selection of superior types for commercial exploitation (Menon and Peter, 2011).

In Karnataka, regional variation in jackfruit diversity was reported by Vasudeva *et al.* (2016). According to the report, the up- Ghat region of Uttara Kannada district recorded highest diversity in jackfruit compared to other places.

In Kerala, regional variation in diversity was reported by Prasannakumariamma and Kumaran (2011). Among the two forms *viz.*, soft fleshed

and firm fleshed, firm fleshed type is more predominant in Northern Kerala and soft fleshed type is predominant in Southern Kerala.

In the Philippines, many varietal collections have been characterized based on traits of the tree. So far, only four varieties having outstanding characteristics were identified as J-01, J-02, TVC, and Torres varieties (Sampilo, 1983). On-site selection and evaluation is a direct method for identification of desirable genotypes in natural jackfruit tree population grown from seed (Dayap, 2006).

Jackfruit trees grown from seeds by farmers or household owners show high phenotypic variability in tree and fruit characters. Thus, direct selection of desirable jack tree with good breeding value is possible (Magdalita *et al.*, 2011).

## **2.1.1 Tree characters**

### **2.1.1.1 Tree growth habit**

Wide variation was observed with respect to trunk height and trunk circumference among the jackfruit types grown under tropical climatic conditions of Andhra Pradesh (Sadarunnisa *et al.*, 2016).

Guruprasad *et al.* (2016) observed variation in the canopy shape of jackfruit types in Tumkur district of Karnataka. The tree canopy shapes reported are round, broad and square.

Muthulakshmy (2003) observed variation with respect to tree vigour, canopy shape and tree growth habit in jackfruit types in Thrissur district of Kerala. Wide variability was observed among 263 jackfruit types collected from Thrissur, Palakkad, Malappuram, Kottayam, Pathanamthitta, Kollam districts of Kerala (Narayanankutty *et al.*, 2010). According to Aswini (2015), tree height varied from 4.50 to 18.00 m and the trunk girth varied from 76 to 270 cm. She also observed different canopy shape such as pyramidal, broadly pyramidal, spherical, oblong,

semi-circular, elliptical and irregular among the jackfruit types grown in Thrissur district of Kerala.

In Bangladesh, Azad (2000) classified tree growth pattern of jackfruit tree as open, spreading, low spreading and sparse upright.

#### **2.1.1.2 Branching pattern**

Sadarunnisa *et al.* (2016) recorded variation in branching pattern among jackfruit types grown under tropical climatic conditions of Andhra Pradesh.

Variation in branching pattern and branching density was reported by Muthulakshmy (2003) in jackfruit types located in four different topographical regions of Thrissur district. Aswini (2015) observed variation in branching pattern in the jackfruit types maintained in the College orchard and Pineapple Research Centre, Vellanikkara, Thrissur. The branching pattern observed were erect, opposite, verticillate, horizontal and irregular.

#### **2.1.1.3 Leaf shape**

Genotypic and phenotypic factors play important roles in determining leaf characters in jackfruit (Maiti *et al.*, 2003; Radha and Mathew, 2007). Leaf length, leaf width, leaf shape, leaf apex shape and leaf base shape also exhibited wide variability in jackfruit types grown in Thrissur district of Kerala (Muthulakshmy, 2003).

According to Sadarunnisa *et al.* (2016), obovate, elliptic, narrowly elliptic and broadly elliptic leaves are the variation in leaf shape observed in jackfruit trees in Andhra Pradesh.

Irregular leaf shapes are seen in younger plants. In aged plants, elliptic or obtuse leaf shape, oblique leaf base and obtuse leaf apex were observed (Radha and Mathew, 2007). Aswini (2015) observed variation in the shape of leaf blade



(obovate, elliptic, broadly elliptic, narrowly elliptic, oblong and lyrate), leaf apex (acute, acuminate, retuse and obtuse), leaf base shape (oblique, rounded, cuneate and shortly attenuate), leaf length (12.34 to 18.02 cm) and leaf breadth (6.37 to 9.43 cm).

Leaf length varied from 5 to 25 cm and leaf width varied from 3.5 to 12.0 cm (CSIR, 1992). Azad (2000) reported variation in leaf shape of jackfruit trees in Bangladesh. The different leaf shapes are elliptic, elliptic-obovate, obovate, oblong, lanceolate and oval.

#### **2.1.1.4 Leaf chlorophyll**

Chlorophyll content in leaves influences fruit size and fruit set in crops (Olmez *et al.*, 2006).

*Artocarpus heterophyllus*, *Psidium guajava*, and *Ficus benghalensis* were the more tolerant species compared to *Mangifera indica*, *Azadirachta indica*, *Ficus racemosa*, *Pongamia pinnata*, *Eugenia jambolana*, (Kumar and Kousar, 2005). Leaf chlorophyll content varied from 0.62 to 1.19 mg/g among the jackfruit types in Bhadravathi town of Karnataka (Kousar *et al.*, 2014). Total leaf chlorophyll (TLC) content is one of the four parameters used to develop an Air Pollution Tolerance Index (APTI).

#### **2.1.1.5 Stomatal density**

Jackfruit has shown more tolerance to drought than sugar apple due to high leaf water potential and different stomatal behavior (Rodrigues *et al.*, 2010).

Sreelakshmi *et al.* (2014) reported that stomatal density in jackfruit leaf as 15/cm<sup>2</sup>.

In general, stomatal density in the leaf influence fruit set and fruit size in tree crops (Olmez *et al.*, 2006). Stomatal frequencies are also associated with adaptation to heat stress during summer in tree crops (Igin and Caglar, 2009).

## **2.1.2 Inflorescence characters**

### **2.1.2.1 Flowering**

Generally, flowering in jackfruit starts from December and continue up to March (Samaddar, 1985). Off-season flowering is also observed in jackfruit during September to October (Singh, 1992). Singh and Srivastava (2000) observed that some jackfruit types in Eastern Uttar Pradesh exhibits flowering twice a year. Das (2010) reported that jackfruit grown in upper plains and hills of India, has unique flowering features. The flower production was highly correlated with the number of leaves produced on the trunk. According to Alila and Sanyal (2011), flowering occurred throughout the year, in Northern and Eastern parts of India. Singh and Dash (2011) observed variation in flowering in jackfruit types in Odisha and the trees were categorized as very early bearer, mid season bearer, late bearer and round the year bearer.

In Tamilnadu the main flowering season is from November to February. In Kanyakumari district, flowering occurs twice a year, the main season being April-June and off season flowering from November-December (Balamohan, 2016).

In Kerala, flowering starts from November and extends up to March. Sometimes, off season flowering is also noticed in September (Prasannakumariamamma and Kumaran, 2011).

Seasonality of flowering and fruiting in *Artocarpus heterophyllus* has been reported in India, Sumatra and Malaysia (Primack, 1985).

According to Pushpakumara (2006) jackfruit types in Sri Lanka have a major flowering phase during March to June with occasional flowering during October to January.

In Philippines, in areas with dry and wet season flowering occurs only during rainy season (Angeles 1983; Querijero 1988). Jackfruit trees bear fruits throughout the year in areas where rainfall is evenly distributed (Hensleigh and Holaway, 1988). Acedo (1992) reported continuous flowering and fruiting in Jackfruit trees in Philippines. Namuco (2011) reported that flowering and fruiting season in Philippines mainly depends on rainfall pattern.

Geographical difference in flowering and fruit maturity was reported in Malaysia, Thailand, Nepal and India (Soepadmo, 1991). The different flowering pattern may be due to climatic variability, variation in resource availability, micro habitat difference and the difference in age and size of individual trees (Pushpakumara, 2011). In Northern provinces of Vietnam, jackfruit starts to flower from March-April and some jack trees flower and yield round the year. In Southern provinces, flowering time is longer. In some varieties, two flowering seasons per year was noticed *ie.* in February-March and October-September or year round (Hung, 2011). Alila and Sanyal (2011) reported that jackfruit crop is seasonal in many countries but is available round the year in Malaysia, Thailand and Indonesia.

The distribution of male and female inflorescence in jackfruit trees showed wide variation with female inflorescence ranging from 3 to 40 % (Sahadevan *et al.*, 1950). The inflorescences produced during the initial and final stage of flowering season are males (Sambamoorthy and Ramalingam, 1954). Srivastava (1961) reported that 80 % of the inflorescences in a tree are male inflorescences. In young trees, the male to female inflorescence ratio was 4:1 and in old trees it was 2:1 (Shankar and Singh, 1965). Pushpakumara (2011) reported that jackfruit female inflorescence possesses  $5695 \pm 52$  flowers.

### **2.1.2.2 Position of female inflorescence.**

Female inflorescences are solitary and are produced on axillary leafy twigs called footstalks. These footstalks are developed either on the tree trunk or on older branches. Male inflorescences appear mainly on the terminal shoots and also on the main stem (Pushpakumara, 2006).

Murugan (2007) studied variation in position of female inflorescence in the jackfruit germplasm in Periakulam in Tamilnadu. Among the jackfruit types 57.14 % of the jackfruit types bore female inflorescence on main trunk and primary branches only whereas 40.00 % of jackfruit types produced female inflorescence on main trunk, primary branches and on secondary branches.

In Bangladesh, Ullah and Haque (2008) reported that in a jackfruit tree 33.0 % of the female inflorescences were produced on primary branches, 31.5% on main trunk, 12.3% on secondary branches and 8.4% quaternary branches.

### **2.1.3 Fruit characters**

An ideal jackfruit type should have precocity in bearing, fruit weight varying from 10 to 15 kg with attractive yellow skin, production potential of 150 fruits per tree per year, high recovery of flakes, flakes weighing above 50 g with attractive golden yellow colour, juicy and fibreless (Kumar and Kavino, 2011).

According to Wangchu *et al.* (2013), characters like fruit yield per tree, number of flakes per kg of fruit, number of seeds per kg of fruit, weight of flakes with seed, weight of flakes without seed, stalk length, rachis diameter, rachis length, fruit length, flake width and shelf life could be used as selection criteria for the development of elite trees in jackfruit.

In Sri Lanka characters used for crop improvement include absence of seed coat, absence of gum in ripe fruit, colour variation in flakes and absence of perianth (flakeless- for culinary purpose) (Medagoda, 2003).

#### **2.1.3.1 Fruiting season**

Considerable variation is observed in fruiting season of jackfruit in different region. Jackfruit is either considered as a vegetable at immature stage or as table fruit after ripening. Immature green fruits of one to three months old are harvested for culinary purposes. Maturity period of jackfruit varies from 3 to 8 months after flowering. In jackfruit, fruiting season varies from country to country. Jackfruit ripens principally from March-June, April-September and June- August with some off season fruits from September- December (Prasannakumariamamma and Kumaran, 2011).

In Karnataka, jackfruit types bearing twice in a year are reported and stress is given for popularizing twice bearing, early season bearing and off season bearing jackfruit types (Padre, 2016). According to Hittalmani (2016), the jackfruit selection ‘Lalbagh Madhura’ bears fruits twice a year during April-July and during November - January whereas the jackfruit selection ‘Byra Chandra’ bears almost throughout the year.

Kumar and Singh (1996) studied the fruiting season in jackfruit. Except one genotype, which matured during March – May, all genotypes matured during July– August. In West Bengal, 1460 jackfruit trees were evaluated by Mitra and Maity (2002) of which 35 superior clones were identified. The growth, bearing (twice a year in some types) and maturity period of fruits (June-September) varied among the various genotypes.

In Kerala, Muthulakshmy (2003) observed three bearing habits *viz*, regular, alternate and irregular. She grouped the trees based on the bearing season into early

bearing (December-February), mid season bearing (March- May) and late bearing (June-August). Fruiting season of jackfruit types was studied by Gomez *et al.* (2015). Jack fruit accessions with off season fruiting (January to July) were observed. Accession AH-6 produced fruits round the year. Three accessions, namely AH-1, AH-2 and AH-5 came to maturity by January end, whereas accession AH-16 matured in July; thereby indicating the possibility of finding accessions with off-season fruiting.

In Philippines, flowering season varies according to the rainfall pattern. In areas which received evenly distributed rainfall, jackfruit tree bore fruits throughout the year (Hensleigh and Holaway, 1988) but in areas with distinct dry and wet seasons, flowering occurred during rainy months (Querijero, 1988).

Ullah and Haque (2008), studied fruiting, bearing habit and fruit growth of jackfruit at orchard of Jackfruit Research Project, Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh. There was wide variation in the period of fruit set among the ten genotypes. Genotype J-07 had the longest fruit setting period (85 days), which was followed by J-31/2 (78 days) and the shortest fruit setting period (23 days) observed in J-22.

Medagoda (2011) reported that in Sri Lanka, there were two fruiting season. The main fruiting season was from March to June and the minor season was from November to January.

#### **2.1.3.2 Number of fruits per tree**

Generally 150 fruits per tree is found to be ideal (Kumar and Kavino, 2011). However wide variability is observed number of fruits per tree per year.

Singh and Srivastava (2000) studied genetic variability in jackfruit germplasm collected from Eastern Uttar Pradesh. Among the genotypes, 18 were identified as superior clones which showed variation in yield (12 to 400 fruits per tree). Sharma *et*

*al.* (2005) reported that the number of fruits per tree varied from 27.3 to 68.6 among the genotypes collected from Uttar Pradesh and Uttaranchal.

In ten genotypes of jackfruit, Sharma *et al.* (2006) assessed different quantitative traits. At the genotypic and phenotypic level, fruit yield per tree showed significant and positive association with average fruit weight, which had highly significant positive correlation with fruit length, weight of bulbs with seed and weight of bulb without seed per fruit. Thus, in jackfruit, these characters are considered as important components of fruit yield per tree. Path analysis revealed that the most important direct effect on fruit yield per tree was exhibited by number of fruits per tree, number of bulbs per fruit and average fruit weight.

To assess the variability and performance of 18 jackfruit germplasms, a study was conducted at Hill Tracts Agricultural Research Station, Ramgarh, Jharkhand, during 2006-2008. The number of fruits per plant varied from 13.5 to 75.50 (Firoz *et al.*, 2009).

In Assam, the maximum fruits per tree reported are 500 (CSIR, 1992). In Brahmaputhra valley, the highest fruit yield was 60 fruits per tree (Sarma *et al.*, 1997). Mitra and Mani (2000) conducted a survey for the identification and collection of superior genotypes in jackfruit in Eastern India during 1990-1997.

Wide variability in number of fruits per tree (14 to 325) was observed in West Bengal by Mitra (1998). Mitra and Maity (2002) observed wide variability in yield ranging from 15 to 1450 fruit per tree of jackfruit types in West Bengal. Maiti *et al.* (2003) observed that yield per tree varied due to genotypic and phenotypic factors. In jackfruit wide variability existed with regards to yield per tree (18–1,100 fruits per year) and path analysis revealed that, fruit length and flake length were the important characters which had maximum direct and indirect effects on fruit yield per tree and it helped in selecting the superior genotypes (Wangchu *et al.*, 2013).

Marri *et al.* (2016) compared fruit yield of nine jackfruit varieties under West Godavari conditions of Andhra Pradesh. Significant differences were observed in growth and yield parameters of the nine varieties. The highest number of fruits per tree was found in Palur -1 (13.77) followed by Muttam varikka (12.11). Sadarunnisa *et al.* (2016) studied jackfruit accessions for growth and yield under tropical climatic conditions of Andhra Pradesh. A wide variability was observed in the number of fruits per plant which ranged from 7.67 to 68 fruits.

Shyamamma *et al.* (2016) conducted a survey in four districts of Karnataka viz., Bangalore Rural, Ramanagara, Hassan and Tumkur to identify elite jackfruit types suitable for table purpose. Out of 56 elite genotypes 18 were grouped as small sized jackfruits and 38 as large sized fruits.

Murugan (2007) observed variation in number of fruits per tree from 50 to 110 in jackfruit types in Periakulam region of Tamilnadu.

Aswini (2015) reported variation with respect to fruit yield ranged from 41.25 to 1593 fruits per tree in Thrissur district of Kerala.

Evaluation of ten genotypes of existing jackfruit was conducted at Regional Agricultural Research Station, Rangpur, Bangladesh during 2012-13. The number of fruits per plant was highest (220) in AH Bur-001 and the lowest (35) in AHBur-004 (Ali *et al.*, 2015).

### **2.1.3.3 Fruit shape**

Singh and Srivastava (2000) observed variability in jackfruit germplasm collected at Eastern Uttar Pradesh with respect to fruit shape, fruit length and circumference.

Mitra (1998) found wide variability in fruit shape (oblong, roundish and conical), skin colour (greenish, light to dark brown, yellow and yellow with brown) and number of tubercles in skin (5 to 27 per cm<sup>2</sup>).



Ten open pollinated fruits of jackfruit from elite clones of South Karnataka were evaluated by Reddy *et al.* (2004). Among the quantitative characters, highest variability was observed for fruit shape.

Aswini (2015) reported variation with respect to shape and surface of jackfruit types in Thrissur district of Kerala.

In Bangladesh, Hussain and Haque (1977) observed that skin colour ranged from yellow and pale green to brown. According to Azad (2000), the variation in fruit shape was from oblong, ellipsoid, triangular, spheroid, claviform to round.

#### **2.1.3.4 Mean fruit weight**

Wide variability was observed in fruit weight of jackfruit types. In a study conducted by Berry and Kalra (1988), the average fruit weight varied from 3.24 kg to 17.39 kg. Based on fruit morphology, Kumar and Singh (1996) grouped genotypes into nine categories. Average fruit weight varied from 12 kg to 21.2 kg.

Variability of 18 jackfruit types was assessed at Hill Tracts Agricultural Research Station, Ramgarh during 2006-2008. The single fruit weight varied from 6.4 to 10.9 kg (Firoz *et al.*, 2009).

Mitra and Mani (2000) conducted a survey for the identification and collection of superior genotypes in jackfruit in Eastern India. The individual fruit weight varied from 2.10 to 10.22 kg. In West Bengal, 1460 jackfruit trees were evaluated by Mitra and Maity (2002) of which 35 superior clones were identified. The fruit weight varied from 1.22-17.30 kg. Maiti *et al.* (2003) studied the genetic variability, heritability, genetic advance, genotypic and phenotypic variability in the physico-chemical characters of 44 jackfruit genotypes collected from different agroclimatic zones of West Bengal. Fruit weight showed highest magnitude of genotypic and phenotypic variance and genetic advance. Great variability existed with regards to average fruit weight (1.6–16.47 kg) (Wangchu *et al.*, 2013).

Maiti (2010) reported that fruit weight of edible part (0.98 and 0.97), fruit and rind weight (0.976 and 0.971) and number of seeds and flakes (0.999 and 0.999) showed highly significant positive genotypic and phenotypic correlation. The path coefficient analysis revealed that both at genotypic (0.459) and phenotypic (0.451) levels, the weight of edible part had positive direct effect on fruit weight. Hence during the selection of jackfruit genotypes, more emphasis has to be given on weight of edible part, rind weight, flake and seed number. Fruit weight exhibited highly significant positive association with rind weight, rachis length, fruit length and flake length. Shelf life showed highly significant positive relation with stalk diameter and fruit diameter (Wangchu *et al.*, 2013).

In a study conducted by Marri *et al.* (2016) significant differences were observed in growth and yield parameters of the nine jackfruit varieties in Andhra Pradesh. Average fruit weight varied from 12.12 to 12.98 kg. Sadarunnisa *et al.* (2016) studied jackfruit accessions for growth and yield under tropical climatic conditions of Andhra Pradesh. A wide variability was observed in fruit weight which varied from 6 kg to 11.67 kg.

Ten open pollinated fruits of jackfruit from elite clones of South Karnataka were evaluated by Reddy *et al.* (2004). Among the quantitative characters, highest variability was observed for fruit weight. Jagadeesh *et al.* (2010) observed significant variation in physico-chemical characters of jackfruit bulbs among the 30 jackfruit selections in Coastal zone of Karnataka. A high coefficient of variation was observed for cylinder mass (74.00%) and fruit mass (62.84%).

Murugan (2007) observed wide variation in fruit weight among the genotypes in Periakulam in Tamil Nadu. It varied from 3.6 to 17.00 kg.

In Kerala, a variety namely “Muttam Varikka” produced fruits of average weight of 7 kg with 46 cm in length and 23 cm in width (Srinivasan, 1970). Aswini (2015) reported variation with respect to fruit weight which ranged from 1.65 to

20.00 kg. Fruit weight of the accessions varied significantly ranging from 3.95 kg in AH-11 to 20.13kg in AH-8 (Gomez *et al.*, 2015). Similarly, a study was conducted at Regional Agricultural Research Station, Kumarakom during 2011 - 2014 to assess the variation in fruit quality and bearing habit of jackfruit trees grown under the agroclimatic conditions of Kuttanad. Significant variation was observed among the 21 identified firm fleshed types in terms of physico-chemical characters. Individual fruit weight varied from 1.69 to 17.50 kg (Krishnan *et al.*, 2015).

In Indonesia, based on the tree performance and fruit weight, jackfruit types were divided into two types *ie.*, big jackfruit and mini or small jackfruit (Yuniarti, 2011).

The jackfruits from different trees were compared by Hussain and Haque (1977) and the average fruit weight ranged from 3.24 to 7.39 kg. Azad (2000) reported that the fruit weight of the evaluated jackfruit types of Bangladesh varied from 1.2 to 22.0 kg. Evaluation of ten genotypes of existing jackfruit was conducted at Regional Agricultural Research Station, Rangpur, Bangladesh during 2012-13. However, fruit weight did not differ greatly and ranged from 5.0 to 7.5 kg. Larger fruit (7.5 kg) was recorded by AH Bur-008 and smaller fruit (5.0 kg) was recorded by AHBur-009. The genotype AH Bur-001 performed better in terms of earliness, fruit size, quality and yield followed by AH Bur-003 and AH Bur-007 (Ali *et al.*, 2015).

Magdalita *et al.* (2011) reported that the fruit weight of eight genotypes in Philippines varied from 7.20 to 20.20 kg.

According to Crane *et al.* (2002), fruit weight varied from 1.5 to 20 kg among the varieties of Australia, Malaysia, Indonesia and Thailand.

### 2.1.3.5 Number of flakes per fruit

Singh and Srivastava (2000) studied genetic variability in jackfruit types in Eastern Uttar Pradesh and reported number of bulbs per fruit. Sharma *et al.* (2005) reported that number of flakes per fruit varied from 117.3 to 362.3.

According to Mitra (1998), number of flakes per fruit varied from 34 to 384 in jackfruit types in West Bengal. Mitra and Maity (2002) evaluated 35 jackfruit types and variation was observed in number of flakes (30-380 per fruit) and number of seeds (30-365 per fruit). Wangchu *et al.* (2013) observed that the number of flakes per kg of fruit varied from 6 to 60.3.

Ten open pollinated fruits of jackfruit from elite clones of South Karnataka were evaluated by Reddy *et al.* (2004). Among the quantitative characters, highest variability was observed for flake number and size.

Aswini (2015) reported variation with respect to number of flakes as 12.61 to 71.15 among the types maintained at KAU, Vellanikkara. Number of bulbs ranged from 48 in the accession AH-7 to 300 in AH-10 (Gomez *et al.*, 2015).

Haq (2006) observed variation in number of flakes per fruit from 24.2 to 580.2 among the evaluated jackfruit types in Bangladesh.

### 2.1.3.7 Flake shape

According to Dash *et al.* (2016), variation observed in the flake shape was rectangular, spheroid, twisted, obovate, cordate, irregular, twisted and obovate, spheroid and obovate, rectangular and twisted and oblong with curved tip among the jackfruit types in Odisha.

Spheroid, cordate, twisted, obovate, rectangular, curved tip and irregular are the flake shapes in jackfruit in Kerala (Menon and Peter, 2011).

### 2.1.3.6 Flake colour

According to Singh *et al.* (1967), the colour of bulbs varied from pale yellow to golden or dark yellow. Variability observed in flake colour are white, yellow, reddish yellow and pinkish yellow (Mitra, 1998). Variation in flake colour was also reported by Singh and Srivastava (2000). Dash *et al.* (2016) observed yellow, deep yellow, light yellow, orange and cream coloured flakes in jackfruit types in Odisha.

Variation in flake colour was observed in 35 types identified in South Karnataka. Among the qualitative characters of jackfruit, flake colour exhibited highest variability (Reddy *et al.* 2004).

Bulb colour varied from creamy yellow to reddish in jackfruit types of Kerala (Aswini 2015; Gomez *et al.*, 2015).

### 2.1.3.7 Flake Texture

Texture of pulp showed variation from soft, moderately soft to hard (Mitra, 1998). According to Alila and Sanyal (2011), soft fleshed varieties are more juicy and firm fleshed varieties are less juicy and there are also intermediate types. Patil *et al.* (2016) reported that the flake texture varied from fibrous, firm, coarse, melting and crisp.

Cultivated jackfruits can be broadly divided into two groups on the basis of texture of flakes *viz.*, soft flakes known as koozha and crisp flakes known as varikka. Majority of trees in Southern Kerala belong to Koozha type. In Central Kerala, both Koozha and Varikka types were seen in equal proportions. In Northern Kerala, Varikka type was more predominant (Prasannakumariamamma and Kumaran, 2011). Aswini (2015) reported variation with respect to flake texture.

Haq (2006) observed variation in flake texture from crisp, coarse, fibrous to smooth among jackfruit types in Bangladesh. The two types *viz.*, firm flesh type and

soft flesh type may have the same origin since they did not show significant difference in DNA (Yingzhi *et al.*, 2007).

#### **2.1.3.8 Flake Thickness**

Jagadeesh *et al.* (2016) conducted a survey in four districts of Karnataka and 27 jackfruit types were selected to study the physico-chemical characters. A high coefficient of variation was observed for bulb parameters such as flake thickness (71.52%).

Significant variation was observed in flake thickness from 0.31 to 0.63 cm in jackfruit types grown in Kuttanad region of Kerala (Krishnan *et al.*, 2015). Aswini (2015) reported that flesh thickness varied from 1.26 mm to 7.8 mm. The bulb diameter varied from 6.08 to 10.11 cm.

#### **2.1.3.9 Weight of flakes (Total flake weight per fruit and mean flake weight)**

Krishnan *et al.* (2015) reported that the total flake weight varied from 0.80 kg to 10.25 kg among the jackfruit types grown in Kuttanad, Kerala. Patil *et al.* (2016) reported that the flake weight per fruit varied from 1.19 kg to 8.18 kg among the jackfruit types at IIHR, Bangalore. Study conducted by Shymalamma *et al.* (2016) revealed that the total flake weight varied from 440 g to 590 g in jackfruit types with small sized fruits weighing below 5 kg.

In Kerala, Aswini (2015) reported variation with respect to mean flake weight from 16.69 to 33.91 g. According to Narayanankutty *et al.* (2016) mean flake weight varied from 5 to 46 g.

#### **2.1.3.10 Seed shape**

According to Singh *et al.* (1967), the seeds were comparatively larger in soft fleshed type than that of hard pulped type. Oblong, ellipsoid, irregular, reniform, elongate and spheroid are the seed shapes observed in jackfruit (Haq, 2006).

### 2.1.3.11 Weight of seed

The relationship between seed weight and flake colour was reported by Guruprasad and Thimmaraju (1989). The highest seed weight (7.66 g), seed length (3.23 cm) and seed breadth (2.10 cm) was observed in light yellow types. The yellow types showed highest number of seeds per fruit (124.6) and the highest pulp to seed ratio (4.24). Guruprasad *et al.* (2016) observed that seed weight was the highest in yellow bulb types and lowest in orange bulb type in Tumkur district of Karnataka.

Wide variation in seed weight was observed in Kerala also. Aswini (2015) observed that 100 seed weight ranged from 240 to 800 g. According to Narayanankutty *et al.* (2016), 100 seed weight of jackfruit varied from 400 to 1250 g. Naryanaswamy *et al.* (2016) reported that the 100 seed weight varied from 250 to 1230 g.

The total seed weight in the smallest fruit and the largest fruit were 0.39 kg and 1.01 kg respectively among the evaluated jackfruit types in Bangladesh (Hussain and Haque, 1977).

### 2.1.3.12 Flake per cent

Kumar and Kavino (2011) reported that flake percentage is as high as 60.75 % in jackfruit cultivar Burliar 1. Balamohan (2016) reported that the flake percentage is 19.68 % in the variety PLR-1 developed by TNAU. Narayanaswamy *et al.* (2016) reported that the flake percentage varied from 18.3 to 60.9 % among jackfruit types in Karnataka.

In Kerala, Menon and Peter (2011) reported that flake percent varied from 32 to 41 % among exotic jackfruit varieties introduced from Queensland, Australia, Thailand, Malaysia and Indonesia. Flake per cent varied from 5.80 % to 43.04% in jackfruit types collected by Gomez *et al.* (2015).

Haq (2006) observed that the flake percentage varied from 18.3 to 60.9 % in jackfruit types in Bangladesh.

#### **2.1.3.13 Seed per cent**

Percentage of seeds varied from 7.11 % to 16.39 % among the evaluated jackfruit types in Kerala (Gomez *et al.*, 2015). Patil *et al.* (2016) reported that seed percentage varied from 2.60 to 23.10 % in the jackfruit types at IIHR, Bangalore.

In Bangladesh, Haq (2006) reported that the seed percentage of evaluated jackfruit types varied from 2.6 to 23.1 %. Ibrahim *et al.* (2013) compared the seed content of jackfruit types in Rajshahi region of Bangladesh. He observed seed percent variation from 9.46 to 19.33 %.

#### **2.1.3.14 Rind percent**

Rind percentage varied from 11.83% to 61.83% among the evaluated jackfruit types in Kerala (Gomez *et al.*, 2015). Patil *et al.* (2016) reported that rind percentage varied from 20.6 to 72.0 % among the jackfruit types at IIHR, Bangalore.

In Bangladesh, among the jackfruit types, the rind percentage varied from 20.6 to 72.0 % (Haq, 2006). Ibrahim *et al.* (2013) recorded the variation in rind percentage from 14.86 to 23.68 %.

#### **2.1.4 Fruit quality**

In Kerala Agricultural University, germplasm collection of 200 superior jackfruit types has been maintained at Thrissur. Selection of superior trees for table, culinary, chip making and all purpose were identified and are under evaluation (KAU, 1983). Jackfruit is consumed as tender jack and mature unripe fruit which is used for chips making and culinary purposes and ripe fruits with high TSS are used as table fruit.



Variation in fruit quality of jackfruit has been well documented (Jagadeesh *et al.*, 2007; Kumar and Kavino, 2011; Gomez *et al.*, 2015; Guruprasad, 2016; Shyamalamma *et al.*, 2016).

Srinivasan (1970) evolved a variety 'Muttam varikka' with sweet flesh and excellent fruit quality. A red fleshed jackfruit variety called Sindhoor was released by Kerala Agricultural University in 2015. It has firm fleshed fruits bearing twice in a year (Narayanankutty *et al.*, 2016)

A number of varieties have been evolved in different parts of the country based on fruit quality (Kumar and Kavino, 2011; Hittalmani, 2016; Balamohan, 2016).

#### 2.1.4.1 TSS

Wide variation in the Total Soluble Solids has been documented by several workers. Firoz *et al.* (2009) reported that TSS (°B) ranged from 13.1 to 19.6 °B among the jackfruit types in Jharkhand. According to Dash *et al.* (2016), the variation in TSS of jackfruit flakes is from 10 to 30°B among the jackfruit types in Odisha.

In West Bengal, among 672 jackfruit types evaluated, Mitra (1998) observed wide variability in total soluble solids (TSS), which varied from 15.4 to 29.6 °B. According to Wangchu *et al.* (2013), variation in TSS was from 20 to 28.67 °B).

Marri *et al.* (2016) reported highest TSS in Pechiparai-1 (29.46 °B) among the jackfruit types evaluated in Andhra Pradesh.

Reddy *et al.* (2004) evaluated ten open pollinated jackfruits of elite clones of South Karnataka. Of the qualitative parameters studied, TSS recorded the highest variability (24.8 to 40.5 °B). Wide variation was observed in TSS (19.87 °B to 35.00 °B) by Jagadeesh *et al.* (2007). Jagadeesh *et al.* (2010) observed significant variation

in physico-chemical characters of jackfruit bulbs among the 30 jackfruit selections in Coastal zone of Karnataka. Patil *et al.* (2016) reported variation in TSS from 13.8 to 25.3 °B among the jackfruit types maintained at IIHR, Bangalore.

In Kerala, a survey was conducted in Thrissur, Ernakulam and Palakkad districts and among the 211 trees evaluated, TSS varied from 17 to 37 °B (Kumar and Kavino, 2011).

Muthulakshmy (2003) found significant variation in TSS (14.63 to 33.00 °B) among 263 jackfruit types in Thrissur district of Kerala. Aswini (2015) observed variation in moisture percentage (29 to 74 %) and TSS (20.30 to 33.80 °B). In a study conducted by Gomez *et al.* (2015) highest total soluble solids were recorded in AH-5 (30.2° B). Krishnan *et al.* (2015) reported that TSS varied from 12.6 to 31.8 °B among jackfruit trees grown under the agro-climatic conditions of Kuttanad.

In a study conducted by Ibrahim *et al.* (2013) at Bangladesh, TSS varied from 18.80 to 27.37°B. The genotypes AHBur-001 and AH Bur-003 had the greater sweetness (TSS value of 22) and the germplasm AH Bur-005, AH Bur-008 and AH Bur-010 had less sweetness indicating TSS value of 18. The excellent taste was also observed in AH Bur-001 and AHBur-003, and good taste was observed in rest of the genotypes maintained at Regional Agricultural Research Station, Rangpur of Bangladesh (Ali *et al.*, 2015).

Magdalita *et al.* (2011) reported that TSS varied from 22.3 to 30°B among the jackfruit varieties developed through farmer participatory breeding in Philippines.

#### **3.1.4.2 Total sugars**

Among 672 jackfruit types evaluated, Mitra (1998) observed wide variability in total sugars which varied from 12.9 to 26.6 %. Mitra and Maity (2002) evaluated 1460 jackfruit types in West Bengal. In the identified 35 superior clones, wide

variability was observed in total sugar (7.6-23.6%). Wangchu *et al.* (2013) observed that total sugars varied from 8.3 to 20.3 % among the jackfruit types in West Bengal.

The variation in total sugars of jackfruit flakes was observed by Jagadeesh *et al.* (2007) among the jackfruit types in Karnataka.

In Kerala also variation in total sugars was observed. Muthulakshmy (2003) observed variation in total sugars from 8.16 to 19.30 % among the jackfruit types in Thrissur district. According to Narayanankutty *et al.* (2010), out of 263 germplasm collected from Thrissur, Malappuram, Palakkad, Kottayam, Kollam, and Pathanamthitta districts, the total sugars varied from 9.61 to 18.60 %.

In a study conducted by Ibrahim *et al.* (2013) at Bangladesh, the total sugars varied significantly from 11.84 to 17.01 %.

#### **2.1.4.3 Reducing sugar**

In jackfruit the carbohydrate content varied from 22.4 to 24 % in ripe fruits (Wealth of India, 1985). The perianth is rich in sugars. Reducing sugars present are fructose and glucose (Medagoda and Valavi, 2011).

Wangchu *et al.* (2013) reported that the reducing sugar content varied from 3.78–15.26 % in jackfruit genotypes collected from three districts of West Bengal.

According to Reddy *et al.* (2004), maximum reducing sugar content was 8.62 % in Acc. No. 15 among the jackfruit types evaluated in South Karnataka. Jagadeesh *et al.* (2007) reported that reducing sugar varied from 8.63 to 14.60 % among the jackfruit types in Karnataka.

In Kerala, Muthulakshmy (2003) observed significant variation in reducing sugar which varied from 1.63 to 5.23 %. According to Aswini (2015), reducing sugars varied from 6.61 to 13.16 % in jackfruit types maintained by KAU. Krishnan *et al.* (2015) observed that reducing sugar content ranged from 3.18 to 9.39% among the jackfruit types in Kuttanad.

#### 2.1.4.4 Non reducing sugar

Marri *et al.* (2016) reported variation in non-reducing sugar content from 9.90 to 16.27 % among the evaluated jackfruit types in Andhra Pradesh.

In Kerala, Muthulakshmy (2003) observed significant variation in non-reducing sugar (5.96 to 14.98 %). Aswini (2015) found variation in non – reducing sugars (5.16 to 13.29 %) in the jackfruit types in Thrissur district of Kerala. According to Narayanankutty *et al.* (2016) non-reducing sugar varied from 1.05 to 4.80 % among the 263 accessions collected from Thrissur, Malappuram, Palakkad, Kottayam, Kollam, and Pathanamthitta districts.

#### 2.1.4.5 Acidity

Singh and Srivastava (2000) studied 18 superior clones in Eastern Uttar Pradesh which showed variation in acidity and total minerals. Dash *et al.* (2016) observed variation in acidity from 0.1 to 0.4 % among the jackfruit types in Odisha.

Mitra (1998) observed wide variability in acidity (0.10 to 0.31 %) among the jackfruit types in West Bengal. When Mitra and Maity (2002) evaluated 35 superior clones, wide variability was observed in fruit acidity (0.10-0.33%). Wangchu *et al.* (2013) reported variation in acidity among the evaluated jackfruit types in West Bengal and was ranged from 0.13–0.42 % .

Reddy *et al.* (2004) evaluated ten elite clones of South Karnataka. The lowest acidity observed was 0.18 %. Shyamamma *et al.* (2008) also noticed variation in acidity of jackfruit types in Karnataka and the variation was from 0.10 to 0.31 %. Jagadeesh *et al.* (2010) observed significant variation in titratable acidity among 30 jackfruit selections, which varied from 0.16 to 0.552 %.

Murugan (2007) reported variation in acidity from 0.15 to 0.31 % among four promising jackfruit types at Periakulam in Tamil Nadu.

Muthulakshmy (2003) observed significant variation in total acidity (0.69 to 4.95 %) and sugar acid ratio (2.32 to 20.81 %) among the jackfruit types in Thrissur District of Kerala. Krishnan *et al.* (2015) observed variation from 0.20 to 1.02% in jackfruit types in Kuttanad. Narayanankutty *et al.* (2016) reported that acidity content of the pulp varied from 0.1 to 0.5 % in jackfruit types collected from Thrissur, Malappuram, Palakkad, Kottayam, Kollam, and Pathanamthitta districts.

Ibrahim *et al.* (2013) recorded the variation in acidity from 0.037 to 0.075 % as citric acid among the jackfruit types evaluated at Bangladesh.

## 2.2 Morphological characterization

Descriptors for jackfruit by IPGRI (2000) provide the list of characters in which variations are noticed which enable easy discrimination between phenotypes for selection of superior types (Menon and Peter, 2011).

Morphological characterization of 44 jackfruit types of West Bengal based on jackfruit descriptor (IPGRI, 2000) was carried out. They were grouped into 10 clusters for quantitative characters and 8 clusters for qualitative characters (Wangchu *et al.* 2013).

Reddy *et al.* (2004) carried out morphological characterization of 10 promising jackfruit types collected from South Karnataka based on jackfruit descriptor developed by IPGRI so as to identify and popularize the superior types among the farmers.

As part of All India Coordinated Research Project on tropical fruits, 211 trees from three districts of Kerala are collected characterized and conserved *in situ* (Menon and Peter, 2011). Aswini (2015) morphologically characterized 10 firm fleshed and 10 soft fleshed jackfruit types in Thrissur district of Kerala.

Morphological characterization of different jackfruit collections in the University of Philippines was carried out by Dayap (2000). Morphological characterization is used to compare tree and fruit characters of the superior types with

check variety and based on which superior types were identified and released in Philippines. Cluster analysis was also carried out to determine genetic relation and magnitude of variability (Magdalita *et al.*, 2011).

In Sri Lanka, promising jackfruit trees are characterized according to IPGRI descriptor for crop improvement (Medagoda, 2011).

# **MATERIAL AND METHODS**

### **3. MATERIAL AND METHODS**

The present study entitled 'Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district' was conducted during the period from August 2014 to July 2016. The experiment focused on survey, identification and characterization of jackfruit types in Kasargod district, Kerala with special emphasis on earliness and high table quality of the fruit.

#### **3.1 Location**

Kasargod district is the northernmost district of Kerala, India. It is situated at latitude of N 12° 30' 5" and longitude of E 74° 59' 24". It lies 19 m above the MSL and experiences a warm humid climate. The present investigation was conducted in the farmer's field within the Kasargod district.

#### **Experiment 1: Identification of jackfruit types**

#### **3.2 Survey**

The name and address of farmers who possess promising jackfruit types in their homestead were collected through Krishi Bhavans in Kasargod district. The farmers were contacted and data on jackfruit types were collected by visiting the homestead of each farmer. The information regarding location of the tree, age of the tree, fruiting season, bearing habit, number of fruits per tree per year, average fruit weight, shape of fruit, sweetness, texture of the flakes, suitability for processing are collected directly from the farmers. All together 400 jackfruit types were surveyed from various parts of Kasargod district including 29 panchayats and two municipalities. The observations recorded are location of the tree, age of the tree, texture of flakes, whether seedling or graft, fruiting season (from first harvest to last harvest), yield per tree (numbers/tree) and special characteristics if any.



From the jackfruit types surveyed, most promising 30 jackfruit types were selected for further characterization based on the following criteria:

- i) Bearing habit (regular bearing, off season bearing, bearing in clusters)
- ii) Period of fruit ripening (early ripening, off season ripening)
- iii) Yield (more number of fruits per tree)
- iv) Fruit size (medium sized fruits)
- v) More number of flakes per fruit
- vi) High TSS
- vii) Attractive colour and flavor of flakes
- viii) Suitability for chip making
- ix) Special characters such as seedlessness and gumlessness
- x) Flakeless jackfruit (for culinary purpose as tender jack).

## **Experiment 2: Characterization of jackfruit types**

### **3.3 Characterization**

Descriptor for jackfruit developed by IPGRI (2000) was used as a standard guideline for characterization of the selected jackfruit types. Morphological characterization was carried out based on the following morphological characters.

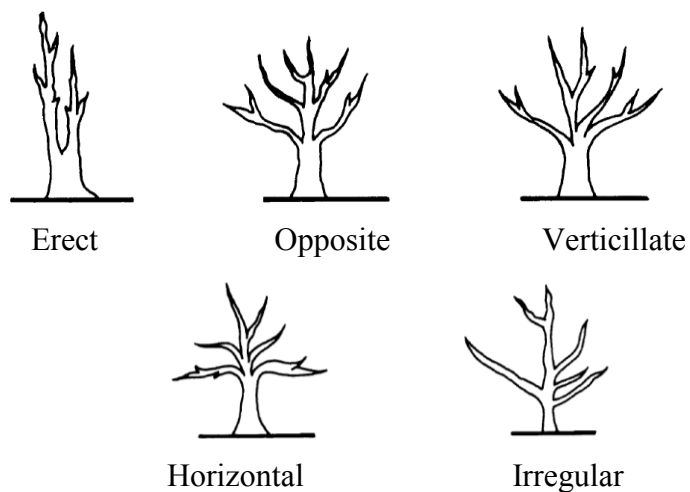
#### **3.3.1 Tree characters**

##### **3.3.1.1 Tree growth habit**

The growth habit of jackfruit trees were recorded as per the jackfruit descriptor (IPGRI, 2000) and are classified in to three groups namely erect, semi erect by visual observation.

##### **3.3.1.2 Branching pattern**

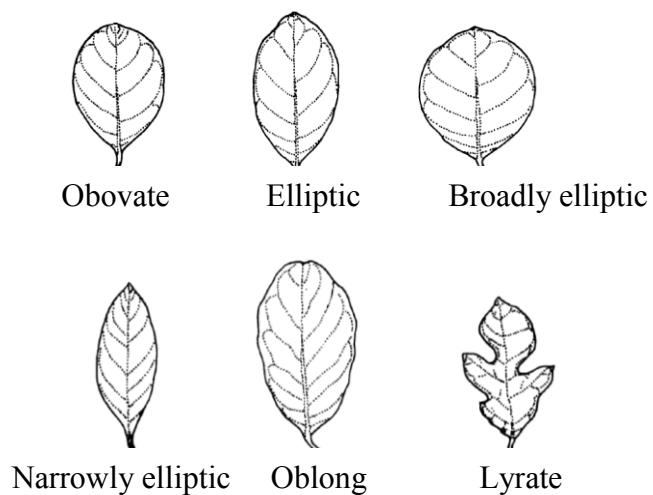
Branching pattern of the jackfruit trees were recorded and classified into erect, verticillate and irregular (Fig. 1.) as per IPGRI descriptor.



**Fig.1. Branching pattern of jackfruit as per IPGRI descriptor**

### 3.3.1.3 Leaf blade shape

The leaf blade shape of the jackfruit trees were recorded and classified into four groups such as obovate, elliptic, broadly elliptic and narrowly elliptic (Fig. 2.) as per IPGRI descriptor.



**Fig.2. Leaf blade shape of Jackfruit as per IPGRI descriptor**

#### **3.3.1.4 Leaf length (cm) and Leaf breadth (cm)**

Leaf length and breadth of five physiologically matured leaves of each tree were recorded.

#### **3.3.1.5 Leaf chlorophyll**

Leaf chlorophyll content was measured using SPAD chlorophyll meter and the values were expressed in terms of SPAD units.

#### **3.3.1.6 Stomatal density**

For counting the stomata, epidermal layer of abaxial side of the leaf was smeared with a thin layer of clear nail varnish as per the method described by Bajracharya (1999). The layer of nail varnish was detached from the leaf and the imprints of stomata were observed. Three imprints were taken respectively from the tip, middle and lower portion of three leaves per tree. These imprints were observed under compound microscope of  $40 \times 10$  magnification and the numbers of stomata were counted. The mean number were calculated and expressed as number of stomata per  $\text{mm}^2$  area.

### **3.3.2 Inflorescence characters**

#### **3.3.2.1. Date of first flowering**

Date of first flowering was recorded by observing the emergence of first inflorescence on each jackfruit trees.

#### **3.3.2.2 Position of female inflorescence**

Female inflorescence positions were recorded and classified into three groups  
a) on trunk and primary branches b) on trunk, primary and secondary branches and c) on the whole stem including primary, secondary and tertiary branches as per IPGRI descriptor.

### 3.3.2.3 Bearing habit

Information on bearing habit of each jackfruit type was collected directly from the farmers and are classified into three categories namely, regular, alternate and irregular as per IPGRI descriptor.

### 3.3.3 Fruit characters

#### 3.3.3.1 Fruiting season

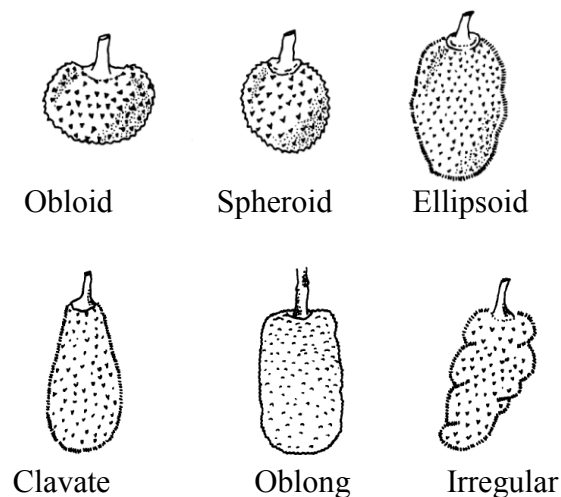
Fruiting season (number of days from first harvest to last harvest) of each jackfruit type was recorded.

#### 3.3.3.2 Number of fruits per tree

Total number of fruits per tree was counted and recorded.

#### 3.3.3.3 Fruit shape

Fruit shape of each jackfruit type was observed and categorized into obloid, spheroid, ellipsoid, clavate, oblong and irregular (Fig. 3.) as per IPGRI descriptor.



**Fig.3. Fruit shape of jackfruit as per IPGRI descriptor**

#### 3.3.3.4 Mean fruit weight (kg)

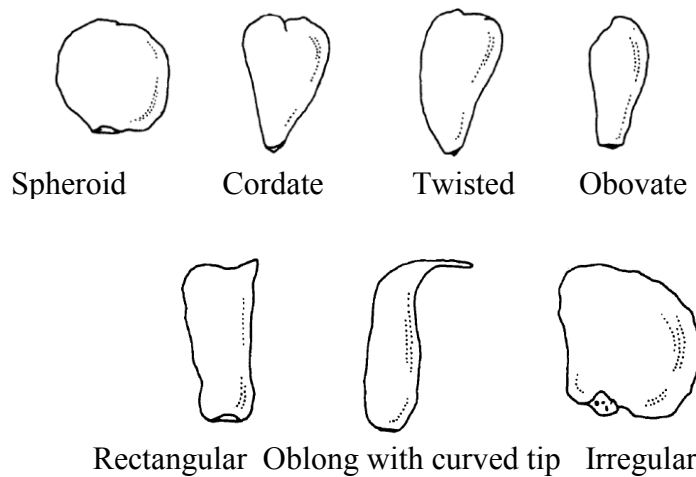
Fruit weight of mature ripe fruits of each jackfruit type was taken and their mean values were calculated. The fruit weight was expressed in kilo grams.

### 3.3.3.5 Number of flakes per fruit

Total number of flakes per fruit was counted and the mean values were calculated.

### 3.3.3.6 Flake shape

Flake shapes of each fruit from each jackfruit type was observed and are grouped into seven categories such as cordate, twisted, obovate, rectangular, oblong with curved tip, irregular and others (Fig. 4.) as per IPGRI descriptor.



**Fig.4. Flake shape of jackfruit as per IPGRI descriptor**

### 3.3.3.7 Flake colour

Colours of the flakes were recorded by visual observation at the ripening stage and were classified into deep yellow, yellow, light yellow and creamy white as per IPGRI descriptor.

### 3.3.3.8 Flake texture

Texture of the flakes were assessed based on the crispiness of the flakes and were grouped into soft and firm.

### 3.3.3.9 Flake thickness (cm)

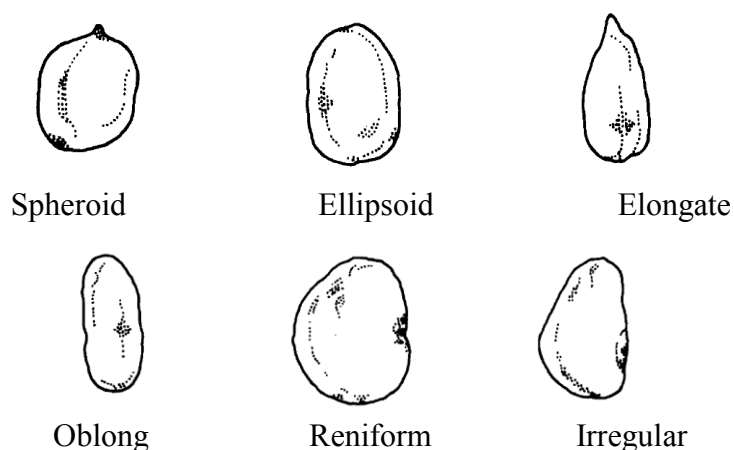
Thickness of the flakes at the base were measured using scale and recorded.

### 3.3.3.10 Weight of flakes (g)

All the flakes in a fruit were weighed without seed and expressed in gram.

### 3.3.3.11 Seed shape

Shapes of seeds of each jackfruit type was recorded and grouped into ellipsoid, elongate, oblong, reniform, irregular and others (Fig. 5.) per IPGRI descriptor.



**Fig.5. Seed shape of jackfruit as per IPGRI descriptor**

### 3.3.3.12 Weight of seeds (g)

Total weight of seeds per fruit was recorded and expressed in grams.

### 3.3.3.13 Flake percentage

The total flake weight per fruit was divided by total fruit weight and then multiplied with 100 to obtain the flake percentage.

### 3.3.3.14 Rind percentage

Weight of rind and core of each fruit was recorded and the rind percentage per fruit per fruit was also estimated.

### 3.3.3.15 Perigone percentage

Perigone weight of each fruit was measured and perigone percentage per fruit was also calculated.

### 3.3.3.16 Seed percentage

The total seed weight per fruit was recorded and seed percentage per fruit was calculated.

## 3.3.4 Fruit quality parameters

### 3.3.4.1 Sensory evaluation

Sensory evaluation was carried out using Hedonic scale, for taste, flavor, colour, texture, sweetness, appearance and overall acceptability. A scoring card (Appendix II) was prepared for the evaluation including all the quality parameters. Organoleptic evaluation of fruits was carried out by a panel of 20 members. Total score for each parameter was calculated separately by taking the average.

### 3.3.4.2 Biochemical analysis

#### 3.3.4.2.1 TSS

Total Soluble Solids (TSS) of jackfruit pulp was measured using Hand refractometer and expressed the values in °B.

#### 3.3.4.2.2 Reducing sugar

Reducing sugars were determined by adopting a procedure described by AOAC (1984). A known weight of the fruit sample was grinded and filtered through Whatman No. 4 filter paper. Weighed and transferred 25 g of the filtered solution into a 250 ml volumetric flask. Added 100 ml distilled water and neutralized with 1N NaOH. Added 2 ml of lead acetate solution. Excess lead acetate was removed by adding potassium oxalate solution and the volume was made up to 250 ml. The solution was filtered and the aliquot was titrated against the mixture of Fehling's solution A and B using methylene blue as indicator. The reducing sugar was expressed in percentage.

$$\text{Reducing sugar (\%)} = \frac{0.05 \times \text{volume made upto (250 ml)} \times 100}{\text{Titre Value} \times \text{Weight of fruit juice}}$$

### 3.3.4.2.3 Total sugar

For the estimation of total sugars, 50 ml clarified solution (prepared for the estimation of reducing sugar) was boiled for 10 minutes after adding 5 g of citric acid and 50 ml of water. It was neutralized using 1 N NaOH and made up to 250 ml. Titrated the made up solution against a mixture of Fehling's solution A and B. The total sugar was expressed in percentage (AOAC, 1984).

$$\text{Total sugar (\%)} = \frac{0.05 \times \text{Vol. made up to} \times \text{Vol. made up to after inversion} \times 100}{\text{Titre Value} \times 50 \times \text{Weight of the sample}}$$

### 3.3.4.2.4 Non-reducing Sugar

$$\text{Non reducing sugar (\%)} = \text{Total sugar (\%)} - \text{Reducing sugar (\%)}$$

### 3.3.4.2.5 Acidity as citric acid

For the estimation of acidity, 25 g of pulped fruit material was taken in a 250 ml beaker and boiled for 30 minutes after adding 100 ml of water. After cooling the content was transferred into a 250 ml volumetric flask and made up to 250 ml. 50 ml of the prepared sample was taken into a conical flask and titrated against 0.1 N NaOH using phenolphthalein as indicator. The acidity was expressed in terms of percentage (AOAC, 1984).

$$\text{Acidity (\%)} = \frac{\text{Titre Value} \times \text{Normality of alkali (0.1)} \times 0.064 \times \text{Volume made up} \times 100}{\text{Volume of aliquot} \times \text{Weight of sample}}$$

## 3.4 Statistical Analysis

The data collected as part of morphological characterization were subjected to statistical analysis. Coefficient of variation was calculated to find out the extend of variation in morphological and fruit characters among the 30 jackfruit types selected as per the method described by Rangaswamy (1995). Multiple correlations were worked out to find out the correlation between the morphological, physiological and



fruit characters (Jibouri *et al.*, 1958). Cluster analysis was carried out by between groups linkage method using SPSS 16.0 version, for the grouping the genotypes based on their similarity.

# **RESULTS**

## 4. RESULTS

The results of the study entitled “Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district” are presented in this chapter.

### Experiment 1

#### 4.1. Survey and identification of jackfruit types

##### 4.1.1 Location of jackfruit types

All together 400 jackfruit types were identified through survey. The survey covered 29 panchayats and two municipalities in Kasargod district of Kerala. Location of the jackfruit types identified and the name and address of the farmers who possess them are presented in Appendix I.

##### 4.1.2 Age of jackfruit types

The trees were categorized into three age groups as per the information given by the farmer *viz.*, below 25 years, between 25 to 50 years and above 50 years. Among the jackfruit trees surveyed, 238 trees belongs to the age group below 25 years, 156 belongs to the age group between 25 to 50 years and six trees belongs to age group above 50 years (Table 1).

**Table 1. Number of trees under different age group**

Age group	Below 25 years	25-50 years	Above 50 years	Total
Total number of trees	238	156	6	400
Percentage (%)	59.50	39.00	1.50	100

#### 4.1.3. Type of tree (Seedling/graft)

Out of the jackfruit trees surveyed 377 were of seedling origin and 23 were grafted plants. Total number of trees surveyed under each group was shown in Table 2.

**Table 2. Type of tree (seedling/graft)**

Type of planting material	Seedling	Graft	Total
Total number of trees	377	23	400
Percentage (%)	94.25	5.75	100

#### 4.1.4. Fruiting season

The data collected revealed that there were three fruit maturing seasons (Table 3) for jackfruit types identified. They were December –February, March – May and June –August. Out of 400 jackfruit types surveyed, the period of fruit maturity was March- May in 326 jackfruit types. Three jackfruit types were very early maturing, the fruits of which ripe by the end of December and harvesting was completed by the first week of February. Among the trees surveyed, 71 types were late maturing types.

**Table 3. Fruiting season**

Fruiting season	December – February	March –May	June –August	Total
Total number of trees	3	326	71	400
Percentage (%)	0.75	81.50	17.75	100

#### 4.1.5. Flake texture (Firm or soft fleshed)

Firm fleshed, soft fleshed and intermediate types were observed. Among the 400 trees surveyed, 84 % of trees were coming under firm fleshed type. The soft flesh types and intermediate ones contribute 15 % and 1 % respectively. The number of trees coming under each category are shown in Table 4.

**Table 4. Classification of jackfruit types based on flake texture**

Type of jackfruit	Firm fleshed	Soft fleshed	Intermediate type	Total
Total number of trees	336	60	4	400
Percentage (%)	84.00	15.00	1.00	100.00

#### 4.1.6 Yield per tree

The trees were grouped into five categories according to the number of fruits produced per tree per year. The five groups are a) trees producing upto 25 fruits/tree/year b) between 25 to 50 fruits/tree/year c) between 50 to 75 fruits/tree/year d) between 75 to 100 fruits/tree/year and e) above 100 fruits/tree/year. The data are presented in Table 5 and Fig. 6. Among the 400 trees surveyed, 18 trees produced more than 100 fruits per year and 33 trees produced 75 to 100 fruits per year. Production between 25 to 50 fruits per tree per year was more predominant among the jackfruit types surveyed (38%).

**Table 5. Number of trees under different yield groups (number of fruits/tree)**

Number of fruits/tree	Below 25	Between 25-50	Between 50-75	Between 75-100	Above 100	Total
Total number of trees	130	152	67	33	18	400
Percentage (%)	32.50	38.00	16.75	8.25	4.50	100.00

**4.1.6.1. Mean fruit weight**

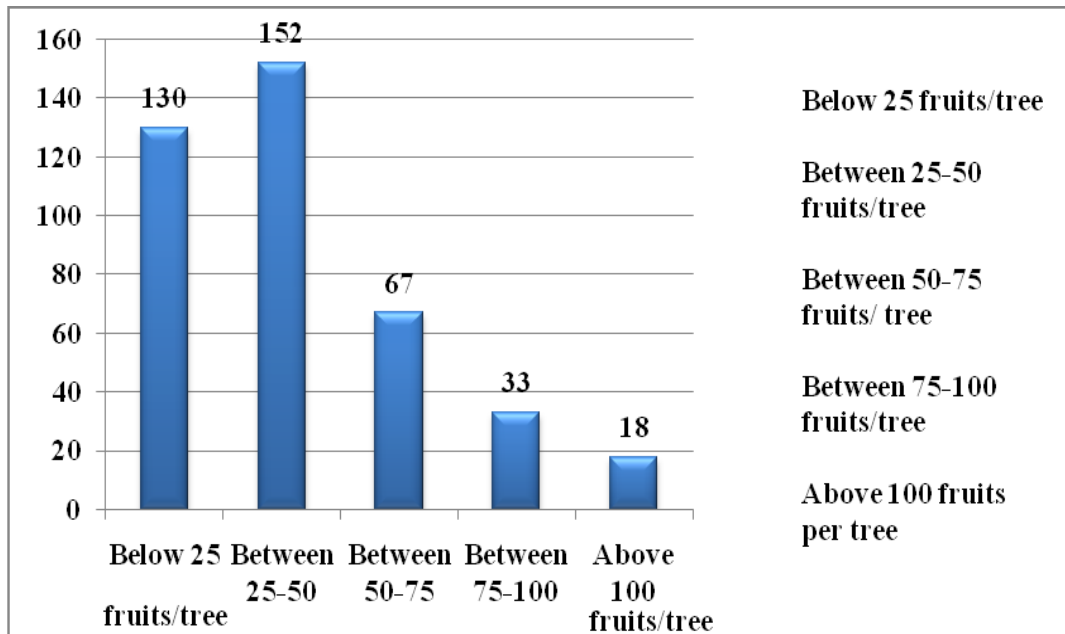
Mean fruit weight varied widely among the jackfruit trees surveyed. Out of 400 trees surveyed, fruit weight was between 10 to 20 kg in the case of 184 trees; whereas the fruit weight was between 5 to 10 kg in the case of 160 trees. The number of trees producing large sized fruits (20-40 kg) was comparatively less (4.75 %) (Table 6 and Fig. 7).

**Table 6. Number of trees under different categories based on mean fruit weight**

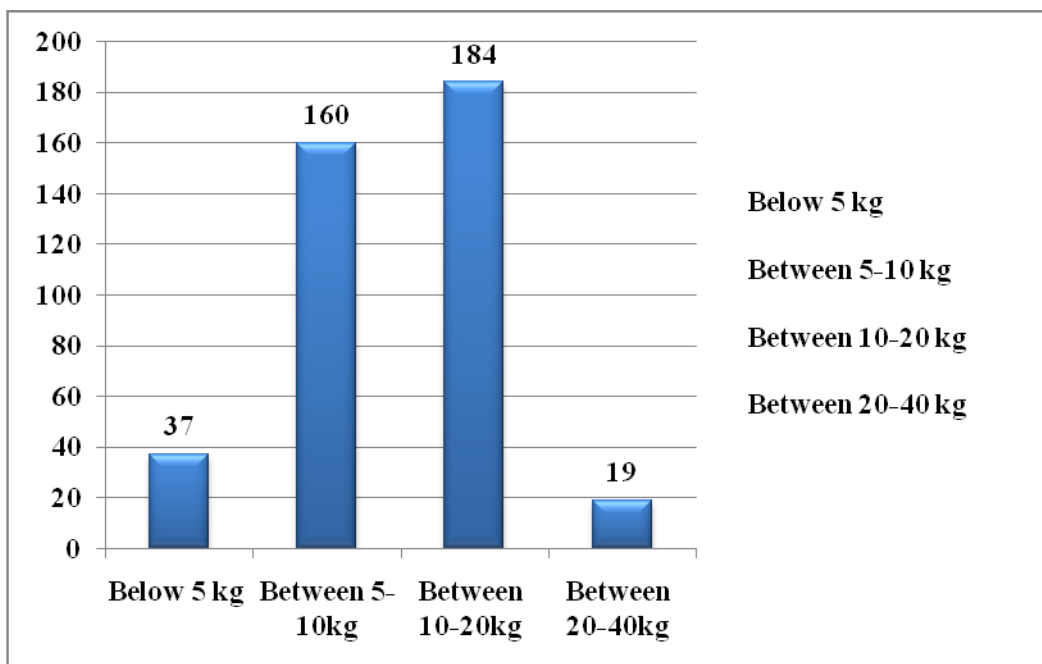
Fruit weight	Below 5 kg	Between 5-10kg	Between 10-20kg	Between 20-40kg	Total
Total number of trees	37	160	184	19	400
Percentage (%)	9.25	40.00	46.00	4.75	100.00

**4.1.6.2. Shape of fruit**

The fruit shapes observed were round, elliptic and oblong. Out of 400 trees surveyed, 280 trees produced fruits of elliptic shape, 109 trees produced round fruits and 11 trees produced oblong fruits (Table 7).



**Fig. 6. Number of trees under different yield groups (number of fruits/tree)**



**Fig. 7. Number of trees under different categories based on mean fruit weight**

**Table 7. Shape of fruit**

Fruit shape	Round	Elliptical	Oblong	Total
Total number of trees	109	280	11	400
Percentage (%)	27.25	70.00	2.75	100.00

**4.1.6.3 Sweetness of flakes**

Based on the sweetness of the ripe flakes the jackfruit types were categorized into four groups. They are flakes with less sweetness, medium sweetness, high sweetness and very high sweetness as per the information provided by the farmers. The jackfruit types under each category are presented in the Table 8. Sweetness was very high in 25 types.

**Table 8. Number of trees under different categories based on sweetness of flake**

Taste	Less sweet	Medium sweet	High sweet	Very high sweet	Total
Total number of trees	13	102	260	25	400
Percentage (%)	3.25	25.50	65.00	6.25	100.00

**4.1.6.4. Uses of fruits**

Out of the 400 jackfruit types surveyed 211 trees produce fruits which can be used for both desert and culinary purposes. Seventy trees produce fruits suitable for desert purpose, culinary purposes and for making chips.



**Table 9. Number of trees under different categories based on utility**

Uses	D	C	CH	D+C	C+CH	D+CH	D+C+CH	Total
Total number of trees	54	50	1	211	11	3	70	400

\* D- Dessert purpose, C- Culinary purpose, CH- Chip making

#### 4.1.6.5 Pattern of production

Out of 400 trees surveyed 359 trees exhibited regular bearing habit. Alternate bearing was noticed in 27 trees; while 14 trees possessed irregular bearing habit (Table 10).

**Table 10. Pattern of production**

Production pattern	Regular bearers	Alternate bearers	Irregular bearers	Total
Total number of trees	359	27	14	400
Percentage (%)	89.75	6.75	3.50	100.00

#### 4.1.7. Jackfruit types with special characters

Among the jackfruit types surveyed some trees possess certain special characteristics having economic importance. The details are presented Table 11.

**Table 11. Jackfruit types with special characters**

Special characters	Total number of trees
Seedless type (flakes with rudimentary seeds)	1
Gumless type	4
Flakelless type ideal for tender jack purpose with large number of fruits per tree	1
Fruit production more than thrice in a year	1
Fruiting three times in a year	1
Very early ripening type	2
Early ripening type	4
Late ripening type	4
Fruiting at collar region only	2
Bearing on entire trunk in clusters with small sized fruits in large numbers	1
Orange-yellow flakes	2
Golden yellow flakes	3
Fruits with thick flakes	7
Fruits with large sized flakes	8
Flakes with very thin seed	1
Flakes with very high TSS (above 25°B)	14

Among the 400 jackfruit types surveyed, one jackfruit type possesses rudimentary seeds with high flake percentage which is known as seedless jack among the farmers. This is a very rare character among the jackfruit types which can be included in future breeding programmes. Another jackfruit type exhibited the

character of flakelessness which is prolific bearer and is exclusively used as tender jack. Gumlessness was noticed in four jackfruit types which is a character preferred by farmers and consumers. Very early fruit ripening was observed in two types in which harvest is completed by first week of February when jackfruits are not available in the market. Out of the jackfruit types surveyed, 14 trees possessed high TSS (above 25 °B). Late ripening (August- September) with superior fruit quality was observed in four types which enable to market jackfruits in off season. A jackfruit type bearing more than thrice in a year was also observed.

The jackfruit types surveyed were serially numbered from 1 to 400 with a code KJ which stands for Kasargod Jackfruit types. The code numbers given to the jackfruit types surveyed are furnished in Appendix 1. The following most promising 28 jackfruit types were selected for morphological characterization along with two local checks namely Muttam varikka and Singapore jack as per descriptors for jackfruit by IPGRI (Table 12).

**Table 12. Jackfruit types selected for characterization**

Code number for Jackfruit type	Desirable traits
KJ 53	High TSS
KJ 54	High TSS
KJ 121	Fruiting more than thrice in a year, fruit production on trunk, primary, secondary and tertiary branches
KJ 168	More number of fruits per tree, more fruits at the lower part of main trunk, suitable for culinary and desert purpose.
KJ 173	Very small fruits without flakes (flakeless jack) which is exclusively used for tender jack purpose. More number of fruits
KJ 176	Early ripening, attractive flake colour, small to medium sized fruits
KJ 178	Gumlessness, high fruit yield, high TSS
KJ 179	High flake percentage, Large sized flakes, production on trunk, primary, secondary and tertiary branches
KJ 180	Seedlessness (flakes with rudimentary seeds),
KJ 182	High TSS, small to medium sized fruits produced in clusters. Fruit production on the whole trunk and on primary, secondary, tertiary
KJ 183	Off season ripening (August-September) with good fruit quality, More number of fruits per tree.
KJ 185	Very early ripening (January), high TSS, good flavor
KJ 186	Very early ripening, attractive flake colour, very high TSS,
KJ 221	More number of fruits per tree, medium sized fruit, production on main trunk, primary, secondary and tertiary branches.
KJ 223	More number of fruits per tree, medium sized fruits, good for chip making
KJ 224	High TSS, medium sized fruit
KJ 226	High TSS

KJ 227	High TSS, attractive colour and shape of flake
KJ 243	Compact tree growth, late ripening during rainy season with good quality flakes.
KJ 354	Late ripening, high flake percentage
KJ 356	High TSS, more number of fruits, late ripening during rainy season with good fruit quality
KJ 357	Late maturing, excellent fruit quality for culinary purpose during monsoon season, more number of medium sized fruits
KJ 391	More number of fruits, medium sized fruits, good flake colour and good quality flakes in rainy season
KJ 392	Attractive fruit shape, attractive flake colour, high flake percentage
KJ 394	High TSS, small to medium sized fruits
KJ 396	Gumless type, less perigone percentage
KJ 397	Gumless, high TSS, high flake percentage, low perigone percentage
KJ 398	Late ripening, good quality fruits during off season, high flake percentage
Muttam varikka	Local check
Singapore jack	Local check

#### 4.2. Characterization of jackfruit types

The results of morphological characterization of the 30 jackfruit types as per IPGRI descriptor are presented below (Table 13 to Table 42 and Plate 1 to Plate 30).

**Table 13. Morphological characterization of Jackfruit type : KJ 53**

Location	Smt. Radha. T, Madhuramkkai, Uppilikkai P.O, Kanhangad
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	16.00
Leaf breadth (cm)	10.00
Leaf chlorophyll (SPAD Unit)	51.68
Stomatal density per mm <sup>2</sup>	7.48
<b>Inflorescence characters</b>	
Date of first flowering	11 <sup>th</sup> February (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days from first harvest to last harvest)	65 (March-May)
Number of fruits per tree	17
Fruit shape	Oblong
Mean fruit weight (kg)	8.40
Fruit length (cm)	39.50
Fruit diameter (cm)	22.19
Number of flakes/fruit	301
Flake shape	Cordate
Flake colour	Light yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.10
Total flake weight (without seed in g)	2160
Mean flake weight	7.18
Seed shape	Irregular
Total seed weight (g)	1830
Mean seed weight	6.08
Flake (%)	25.71
Rind (%)	31.56
Perigone (%)	20.95
Seed (%)	21.79
<b>Fruit quality parameters</b>	
TSS (°B)	25.00
Total sugars (%)	21.30
Reducing sugar (%)	8.10
Non reducing sugar (%)	13.20
Acidity (%)	1.12
Sensory evaluation	
Taste	7.10
Flavor	6.35
Colour	5.65
Texture	6.80
Sweetness	7.00
Appearance	6.80
Overall acceptability	7.10

Name of farmer: Smt. Radha. T, Madhuramkkai, Uppilikkai P.O, Kanhangad

**Table 14. Morphological characterization of Jackfruit type : KJ 54**

Location	Smt. Radha. T, Madhuramkkai, Uppilikkai P.O, Kanhangad
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	12.00
Leaf breadth (cm)	7.70
Leaf chlorophyll (SPAD Unit)	57.90
Stomatal density per mm <sup>2</sup>	7.04
<b>Inflorescence characters</b>	
Date of first flowering	4 <sup>th</sup> February (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	65 (March-May)
Number of fruits per tree	22
Fruit shape	Oblong
Mean fruit weight (kg)	9.18
Fruit length (cm)	34.95
Fruit diameter (cm)	23.24
Number of flakes/fruit	182
Flake shape	Rectangular
Flake colour	Light yellow
Flake texture	Firm
Flake thickness (at the base in cm)	1.14



Total flake weight (without seed in g)	3350
Mean flake weight (g)	18.46
Seed shape	Irregular
Total seed weight (g)	1230
Mean seed weight (g)	6.78
Flake (%)	36.49
Rind (%)	27.89
Perigone (%)	22.23
Seed (%)	13.39
<b>Fruit quality parameters</b>	
TSS (°B)	25.00
Total sugars (%)	21.24
Reducing sugar (%)	8.26
Non reducing sugar (%)	12.98
Acidity (%)	1.28
Sensory evaluation	
Taste	7.95
Flavor	7.20
Colour	7.30
Texture	7.50
Sweetness	7.95
Appearance	7.45
Overall acceptability	7.70

Name of farmer: Smt. Radha. T, Madhuramkkai, Uppilikkai P.O, Kanhangad



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 01. Fruit characters of KJ 53



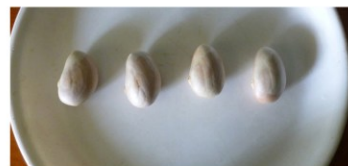
Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 02. Fruit characters of KJ 54

**Table 15. Morphological characterization of Jackfruit type : KJ 121**

Location	Smt. Janaki. K, Kadayangal House, Kanhangad South, Padannakkad P.O
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Elliptic
Leaf length (cm)	10.50
Leaf breadth (cm)	7.50
Leaf chlorophyll (SPAD Unit)	58.02
Stomatal density per mm <sup>2</sup>	6.86
<b>Inflorescence characters</b>	
Date of first flowering	4 <sup>th</sup> January (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches.
<b>Fruit characters</b>	
Fruiting season (No. of days)	92 (March- May)
Number of fruits per tree	44
Fruit shape	Clavate
Mean fruit weight (kg)	4.90
Fruit length (cm)	34.00
Fruit diameter (cm)	13.21
Number of flakes/fruit	40
Flake shape	Oblong with curved tip
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.40
Total flake weight (without seed in g)	1240
Mean flake weight (g)	31.00
Seed shape	Reniform
Total seed weight (g)	280
Mean seed weight (g)	7.00
Flake (%)	25.31
Rind (%)	38.98
Perigone (%)	30.00
Seed (%)	5.71
<b>Fruit quality parameters</b>	
TSS (°B)	24.00
Total sugars (%)	22.28
Reducing sugar (%)	8.79
Non reducing sugar (%)	13.49
Acidity (%)	0.14
Sensory evaluation	
Taste	6.55
Flavor	6.40
Colour	7.40
Texture	6.30
Sweetness	5.75
Appearance	6.40
Overall acceptability	6.55

Name of the farmer: Smt. Janaki. K, Kadayangal House, Kanhangad South, Padannakkad P.O

**Table 16. Morphological characterization of Jackfruit type : KJ 168**

Location	Sri. P. Ramachandran Adiyodi, Padinhattath House, Kodakkad P.O, Pala, Anikady
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Narrowly elliptic
Leaf length (cm)	14.40
Leaf breadth (cm)	8.00
Leaf chlorophyll (SPAD Unit)	62.06
Stomatal density per mm <sup>2</sup>	6.98
<b>Inflorescence characters</b>	
Date of first flowering	28 <sup>th</sup> January (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	131(March- May)
Number of fruits per tree	75
Fruit shape	Oblong
Mean fruit weight (kg)	8.38
Fruit length (cm)	36.50
Fruit diameter (cm)	19.10
Number of flakes/fruit	288
Flake shape	Irregular
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.21
Total flake weight (without seed in g)	2650
Mean flake weight (g)	9.20
Seed shape	Irregular
Total seed weight (g)	2100
Mean seed weight (g)	7.30
Flake (%)	31.62
Rind (%)	28.88
Perigone (%)	14.44
Seed (%)	25.06
<b>Fruit quality parameters</b>	
TSS (°B)	21.00
Total sugars (%)	19.50
Reducing sugar (%)	6.98
Non reducing sugar (%)	12.52
Acidity (%)	0.11
Sensory evaluation	
Taste	5.95
Flavor	5.85
Colour	5.75
Texture	6.15
Sweetness	5.95
Appearance	6.10
Overall acceptability	6.10

Name of the farmer: Sri. P. Ramachandran Adiyodi, Padinhattath House, Kodakkad P.O, Pala, Anikady



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 03. Fruit characters of KJ 121



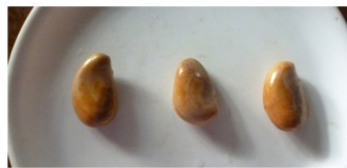
Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 04. Fruit characters of KJ 168

**Table 17. Morphological characterization of Jackfruit type : KJ 173**

Location	Sri. Lakshmanan. K, Kannothe House, Udhinoor P.O, Padanna, Padanna Panchayat.
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	14.50
Leaf breadth (cm)	8.10
Leaf chlorophyll (SPAD Unit)	52.16
Stomatal density per mm <sup>2</sup>	6.75
<b>Inflorescence characters</b>	
Date of first flowering	26 <sup>th</sup> December (Year-2014)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	67 (March- May)
Number of fruits per tree	183
Fruit shape	Oblong
Mean fruit weight (kg)	1.85
Fruit length (cm)	24.5
Fruit diameter (cm)	16.56
Number of flakes/fruit	Nil
Flake shape	NA
Flake colour	NA
Flake texture	NA



Flake thickness at the base (cm)	NA
Total flake weight (g)	NA
Seed shape	NA
Total seed weight (g)	NA
Flake (%)	Nil
Rind (%)	44.05
Perigone (%)	55.95
Seed (%)	Nil

Name of the farmer: Sri. Lakshmanan. K, Kannothe House, Udhinoor P.O, Padanna, Padanna Panchayat.

**Table 18. Morphological characterization of Jackfruit type : KJ 176**

Location	Sri. Abdul Khadar. K, Kallangadi House, Ujjrikkara P.O, Mogral-Puthur, Mogral- Puthur panchayat.
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Broadly elliptic
Leaf length (cm)	16.00
Leaf breadth (cm)	8.30
Leaf chlorophyll (SPAD Unit)	56.02
Stomatal density per mm <sup>2</sup>	7.48
<b>Inflorescence characters</b>	
Date of first flowering	15 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	44 (March-May)
Number of fruits per tree	13
Fruit shape	Clavate
Mean fruit weight (kg)	4.03
Fruit length (cm)	42.50
Fruit diameter (cm)	19.42
Number of flakes/fruit	55
Flake shape	Obovate
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.20
Total flake weight (without seed in g)	927.00
Mean flake weight (g)	16.85
Seed shape	Reniform
Total seed weight (g)	472.00
Mean seed weight (g)	8.57
Flake (%)	23.00
Rind (%)	44.42
Perigone (%)	20.87
Seed (%)	11.71
<b>Fruit quality parameters</b>	
TSS (°B)	24.00
Total sugars (%)	21.10
Reducing sugar (%)	8.37
Non reducing sugar (%)	12.73
Acidity (%)	2.09
<b>Sensory evaluation</b>	
Taste	7.80
Flavor	7.30
Colour	7.80
Texture	7.55
Sweetness	7.60
Appearance	7.55
Overall acceptability	7.60

Name of the farmer: Sri. Abdul Khadar. K, Kallangadi House, Ujjrikkara P.O, Mogral-Puthur, Mogral-Puthur panchayat.



Fruit



Longitudinal section of the fruit



Perigones

**Plate 05. Fruit characters of KJ 173**



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 06. Fruit characters of KJ 176**

**Table 19. Morphological characterization of Jackfruit type : KJ 178**

Location	Sri. Abdul Khadar. K, Kallangadi House, Ujjrikkara P.O, Mogral-Puthur, Mogral- Puthur panchayat.
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Broadly elliptic
Leaf length (cm)	12.50
Leaf breadth (cm)	7.10
Leaf chlorophyll (SPAD Unit)	71.24
Stomatal density per mm <sup>2</sup>	9.32
<b>Inflorescence characters</b>	
Date of first flowering	3 <sup>rd</sup> November (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	76 (December-February)
Number of fruits per tree	62
Fruit shape	Ellipsoid
Mean fruit weight (kg)	13.50
Fruit length (cm)	48.50
Fruit diameter (cm)	16.56
Number of flakes/fruit	132
Flake shape	Rectangular
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.16
Total flake weight (without seed in g)	4230
Mean flake weight (g)	32.05
Seed shape	Reniform
Total seed weight (g)	2480
Mean seed weight (g)	18.79
Flake (%)	31.40
Rind (%)	41.30
Perigone (%)	8.90
Seed (%)	18.40
<b>Fruit quality parameters</b>	
TSS (°B)	30.50
Total sugars (%)	25.19
Reducing sugar (%)	12.49
Non reducing sugar (%)	12.70
Acidity (%)	0.06
Sensory evaluation	
Taste	7.75
Flavor	7.45
Colour	7.80
Texture	7.30
Sweetness	7.55
Appearance	7.75
Overall acceptability	7.55

Name of the farmer: Sri. Abdul Khadar. K, Kallangadi House, Ujjrikkara P.O, Mogral-Puthur Panchayat.

**Table 20. Morphological characterization of Jackfruit type : KJ 179**

Location	Sri. Ramakrishnan.K, R.S. Nilayam, Kootakkani, Pakkam P.O, Pallikkara Panchayat
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	13.50
Leaf breadth (cm)	8.50
Leaf chlorophyll (SPAD Unit)	57.66
Stomatal density per mm <sup>2</sup>	3.89
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> January (Year-2015)
Female inflorescence position	Mainly on trunk, primary and secondary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	71(March-May)
Number of fruits per tree	34
Fruit shape	Ellipsoid
Mean fruit weight (kg)	11.68
Fruit length (cm)	37.25
Fruit diameter (cm)	25.58
Number of flakes/fruit	116
Flake shape	Twisted
Flake colour	Light yellow

Flake texture	Firm
Flake thickness (at the base in cm)	1.60
Total flake weight (without seed in g)	4905
Mean flake weight (g)	42.47
Seed shape	Reniform
Total seed weight (g)	1420
Mean seed weight (g)	12.29
Flake (%)	42.04
Rind (%)	27.56
Perigone (%)	18.24
Seed (%)	12.16
<b>Fruit quality parameters</b>	
TSS (°B)	24.50
Total sugars (%)	21.29
Reducing sugar (%)	8.72
Non reducing sugar (%)	12.57
Acidity (%)	0.12
Sensory evaluation	
Taste	8.65
Flavor	8.15
Colour	7.20
Texture	7.95
Sweetness	8.85
Appearance	8.05
Overall acceptability	8.30

Name of the farmer: Sri. Ramakrishnan.K, R.S. Nilayam, Koottakkani, Pakkam P.O, Pallikkara Panchayat





Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 07. Fruit characters of KJ 178



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 08. Fruit characters of KJ 179

**Table 21. Morphological characterization of Jackfruit type : KJ 180**

Location	Sri. Ramakrishnan. K, R.S. Nilayam, Pakkam P.O, Koottakkani
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Elliptic
Leaf length (cm)	15.20
Leaf breadth (cm)	8.20
Leaf chlorophyll (SPAD Unit)	55.80
Stomatal density per mm <sup>2</sup>	7.37
<b>Inflorescence characters</b>	
Date of first flowering	15 <sup>th</sup> March (Year-2015)
Female inflorescence position	Mainly on trunk, primary and secondary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	51 (May- August)
Number of fruits per tree	8
Fruit shape	Clavate
Mean fruit weight (kg)	10.53
Fruit length (cm)	40.00
Fruit diameter (cm)	24.37
Number of flakes/fruit	459
Flake shape	Rectangular
Flake colour	Light yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.14
Total flake weight (without seed in g)	5860
Mean flake weight (g)	12.77
Seed shape	Irregular
Total seed weight (g)	400.50
Mean seed weight (g)	0.87
Flake (%)	55.70
Rind (%)	27.64
Perigone (%)	12.87
Seed (%)	3.79
<b>Fruit quality parameters</b>	
TSS (°B)	18.50
Total sugars (%)	17.68
Reducing sugar (%)	7.12
Non reducing sugar (%)	10.56
Acidity (%)	2.50
Sensory evaluation	
Taste	5.45
Flavor	5.50
Colour	6.20
Texture	6.60
Sweetness	5.30
Appearance	6.75
Overall acceptability	6.30

Name of the farmer: Sri. Ramakrishnan. K, R.S. Nilayam, Pakkam P.O, Koottakkani

**Table 22. Morphological characterization of Jackfruit type : KJ 182**

Location	Sri. Abdul Rasak, Noushad Manzil, Chirappuram, Nileswar Municipality
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Elliptic
Leaf length (cm)	14.10
Leaf breadth (cm)	9.20
Leaf chlorophyll (SPAD Unit)	48.54
Stomatal density per mm <sup>2</sup>	5.36
<b>Inflorescence characters</b>	
Date of first flowering	20 <sup>th</sup> December (year-2014)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	153 (March- May)
Number of fruits per tree	112
Fruit shape	Spheroid
Mean fruit weight (kg)	2.31
Fruit length (cm)	18.80
Fruit diameter (cm)	16.80
Number of flakes/fruit	44
Flake shape	Irregular
Flake colour	Light yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.38
Total flake weight (without seed in g)	840
Mean flake weight (g)	19.24
Seed shape	Reniform
Total seed weight (g)	290
Mean seed weight (g)	6.64
Flake (%)	36.36
Rind (%)	30.30
Perigone (%)	20.78
Seed (%)	12.56
<b>Fruit quality parameters</b>	
TSS (°B)	30.50
Total sugars (%)	24.95
Reducing sugar (%)	12.37
Non reducing sugar (%)	12.58
Acidity (%)	0.07
Reducing sugar (%)	12.37
Sensory evaluation	
Taste	7.75
Flavor	6.35
Colour	6.45
Texture	7.10
Sweetness	7.65
Appearance	6.85
Overall acceptability	7.35

Name of the farmer: Sri. Abdul Rasak, Noushad Manzil, Chirappuram, Nileswar Municipality



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 09. Fruit characters of KJ 180



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 10. Fruit characters of KJ 182

**Table 23. Morphological characterization of Jackfruit type : KJ 183**

Location	Sri. Ramdas. P.M, Puthukkai Madam, Chirappuram, Nileswar
Seedling /Graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	12.20
Leaf breadth (cm)	7.50
Leaf chlorophyll (SPAD Unit)	65.08
Stomatal density per mm <sup>2</sup>	8.44
<b>Inflorescence characters</b>	
Date of first flowering	15 <sup>th</sup> January (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	62 (June –August)
Number of fruits per tree	65
Fruit shape	Oblong
Mean fruit weight (kg)	5.89
Fruit length (cm)	37.00
Fruit diameter (cm)	18.60
Number of flakes/fruit	104
Flake shape	Oblong with curved tip
Flake colour	Light yellow
Flake texture	Firm
Flake thickness (at the base in cm)	1.08

Total flake weight (without seed in g)	2040
Mean flake weight (g)	19.62
Seed shape	Reniform
Total seed weight (g)	690
Mean seed weight (g)	6.63
Flake (%)	34.63
Rind (%)	39.39
Perigone (%)	14.27
Seed (%)	11.71
<b>Fruit quality parameters</b>	
TSS (°B)	24.25
Total sugars (%)	21.07
Reducing sugar (%)	8.63
Non reducing sugar (%)	12.44
Acidity (%)	0.91
Sensory evaluation	
Taste	7.60
Flavor	7.45
Colour	7.95
Texture	7.55
Sweetness	7.95
Appearance	7.65
Overall acceptability	7.70

Name of the farmer: Sri. Ramdas. P.M, Puthukkai Madam, Chirappuram, Nileswar



**Table 24. Morphological characterization of Jackfruit type : KJ 185**

Location	Sri. Kunjabdulla, Sahidha Manzil, Pallikkara, Nileswar Municipality.
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Elliptic
Leaf length (cm)	13.50
Leaf breadth (cm)	6.50
Leaf chlorophyll (SPAD Unit)	56.30
Stomatal density per mm <sup>2</sup>	6.15
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> October (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	16 (December- February)
Number of fruits per tree	6
Fruit shape	Ellipsoid
Mean fruit weight (kg)	6.00
Fruit length (cm)	31.00
Fruit diameter (cm)	18.20
Number of flakes/fruit	51
Flake shape	Oblong with curved tip
Flake colour	Yellow
Flake texture	Firm
Flake thickness (at the base in cm)	1.2

Total flake weight (without seed in g)	1580
Mean flake weight (g)	30.98
Seed shape	Reniform
Total seed weight (g)	1180
Mean seed weight (g)	23.14
Flake (%)	26.33
Rind (%)	35.33
Perigone (%)	18.66
Seed (%)	19.66
<b>Fruit quality parameters</b>	
TSS (°B)	26.00
Total sugars (5)	22.29
Reducing sugar (%)	8.84
Non reducing sugar (%)	13.45
Acidity (%)	0.08
Sensory evaluation	
Taste	7.75
Flavor	7.70
Colour	7.90
Texture	7.45
Sweetness	8.45
Appearance	7.85
Overall acceptability	7.80

Name of the farmer: Sri. Kunjabdulla, Sahidha Manzil, Pallikkara, Nileswar Municipality.



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 11. Fruit characters of KJ 183**



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 12. Fruit characters of KJ 185**

**Table 25. Morphological characterization of Jackfruit type : KJ 186**

Location	Sri. Pramod M, Taliyathil House, Karuvacheri, Nileswar P.O
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Semi erect
Branching pattern	Opposite
Leaf blade shape	Elliptic
Leaf length (cm)	14.30
Leaf breadth (cm)	8.00
Leaf chlorophyll (SPAD Unit)	53.88
Stomatal density per mm <sup>2</sup>	7.52
<b>Inflorescence characters</b>	
Date of first flowering	21 <sup>st</sup> October (Year-2014)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	39 (December- February)
Number of fruits per tree	6
Fruit shape	Clavate
Mean fruit weight (kg)	12.02
Fruit length (cm)	48.50
Fruit diameter (cm)	16.80
Number of flakes/fruit	200
Flake shape	Oblong with curved tip
Flake colour	Deep yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.14
Total flake weight (without seed in g)	5780
Mean flake weight (g)	28.90
Seed shape	Reniform
Total seed weight (g)	1640
Mean seed weight (g)	8.20
Flake (%)	48.09
Rind (%)	24.46
Perigone (%)	13.81
Seed (%)	13.64
<b>Fruit quality parameters</b>	
TSS (°B)	31.00
Total sugars (%)	23.95
Reducing sugar (%)	11.87
Non reducing sugar (%)	12.08
Acidity (%)	0.11
Sensory evaluation	
Taste	8.45
Flavor	8.45
Colour	8.45
Texture	8.00
Sweetness	8.60
Appearance	8.20
Overall acceptability	8.60

Name of the farmer: Sri. Pramod M, Taliyathil House, Karuvacheri, Nileswar P.O

**Table 26. Morphological characterization of Jackfruit type : KJ 221**

Location	Sri. Chandran. P, Near Sri Sankaranarayana temple, Madhuramkkai, Uppilikkai P.O, Kanhangad Municipality.
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Elliptic
Leaf length (cm)	12.70
Leaf breadth (cm)	7.20
Leaf chlorophyll (SPAD Unit)	59.26
Stomatal density per mm <sup>2</sup>	5.63
<b>Inflorescence characters</b>	
Date of first flowering	27 <sup>th</sup> January (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	78 (March-May)
Number of fruits per tree	78
Fruit shape	Oblong
Mean fruit weight (kg)	7.13
Fruit length (cm)	38.00
Fruit diameter (cm)	19.58
Number of flakes/fruit	201
Flake shape	Rectangular
Flake colour	Light yellow

Flake texture	Firm
Flake thickness (at the base in cm)	1.21
Total flake weight (without seed in g)	2290
Mean flake weight (g)	11.42
Seed shape	Irregular
Total seed weight (g)	2250
Mean seed weight (g)	11.22
Flake (%)	32.11
Rind (%)	25.38
Perigone (%)	11.00
Seed (%)	31.55
<b>Fruit quality parameters</b>	
TSS (°B)	21.00
Total sugars (%)	19.40
Reducing sugar (%)	7.03
Non reducing sugar (%)	12.37
Acidity (%)	0.12
Sensory evaluation	
Taste	7.65
Flavor	7.00
Colour	6.75
Texture	7.05
Sweetness	7.60
Appearance	7.25
Overall acceptability	7.35

Name of the farmer: Sri. Chandran. P, Near Sri Sankaranarayana temple, Madhuramkkai, Uppilikkai P.O, Kanhangad Municipality.



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 13. Fruit characters of KJ 186



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 14. Fruit characters of KJ 221



**Table 27. Morphological characterization of Jackfruit type : KJ 223**

Location	Smt. Radha. V, Vattak House, Palayi, Puthariyadukkam P.O, Nileswar Municipality
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Elliptic
Leaf length (cm)	14.10
Leaf breadth (cm)	8.80
Leaf chlorophyll (SPAD Unit)	52.70
Stomatal density per mm <sup>2</sup>	7.28
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> January (Year-2015)
Female inflorescence position	Mainly on the trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	118 (March –May)
Number of fruits per tree	86
Fruit shape	Clavate
Mean fruit weight (kg)	5.56
Fruit length (cm)	34.00
Fruit diameter (cm)	20.85
Number of flakes/fruit	152
Flake shape	Oblong with curved tip
Flake colour	Deep yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.22
Total flake weight (without seed in g)	1710
Mean flake weight (g)	11.25
Seed shape	Elongate
Total seed weight (g)	820
Mean seed weight (g)	5.39
Flake (%)	30.76
Rind (%)	32.91
Perigone (%)	21.58
Seed (%)	14.75
<b>Fruit quality parameters</b>	
TSS (°B)	21.00
Total sugars (%)	19.66
Reducing sugar (%)	7.12
Non reducing sugar (%)	12.54
Acidity (%)	0.15
Sensory evaluation	
Taste	6.60
Flavor	6.80
Colour	6.45
Texture	6.70
Sweetness	6.90
Appearance	6.35
Overall acceptability	6.70

Name of the farmer: Smt. Radha. V, Vattak House, Palayi, Puthariyadukkam P.O, Nileswar Municipality

**Table 28. Morphological characterization of Jackfruit type : KJ 224**

Location	Smt. Radha. V, Vattak House, Palayi, Puthariyadukkam P.O, Nileswar municipality
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Elliptic
Leaf length (cm)	15.10
Leaf breadth (cm)	9.50
Leaf chlorophyll (SPAD Unit)	64.18
Stomatal density per mm <sup>2</sup>	6.78
<b>Inflorescence characters</b>	
Date of first flowering	30 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	73 (March-May)
Number of fruits per tree	51
Fruit shape	Oblong
Mean fruit weight (kg)	6.31
Fruit length (cm)	30.50
Fruit diameter (cm)	20.06
Number of flakes/fruit	125
Flake shape	Obovate
Flake colour	Light yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.12
Total flake weight (without seed in g)	1930
Mean flake weight (g)	15.44
Seed shape	Irregular
Total seed weight (g)	1720
Mean seed weight (g)	13.76
Flake (%)	30.58
Rind (%)	31.69
Perigone (%)	10.46
Seed (%)	27.27
<b>Fruit quality parameters</b>	
TSS (°B)	30.50
Total sugars (%)	25.40
Reducing sugar (%)	12.59
Non reducing sugar (%)	12.81
Acidity (%)	0.11
Sensory evaluation	
Taste	8.20
Flavor	8.15
Colour	8.50
Texture	8.45
Sweetness	8.30
Appearance	7.40
Overall acceptability	8.45

Name of the farmer: Smt. Radha. V, Vattak House, Palayi, Puthariyadukkam P.O, Nileswar municipality



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 15. Fruit characters of KJ 223



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 16. Fruit characters of KJ 224

**Table 29. Morphological characterization of Jackfruit type : KJ 226**

Location	Sri. Janardhanan. P, Podora, Palayi, Puthariyadukkam P.O, Nileswar municipality
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	14.80
Leaf breadth (cm)	8.80
Leaf chlorophyll (SPAD Unit)	57.62
Stomatal density per mm <sup>2</sup>	5.85
<b>Inflorescence characters</b>	
Date of first flowering	16 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	32 (March- May)
Number of fruits per tree	12
Fruit shape	Oblong
Mean fruit weight (kg)	8.20
Fruit length (cm)	32.00
Fruit diameter (cm)	23.88
Number of flakes/fruit	171
Flake shape	Obovate
Flake colour	Deep yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.18
Total flake weight (without seed in g)	3170
Mean flake weight (g)	18.54
Seed shape	Oblong
Total seed weight (g)	940
Mean seed weight (g)	5.49
Flake (%)	38.66
Rind (%)	26.71
Perigone (%)	23.17
Seed (%)	11.46
<b>Fruit quality parameters</b>	
TSS (°B)	27.00
Total sugars (%)	23.00
Reducing sugar (%)	10.17
Non reducing sugar (%)	12.83
Acidity (%)	0.09
Sensory evaluation	
Taste	7.20
Flavor	7.15
Colour	7.30
Texture	7.25
Sweetness	6.70
Appearance	7.25
Overall acceptability	6.95

Name of the farmer: Sri. Janardhanan. P, Podora, Palayi, Puthariyadukkam P.O, Nileswar municipality

**Table 30. Morphological characterization of Jackfruit type : KJ 227**

Location	Sri. Janardhanan. P, Podora, Palayi, Puthariyadukkam P.O, Nileswar Municipality
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Narrowly elliptic
Leaf length (cm)	11.40
Leaf breadth (cm)	6.10
Leaf chlorophyll (SPAD Unit)	57.32
Stomatal density per mm <sup>2</sup>	10.63
<b>Inflorescence characters</b>	
Date of first flowering	27 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	25 (March- May)
Number of fruits per tree	10
Fruit shape	Clavate
Mean fruit weight (kg)	5.12
Fruit length (cm)	41.00
Fruit diameter (cm)	10.19
Number of flakes/fruit	109
Flake shape	Others
Flake colour	Deep yellow
Flake texture	Firm



Flake thickness (at the base in cm)	1.18
Total flake weight (without seed in g)	1640
Mean flake weight (g)	15.12
Seed shape	Oblong
Total seed weight (g)	1035
Mean seed weight (g)	9.54
Flake (%)	32.06
Rind (%)	32.82
Perigone (%)	13.88
Seed (%)	21.24
<b>Fruit quality parameters</b>	
TSS (°B)	29.00
Total sugars (%)	23.95
Reducing sugar (%)	11.25
Non reducing sugar (%)	12.70
Acidity (%)	0.07
Sensory evaluation	
Taste	7.25
Flavor	7.30
Colour	7.90
Texture	7.45
Sweetness	7.10
Appearance	7.80
Overall acceptability	7.55

Name of the farmer: Sri. Janardhanan. P, Podora, Palayi, Puthariyadukkam P.O, Nileswar Municipality



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 17. Fruit characters of KJ 226



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 18. Fruit characters of KJ 227

**Table 31. Morphological characterization of Jackfruit type : KJ 243**

Location	Sri. Ramesh. P, Sreedevi Sadhanam, Karuvacheri, Nileswar Municipality
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Broadly elliptic
Leaf length (cm)	22.00
Leaf breadth (cm)	13.50
Leaf chlorophyll (SPAD Unit)	46.04
Stomatal density per mm <sup>2</sup>	6.51
<b>Inflorescence characters</b>	
Date of first flowering	27 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	93 (June- August)
Number of fruits per tree	21
Fruit shape	Clavate
Mean fruit weight (kg)	5.62
Fruit length (cm)	33.00
Fruit diameter (cm)	20.44
Number of flakes/fruit	78
Flake shape	Irregular
Flake colour	Creamy white
Flake texture	Firm
Flake thickness (at the base in cm)	0.94

Total flake weight (without seed in g)	1580
Mean flake weight (g)	20.26
Seed shape	Other
Total seed weight (g)	790
Mean seed weight (g)	10.13
Flake (%)	28.11
Rind (%)	31.14
Perigone (%)	26.69
Seed (%)	14.06
<b>Fruit quality parameters</b>	
TSS (°B)	18.00
Total sugars (%)	16.73
Reducing sugar (%)	6.73
Non reducing sugar (%)	10.00
Acidity (%)	0.09
Sensory evaluation	
Taste	6.95
Flavor	5.90
Colour	5.40
Texture	6.65
Sweetness	6.95
Appearance	5.25
Overall acceptability	6.55

Name of the farmer: Sri. Ramesh. P, Sreedevi Sadhanam, Karuvacheri, Nileswar Municipality

**Table 32. Morphological characterization of Jackfruit type : KJ 354**

Location	Sri. Gopi.M.T, Valliyod Tharavad, Uduma P.O, Uduma
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	18.00
Leaf breadth (cm)	8.50
Leaf chlorophyll (SPAD Unit)	59.00
Stomatal density per mm <sup>2</sup>	9.01
<b>Inflorescence characters</b>	
Date of first flowering	14 <sup>th</sup> February (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	28 (June –August)
Number of fruits per tree	34
Fruit shape	Oblong
Mean fruit weight (kg)	13.49
Fruit length (cm)	39.10
Fruit diameter (cm)	26.97
Number of flakes/fruit	180
Flake shape	Rectangular
Flake colour	Creamy white
Flake texture	Firm
Flake thickness (at the base in cm)	1.24

Total flake weight (without seed in g)	5560
Mean flake weight (g)	30.89
Seed shape	Elongate
Total seed weight (g)	1700
Mean seed weight (g)	9.44
Flake (%)	41.22
Rind (%)	33.73
Perigone (%)	12.45
Seed (%)	12.60
<b>Fruit quality parameters</b>	
TSS (°B)	17.00
Total sugars (%)	16.25
Reducing sugar (%)	6.54
Non reducing sugar (%)	9.71
Acidity (%)	0.92
Sensory evaluation	
Taste	8.05
Flavor	7.30
Colour	6.70
Texture	7.50
Sweetness	7.95
Appearance	6.65
Overall acceptability	7.55

Name of the farmer: Sri. Gopi.M.T, Valliyod Tharavad, Uduma P.O, Uduma



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 19. Fruit characters of KJ 243



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 20. Fruit characters of KJ 354

**Table 33. Morphological characterization of Jackfruit type : KJ 356**

Location	Smt. Kunjamma. K, Kelamvalappil, Bevuri, Uduma P.O, Uduma Panchatyat
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Elliptic
Leaf length (cm)	16.80
Leaf breadth (cm)	8.10
Leaf chlorophyll (SPAD Unit)	56.90
Stomatal density per mm <sup>2</sup>	6.39
<b>Inflorescence characters</b>	
Date of first flowering	18 <sup>th</sup> January (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	81 (June- August)
Number of fruits per tree	52
Fruit shape	Oblong
Mean fruit weight (kg)	9.21
Fruit length (cm)	35.40
Fruit diameter (cm)	19.74
Number of flakes/fruit	110
Flake shape	Twisted
Flake colour	Yellow
Flake texture	Firm



Flake thickness (at the base in cm)	1.18
Total flake weight (without seed in g)	3980
Mean flake weight (g)	36.18
Seed shape	Reniform
Total seed weight (g)	2010
Mean seed weight (g)	18.27
Flake (%)	43.21
Rind (%)	22.80
Perigone (%)	12.17
Seed (%)	21.82
<b>Fruit quality parameters</b>	
TSS (°B)	31.00
Total sugars (%)	25.60
Reducing sugar (%)	12.69
Non reducing sugar (%)	12.91
Acidity (%)	0.08
Sensory evaluation	
Taste	8.50
Flavor	7.80
Colour	7.80
Texture	8.15
Sweetness	8.65
Appearance	8.25
Overall acceptability	8.45

Name of the farmer: Smt. Kunjamma. K, Kalamvalappil, Bevuri, Uduma P.O, Uduma Panchatyat

**Table 34. Morphological characterization of Jackfruit type : KJ 357**

Location	Smt. Rohini. K. V, Kuramban valappu, Uduma P.O, Uduma
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	14.00
Leaf breadth (cm)	8.40
Leaf chlorophyll (SPAD Unit)	63.74
Stomatal density per mm <sup>2</sup>	7.45
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> February (Year-2015)
Female inflorescence position	Mainly on trunk, primary and secondary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	132 (June- August)
Number of fruits per tree	73
Fruit shape	Other
Mean fruit weight (kg)	7.77
Fruit length (cm)	28.00
Fruit diameter (cm)	23.88
Number of flakes/fruit	145
Flake shape	Other
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.26
Total flake weight (without seed in g)	2700
Mean flake weight (g)	18.62
Seed shape	Irregular
Total seed weight (g)	1150
Mean seed weight (g)	7.93
Flake (%)	34.85
Rind (%)	37.06
Perigone (%)	13.29
Seed (%)	14.80
<b>Fruit quality parameters</b>	
TSS (°B)	28.00
Total sugars (%)	23.13
Reducing sugar (%)	11.47
Non reducing sugar (%)	11.66
Acidity (%)	0.08
<b>Sensory evaluation</b>	
Taste	6.90
Flavor	6.05
Colour	6.30
Texture	6.95
Sweetness	6.95
Appearance	6.80
Overall acceptability	6.95

Name of the farmer: Smt. Rohini. K. V, Kuramban valappu, Uduma P.O, Uduma



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 21. Fruit characters of KJ 356



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 22. Fruit characters of KJ 357

**Table 35. Morphological characterization of Jackfruit type : KJ 391**

Location	Sri. Jojo George, Attupuram, Kottody P.O, Kallar Panchayat
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Narrowly elliptic
Leaf length (cm)	11.70
Leaf breadth (cm)	6.50
Leaf chlorophyll (SPAD Unit)	63.58
Stomatal density per mm <sup>2</sup>	6.83
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> March (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	47 (June- August)
Number of fruits per tree	68
Fruit shape	Spheroid
Mean fruit weight (kg)	5.26
Fruit length (cm)	27.50
Fruit diameter (cm)	20.38
Number of flakes/fruit	73
Flake shape	Irregular
Flake colour	Deep yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.26
Total flake weight (without seed in g)	1730
Mean flake weight (g)	23.69
Seed shape	Irregular
Total seed weight (g)	690
Mean seed weight (g)	9.45
Flake (%)	32.88
Rind (%)	36.69
Perigone (%)	17.32
Seed (%)	13.11
<b>Fruit quality parameters</b>	
TSS (°B)	21.00
Total sugars (%)	25.77
Reducing sugar (%)	12.69
Non reducing sugar (%)	13.08
Acidity (%)	1.80
<b>Sensory evaluation</b>	
Taste	8.05
Flavor	6.80
Colour	7.00
Texture	7.30
Sweetness	8.20
Appearance	7.50
Overall acceptability	7.70

Name of the farmer: Sri. Jojo George, Attupuram, Kottody P.O, Kallar Panchayat

**Table 36. Morphological characterization of Jackfruit type : KJ 392**

Location	Sri. Jojo George, Attupuram, Kottody P.O, Kallar
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Elliptic
Leaf length (cm)	10.90
Leaf breadth (cm)	8.40
Leaf chlorophyll (SPAD Unit)	52.18
Stomatal density per mm <sup>2</sup>	8.69
<b>Inflorescence characters</b>	
Date of first flowering	3 <sup>rd</sup> March (Year-2015)
Female inflorescence position	Mainly on trunk, primary and secondary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	71 (June- August)
Number of fruits per tree	45
Fruit shape	Spheroid
Mean fruit weight (kg)	11.13
Fruit length (cm)	30.70
Fruit diameter (cm)	27.07
Number of flakes/fruit	333
Flake shape	Others
Flake colour	Deep yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.28
Total flake weight (without seed in g)	5090
Mean flake weight (g)	15.28
Seed shape	Elongate
Total seed weight (g)	1920
Mean seed weight (g)	5.76
Flake (%)	45.73
Rind (%)	25.97
Perigone (%)	11.05
Seed (%)	17.25
<b>Fruit quality parameters</b>	
TSS (°B)	20.00
Total sugars (%)	19.12
Reducing sugar (%)	7.83
Non reducing sugar (%)	11.29
Acidity (%)	2.10
Sensory evaluation	
Taste	7.95
Flavor	7.80
Colour	7.80
Texture	8.25
Sweetness	7.70
Appearance	7.75
Overall acceptability	7.85

Name of the farmer: Sri. Jojo George, Attupuram, Kottody P.O, Kallar





Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 23. Fruit characters of KJ 391



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 24. Fruit characters of KJ 392

**Table 37. Morphological characterization of Jackfruit type : KJ 394**

Location	Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat
Seedling /graft	Graft
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	18.70
Leaf breadth (cm)	10.20
Leaf chlorophyll (SPAD Unit)	66.94
Stomatal density per mm <sup>2</sup>	6.90
<b>Inflorescence characters</b>	
Date of first flowering	8 <sup>th</sup> January (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	83 (March- May)
Number of fruits per tree	32
Fruit shape	Irregular
Mean fruit weight (kg)	4.55
Fruit length (cm)	38.5
Fruit diameter (cm)	18.21
Number of flakes/fruit	96
Flake shape	Irregular
Flake colour	Yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.2
Total flake weight (without seed in g)	750
Mean flake weight (g)	7.81
Seed shape	Ellipsoid
Total seed weight (g)	920
Mean seed weight (g)	9.58
Flake (%)	16.48
Rind (%)	44.18
Perigone (%)	19.13
Seed (%)	20.21
<b>Fruit quality parameters</b>	
TSS (°B)	30.00
Total sugars (%)	24.78
Reducing sugar (%)	12.28
Non reducing sugar (%)	12.50
Acidity (%)	0.82
Sensory evaluation	
Taste	7.65
Flavor	7.55
Colour	8.00
Texture	5.00
Sweetness	7.85
Appearance	5.55
Overall acceptability	7.35

Name of the farmer: Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat

**Table 38. Morphological characterization of Jackfruit type : KJ 396**

Location	Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Narrowly elliptic
Leaf length (cm)	12.00
Leaf breadth (cm)	4.20
Leaf chlorophyll (SPAD Unit)	61.22
Stomatal density per mm <sup>2</sup>	6.67
<b>Inflorescence characters</b>	
Date of first flowering	15 <sup>th</sup> January (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	81 (March- May)
Number of fruits per tree	28
Fruit shape	Oblong
Mean fruit weight (kg)	7.33
Fruit length (cm)	45.00
Fruit diameter (cm)	18.2
Number of flakes/fruit	162
Flake shape	Rectangular
Flake colour	Creamy white
Flake texture	Firm

Flake thickness (at the base in cm)	1.01
Total flake weight (without seed in g)	2750
Mean flake weight (g)	16.98
Seed shape	Irregular
Total seed weight (g)	1980
Mean seed weight (g)	12.22
Flake (%)	37.52
Rind (%)	28.37
Perigone (%)	7.09
Seed (%)	27.02
<b>Fruit quality parameters</b>	
TSS (°B)	15.00
Total sugars (%)	14.13
Reducing sugar (%)	5.57
Non reducing sugar (%)	8.56
Acidity (%)	0.82
Sensory evaluation	
Taste	6.45
Flavor	6.45
Colour	5.25
Texture	6.70
Sweetness	5.55
Appearance	4.70
Overall acceptability	5.35

Name of the farmer: Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 25. Fruit characters of KJ 394



Fruit



Longitudinal section of the fruit



Flakes



Seeds

Plate 26. fruit characters of KJ 396

**Table 39. Morphological characterization of Jackfruit type : KJ 397**

Location	Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Narrowly elliptic
Leaf length (cm)	11.50
Leaf breadth (cm)	6.50
Leaf chlorophyll (SPAD Unit)	57.94
Stomatal density per mm <sup>2</sup>	7.74
<b>Inflorescence characters</b>	
Date of first flowering	30 <sup>th</sup> January (Year-2015)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	65 (March- May)
Number of fruits per tree	25
Fruit shape	Ellipsoid
Mean fruit weight (kg)	10.00
Fruit length (cm)	37.90
Fruit diameter (cm)	23.56
Number of flakes/fruit	346
Flake shape	Obovate
Flake colour	Creamy white
Flake texture	Firm

Flake thickness (at the base in cm)	1.08
Total flake weight (without seed in g)	4780
Mean flake weight (g)	13.82
Seed shape	Irregular
Total seed weight (g)	2190
Mean seed weight (g)	6.33
Flake (%)	47.80
Rind (%)	22.20
Perigone (%)	8.10
Seed (%)	21.90
<b>Fruit quality parameters</b>	
TSS (°B)	25.00
Total sugars (%)	24.77
Reducing sugar (%)	11.30
Non reducing sugar (%)	13.47
Acidity (%)	0.11
Sensory evaluation	
Taste	8.55
Flavor	8.05
Colour	7.60
Texture	8.15
Sweetness	8.50
Appearance	7.95
Overall acceptability	8.30

Name of the farmer: Sri. Kesava Bhatt, Kamadhenu Farm, Ramdas Nagar P.O, Kudlu, Mogral Puthur Panchayat



**Table 40. Morphological characterization of Jackfruit type : KJ 398**

Location	Sri.Rajan. A. George, Alackaparambil House, Panathadi P.O
Seedling /graft	Seedling
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Irregular
Leaf blade shape	Elliptic
Leaf length (cm)	13.50
Leaf breadth (cm)	8.00
Leaf chlorophyll (SPAD Unit)	55.98
Stomatal density per mm <sup>2</sup>	8.76
<b>Inflorescence characters</b>	
Date of first flowering	4 <sup>th</sup> March (Year-2015)
Female inflorescence position	On the whole stem including primary, secondary and tertiary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	38 (June –August)
Number of fruits per tree	55
Fruit shape	Oblong
Mean fruit weight (kg)	10.32
Fruit length (cm)	40.20
Fruit diameter (cm)	24.44
Number of flakes/fruit	178
Flake shape	Cordate
Flake colour	Light yellow
Flake texture	Firm

Flake thickness (at the base in cm)	1.42
Total flake weight (without seed in g)	4160
Mean flake weight (g)	23.44
Seed shape	Irregular
Total seed weight (g)	1320
Mean flake weight (g)	7.44
Flake (%)	40.31
Rind (%)	22.48
Perigone (%)	24.42
Seed (%)	12.79
<b>Fruit quality parameters</b>	
TSS (°B)	24.00
Total sugars (%)	21.95
Reducing sugar (%)	8.06
Non reducing sugar (%)	13.89
Acidity (%)	2.00
Sensory evaluation	
Taste	8.40
Flavor	8.20
Colour	8.20
Texture	8.30
Sweetness	8.70
Appearance	8.40
Overall acceptability	8.55

Name of the farmer: Sri.Rajan A George, Alackaparambil House, Panathadi P.O



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 27. Fruit characters of KJ 397**



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 28. Fruit characters of KJ 398**

**Table 41. Morphological characterization of Muttam varikka (Local check)**

Location	Dr. Ganapathy Bhatt, Kakunje (H), Nileswar P.O, Nileswar
Seedling /graft	Graft
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Erect
Leaf blade shape	Obovate
Leaf length (cm)	11.30
Leaf breadth (cm)	8.10
Leaf chlorophyll (SPAD Unit)	52.92
Stomatal density per mm <sup>2</sup>	7.56
<b>Inflorescence characters</b>	
Date of first flowering	16 <sup>th</sup> December (Year-2014)
Female inflorescence position	Mainly on trunk and primary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	35 (December – February)
Number of fruits per tree	18
Fruit shape	Ellipsoid
Mean fruit weight (kg)	7.91
Fruit length (cm)	36.00
Fruit diameter (cm)	18.47
Number of flakes/fruit	210
Flake shape	Cordate
Flake colour	Light yellow
Flake texture	Firm
Flake thickness (at the base in cm)	1.20

Total flake weight (without seed in g)	3160
Mean flake weight (g)	15.05
Seed shape	Oblong
Total seed weight (g)	1310
Mean seed weight (g)	6.24
Flake (%)	39.95
Rind (%)	27.94
Perigone (%)	15.55
Seed (%)	16.56
<b>Fruit quality parameters</b>	
TSS (°B)	20.00
Total sugars (%)	19.49
Reducing sugar (%)	7.79
Non reducing sugar (%)	11.70
Acidity (%)	0.12
Sensory evaluation	
Taste	6.50
Flavor	7.05
Colour	6.95
Texture	7.15
Sweetness	6.10
Appearance	7.55
Overall acceptability	6.65

Name of the farmer: Dr. Ganapathy Bhatt, Kakunje (H), Nileswar P.O, Nileswar

**Table 42. Morphological characterization of Singapore jack (Local check)**

Location	Instructional Farm, College of Agriculture Padannakkad, Padannakkad P.O, Nileswar
Seedling /graft	Graft
<b>Tree characters</b>	
Tree growth habit	Erect
Branching pattern	Verticillate
Leaf blade shape	Obovate
Leaf length (cm)	11.10
Leaf breadth (cm)	7.20
Leaf chlorophyll (SPAD Unit)	51.80
Stomatal density per mm <sup>2</sup>	5.80
<b>Inflorescence characters</b>	
Date of first flowering	2 <sup>nd</sup> January (Year-2015)
Female inflorescence position	On trunk, primary and secondary branches
<b>Fruit characters</b>	
Fruiting season (No. of days)	62 (March- May)
Number of fruits per tree	57
Fruit shape	Oblong
Mean fruit weight (kg)	6.76
Fruit length (cm)	37.60
Fruit diameter (cm)	19.49
Number of flakes/fruit	181
Flake shape	Irregular
Flake colour	Yellow
Flake texture	Firm
Flake thickness (cm)	1.28

Total flake weight (without seed in g)	2730
Mean flake weight (g)	15.08
Seed shape	Irregular
Total seed weight (g)	1240
Mean seed weight (g)	6.85
Flake (%)	40.38
Rind (%)	29.73
Perigone (%)	11.54
Seed (%)	18.35
<b>Fruit quality parameters</b>	
TSS (°B)	29.00
Total sugars (%)	21.24
Reducing sugar (%)	8.73
Non reducing sugar (%)	12.51
Acidity (%)	1.17
Sensory evaluation	
Taste	7.65
Flavor	6.90
Colour	7.05
Texture	6.60
Sweetness	7.45
Appearance	6.80
Overall acceptability	7.15

Name of the institute: Instructional Farm, College of Agriculture Padannakkad, Padannakkad  
P.O, Nileswar.



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 29. Fruit characters of Muttam varikka**



Fruit



Longitudinal section of the fruit



Flakes



Seeds

**Plate 30. Fruit characters of Singapore jack**



The tree characters of the 30 jackfruit types are presented in Table 43.

**Table 43. Tree characters of jackfruit types**

Jackfruit types	Tree characters						
	Tree growth habit	Branching pattern	Leaf blade shape	Leaf length (cm)	Leaf breadth (cm)	Leaf chlorophyll (SPAD units)	Stomatal density(per mm <sup>2</sup> )
KJ 53	Erect	Irregular	Elliptic	16.00	8.30	51.68	9.09
KJ 54	Erect	Irregular	Elliptic	15.20	8.20	57.90	7.04
KJ 121	Erect	Erect	Elliptic	13.50	8.50	58.02	6.86
KJ 168	Erect	Erect	Narrowly elliptic	14.10	9.20	62.06	6.98
KJ 173	Erect	Irregular	Elliptic	12.20	7.50	52.16	6.75
KJ 176	Erect	Irregular	Broadly elliptic	13.50	6.50	56.02	7.48
KJ 178	Erect	Verticillate	Broadly elliptic	12.00	4.20	71.24	9.32
KJ 179	Erect	Irregular	Elliptic	18.70	10.20	57.66	3.89
KJ 180	Erect	Verticillate	Elliptic	11.50	6.50	55.80	7.37
KJ 182	Erect	Verticillate	Elliptic	11.10	7.20	48.54	5.36
KJ 183	Erect	Irregular	Elliptic	14.30	8.00	65.08	8.44
KJ 185	Erect	Erect	Elliptic	11.70	6.50	56.30	6.15
KJ 186	Semi erect	Opposite	Elliptic	11.30	8.10	53.88	7.52
KJ 221	Erect	Verticillate	Elliptic	12.00	7.70	59.26	5.63
KJ 223	Erect	Verticillate	Elliptic	16.00	10.00	52.70	7.28
KJ 224	Erect	Verticillate	Elliptic	10.50	7.50	64.18	6.78
KJ 226	Erect	Irregular	Elliptic	14.40	8.00	57.62	5.85
KJ 227	Erect	Irregular	Narrowly elliptic	14.50	8.10	57.32	10.63
KJ 243	Erect	Verticillate	Broadly elliptic	14.10	8.80	46.04	6.51
KJ 354	Erect	Irregular	Elliptic	15.10	9.50	59.00	9.01
KJ 356	Erect	Erect	Elliptic	14.80	8.80	56.90	6.39
KJ 357	Erect	Irregular	Elliptic	11.40	6.10	63.74	7.45
KJ 391	Erect	Erect	Broadly elliptic	22.00	13.50	63.58	6.83
KJ 392	Erect	Erect	Elliptic	14.00	8.40	52.18	8.69
KJ 394	Erect	Irregular	Elliptic	16.80	8.10	66.94	6.90
KJ 396	Erect	Irregular	Narrowly elliptic	18.00	8.50	61.22	6.67
KJ 397	Erect	Irregular	Narrowly elliptic	13.50	8.00	57.94	7.74
KJ 398	Erect	Irregular	Elliptic	10.90	8.40	55.98	8.76
Muttam Varikka	Erect	Erect	Obovate	12.50	7.10	52.92	7.56
Singapore jack	Erect	Verticillate	Obovate	12.70	7.20	51.80	5.80
Mean	-	-	-	13.94	8.08	57.52	7.22
CV (%)	-	-	-	539.88	512.17	1033.90	530.00

All the jackfruit types except KJ 186 exhibited erect growth habit. The branching pattern observed are erect, verticillate, opposite and irregular. Among the jackfruit types, elliptical leaf blade shape was observed in 19 trees. Obovate, narrowly elliptic and broadly elliptic are the other leaf blade shapes observed. The leaf length varied from 10.50 to 22.00 cm and the leaf breadth varied from 4.20 to 13.50 cm. Among the jackfruit types, KJ 178 recorded the highest leaf chlorophyll content (71.24 SPAD units). Stomatal density was maximum in case of KJ 227 (10.63 per 7.065 mm<sup>2</sup>).

The inflorescence characters are presented in Table 44. Among the jackfruit types, KJ 185 was the earliest in flowering. The date of first flowering in this type is 2<sup>nd</sup> October during the year 2014. Flowering was late in KJ 180, KJ 391, KJ 392 and KJ 398. In these types, flowering started only during March. In KJ 180, flowering started only during 3<sup>rd</sup> week of March. Among the jackfruit types, female inflorescence was produced on the whole stem including primary, secondary and tertiary branches in 9 jackfruit types. In all other types female inflorescences are found only in main trunk and primary branches.

The fruit characters of the jackfruit types subjected to characterization are presented in Table 45a, 45b and 45c. The fruiting season was maximum in KJ 182 (153 days) and was minimum in KJ 185 (16 days). Among the jackfruit types, KJ 173 produced the highest number of fruits per tree (183). The fruit shapes observed were oblong, clavate, ellipsoid and spheroid.

Among the jackfruit types, the mean fruit weight was below 5 kg in KJ 121, KJ 173, KJ 182, and KJ 394 and between 5 to 10 kg in 14 types. The jackfruit type KJ 180 recorded the maximum number of flakes per fruit (459). Cordate, rectangular, obovate, oblong with curved tip, twisted and irregular are the flake shape observed. Deep yellow, yellow, light yellow and creamy white are the flake colour observed. Flake texture was firm in all the jackfruit types characterized.

**Table 44. Inflorescence characters of jackfruit types.**

Jackfruit types	Inflorescence characters	
	Date of first flowering	Position of female inflorescence
KJ 53	11 <sup>th</sup> February	Mainly on trunk and primary branches
KJ 54	04 <sup>th</sup> February	Mainly on trunk and primary branches
KJ 121	04 <sup>th</sup> January	On the whole stem including primary, secondary and tertiary branches.
KJ 168	28 <sup>th</sup> January	On the whole stem including primary, secondary and tertiary branches.
KJ 173	26 <sup>th</sup> December	On the whole stem including primary, secondary and tertiary branches.
KJ 176	15 <sup>th</sup> December	Mainly on trunk and primary branches
KJ 178	3 <sup>rd</sup> November	Mainly on trunk and primary branches
KJ 179	2 <sup>nd</sup> January	Mainly on trunk, primary and secondary branches
KJ 180	15 <sup>th</sup> March	Mainly on trunk, primary and secondary branches
KJ 182	20 <sup>th</sup> December	On the whole stem including primary, secondary and tertiary branches.
KJ 183	15 <sup>th</sup> January	Mainly on trunk and primary branches
KJ 185	2 <sup>nd</sup> October	Mainly on trunk and primary branches
KJ 186	21 <sup>st</sup> October	On the whole stem including primary, secondary and tertiary branches.
KJ 221	27 <sup>th</sup> January	On the whole stem including primary, secondary and tertiary branches.
KJ 223	2 <sup>nd</sup> January	Mainly on trunk and primary branches
KJ 224	30 <sup>th</sup> December	Mainly on trunk and primary branches
KJ 226	16 <sup>th</sup> December	Mainly on trunk and primary branches
KJ 227	27 <sup>th</sup> December	Mainly on trunk and primary branches
KJ 243	27 <sup>th</sup> December	Mainly on trunk and primary branches
KJ 354	14 <sup>th</sup> February	Mainly on trunk and primary branches
KJ 356	18 <sup>th</sup> January	On the whole stem including primary, secondary and tertiary branches.
KJ 357	02 <sup>nd</sup> February	Mainly on trunk, primary and secondary branches
KJ 391	02 <sup>nd</sup> march	On the whole stem including primary, secondary and tertiary branches.
KJ 392	03 <sup>rd</sup> march	Mainly on trunk, primary and secondary branches
KJ 394	08 <sup>th</sup> January	Mainly on trunk and primary branches
KJ 396	15 <sup>th</sup> January	Mainly on trunk and primary branches
KJ 397	39 <sup>th</sup> January	Mainly on trunk and primary branches
KJ 398	04 <sup>th</sup> March	On the whole stem including primary, secondary and tertiary branches.
Muttam Varikka	11 <sup>th</sup> February	Mainly on trunk and primary branches
Singapore jack	4 <sup>th</sup> February	Mainly on trunk and primary branches

**Table 45a. Fruit characters of jackfruit types**

Jackfruit types	Fruit characters					
	Days from first to last harvest	Number of fruits per tree	Fruit shape	Mean fruit weight (kg)	Number of flakes per fruit	Flake shape
KJ 53	65	17	Oblong	8.40	301	Cordate
KJ 54	65	22	Oblong	9.18	182	Rectangular
KJ 121	92	44	Clavate	4.90	40	Oblong with curved tip
KJ 168	131	75	Oblong	8.38	288	Irregular
KJ 173	67	183	Oblong	1.85	0	NA
KJ 176	44	13	Clavate	4.03	55	Obovate
KJ 178	76	62	Ellipsoid	13.50	132	Rectangular
KJ 179	71	34	Ellipsoid	11.68	116	Twisted
KJ 180	51	8	Clavate	10.53	459	Rectangular
KJ 182	153	112	Spheroid	2.31	44	Irregular
KJ 183	62	65	Oblong	5.89	104	Oblong with curved tip
KJ 185	16	6	Ellipsoid	6.00	51	Oblong with curved tip
KJ 186	39	6	Clavate	12.02	200	Oblong with curved tip
KJ 221	78	78	Oblong	7.13	201	Rectangular
KJ 223	118	86	Clavate	5.56	152	Oblong with curved tip
KJ 224	73	51	Oblong	6.31	125	Obovate
KJ 226	32	12	Oblong	8.20	171	Obovate
KJ 227	25	10	Clavate	5.12	109	Others
KJ 243	93	21	Clavate	5.62	78	Irregular
KJ 354	28	34	Oblong	13.49	180	Rectangular
KJ 356	81	52	Oblong	9.21	110	Twisted
KJ 357	132	73	Others	7.77	145	Others
KJ 391	47	68	Spheroid	5.26	73	Irregular
KJ 392	71	45	Spheroid	11.13	333	Other
KJ 394	83	32	Irregular	4.55	96	Irregular
KJ 396	81	28	Oblong	7.33	162	Rectangular
KJ 397	65	25	Ellipsoid	10.00	346	Obovate
KJ 398	38	55	Oblong	10.32	178	Cordate
Muttam Varikka	35	18	Ellipsoid	7.91	210	Cordate
Singapore jack	62	57	Oblong	6.76	181	Irregular
Mean	69.13	46.40	-	7.67	160.73	-
CV (%)	210.07	123.48	-	254.10	156.74	-

**Table 45b. Fruit characters of jackfruit types**

Jackfruit types	Fruit characters					
	Flake colour	Flake texture	Flake Thickness (cm)	Total weight of flakes (g)	Mean flake weight (g)	Seed shape
KJ 53	Light yellow	Firm	1.10	2160	7.18	Irregular
KJ 54	Light yellow	Firm	1.14	3350	18.46	Irregular
KJ 121	Yellow	Firm	1.40	1240	31.00	Reniform
KJ 168	Yellow	Firm	1.21	2650	9.20	Irregular
KJ 173	NA	NA	NA	NA	NA	NA
KJ 176	Yellow	Firm	1.20	927	16.85	Reniform
KJ 178	Yellow	Firm	1.16	4230	32.05	Reniform
KJ 179	Light yellow	Firm	1.60	4905	42.47	Reniform
KJ 180	Light yellow	Firm	1.14	5860	12.77	Irregular
KJ 182	Light yellow	Firm	1.38	840	19.24	Reniform
KJ 183	Light yellow	Firm	1.08	2040	19.62	Reniform
KJ 185	Yellow	Firm	1.20	1580	30.98	Reniform
KJ 186	Deep yellow	Firm	1.14	5780	28.90	Reniform
KJ 221	Light yellow	Firm	1.21	2290	11.42	Irregular
KJ 223	Deep yellow	Firm	1.22	1710	11.25	Elongate
KJ 224	Light yellow	Firm	1.12	1930	15.44	Irregular
KJ 226	Deep yellow	Firm	1.18	3170	18.54	Oblong
KJ 227	Deep yellow	Firm	1.16	1640	15.12	Oblong
KJ 243	Creamy white	Firm	0.94	1580	20.26	Other
KJ 354	Creamy white	Firm	1.24	5560	30.89	Elongate
KJ 356	Yellow	Firm	1.18	3980	36.18	Reniform
KJ 357	Yellow	Firm	1.26	2700	18.62	Irregular
KJ 391	Deep yellow	Firm	1.26	1730	23.69	Irregular
KJ 392	Deep yellow	Firm	1.28	5090	15.28	Elongate
KJ 394	Yellow	Firm	1.20	750	7.81	Ellipsoid
KJ 396	Creamy white	Firm	1.01	2750	16.98	Irregular
KJ 397	Creamy white	Firm	1.08	4780	13.82	Irregular
KJ 398	Light yellow	Firm	1.42	4160	23.44	Irregular
Muttam Varikka	Light yellow	Firm	1.20	3160	15.05	Oblong
Singapore jack	Yellow	Firm	1.28	2730	15.08	Irregular
Mean	-	-	1.16	2842.4	19.25	-
CV (%)	-	-	458.97	175.83	204.43	-

**Table 45c. Fruit characters of jackfruit types**

Jackfruit types	Fruit characters					
	Total weight of seeds (g)	Mean seed weight (g)	Flakes (%)	Rind (%)	Perigone (%)	Seed (%)
KJ 53	1830	6.08	25.71	31.56	20.95	21.79
KJ 54	1230	6.78	36.49	27.89	22.23	13.39
KJ 121	280	7.00	25.31	38.98	30.00	5.71
KJ 168	2100	7.30	31.62	28.88	14.44	25.06
KJ 173	0	0	0	44.05	55.95	0
KJ 176	472	8.57	23.00	44.42	20.87	11.71
KJ 178	2480	18.79	31.40	41.30	8.90	18.4
KJ 179	1420	12.29	42.04	27.56	18.24	12.16
KJ 180	401	0.87	55.70	27.64	12.87	3.79
KJ 182	290	6.64	36.36	30.30	20.78	12.56
KJ 183	690	6.63	34.63	39.39	14.27	11.71
KJ 185	1180	23.14	26.33	35.33	18.66	19.66
KJ 186	1640	8.20	48.09	24.46	13.81	13.64
KJ 221	2250	11.22	32.11	25.38	11.00	31.55
KJ 223	820	5.39	30.76	32.91	21.58	14.75
KJ 224	1720	13.76	30.58	31.69	10.46	27.27
KJ 226	940	5.49	38.66	26.71	23.17	11.46
KJ 227	1035	9.54	32.06	32.82	13.88	21.24
KJ 243	790	10.13	28.11	31.14	26.69	14.06
KJ 354	1700	9.44	41.22	33.73	12.45	12.6
KJ 356	2010	18.27	43.21	22.80	12.17	21.82
KJ 357	1150	7.93	34.85	37.06	13.29	14.80
KJ 391	690	9.45	32.88	36.69	17.32	13.11
KJ 392	1920	5.76	45.73	25.97	11.05	17.25
KJ 394	920	9.58	16.48	44.18	19.13	20.21
KJ 396	1980	12.22	37.52	28.37	7.09	27.02
KJ 397	2190	6.33	47.80	22.20	8.10	21.90
KJ 398	1320	7.44	40.31	22.48	24.42	12.79
Muttam Varikka	1310	6.24	39.97	27.94	15.55	16.56
Singapore jack	1240	6.85	40.38	29.73	11.54	18.35
Mean	1266.58	8.91	34.31	31.78	17.69	16.21
CV (%)	191.68	185.27	325.39	486.11	192.18	234.20

The highest flake percentage was observed in KJ 180. Among the jackfruit types KJ 224 recorded the highest seed percentage. The lowest perigone percentage was observed in KJ 396 and lowest rind percentage in KJ 397.

Data on fruit quality parameters are presented in Table 46a. The highest TSS recorded was 31 °B in KJ 186 and KJ 356. Among the jackfruit types, TSS was above in 9 types (KJ 178, KJ 182, KJ 185, KJ 224, KJ 226, KJ 227, KJ 357, KJ 394 and Singapore jack). Maximum total sugar and reducing sugar was recorded in KJ 356 followed by KJ 224. Minimum acidity of 0.06 % was observed in KJ 178.

Result of sensory evaluation of 30 jackfruit types are presented in Table 46b. Among the jackfruit types, with respect to taste 8 types scored above 8 (out of 9) as per Hedonic scale. With regard to flavor five jackfruit types (KJ 186, KJ 398, KJ 179, KJ 224 and KJ 397) scored above 8.00. KJ 224 scored the highest value (8.50) for flake colour followed by KJ 186, KJ 398 and KJ 394. The highest score for flake texture was recorded by KJ 224 (8.45). KJ 179 scored the highest value for sweetness (8.85) followed by KJ 398 (8.70). The jackfruit types KJ 185, KJ 186, KJ 224, KJ 356, KJ 391 and KJ 397 also scored above 8. In case of appearance, four jackfruit types scored above 8 (KJ 398, KJ 356, KJ 186 and KJ 179). Maximum score for overall acceptability was 8.60 (KJ 186) followed by KJ 398 (8.55), KJ 224 (8.45) and KJ 356 (8.45).

**Table 46a. Fruit quality parameters of jackfruit types**

Jackfruit types	Fruit quality characters				
	TSS(°B)	Total sugars (%)	Reducing sugar (%)	Non reducing sugar (%)	Acidity (%)
KJ 53	25.00	21.30	8.10	13.20	1.12
KJ 54	25.00	21.24	8.26	12.98	1.28
KJ 121	24.00	22.28	8.79	13.49	0.14
KJ 168	21.00	19.50	6.98	12.52	0.11
KJ 173	0	0	0	0	0
KJ 176	24.00	21.10	8.37	12.73	2.09
KJ 178	30.50	25.19	12.49	12.70	0.06
KJ 179	24.50	21.29	8.72	12.57	0.117
KJ 180	18.50	17.68	7.12	10.56	2.50
KJ 182	30.50	24.95	12.37	12.58	0.07
KJ 183	24.25	21.07	8.63	12.44	0.91
KJ 185	26.00	22.29	8.84	13.45	0.08
KJ 186	31.00	23.95	11.87	12.08	0.11
KJ 221	21.00	19.40	7.03	12.37	0.12
KJ 223	21.00	19.66	7.12	12.54	0.15
KJ 224	30.50	25.40	12.59	12.81	0.11
KJ 226	27.00	23.00	10.17	12.83	0.09
KJ 227	29.00	23.95	11.25	12.70	0.07
KJ 243	18.00	16.73	6.73	10.00	0.09
KJ 354	17.00	16.25	6.54	9.71	0.92
KJ 356	31.00	25.60	12.69	12.91	0.08
KJ 357	28.00	23.13	11.47	11.66	0.08
KJ 391	21.00	19.71	6.63	13.08	1.80
KJ 392	20.00	19.12	7.83	11.29	2.10
KJ 394	30.00	24.78	12.28	12.50	0.82
KJ 396	15.00	14.13	5.57	8.56	0.82
KJ 397	25.00	24.77	11.3	13.47	0.11
KJ 398	24.00	21.95	8.06	13.89	2.00
Muttam Varikka	20.00	19.49	7.79	11.70	0.12
Singapore jack	29.00	21.24	8.73	12.51	1.17
Mean	23.69	20.67	8.81	11.86	0.64
CV (%)	371.33	425.80	322.66	467.51	82.79



**Table 46b. Sensory evaluation of jackfruit types**

Jackfruit types	Taste	Flavour	Colour	Texture	Sweetness	Appearance	Overall acceptability
MV	6.50	7.05	6.95	7.15	6.10	7.55	6.65
KJ 53	7.10	6.35	5.65	6.80	7.00	6.80	7.10
KJ 54	7.95	7.20	7.30	7.50	7.95	7.45	7.70
KJ 121	6.55	6.40	7.40	6.30	5.75	6.40	6.55
KJ 168	5.95	5.85	5.75	6.15	5.95	6.10	6.10
KJ176	7.80	7.30	7.80	7.55	7.60	7.55	7.60
KJ 178	7.75	7.45	7.80	7.30	7.55	7.75	7.55
KJ 179	8.65	8.15	7.20	7.95	8.85	8.05	8.30
KJ 180	5.45	5.50	6.20	6.60	5.30	6.75	6.30
KJ 182	7.75	6.35	6.45	7.10	7.65	6.85	7.35
KJ 183	7.60	7.45	7.95	7.55	7.95	7.65	7.70
KJ 185	7.75	7.70	7.90	7.45	8.45	7.85	7.80
KJ 186	8.45	8.45	8.45	8.00	8.60	8.20	8.60
KJ 221	7.65	7.00	6.75	7.05	7.60	7.25	7.35
KJ 223	6.60	6.80	6.45	6.70	6.90	6.35	6.70
KJ 224	8.20	8.15	8.50	8.45	8.30	7.40	8.45
KJ 226	7.20	7.15	7.30	7.25	6.70	7.25	6.95
KJ 227	7.25	7.30	7.90	7.45	7.10	7.80	7.55
SJ	7.65	6.90	7.05	6.60	7.45	6.80	7.15
KJ 243	6.95	5.90	5.40	6.65	6.95	5.25	6.55
KJ 354	8.05	7.30	6.70	7.50	7.95	6.65	7.55
KJ 356	8.50	7.80	7.80	8.15	8.65	8.25	8.45
KJ 357	6.90	6.05	6.30	6.95	6.95	6.80	6.95
KJ 391	8.05	6.80	7.00	7.30	8.20	7.50	7.70
KJ 392	7.95	7.80	7.80	8.25	7.70	7.75	7.85
KJ 394	7.65	7.55	8.00	5.00	7.85	5.55	7.35
KJ 396	6.45	6.45	5.25	6.70	5.55	4.70	5.35
KJ 397	8.55	8.05	7.60	8.15	8.50	7.95	8.30
KJ 398	8.40	8.20	8.20	8.30	8.70	8.40	8.55
Mean	7.49	7.11	7.13	7.23	7.43	7.12	7.38
CV (%)	924.45	913.70	786.51	858.77	749.00	861.74	934.11

### 4.3. Variability analysis of morphological and fruit characters of jackfruit types

#### 4.3.1. Coefficient of Variation

The results of variability analysis are presented in Table 47.

**Table 47. Variation in morphological and fruit characters of jackfruit types**

Sl. No.	Parameters	Mean	CV	Range	
				Minimum	Maximum
1	Leaf length (cm)	13.94	18.00	10.50	22.00
2	Leaf breadth (cm)	8.09	19.00	4.20	13.50
3	Chlorophyll	57.52	9.00	46.04	71.24
4	Stomatal density	51.05	18.00	3.89	10.63
5	Fruiting season	70.13	48.00	16.00	153.00
6	No. of fruits/tree	41.67	65.00	6.00	183.00
7	Fruit weight (kg)	7.68	39.00	1.85	13.50
8	Fruit length(cm)	35.91	18.00	18.80	48.50
9	Fruit diameter (cm)	20.33	17.00	13.21	27.07
10	No. of flakes/fruit	160.60	64.00	0.00	459.00
11	Flake thickness (cm)	1.14	21.00	0.00	1.60
12	Total flake weight (g)	2842.00	57.00	0.00	5860.00
13	Total seed weight (g)	1204.00	55.00	0.00	2480.00
14	Flake percent	34.31	31.00	0.00	55.70
15	Seed percent	16.21	43.00	0.00	31.55
16	Perigone percent	17.69	52.00	7.09	55.95
17	Rind percent	31.78	21.00	22.20	44.42
18	Mean flake weight(g)	19.25	49.00	0.00	42.47
19	Mean seed weight(g)	8.69	58.00	0.00	23.14
20	TSS (°B)	23.69	27.00	0.00	31.00
21	Reducing sugar (%)	9.01	31.00	0.00	12.69
22	Non-reducing sugar (%)	11.86	21.00	0.00	13.89
23	Acidity (%)	0.64	121.00	0.00	2.50

CV- Coefficient of Variation

Wide variation was observed in most of the characters studied. The number of fruits per tree varied from 6 to 183. This character also exhibited highest coefficient of variation among all the characters studied (0.65). The number of flakes per fruit varied from 0 to 459 and the coefficient of variation recorded was 0.64. Mean seed weight varied from 0 to 23.14 g and the coefficient of variation recorded was 0.58. The variation total flake weight per fruit recorded varied from 0 to 5860 g and the coefficient of variation was 0.57. The total seed weight per fruit varied from 0 to 2480 g. The variation in flake percent was from 0 to 55.70 %. The seed percentage varied from 0 to 31.55 % and the perigone percentage varied from 7.09 to 55.95 %. The variation in rind percentage was from 22.20 to 44.42 %.

#### **4.3.2. Multiple correlation**

The correlation coefficient for different pairs of quantitative characters is presented in Table 48a, 48b and 48c.

Among the different characters, fruit weight is closely correlated with total flake weight per fruit (0.936). It also exhibited significant positive correlation with flake percentage (0.678), total seed weight per fruit (0.640) and rind weight (0.601). At the same time perigone percentage (-0.515) showed significant negative correlation with fruit weight.

Fruit diameter exhibited significant positive correlation with rind weight (0.678), total flake weight (0.596) and total number of flakes per fruit (0.539). Total number of flakes is correlated with total flake weight (0.675) followed by flake percentage (0.645). Total number of flakes exhibited significant negative correlation with rind percentage (-0.577).

Flake thickness exhibited highly significant positive correlation with non-reducing sugar in the flake (0.833), TSS (0.648) and mean flake weight (0.563). Flake thickness exhibited a significant negative correlation with perigone percentage

(-0.597). Total flake weight significantly correlated with flake percent (0.835) and rind weight (0.635) and is negatively correlated with rind percentage (-0.621).

The total seed weight exhibited significant negative correlation with perigone percentage (-0.618). Perigone weight showed a significant positive correlation with rind weight (0.578). Significant positive correlation was also observed between rind weight and flake percentage. The flake percentage exhibited a highly significant negative correlation with rind percentage (-0.752) where as seed percentage exhibited a significant negative correlation with perigone percentage (-0.647). Perigone percentage exhibited significant negative correlation with non reducing sugar in the flake (-0.599), TSS (-0.559) and reducing sugar (-0.548).

Significant positive correlation was observed between mean flake weight and mean seed weight. TSS of the flakes is more closely correlated with reducing sugar (0.894) than non-reducing sugar (0.826). Correlation between reducing and non reducing sugar is also significant (0.720).

Among the leaf characters significant positive correlation was found between leaf length and leaf breadth.



**Table 48a. Multiple correlation between quantitative characters of jackfruit types (A to M vs A to M)**

	A	B	C	D	E	F	G	H	I	J	K	L	M
A	1												
B	-0.226	1											
C	-0.438*	0.561**	1										
D	-0.082	0.563**	-0.059	1									
E	-0.206	0.593**	0.337	0.539**	1								
F	0.059	0.357	0.210	0.238	0.134	1							
G	-0.252	0.936**	0.472**	0.596**	0.675**	0.315	1						
H	-0.112	0.640**	0.471**	0.272	0.316	0.199	0.527**	1					
I	-0.340	0.369*	0.046	0.528**	0.197	0.209	0.373*	-0.090	1				
J	-0.332	0.601**	0.238	0.678**	0.471**	0.385*	0.635**	0.206	0.578**	1			
K	-0.091	0.678**	0.293	0.487**	0.645**	0.526**	0.835**	0.396*	0.218	0.514**	1		
L	0.119	0.118	0.258	-0.064	0.187	0.236	-0.004	0.632**	-0.361	-0.021	0.111	1	
M	-0.037	-0.515**	-0.445*	-0.212	-0.47**	-0.597**	-0.511**	-0.618**	0.300	-0.333	-0.694**	-0.647**	1

**Character code: A to X.**

(A= Number of fruits per tree, B= Fruit weight, C= Fruit length, D= Fruit diameter, E= Number of flakes, F= Flake thickness, G= Total flake weight, H= Total seed weight, I= Weight of perigone, J= Weight of rind, K= Flake %, L= Seed %, M= Perigone %, N= Rind %, O= Mean flake weight, P= Mean seed weight, Q= TSS, R= Reducing sugar, S= Non-reducing sugar, T= Acidity, U= Leaf length, V= Leaf breadth, W= Leaf chlorophyll, X= Stomatal density)

**Table 48b. Multiple correlation between quantitative characters of jackfruit types (A to M vs N to X)**

	A	B	C	D	E	F	G	H	I	J	K	L	M
N	0.073	-0.493**	-0.119	-0.420*	-0.577**	-0.258	-0.621**	-0.438*	-0.391*	-0.338	-0.752**	-0.326	0.396*
O	-0.059	0.465**	0.180	0.074	-0.268	0.563**	0.420*	0.277	0.236	0.257	0.379*	-0.098	-0.255*
P	-0.081	0.163	0.177	-0.165	-0.387*	0.310	0.019	0.540**	-0.245	-0.112	0.005	0.438*	-0.366*
Q	0.071	0.181	0.195	-0.108	-0.015	0.648**	0.133	0.301	-0.105	-0.012	0.348	0.367*	-0.559*
R	0.129	0.137	0.055	-0.106	-0.064	0.535**	0.121	0.282	-0.242	-0.072	0.331	0.306	-0.548**
S	0.064	0.238	0.224	0.085	0.170	0.833**	0.181	0.258	0.100	0.149	0.447*	0.387*	-0.599**
T	-0.158	0.151	0.168	0.441*	0.379*	0.128	0.237	-0.098	0.213	0.296	0.253	-0.247	-0.102
U	-0.040	-0.027	0.029	0.146	-0.106	0.199	-0.073	-0.008	0.096	0.191	-0.058	0.053	-0.046
V	0.133	-0.060	-0.209	0.209	-0.072	0.168	-0.013	-0.149	0.334	0.304	0.057	-0.020	0.080
W	-0.350	0.263	0.045	0.206	0.030	-0.079	0.237	0.278	0.087	0.188	-0.001	-0.121	0.078
X	-0.082	0.155	0.033	0.365*	0.263	-0.314	0.196	0.229	0.098	0.157	0.133	-0.009	-0.024

**Table 48c. Multiple correlation between quantitative characters of jackfruit types (N to X vs N to X)**

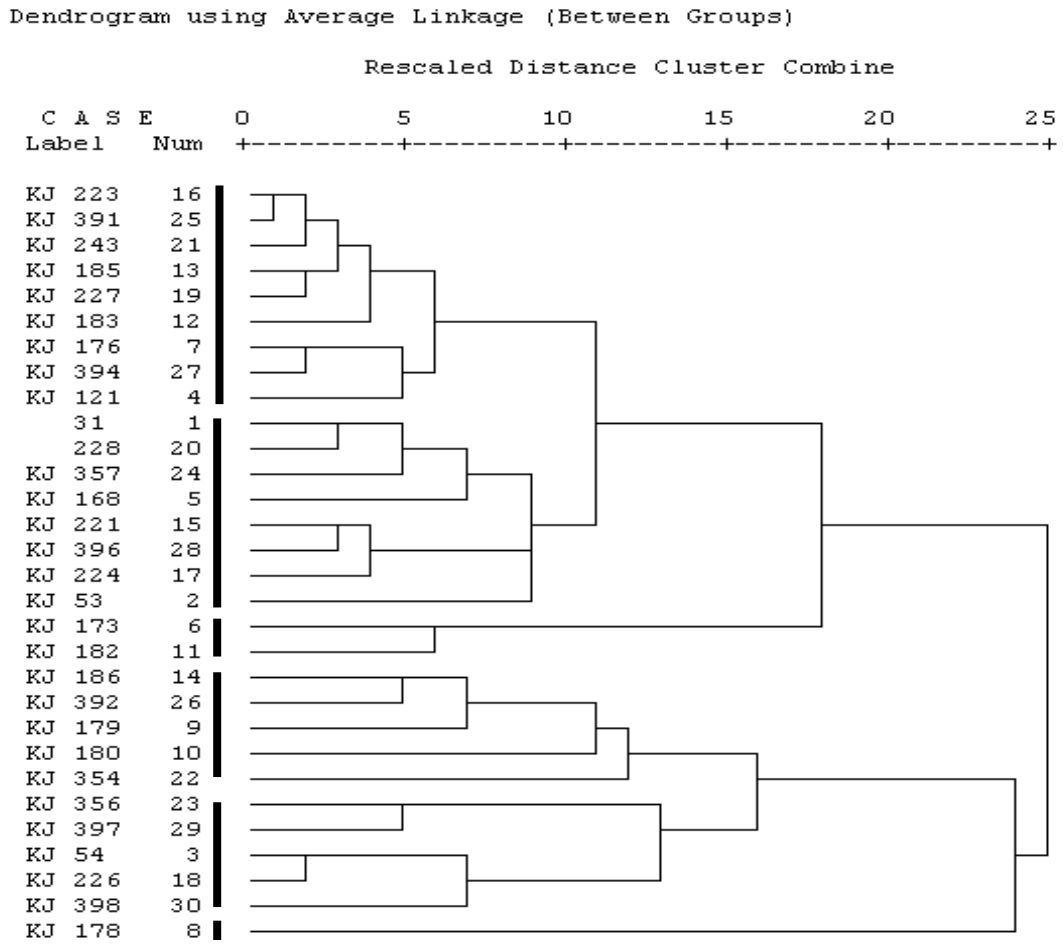
	N	O	P	Q	R	S	T	U	V	W	X
N	1										
O	-0.149	1									
P	0.043	0.633**	1								
Q	-0.162	0.387*	0.442*	1							
R	-0.087	0.391*	0.442*	0.894**	1						
S	-0.287	0.372*	0.331	0.826**	0.720**	1					
T	-0.002	-0.139	-0.274	-0.140	-0.127	0.084	1				
U	0.101	0.121	0.032	-0.146	0.022	0.054	0.175	1			
V	-0.183	0.114	-0.157	-0.208	-0.026	0.059	0.132	0.768**	1		
W	0.019	0.159	0.178	-0.249	-0.315	-0.329	-0.143	-0.168	-0.370*	1	
X	-0.172	-0.288	-0.165	-0.301	-0.237	-0.287	0.011	-0.094	-0.123	0.178	1

\*\* - Correlation is significant at the 0.01 level    \* - Correlation is significant at the 0.05 level

**4.3.3 Cluster analysis**

**4.3.3.1 Quantitative characters of fruit**

The dendrogram of quantitative characters of fruit by cluster analysis is presented in Fig.8.



**Fig. 8. Dendrogram of quantitative characters of fruit**

\*31- Muttam varikka, 228-Singapore jack



At 10 rescaled distance unit, grouping of jackfruit types was done which resulted in six non- overlapping clusters.

Cluster wise listing of the jackfruit types based on quantitative characters of fruit is presented in the Table 49. Maximum number of jackfruit types (9) came under Cluster 1 and the minimum (1) was found in Cluster 6.

**Table 49. Cluster wise listing of jackfruit types based on fruit characters**

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
KJ 223	31	KJ 173	KJ 186	KJ 356	KJ 178
KJ 391	228	KJ 182	KJ 392	KJ 397	
KJ 243	KJ 357		KJ 179	KJ 54	
KJ 185	KJ 168		KJ 180	KJ 226	
KJ 227	KJ 221		KJ 354	KJ 398	
KJ 183	KJ 396				
KJ 176	KJ 224				
KJ 394	KJ 53				
KJ 121					

Cluster wise summary of fruit characters is presented in Table 50.

Jackfruit types under cluster 3 recorded the highest value for duration of fruiting season ( $110 \pm 24.83$  days from first harvest to last harvest). The maximum number of fruits per tree was also recorded by cluster 3 ( $147.5 \pm 35.5$ ).

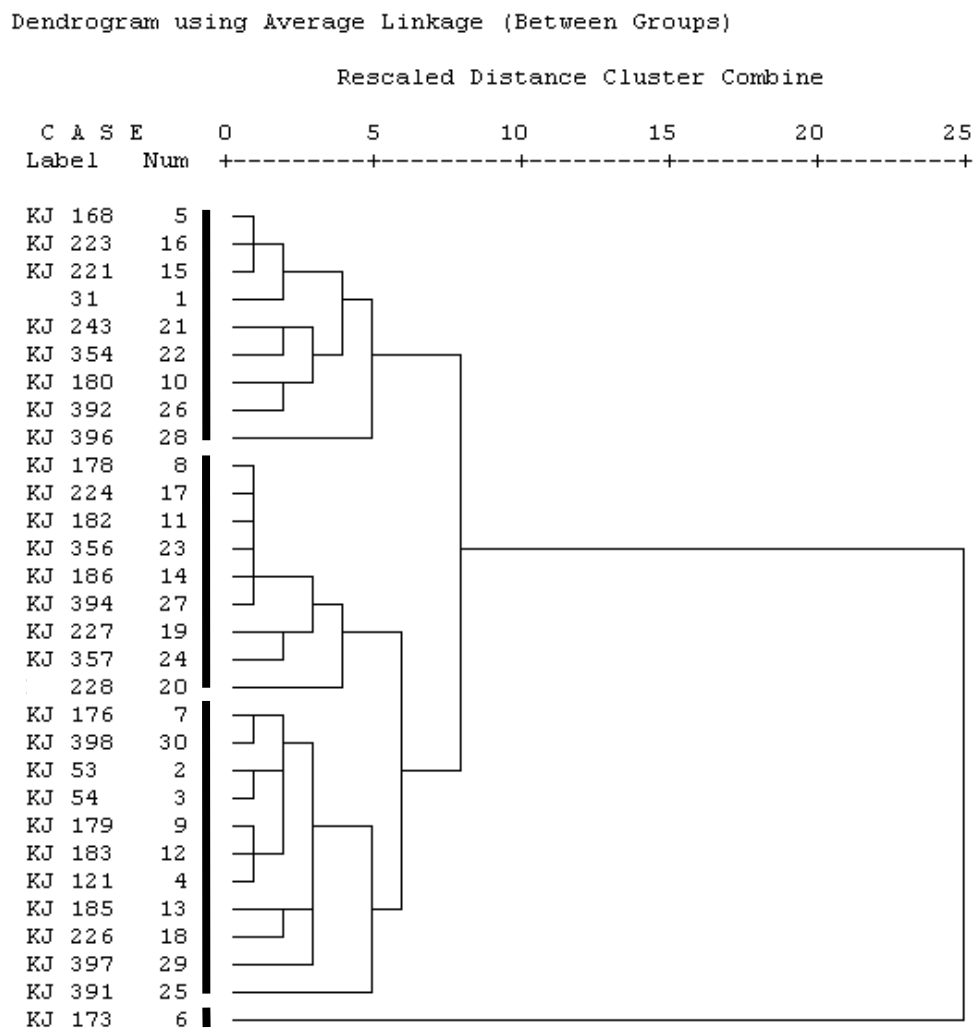
**Table 50. Cluster wise summary based on quantitative fruit characters**

Fruit characters	Clusters					
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Fruiting season	67.78±11.5	82.12±10.5	110.0±24.8	52.00±8.6	56.20±7.5	76.0
No.of fruits	38.33±8.6	49.38± 7.9	147.5± 5.5	25.40±7.8	33.2±7.0	62.0
Mean fruit weight (kg)	5.21±0.2	7.49±0.2	2.08±0.1	11.77±0.5	9.38±0.3	13.5
Fruit length (cm)	35.17±1.5	36.58±1.6	21.65±1.7	39.11±2.9	36.15±1.2	48.5
Fruit diameter (cm)	18.15±0.8	20.13±0.6	16.70±0.1	24.16±1.9	22.97±0.6	16.6
No.of flakes	84.17±10.4	201.56±19.9	21.83±12.6	257.50±61.6	197.27±32.2	132.0
Flake thickness	1.19±0.02	1.15±0.02	0.6±0.3	1.26±0.09	1.14	1.16±0.03
Total flake weight (g)	1466.3±123.3	2546.25±122.5	420±242.4	5439±189.09	3888±236.86	4230±0.00
Total seed weight (g)	764.05±82.01	1461.25±198.2	145±83.7	1416.10±266.1	1538±195.6	2480.0
Flake %	27.74±1.7	34.09±1.6	18.18±10.5	46.56±2.6	41.29±1.6	31.40
Seed %	14.68±1.5	22.8±1.8	6.28±3.6	13.68±1.2	18.02±2.7	8.90
Perigone %	20.26±1.6	13.04±1.3	38.36±10.2	13.68±1.2	18.02±2.7	8.90
Rind %	37.32±1.4	30.08±1.1	37.18±3.9	27.87±1.6	24.42±0.9	41.30

Mean fruit weight was the maximum in cluster 6 (13.50 kg) where as the minimum fruit weight was recorded by cluster 3 (2.08±0.1 kg). The highest mean value for fruit length, fruit diameter, total number of flakes, flake thickness, total weight of flakes and flake percentage was observed in cluster 4. Seed weight and seed percentage were the lowest in cluster 3. Cluster 6 recorded the lowest perigone percentage and cluster 4 recorded the minimum rind percentage.

### 4.3.3.2 Qualitative characters of fruit

Dendrogram of qualitative characters of fruit are presented in the Fig. 9. Grouping at the rescaled distance of 6, resulted in four non- overlapping clusters.



**Fig. 9. Dendrogram of qualitative characters of fruit**

\*31- Muttam varikka, 228- Singapore jack

Cluster wise listing of the jackfruit types based on fruit quality parameters are presented in the Table 51. The highest number of jackfruit types (11) came under cluster 3 and the lowest number (1) was observed under cluster 4.

**Table 51. Cluster wise listing of jackfruit types based on fruit quality characters**

Cluster 1	Cluster 2	Cluster 3	Cluster 4
KJ 168	KJ 178	KJ 176	KJ 173
KJ 223	KJ 224	KJ 398	
KJ 221	KJ 182	KJ 53	
31	KJ 356	KJ 54	
KJ 243	KJ 186	KJ 179	
KJ 354	KJ 394	KJ 183	
KJ 180	KJ 227	KJ 121	
KJ 392	KJ 357	KJ 185	
KJ 396	228	KJ 226	
		KJ 397	
		KJ 391	

Cluster wise summary of jackfruit types based on fruit quality are presented in Table 52.

Cluster 2 recorded the highest mean value for TSS ( $29.94 \pm 0.3^{\circ}\text{B}$ ) and reducing sugar (11.75 %). Cluster 3 recorded the highest mean value for non-reducing sugar ( $12.49 \pm 0.1$  %) and acidity ( $0.85 \pm 0.3$  %). Cluster 4 included only one jackfruit type which is flakeless and therefore zero value was recorded for all fruit quality parameters.

**Table 52. Cluster wise summary based on fruit quality parameters**

Biochemical characters	Clusters			
	Cluster 1	Cluster 2	Cluster 3	Cluster 4
TSS (°B)	19.06±0.7	29.94± 0.3	24.53±0.6	0.00
Reducing sugar (%)	6.97±0.2	11.75±0.4	8.72±0.4	0.00
Non reducing sugar (%)	11.03±0.5	12.49±0.1	12.97±0.1	0.00
Acidity (%)	0.77±0.3	0.28±0.1	0.85±0.3	0.00

# **DISCUSSION**

## 5. DISCUSSION

The results of the study entitled “Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district” are discussed in this chapter.

### 5.1 Experiment 1: Survey and identification of jackfruit types

Jackfruit is a popular and important component in the homesteads of Kerala. Being cross pollinated and of seedling origin there exists wide variability in jackfruit population in the homesteads. For exploring the tremendous variability in jackfruit survey work was carried out in the farmer’s field in Kasargod district.

Among the 400 jackfruit types surveyed, 84 % were with firm fleshed type. This observation is in conformity with the earlier report by Prasannakumariamma and Kumaran (2011) that firm fleshed varikka types are more predominant in Northern Kerala compared to soft fleshed koozha types. It was also observed that four jackfruit types exhibited an intermediary flake texture between firm and soft fleshed types. Kumar and Kavino (2011) reported such a jackfruit type Navarikka (Pazham varikka).

The conventional method of propagation in jackfruit was through seeds. This kind of propagation and cross pollinating nature of the crop offers wide variability in homesteads of Kerala. In Kasargod district, the widely used planting material was seedlings. Only 5.75 % grafted trees were found out of the 400 surveyed jackfruit types.

A production potential of 25 to 50 fruits per year was predominant (38%) among the jackfruit trees surveyed. Similarly, the mean fruit weight between 10 to 20 kg was predominant (46 %) among the surveyed jackfruit types. Very large sized

fruits (above 20 kg) are not common in Kasargod district. Similar result was reported from Philippines by Magdalita *et al.*, (2011). From the data collected, it can be inferred that large sized fruit (above 10 kg) is more predominant in Kasargod district.

Ellipsoid fruit shape was more predominant (70 %) among the jackfruit types in Kasargod. Similar observation was recorded by Muthulakshmy (2003) among the jackfruit types in Thrissur district. Sadarunnisa *et al.*, (2016) observed predominance of ellipsoid fruit shape, among the jackfruit types at Horticultural College and Research Institute, Anantharajupet, Andhra Pradesh,

In Kasargod district, mainly three jackfruit maturing seasons were observed. They were December–February, March–May and June–August. In majority (81.50 %) of the jackfruit types, the fruits matured during March- May. Muthulakshmy (2003) reported that there were three fruiting season for jackfruit in Thrissur district of Kerala *viz.*, early season (December- February), mid season (March- May) and late season (June- August).

Very early types (fruit ripening was completed by early February) were observed during this study. These were very rare types and such desirable types are to be conserved. Similarly, very late maturing type maintaining the fruit quality was also observed. They can be exploited for off season marketing during September for fetching high market price. The study revealed that in Kasargod district, ripening of jackfruit begins during December and extend up to September. Wide variations in the fruit maturity provide immense potential for commercial exploitation of promising jackfruit types of Kasargod district.

Among the jackfruit types surveyed, 25 trees produced fruits with very high sweetness according to the information provided by the farmers. Since, sweetness is an important quality parameter of jackfruit; the results indicate the need of conserving such jackfruit types with very high sweetness with farmer's participation. Out of the



400 trees surveyed, 17.50 % of trees produced fruits with multipurpose uses such as dessert purpose, culinary purpose and for making chips.

Trees with special desirable characters were also present among the jackfruit trees surveyed. The jackfruit type (KJ 121) which bore more than thrice a year and the type (KJ 219) bore three times in a year deserve further investigation for commercial exploitation. Jackfruit types which exhibited seedlessness (KJ 180) and jackfruit types which exhibited gumlessness (KJ 177, KJ 178, KJ 396 and KJ 397) can also be subjected to further study for selection and crop improvement in jackfruit. Flakelessness is a very rare character observed in jackfruit types which can be exploited to market tender jack as an organic vegetable. As per the information provided by the farmer, flakeless jack is preferred by the local people as tender jack for culinary purpose. Since there is a growing demand for organic vegetable, flakeless jack possess immense potential for commercial exploitation. The only report regarding flakelessness in jackfruit is by Medagoda *et al.* (2011) from Sri Lanka where it is used as vegetable. By the survey conducted in Kasargod district, 28 promising types with commercially important desirable traits were identified for characterization.

## **5.2 Experiment 2: Characterization of jackfruit types**

Identification, characterization and evaluation are the widely followed method for selection of promising jackfruit types in major jackfruit growing countries. In India, 281 jackfruit types were characterized and evaluated and 54 improved selections were made. In Nepal, 350 jackfruit types were characterized and 47 selections were made for commercial purpose. Characterization and evaluation was carried out in Bangladesh, Indonesia, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam and improved selections of jackfruit types were developed (Haq, 2006).

As part of the present experiment, 28 promising jackfruit types were characterized as per IPGRI descriptor. The promising characters noticed were high

TSS (above 25°B), gumlessness, seedlessness, flakelessness, fruiting more than thrice in a year, more number of fruits per tree, more fruits at the lower part of main trunk, high flake percentage, very early ripening and late ripening with good fruit quality.

Aswini (2015) conducted morphological characterization of 20 accessions and their characters were compared with that of Muttam Varikka, Sindhoor and Thamarachakka. As part of All India Coordinated Research Project on tropical fruits, 211 trees from three districts of Kerala were collected characterized and conserved *in situ* (Menon and Peter, 2011). Krishnan *et al.* (2015) conducted a survey in Kuttanad region and 10 promising jackfruits are under evaluation. A total of 204 jackfruit trees from Kerala, Karnataka and Tamil Nadu are maintained at the NBPGR Research station, Thrissur, Kerala. Germplasm characterization of jackfruit trees are being under taken in North Eastern India, West Bengal, Bihar, Jharkhand, Kerala, Tamil Nadu and Karnataka. Characterization and evaluation of fruit characters of 12 trees have been completed (Patil *et al.*, 2016).

According to Jagadeesh *et al.* (2007), 95 jackfruit types have been identified in Karnataka and evaluated for further breeding work.

The most predominant tree growth habit is erect among the promising jackfruit types subjected to characterization; this is because majority of jackfruit types of seedling origin shows erect growth habit. Similar result was reported by Dash *et al.* (2016) who conducted characterization of jackfruit types in North Odisha.

In Kasargod district, flowering of jackfruit types starts from first week of October and extends up to third week of March. This enables the availability of ripe jackfruit from the last week of December to the first week of September. This is due to the wide variation observed in duration of flowering and duration of fruit maturity among different jackfruit types surveyed. By selecting and popularizing very early ripening, mid season ripening and late ripening jackfruit types with superior fruit quality (as identified by the present study), ripe jackfruit can be marketed for about

nine months in a year. Further studies on propagation of elite types and their field evaluation are required to achieve this goal.

Fruit maturing season in jackfruit vary due to climatic and geographic conditions. In Tamil Nadu, the main flowering season starts from November-February and the fruits are available from March- July. Panruti taluk of Cudallore district of Tamil Nadu produce jackfruit round the year. In Kanyakumari district of Tamil Nadu, jackfruit production is observed twice a year, the main season being April-June and off season during November-December (Balamohan, 2016).

In Karnataka, the regular fruiting is between April and August. However, the selection 'Byra Chandra' bore fruits almost throughout the year (Hittalmani, 2016). In Sri Lanka, two flowering season were observed in jackfruit *viz.*, major flowering season (March-June) and minor flowering season (October- January). Geographical differences in harvesting period of jackfruits were reported by Pushpakumara (2011) in Malaysia (April to August or September to October), Thailand (January to May), Nepal (July-October) and India (June to October).

In the present study, the highest fruit number reported was 183 (KJ 173). The number of fruits per tree varies with age of the tree, position of female inflorescence, and agro climatic conditions. Mitra and Maity (2002) reported that a jackfruit tree can be produce 1450 fruits per year.

Jackfruit is the largest tree borne fruit in the nature. However, in Kerala large sized jackfruits are not preferred by the nuclear families. Therefore more attention has to be paid for popularizing small and medium sized jackfruits with superior fruit quality. In the present study, 18 jackfruit types identified had small to medium sized fruits with superior quality. Muthulakshmy (2003) reported that medium sized fruits weighing from 5 to 8 kg are much preferred for household consumption and large sized fruits ranging 10 to 20 kg are preferred for commercial purposes. Among the

elite jackfruit varieties released by research organizations, medium sized fruit character was predominant in most of the types (Marri *et al.*, 2016).

In the present study the highest number of flakes per fruit and the highest flake percentage was observed in KJ 180. KJ 53, KJ 168, KJ 392 and KJ 397 also recorded higher number of flakes when compared to the check varieties *viz.*, Muttam varikka and Singapore jack. Higher number of flakes per fruit (658) was reported in jackfruit by Kumar and Kavino (2011).

The wide range in perigone percentage and the rind percentage observed in the present study also signifies the scope for further studies on variability in carbon partitioning to the edible part so as to isolate the most photosynthetically efficient jackfruit types with minimum perigone and rind percentage. KJ 396 with lowest perigone percentage and KJ 397 with lowest rind percentage deserve attention here.

Total Soluble Solids content in the fruit is an important character in determining fruit quality of jackfruit. TSS above 25°B and total sugars above 20 % are considered as the important traits for evaluation and selection of dessert purpose jackfruit (Mitra and Maity, 2000). In the present study 13 types subjected to characterization possessed TSS 25 °B and above. The maximum TSS was 31°B (KJ 186 and KJ 356) followed by 30.5 °B (KJ 182) and 30 °B (KJ 194). All these jackfruit types showed excellent fruit quality compared to the check variety Singapore jack (29°B). The result showed the possibility of selection of jackfruit types with higher TSS from Kasargod district for commercial exploitation. The total sugars content was more than 20 in 17 jackfruit types.

The sensory evaluation also confirmed the superiority of jackfruit types KJ 54, KJ 176, KJ 178, KJ 179, KJ 182, KJ 185, KJ 221, KJ 224, KJ 354, KJ 356, KJ 391, KJ 392, KJ 397 and KJ 398 over the check varieties- Singapore jack and Muttam varikka, highlighting the need of further studies in these jackfruit types.

### 5.3. Variability analysis

Jackfruit is a cross pollinated crop. It has been propagated through seeds till recently. Therefore the chances of variation in tree and fruit characters are very high. In the present study, wide range of variation was observed in morphological and fruit traits of jackfruit types subjected to characterization. Morphological variation in jackfruit types were reported from different jackfruit growing zones.

In Kerala, the variability in jackfruit types were reported by Srinivasan (1970), Joseph (1983), Joseph and Kumaran (1996), Muthulakshmy (2003), Narayanankutty *et al.* (2010), Prasannakumariamamma and Kumaran (2011), Aswini (2015) and Krishnan (2015).

Variability in jackfruit types has also been reported from Karnataka (Jagadeesh *et al.*, 2007; Shymalamma *et al.*, 2008; Guruprasad *et al.*, 2016), Tamil Nadu (Kumar and Kavino, 2011; Balamohan, 2016), Andhra Pradesh (Sadarunnisa *et al.*, 2016; Marri *et al.*, 2016), Goa (Desai *et al.*, 2016), Maharashtra (Haldankar *et al.*, 2016), Odisha (Dash *et al.*, 2016), Bihar (Rai *et al.*, 2003), West Bengal (Mitra and Maity, 2002; Wangchu *et al.*, 2013), Uttar Pradesh (Kumar and Singh, 1996) and Assam (Sarma *et al.*, 1997).

Jackfruit types exhibited wide variability in Sri Lanka (Medagoda, 2011), Indonesia (Yuniarti, 2011), Philippines (Namuco, 2011), Malaysia (Milan, 2011), Vietnam (Hung, 2011), Mauritius (Abeeluck *et al.*, 2011) and Bangladesh (Haq, 2006).

#### 5.3.1. Coefficient of variation

Among the various characters studied, the highest coefficient of variation (0.65) was observed in the case of number of fruits per tree. The number of flakes per fruit, mean seed weight and total flake weight per fruit also recorded relatively higher coefficient of variation. Therefore, number of fruits per tree, number of flakes



KJ 186 (Oblong with curved tip)



KJ 226 (Obovate)



KJ 227 (Others)



KJ 243 (Irregular)



KJ 354 (Rectangular)



KJ 392 (Others)



KJ 394 (Irregular)



KJ 396 (Rectangular)

Plate 31a. Variability in flake characters of jackfruit types





KJ 168 (Irregular, mean seed weight : 7.30g)



KJ 180 (Irregular, 0.87 g)



KJ 182 (Others, 6.64 g)



KJ 223 (Elongate, 5.39 g)



KJ 227 (Oblong, 9.54 g)



KJ 356 (Reniform, 18.27 g)



KJ 392 (Elongate, 5.76 g)



Variation in size of seeds

Plate 31b. Variability in seed characters of jackfruit types

per fruit, mean seed weight and total flake weight per fruit are the important characters to be considered for selection of elite superior jackfruit types from the variable population. Jagadeesh *et al.* (2010) reported that among the bulb characters, flake weight recorded the highest coefficient of variation. In the present study also, total flake weight exhibited a relatively higher coefficient of variation along with total number of flakes and mean seed weight among the bulb characters studied. Therefore, number of fruits per tree, total number of flakes per fruit and total flake weight can be considered for selection of elite jackfruit types.

On the other hand, a relatively low coefficient of variation of 0.23 was reported with regard to total number of fruits per tree at Periakulam in Tamil Nadu by Murugan (2007) as against 0.65 observed in present study in Kasargod district of Kerala. This result showed that the extend of variability of the same character vary widely from region to region underlines the need for location specific variability analysis in jackfruit types.

### **5.3.2 Multiple correlation**

The present study revealed highly significant positive correlation between fruit weight and total flake weight, fruit weight and flake percentage, fruit weight and total seed weight and fruit weight and rind weight. The total number of flakes exhibited significantly negative correlation with rind percentage. The perigone percentage showed significant negative correlation with fruit weight, flake thickness, TSS, reducing sugars and non-reducing sugars. TSS of flakes is more correlated with reducing sugars than non reducing sugars. In the present study, fruit diameter was more closely correlated with fruit weight than fruit length.

Muthulakshmy (2003) observed fruit length and fruit diameter were significantly correlated with fruit yield. Sharma *et al.* (2006) reported that average fruit weight showed highly significant positive correlation with fruit length, total bulb weight and total flake weight. Significant positive correlation between fruit weight



and rind weight was also reported (Maiti, 2010). Magdalita *et al.* (2011) reported that fruit weight was positively correlated with fruit length, fruit width and flake length. Wangchu *et al.* (2013) also reported significant positive correlation between fruit weight and rind weight.

Fruit diameter exhibited significant positive correlation with rind weight, total flake weight and total number of flakes per fruit. Significant positive correlation between fruit diameter and number of flakes was earlier reported by Sanjem *et al.*, (2012) among jackfruit types in Karnataka.

### 5.3.3 Cluster analysis

Cluster analysis based on quantitative characters resulted in grouping of 30 jackfruit types into six clusters. Among the fruit characters, the flake percentage increased with an increase in fruit diameter. Similarly, increase in duration of fruiting season was observed with an increase in number of fruits per tree. Therefore it is desirable that irrespective of fruit shapes, fruits with maximum diameter can be considered for selection to get maximum edible part per fruit. Similarly, higher the number of fruits per tree, longer will be the duration of fruiting season. Fifty jackfruit type accessions in Karnataka were grouped into three cluster by Shymalamma *et al.* (2008). They observed low to moderate genetic diversity in morphological characters among the accessions subjected to cluster analysis. Chunghai *et al.* (2009) conducted clusters analysis of variation in 76 jackfruit accessions in China and grouped them into four clusters. Based on cluster analysis Aswini *et al.* (2015) concluded that fruit weight increased with decrease in core length.

The jackfruit types were grouped into four non overlapping clusters based on fruit quality parameters. The character *viz.*, TSS of flake followed by reducing sugars exhibited maximum divergence indicating their significance as choice for crop improvement. Jackfruit types grouped in cluster 2 possessing higher TSS and

reducing sugars also recorded better acceptability in sensory evaluation. Therefore, the jackfruit types coming under cluster 2 deserve priority in crop improvement of jackfruit in Kasargod district. The clustering of jackfruit types based on fruit quality parameters revealed that types identified in the same location did not necessarily belong to the same cluster, indicating that natural selection, cross pollination, predominance of seedling origin of the plant are responsible for variability than geographical distance as reported earlier by Wangchu *et al.* (2013).

Cluster 4 included only one jackfruit type which possessed a unique character of flakelessness. This type produced maximum number of fruits per year. This jackfruit is much preferred by local villagers as tender jack for culinary purpose. Further studies on flowering season, growth and development of fruit and fruiting season of this very rare jackfruit type may result in developing a new jackfruit selection exclusively for tender jack purpose. Similarly, further studies on seedless jackfruit type with the highest flake percentage, the gumless jackfruit types, very early maturing jackfruit types, late ripening jackfruit types with superior fruit quality, jackfruit type with prolific bearing in clusters and jackfruit types suitable for dessert purpose, culinary and chip making purpose, identified and characterized as part of this study will lead to conservation and popularization of superior jackfruit types preferably either as part of Underutilized Tropical Fruits in Asia Network (UTFANET) funded by International Centre for Underutilized Crops or under All India Coordinated Research Project on Tropical fruits.

# **SUMMARY**

## 6. SUMMARY

The study entitled 'Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district was under taken in the Department of Pomology and Floriculture, College of Agriculture, Padannakkad during October 2014 to May 2016.

The findings of the study are summarized below:-

- Ripening of jackfruit started by the end of December and extended up to first week of September among the 400 jackfruit types surveyed in Kasargod district. However the main fruit maturity season was during March to May.
- The mean yield was between 25 to 50 fruits per tree per year and mean fruit weight was between 10 to 20 kg among the jackfruit types surveyed.
- Characterization of 28 jackfruit types along with local checks viz.,-Muttam varikka and Singapore jack revealed considerable genetic diversity among jackfruit types in Kasargod district. The desirable traits recorded were seedlessness, gumlessness, flakelessness, high TSS, fruiting more than thrice in a year, prolific bearing throughout the trunk, very early ripening, high flake percentage and late ripening maintaining the quality of fruits.
- The jackfruit types KJ 179, KJ 186, KJ 224, KJ 356, KJ 397 and KJ 398 scored above eight in the nine point Hedonic scale with respect to over all acceptability. This score was higher than that of checks Muttam varikka and Singapore jack.
- Among the characters studied, the number of fruits per tree, number of flakes per fruit, mean seed weight, total flake weight per fruit and flake percentage exhibited wide variability compared to other characters.
- Fruit weight was closely correlated with total flakes per fruit, flake percentage and total seed weight per fruit.

- Perigone percentage showed significant negative correlation with fruit weight, flake thickness, total seed weight, TSS and non-reducing sugar. Rind percentage exhibited significant negative correlation with total number of flakes.
- Flake thickness exhibited significant positive correlation with percentage of non-reducing sugar.
- TSS of the flake was more closely correlated with reducing sugar than non-reducing sugar.
- At 10 rescaled distance unit, grouping of jackfruit types based on quantitative characters resulted in six non-overlapping clusters. Jackfruit types under cluster 3 recorded the highest value for duration of fruiting season and maximum number of fruits per tree.
- Cluster analysis based on qualitative characters of fruit resulted in four non-overlapping clusters at rescaled distance of six. Cluster 2 recorded the highest mean value for TSS.

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**IDENTIFICATION AND CHARACTERIZATION OF JACKFRUIT TYPES  
(*Artocarpus heterophyllus* Lam.) IN KASARGOD DISTRICT**

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**Abstract of the Thesis**

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## ABSTRACT

The study entitled “Identification and characterization of jackfruit types (*Artocarpus heterophyllus* Lam.) in Kasargod district” was undertaken at the College of Agriculture, Padannakkad during 2014-16. The study included survey and identification of jackfruit types in Kasargod district and characterization of selected jackfruit types based on IPGRI descriptor. The data were subjected to statistical analysis to find out the extend of variation among the jackfruit types, to locate the traits correlated with fruit yield and quality and to analyze the genetic divergence by cluster analysis.

Wide variability was observed among the jackfruit types studied. In Kasargod district, ripening of jackfruits started by December and extended up to September. However, the main fruit maturing season was from March to May. Seedlessness, gumlessness, flakelessness, high TSS (above 25°B), fruiting more than thrice in a year, very early ripening (December), high flake percentage and late ripening with good table quality were the important desirable characters observed.

Fruit weight exhibited significant positive correlation with number of flakes per fruit, flake percentage and total seed weight per fruit. Perigone percentage showed significant negative correlation with fruit weight, flake thickness, total seed weight, TSS and non-reducing sugar. Cluster analysis resulted in six non-overlapping clusters based on quantitative characters of fruit and four non-overlapping clusters based on qualitative characters of fruit.

Among the jackfruit types subjected to characterization, KJ 180, KJ 182, KJ 183, KJ 185, KJ 186, KJ 356 and KJ 397 were the most promising types identified for dessert purpose. KJ 173 (flakeless) was an ideal type for tender jack purpose. Fruiting more than thrice in a year with overlapping fruiting phase was observed in KJ 121. All these promising jackfruit types deserve further research intervention for conservation and popularization.

## സംക്ഷിപ്തം

കാസർഗോഡ് ജില്ലയിലെ മികവുള്ള പ്ലാവുകളെ കണ്ടെത്തി തിരിച്ചറിയുന്നതിനും, അവയിൽനിന്നും ഏറ്റവും മികച്ചവയെ തിരഞ്ഞെടുത്ത് രൂപഗുണനിർണ്ണയം നടത്തുന്നതിനുമായി പടന്നക്കാട് കാർഷിക കോളേജിലെ പഴവർഗ്ഗ ശാസ്ത്രവിഭാഗത്തിൽ 2014-2016 കാലയളവിൽ പഠനം നടത്തുകയുണ്ടായി. ഇതിന്റെ ഭാഗമായി കർഷകർക്കിടയിൽ സർവ്വേ നടത്തുകയും അതിന്റെ അടിസ്ഥാനത്തിൽ തെരഞ്ഞെടുത്ത 28 പ്ലാവുകളെ, സിംഗപ്പൂർ ജാക്ക്, മുട്ടം വരിക്ക എന്നീ പ്ലാവിനങ്ങൾക്കൊപ്പം, ഇന്റർനാഷണൽ ബ്യൂറോ ഓഫ് പ്ലാന്റ് ജനിറ്റിക്സ് റിസോർസ് (ബയോ ഡൈവേർസിറ്റി ഇന്റർനാഷണൽ) ചിട്ടപ്പെടുത്തിയ വിവരിണിപ്രകാരം ബാഹ്യരൂപ, പഴഗുണ ഘടകങ്ങൾ നിർണ്ണയം ചെയ്ത് രേഖപ്പെടുത്തുകയും ചെയ്തു. പ്ലാവുകളിലും ചക്കകളിലും കാണപ്പെട്ട രൂപ, ഗുണ വ്യതിയാനം, അവ തമ്മിലുള്ള പരസ്പര ബന്ധത്തിന്റെ തോത്, ഗുണസാമ്യതയുടെ അടിസ്ഥാനത്തിൽ പ്ലാവുകളുടെ ശ്രേണീകരണം എന്നിവയും ശാസ്ത്രീയമായി വിശകലനം ചെയ്തു.

പഠനത്തിൽ ഉൾപ്പെടുത്തിയ പ്ലാവുകളുടെ സ്വഭാവഘടകങ്ങളിൽ ഗണ്യമായ വ്യതിയാനങ്ങൾ കാണപ്പെട്ടു. കാസർഗോഡ് ജില്ലയിൽ ചില പ്ലാവുകളിൽ ഡിസംബർ മാസത്തിൽ തന്നെ ചക്കകൾ പഴുത്തു തുടങ്ങുന്നതായി കാണപ്പെട്ടു. എന്നാൽ ഭൂരിഭാഗം പ്ലാവുകളിലും ചക്കകൾ മുത്ത് പഴുക്കുന്നത് മാർച്ച് - മെയ് മാസങ്ങളിലാണ്. ഗുണമേന്മ ഒട്ടും നഷ്ടപ്പെടാതെതന്നെ വളരെ വൈകി സെപ്തംബർ മാസംവരെ വിളവെടുക്കാവുന്ന പ്ലാവുകളും കാണപ്പെട്ടു.

കുരുവില്ലാത്ത ചുളയോടുകൂടിയ (വളരെ നേർത്ത കുരു) ചക്ക ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവ്, പഴുത്തുവരുമ്പോൾ പശയില്ലാത്ത ചക്ക ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവ്, ഒട്ടും തന്നെ ചുളയില്ലാത്തതും ഇടിച്ചുകയായി മാത്രം ഉപയോഗിക്കാൻ കഴിയുന്നതുമായ ചക്ക ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവ്, ഉയർന്ന തോതിൽ മധുരത്തോടുകൂടി വിശിഷ്ട രുചിയുള്ള ചക്കകൾ ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവുകൾ, കുലകളായി ധാരാളം ഇടത്തരം വലിപ്പമുള്ള ചക്കകൾ ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവുകൾ, ഒരു വർഷം മൂന്നിൽ കൂടുതൽ തവണ

ചക്ക ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവ് എന്നിങ്ങനെ അഭികാമ്യമായ സ്വഭാവഗുണങ്ങൾ ഉള്ള പ്ലാവുകളെ കണ്ടെത്തി.

ചുളകളുടെ എണ്ണം, ഭാരത്തിന്റെ അടിസ്ഥാനത്തിൽ ചുളകളുടെ ശതമാനം, കുരുവിന്റെ തൂക്കം എന്നിവ ക്രമത്തിൽ ചക്കയുടെ ശരാശരി തൂക്കവുമായി ഏറ്റവും അധികം ബന്ധപ്പെട്ടു നിൽക്കുന്നതായി കണ്ടെത്തി. ചക്കയിലുള്ള ചവിണിയുടെ ശതമാനം, ചക്കയുടെ തൂക്കവുമായും, ചുളയുടെ കനവുമായും, കുരുക്കളുടെ എണ്ണവുമായും ചുളയുടെ മധുരാംശവുമായും പ്രതികൂല രീതിയിൽ ബന്ധപ്പെട്ടിരിക്കുന്നതായും കണ്ടു.

ചക്കയുടെ ഭൗതിക ഗുണങ്ങളെ അടിസ്ഥാനമാക്കി ആറും ചുളകളുടെ രാസഗുണങ്ങളെ അടിസ്ഥാനമാക്കി നാലും ശ്രേണികളിൽ പ്ലാവിനങ്ങൾ തരംതിരിഞ്ഞ് നിൽക്കുന്നതായി കണ്ടു.

കണ്ടെത്തിയ മികച്ച പ്ലാവുകളിൽ കെ.ജെ. 180, കെ.ജെ. 182, കെ.ജെ. 185, കെ.ജെ. 186, കെ.ജെ. 356, കെ.ജെ. 397 എന്നിവ നിലവിൽ ശുപാർശ ചെയ്യപ്പെടുന്ന സിംഗപ്പൂർ ജാക്ക്, മുട്ടംവരിക്ക എന്നിവയേക്കാൾ പഴഗുണ ഘടകങ്ങളിലും രുചി പരിശോധനയിലും ഏറെ മുന്നിട്ടുനിന്നു. അപൂർവ്വ സ്വഭാവഗുണങ്ങൾ പ്രദർശിപ്പിക്കുന്ന കെ.ജെ. 173 (ചുളയില്ലാത്തതും ഇടിച്ചക്കക്ക് ഏറ്റവും അനുയോജ്യവും), കെ.ജെ. 121 (വർഷത്തിൽ 3 ൽ കൂടുതൽ തവണ ചക്ക ഉൽപ്പാദനം) എന്നിവയും വാണിജ്യപ്രാധാന്യമുള്ളവയാണെന്നു തെളിഞ്ഞു.

ഇവയെല്ലാം സംരക്ഷണവും തുടർപഠനവും അർഹിക്കുന്നു.



ചക്ക ഉൽപ്പാദിപ്പിക്കുന്ന പ്ലാവ് എന്നിങ്ങനെ അഭികാമ്യമായ സ്വഭാവഗുണങ്ങൾ ഉള്ള പ്ലാവുകളെ കണ്ടെത്തി.

ചുളകളുടെ എണ്ണം, ഭാരത്തിന്റെ അടിസ്ഥാനത്തിൽ ചുളകളുടെ ശതമാനം, കുരുവിന്റെ തൂക്കം എന്നിവ ക്രമത്തിൽ ചക്കയുടെ ശരാശരി തൂക്കവുമായി ഏറ്റവും അധികം ബന്ധപ്പെട്ടു നിൽക്കുന്നതായി കണ്ടെത്തി. ചക്കയിലുള്ള ചവിണിയുടെ ശതമാനം, ചക്കയുടെ തൂക്കവുമായും, ചുളയുടെ കനവുമായും, കുരുക്കളുടെ എണ്ണവുമായും ചുളയുടെ മധുരാംശവുമായും പ്രതികൂല രീതിയിൽ ബന്ധപ്പെട്ടിരിക്കുന്നതായും കണ്ടു.

ചക്കയുടെ ഭൗതിക ഗുണങ്ങളെ അടിസ്ഥാനമാക്കി ആറും ചുളകളുടെ രാസഗുണങ്ങളെ അടിസ്ഥാനമാക്കി നാലും ശ്രേണികളിൽ പ്ലാവിനങ്ങൾ തരംതിരിഞ്ഞ് നിൽക്കുന്നതായി കണ്ടു.

കണ്ടെത്തിയ മികച്ച പ്ലാവുകളിൽ കെ.ജെ. 180, കെ.ജെ. 182, കെ.ജെ. 185, കെ.ജെ. 186, കെ.ജെ. 356, കെ.ജെ. 397 എന്നിവ നിലവിൽ ശുപാർശ ചെയ്യപ്പെടുന്ന സിംഗപ്പൂർ ജാക്ക്, മുട്ടംവരിക്ക എന്നിവയേക്കാൾ പഴഗുണ ഘടകങ്ങളിലും രുചി പരിശോധനയിലും ഏറെ മുന്നിട്ടുനിന്നു. അപൂർവ്വ സ്വഭാവഗുണങ്ങൾ പ്രദർശിപ്പിക്കുന്ന കെ.ജെ. 173 (ചുളയില്ലാത്തതും ഇടിച്ചക്കക്ക് ഏറ്റവും അനുയോജ്യവും), കെ.ജെ. 121 (വർഷത്തിൽ 3 ൽ കൂടുതൽ തവണ ചക്ക ഉൽപ്പാദനം) എന്നിവയും വാണിജ്യപ്രാധാന്യമുള്ളവയാണെന്നു തെളിഞ്ഞു.

ഇവയെല്ലാം സംരക്ഷണവും തുടർപഠനവും അർഹിക്കുന്നു.

# **APPENDICES**

**APPENDIX I**

**List of farmers contacted for conducting the preliminary survey**

Jackfruit	Name of the farmer	Address	Panchayath/
KJ 1	Sri. Narayanan Nambiar	Nileswar P.O, Pallikkara	Nileswar
KJ 2	"	"	"
KJ 3	"	"	"
KJ 4	"	"	"
KJ 5	"	"	"
KJ 6	Sri. Ramesh. P	Parvathi (H), Vellikoth P.O, Ajanoor	Ajanoor
KJ 7	"	"	"
KJ 8	Smt. Laxmi	Laxmi Nivas, Amethodi, Mugu P.O	Puthige
KJ 9	Sri. Thyampa Moolya	"	"
KJ 10	"	"	"
KJ 11	Sri. Subba Moolya	Amethodi, Mugu P.O	Puthige
KJ 12	Sri. Sankara Moolya	"	"
KJ 13	"	"	"
KJ 14	Smt. Leela. P	Mekkat, Madikkai P.O, Nileswar	Madikkai
KJ 15	Smt. Narayani. M	Madhuramkkai, Uppilikkai, Nileswar	Kanhangad
KJ 16	Sri. K.M. Babu	Koovallur (H), Kayyeni P.O, Cherupuzha via	East Eleri
KJ 17	"	"	"
KJ 18	Sri. Sasidharan. T	Thottiyil (H), Kotrachal P.O, Ozhinjalappu	Kanhangad
KJ 19	Sri. Kuriakkose V. T	Thondikkal (H), Karindhalam P.O	Kinanoor
KJ 20	"	"	"
KJ 21	Sri. Francis. M. V	Mukkalel (H), Sankarampady P.O	kuttikkol
KJ 22	Smt. Anitha	Uthradam, Thaikkadappuram P.O, Nileswar	Nileswar
KJ 23	Smt. Sakunthala	Lakshmi Nagar, Kanhangad P.O	Kanhangad
KJ 24	Smt. Shantha	Thoyammal, Kanhangad P.O	Kanhangad
KJ 25	Sri. Sakku Bhai	Lakshmi Nagar, Kanhangad P.O	Kanhangad
KJ 26	Sri. Kadavath Narayanan	Madhavi Nivas, Nileswar P.O, Nileswar	Nileswar
KJ 27	Sri. Sreedharan. P	Karakkuzhi (H), Ajanoor P.O, Anandhasramam,	Ajanoor
KJ 28	Sri. Unnikrishnan. P	Karimbil (H), Periyanganam,	Kinanoor
KJ 29	Sri. Ajayan K. V	Maadikkal, Haripuram, Anandhasramam	Pulloor Periya
KJ 30	Smt. Ajitha	Navadhyan Veedu, Kumbalalappalli P.O	Kinanoor
Muttam	Sri. Ganapathy Bhatt	Kakunje, Padinjattamkovval, Nileswar	Nileswar
KJ 32	Sri. Unnikrishnan Nair.	Jaya Sree, Padinjattamkovval, Nileswar	Nileswar
KJ 33	Smt. Bharathi	Kottaram (H), Padinjattamkovval	Nileswar
KJ 34	"	"	"
KJ 35	"	"	"
KJ 36	Sri. Vinod Kumar.K.M	Karingate (H), Moolappally	Nileswar
KJ 37	"	"	"
KJ 38	Smt. Saraswathi	Priya Nivas, Moolappally	Nileswar
KJ 39	Sri. Muraleedharan	Sree Navyam, Padinjattamkovval	Nileswar
KJ 40	Smt. Kalyani T.V	Madiyan veed, Moolappally	Nileswar
KJ 41	Smt. Chirutha	Arayakkil (H), Moolappally	Nileswar
KJ 42	Smt. Chandrika	Ayilyam, Padinjattamkovval	Nileswar
KJ 43	"	"	"

KJ 44	Smt. Janaki M	Uniyamkkai (H), Moolappally	Nileswar
KJ 45	Sri. Jayaprasad	Moolacheri (H), Moolappally	Nileswar
KJ 46	Smt. Mariyam	Sameera manzil, Moolappally	Nileswar
KJ 47	Sri. Baskaran V. V	Madhuramkkai (H), Ilampachi	Thrikkarippur
KJ 48	"	"	"
KJ 49	Sri. Kunjikirishnan. K. V	Kadannappaly valiya veetil, Anikkadi	Pilicode
KJ 50	Smt. Lalitha	Anikkadi, Kodakkad P.O	Pilicode
KJ 51	Smt. Pathmavathi	Anikkadi, Kodakkad P.O	Pilicode
KJ 52	Smt. Karthyayani	Anikkadi, Kodakkad P.O	Pilicode
KJ 53	Smt. Radha	Radha. T, Madhuramkkai, Uppilikkai P.O,	Kanhangad
KJ 54	"	"	"
KJ 55	Smt. Karthyayani	Reshma Nivas, Madhuramkkai, Uppilikkai P.O,	Kanhangad
KJ 56	Sri. Narayanan. P	Madhuramkkai, Uppilikkai P.O, Kanhangad	Kanhangad
KJ 57	"	"	"
KJ 58	"	"	"
KJ 59	Sri. Manoharan M. V	Mavunkal P.O, Anandhasramam	Ajanoor
KJ 60	"	"	"
KJ 61	"	"	"
KJ 62	Smt. Radhambika	Mavunkal P.O, Anandhasramam	Ajanoor
KJ 63	"	"	"
KJ 64	Sri. Vasudevan M. V	Dhanwanthary, Mavunkal P.O, Anandhasramam	Ajanoor
KJ 65	"	"	"
KJ 66	Sri. Vithan Kunjatha	Thadiyankovval, Udhinoor P.O	Padanna
KJ 67	Devaswam	Thadiyankovval devaswam	Padanna
KJ 68	Sri. Krishnan. C.T	Thadiyankovval, Udinoor P.O	Padanna
KJ 69	Smt. Narayani	Melanjeri, Kattipoyil P.O	Kinanoor
KJ 70	Sri. Kunhambu. C	Kadayamnkayam thattu, Kattipoyil P.O	Kinanoor
KJ 71	Smt. Thankamani	Melanjeri, Kattipoyil P.O	Kinanoor
KJ 72	Sri. Krishnan	Melanjeri, Kattipoyil P.O	Kinanoor
KJ 73	Sri. Ambu. M	Chembena, Kattilpoyil P.O	Kinanoor
KJ 74	Smt. Shyamala	Melanjeri, Kattipoyil P.O	Kinanoor
KJ 75	Sri. Byju. M	Chembena, Kattilpoyil P.O	Kinanoor
KJ 76	Smt. Madhavi	Melanjeri, Kattipoyil P.O	Kinanoor
KJ 77	Sri. Rajesh	Kaduvakkad, Pilicode	Pilicode
KJ 78	"	"	"
KJ 79	"	"	"
KJ 80	"	"	"
KJ 81	"	"	"
KJ 82	"	"	"
KJ 83	"	"	"
KJ 84	"	"	"
KJ 85	Smt. Janaki. A	Kaduvakkad, Pilicode	Pilicode
KJ 86	"	"	"
KJ 87	Sri. Chandran.A	Kaduvakkad, Pilicode	Pilicode

KJ 88	"	"	"
KJ 89	"	"	"
KJ 90	Sri. P.B.C. Nair	Sreevalsam, Kaduvakkad, Pilicode	Pilicode
KJ 91	"	"	"
KJ 92	"	"	"
KJ 93	Sri. Krishnan. A.V	Kaduvakkad, Pilicode	Pilicode
KJ 94	"	"	"
KJ 95	"	"	"
KJ 96	Sri. Balakrishnan.K	Kaduvakkad, Pilicode	Pilicode
KJ 97	"	"	"
KJ 98	"	"	"
KJ 99	"	"	"
KJ 100	Smt. Thampayi.A.P	Kaduvakkad, Pilicode	Pilicode
KJ 101	"	"	"
KJ 102	"	"	"
KJ 103	"	"	"
KJ 104	"	"	"
KJ 105	Sri. Suresh	Kaduvakkad, Pilicode	Pilicode
KJ 106	"	"	"
KJ 107	"	"	"
KJ108	"	"	"
KJ 109	"	"	"
KJ 110	"	"	"
KJ 111	"	"	"
KJ 112	Sri. Thamban. A	Kaduvakkad, Pilicode	Pilicode
KJ 113	"	"	"
KJ 114	"	"	"
KJ 115	"	"	"
KJ 116	"	"	"
KJ 117	"	"	"
KJ 118	Smt. Madhavi	Kaduvakkad, Pilicode	Pilicode
KJ 119	"	"	"
KJ 120	Sri. Sreedharan Nambiar	Kaduvakkad, Pilicode	Pilicode
KJ 121	Smt. Janaki	Kadayangal (H), Kanhangad South, Padannakkad	Kanhangad
KJ 122	"	"	"
KJ 123	"	"	"
KJ 124	Smt. Karthyayani.K	Kadayangal (H), Kanhangad South, Padannakkad	Kanhangad
KJ 125	Smt. Madhavi	Payangapaadam veedu, Kanhangad South,	Kanhangad
KJ 126	"	"	"
KJ 127	"	"	"
KJ 128	"	"	"
KJ 129	Sri. Abdurahman	Oppst. Arangadi Mazjid, Kanhangad South,	Kanhangad
KJ 130	"	"	"
KJ 131	"	"	"
KJ 132	"	"	"
KJ 133	"	"	"
KJ 134	"	"	"
KJ 135	Sri. Latheef	Kanhangad South, Padannakkad P.O,	Kanhangad
KJ 136	"	"	"

KJ 137	Smt. Safiya	Kanhangad South, Padannakkad P.O,	Kanhangad
KJ 138	Smt. Usha T. V	Panakkol, Pallikkara	Nileswar
KJ 139	"	"	"
KJ 140	"	"	"
KJ 141	Sri. Vijayan	Karipadakkan Veedu, Pallikkara	Nileswar
KJ 142	Smt. Shantha. C. V	Kunjipulikkara, Pallikkara	Nileswar
KJ 143	Smt. Sakunthala	Lakshmi Nagar, Kanhangad	Kanhangad
KJ 144	Sri. Rameshan	Lakshmi Nagar, Kanhangad	Kanhangad
KJ 145	Sri. Manoj	Lakshmi Nagar, Kanhangad	Kanhangad
KJ 146	Sri. Sudhakaran .M	Omacheri (H), Karinthalam	Karinthalam
KJ 147	Smt. Sarojini. T	Omacheri (H), Karinthalam	Karinthalam
KJ 148	Sri. Rajesh	Paarakkol, Karinthalam	Karinthalam
KJ 149	Sri. Sreedharan. C. P	Gopasree, Nileswar	Nileswar
KJ 150	"	"	"
KJ 151	Smt. Sathyabhama. K.K	Puthiya Madam, Nileswar	Nileswar
KJ 152	"	"	"
KJ 153	"	"	"
KJ 154	"	"	"
KJ 155	Smt. Baby	Padumandame, Adhoor P.O	Karadukka
KJ 156	"	"	"
KJ 157	"	"	"
KJ 158	"	"	"
KJ 159	Sri. Krishnan. K.V	K.V.(H), Mallavara, Aadhoor P.O	Karadukka
KJ 160	"	"	"
KJ 161	"	"	"
KJ 162	Sri. Shyambavi	K.V.(H), Mallavara, Aadhoor P.O	Karadukka
KJ 163	"	"	"
KJ 164	Sri. Achuthan	Mallavara, Aadhoor P.O	Karadukka
KJ 165	"	"	"
KJ 166	"	"	"
KJ 167	Sri. Manoj Kumar	Pala,Aanikkadi	Pilicode
KJ 168	Sri. Ramachandran.P	Padinhattath House, Kodakkad P.O, Pala,	Pilicode
KJ 169	"	"	"
KJ 170	Smt. Parvathy. K.V	Pala,Aanikkadi	Pilicode
KJ 171	Smt. Parvathiamma. K	Pala, Anikkadi	Pilicode
KJ 172	Sri. Pathmanabhan	Cheruvacheri Veedu, Anikkadi	Pilicode
KJ 173	Sri. Lakshmanan.K	Kannoth House, Udhinoor P.O, Padanna	Padanna
KJ 174	Sri. Raveendran	Haritha, Kalikkadavu	Pilicode
KJ 175	Sri. Abdul Khadar.K	Kallangadi House, Ujjrikkara P.O, Mogral-Puthur	Mogral Puthur
KJ 176	"	"	"
KJ 177	"	"	"
KJ 178	"	"	"
KJ 179	Sri. Ramakrishnan	R.S. Nilayam, Koottakkani, Pakkam P.O	Pallikkara
KJ 180	"	"	"
KJ 181	Smt. Vidhya.M	Chaithanya, Karuvacheri	Nileswar
KJ 182	Sri. Abdul Rasak	Noushad Manzil, Chirappuram	Nileswar
KJ 183	Sri. Ramdas.P.M	Puthukkai Madam, Chirappuram	Nileswar
KJ 184	Smt. Vidhya. M	Chaithanya, Karuvacheri	Nileswar

KJ 185	Sri. Kunjabdulla	Sahidha Manzil, Pallikkara	Nileswar
KJ 186	Sri. Pramod.M	Taliyathil House, Karuvacheri, Nileswar P.O	Nileswar
KJ 187	Sri. Manoj Kumar	Kaaryath (H), Kanichira, Nileswar	Nileswar
KJ 188	Smt. Dhakshayani	Medhupathayppura, Vidhyanagar	Chengala
KJ 189	"	"	"
KJ 190	"	"	"
KJ 191	"	"	"
KJ 192	Smt. Rajalakshmi. P.K	Nileswar	Nileswar
KJ 193	"	"	"
KJ 194	"	"	"
KJ 195	"	"	"
KJ 196	Sri. Muneer	Adukkath Vayal	Udhuma
KJ 197	"	"	"
KJ 198	Sri. Abdul Khadar	Adukkath Vayal	Udhuma
KJ 199	Sri. Manoj Kumar	Anikkadi	Pilicode
KJ 200	Sri. Ravi. N	Kaduvakkad, Pilicode	Pilicode
KJ 201	Smt. Narayani. K	Kaduvakkad, Pilicode	Pilicode
KJ 202	"	"	"
KJ 203	"	"	"
KJ 204	"	"	"
KJ 205	"	"	"
KJ 206	"	"	"
KJ 207	"	"	"
KJ 208	"	"	"
KJ 209	Smt. Narayani. T	Kaduvakkad, Pilicode	Pilicode
KJ 210	"	"	"
KJ 211	"	"	"
KJ 212	"	"	"
KJ 213	"	"	"
KJ 214	"	"	"
KJ 215	"	"	"
KJ 216	"	"	"
KJ 217	Sri. Parameswaran Nair	Kousthubham, Puthukkai	Nileswar
KJ 218	Sri. Kunjiraman. K	Thadiyankovval, Mundia	Padanna
KJ 219	Sri. Alayil Amboonji	Alayil Tharavad, Mundia	Padanna
KJ 220	Sri. Kannan Master.	Kamalalayam, Thadiyankovval	Padanna
KJ 221	Sri. Chandran. P	Near Sri Sankara Narayana	Kanhangad
KJ 222	"	"	"
KJ 223	Smt. Radha	Vattak (H), Palayi, Puthariyadukka	Nileswar
KJ 224	"	"	"
KJ 225	"	"	"
KJ 226	Sri. Janardhanan	Padora, Palayi, Puthariyadukka	Nileswar
KJ 227	"	"	"

Singapore Jjack	COA, Padannakkad	COA, Padannakkad	Kanhangad
KJ 229	"	"	Kanhangad
KJ 230	"	"	"
KJ 231	COA, Padannakkad	Instructional Farm, COA, Padannakkad	Kanhangad
KJ 232	Smt. Janaki	Near Instructional Farm, Nileswar	Nileswar
KJ 233	Guruvanam	Guruvanam, Arayi	Kanhangad
KJ 234	"	"	"
KJ 235	"	"	"
KJ 236	"	"	"
KJ 237	"	"	"
KJ 238	"	"	"
KJ 239	"	"	"
KJ 240	"	"	"
KJ 241	Sri. Kannan	Therikunnu, Arayi	Kanhangad
KJ 242	"	"	"
KJ 243	Sri. Ramesh. P	Sreedevi Sadhanam, Karuvacheri	Nileswar
KJ 244	"	"	"
KJ 245	"	"	"
KJ 246	Sri. Somanadhan	Mangalalayam, Kodakkadu	Pilicode
KJ 247	Sri. Raghavan. K. V	Puthiyakandam, Cheruvattur	Cheruvathur
KJ 248	"	"	"
KJ 249	Smt. Shyla	Vilanjadukkam, Kayyur	Kayyur
KJ 250	"	"	"
KJ 251	Smt. Devaki	Sree Pathmam, Thrikkaripur	Pilicode
KJ 252	Smt. Subadra	Kizhakkemuri, Cheruvattur	Cheruvattur
KJ 253	Smt. Jayasree	Chayoth via, Nileswar	Kinanoor
KJ 254	Smt. Shyla	Vilanjadukkam, Kayyur	Kayyur
KJ 255	Smt. Kunjammar	Karicheri, Kayyur	Kayyur
KJ 256	"	"	"
KJ 257	Sri. Vijayan	Vismaya Nivas, Njandadi	Kayyur
KJ 258	"	"	"
KJ 259	"	"	"
KJ 260	"	"	"
KJ 261	"	"	"
KJ 262	"	"	"
KJ 263	Sri. Gangadharan Nair	Gangodhayam, Chengala via	Bedadukka
KJ 264	Tashco Crusher Unit	Tashco Crusher Unit, Perladukka	Bedadukka
KJ 265	Sri. Thamban Nair	Melanjeri, Parappa	Kinanoor
KJ 266	Sri. Ibrahim	Kolamje (H), Near Kunnil Mazjid	Madhur



KJ 267	Sri. Bharathan. K	Karalamkalathil (H), Kattipoyil	Kinanoor
KJ 268	Sri. Satheesh Chandran	Karalamkalathil (H), Kattipoyil	Kinanoor
KJ 269	Sri. Joseph George	Poovathingal (H), Bheemanadi	West Eleri
KJ 270	"	"	"
KJ 271	"	"	"
KJ 272	Smt. Sindhu. K.U	Anandha Vilasam,Kunnumkkai	West Eleri
KJ 273	Sri. Alexander. K. M	Kubhampadathu Veed, West Eleri	West Eleri
KJ 274	Sri. Joy. E.J	Idathikkara (H), Chempan kunnu	West Eleri
KJ275	Sri. Xavier	Kannam Velil(H), Nadakkal	West Eleri
KJ 276	Sri. Jobin George	Nangalithar, Attakkad, Plachikara	West Eleri
KJ 277	Sri. Bhaskaran. K.V	Kunjippurayil,Kunnamkkai	West Eleri
KJ 278	Sri. Balakrishnan. M.B	Narkkilakkadu	West eleri
KJ 279	Sri. Madhusudhanan	Pallikki (H), Cheerayam	West Eleri
KJ 280	Sri. Kunjiraman. P.P	Puthiyapurayil (H), West Eleri	West Eleri
KJ 281	Smt. Pathmini Nambiar	Pathmalayam, Pallikkara	Nileswar
KJ 282	Smt. Rukiya	Pallikkara	Pallikkara
KJ 283	Sri. Raghavan	Pilicode	Pilicode
KJ 284	Sri. Vinod	chittanikkara	East Eleri
KJ 285	Sri. Vijayan	Kodom Belur	Kodom Belur
KJ 286	Sri. Rajesh Babu	Kanhangad	Kanhangad
KJ 287	Sri. Syriac Antony	Nileswar	Nileswar
KJ 288	Sri. Venugopal	Nileswar	Nileswar
KJ 289	Sri. Madhu. K	Pallikkara, Nileswar	Nileswar
KJ 290	Sri. Soman	Kanhangad	Kanhangad
KJ 291	Sri. Lakshmanan	Kovvai	Kanhangad
KJ 292	Sri. Purushothaman	Kanhangad	Kanhangad
KJ 293	Smt. Deepa	Nileswar	Nileswar
KJ 294	Smt. Neethu	Ajanoor	Ajanoor
KJ 295	Sri. Thomas	Kanhangad	Kanhangad
KJ 296	Sri. Johnson	West Eleri	West Eleri
KJ 297	Sri. Dinesh Kumar	Thrikkarippur	Thrikkaripur
KJ 298	Sri. Abdul Salam	West Eleri	West Eleri
KJ 299	Sri. Unnikrishnan	Moolacher (H), Chayoth	Kinanoor
KJ 300	Sri. Shambu. P	Chayoth	Karinthalam
KJ 301	Sri. Rajan	Nileswar	Nileswar
KJ 302	Sri. John	Malakkallu, Kallar	Kallar
KJ 303	Sri. Sunil	Nileswar	Nileswar
KJ 304	Sri. Mathew	Chullikkara	Chullikkara
KJ 305	Sri. Krichiri Kunjambunair	Kinanoor Karinthalam	Kinanoor
KJ 306	"	"	"
KJ 307	Sri. Ranjith Kumar	Kuttikol	Kuttikkol

KJ 308	Sri. Ambu. K	Mailatti, Udhumma	Udhumma
KJ 309	Sri. Asokan	Nileswar	Nileswar
KJ 310	Smt. Nimya	Eyyakkad	Thrikkarippur
KJ 311	Sri. Abhilash	Kodom-Belur	Kodom-Belur
KJ 312	Sri. Raju	Nileswar	Nileswar
KJ 313	Sri. Krishnan	Nileswar	Nileswar
KJ 314	Sri. Viswanath	Nileswar	Nileswar
KJ 315	Smt. Namitha	Nileswar	Nileswar
KJ 316	Sri. Faisal	Kayyur Cheemeni	Kayyur
KJ 317	Sri. Faris	Nileswar	Nileswar
KJ 318	Sri. Raghavan	Nileswar	Nileswar
KJ 319	Sri. Musthafa	Chemmanad, Kozhidukkam	Chemmanad
KJ 320	Sri. Vikramanan	Vazhannoradi, Kanhangad	Kanhangad
KJ 321	Smt. Bhanu Kannan	Athiyampoyil, Kanhangad	Kanhangad
KJ 322	Sri. Narayanan	Kalichanadukkam	Kodom Belur
KJ 323	Smt. Saraswathi	Thekkumpad	Thrikkarippur
KJ 324	Smt. Thulasi	Kottodi, Kallar	Kallar
KJ 325	Sri. Kunjiraman nambiar	Maniyatt, Pilicode	Pilicode
KJ 326	Sri. Sivaraman	Kattipoyil, Kinanoor Karinthalam	Kinanoor
KJ 327	Smt. Sujatha	Nileswar	Nileswar
KJ 328	Smt. Leelama	Kodom Belur	Kodom Belur
KJ 329	Sri. Sasidharan	Pilicode	Pilicode
KJ 330	Sri. George. M. P	Gounyadka, Movvar P.O	Pallikkara
KJ 331	Sri. Madhusudhanan. V	Parkkalayi	Kanhangad
KJ 332	Sri. Madhusudhanan. M. K	Valiyaparamba	Valiyaparamba
KJ 333	Sri. Pavithran Nambiar	Puthukkai, Kanhangad	Kanhangad
KJ 334	Smt. Shemi Nishad	Chittarikkavu	Kanhangad
KJ 335	Smt. Rajini	Avikkara, Kanhangad	Kanhangad
KJ 336	Sri. Ramachandran	Kayyur Cheemeni	Kayyur
KJ 337	Sri. Karunakaran	Cheruvattur	Cheruvattur
KJ 338	Sri. Abdul Azeez	Mundol P.O, Thekkil	Chemmanad
KJ 339	Sri. Deepak	Nileswar	Nileswar
KJ 340	Smt. Rama	Nileswar	Nileswar
KJ 341	Sri. Vishnu. K. N	Madikkai	Madikkai
KJ 342	Sri. Midlaj	Karadukka	Karadukka
KJ 343	Sri. Jayarajan	Cheruvattur	Cheruvattur
KJ 344	Sri. Sumesh	Malom	West Eleri
KJ 345	Sri. Sathar	Nizar Manzil, Thakkuva Nagar	Cheruvattur
KJ 346	Sri. Sreekumar	Kusumam (H), Maniyat	Pilicode
KJ 347	Sri. Benny Thomas	Ushathuval (H), Kottamala P.O, Narkkilakkad	West Eleri
KJ348	Sri. George.K. T	Kandathil (H), Plachikkara, Vellarikkundu	West Eleri

KJ 350	Sri. Raghavan. T	CPCRI Head Quarters	Mogral- Puthur
KJ 351	Sri. Jameela. M.T.P	Kanjiyil (H), Thrikkariapur	Thrikkariapur
KJ 352	Sri. Narayanan	Moonnamkutti, Puthariyadukkam	Nileswar
KJ 353	Sri. Vijaykrishnan.C.G	Punoor (H), Iriya P.O,	Belur
KJ 354	Sri. Gopi.M.T	Valliyod Tharavad, Uduma P.O	Udhuma
KJ 355	Sri. Chandrasekharan. P. P	Krishna (H), Ambika Nagar, Udhuma	Udhuma
KJ 356	Smt. Kunjamma. K	Kelam Valappil, Bevuri, Uduma P.O	Udhuma
KJ 357	Smt. Rohini.K.V	Kuvamban Valappu, Uduma P.O	Udhuma
KJ 358	Sri. Umeshan	Kallar	Kallar
KJ 359	Sri. Kunjambu Nair. P	Maruthamkkara, Munnad, Chengala	Bedadukka
KJ 360	Sri. Narayanan. B	Kakkodu, Munda	Bedadukka
KJ 361	Sri. Bhasharan. C	Thoranam, Munnad, Chengala	Bedadukka
KJ 362	Sri. Ragesh. K	Thoranam, Bedadukka	Bedadukka
KJ 363	Sri. Prabhakaran. V	Kakkodu, Munda	Bedadukka
KJ 364	Smt. Shantha. T	Paduppumkal, Munnad	Bedadukka
KJ 365	Smt. Shantha. T	Paduppumkal, Munnad	Bedadukka
KJ 366	Sri. Gangadharan Nair	Munnad, Chenkala	Bedadukka
KJ 367	Sri. Kunjikkannan Nair	A.K Nivas, Munnad, Chenkala	Bedadukka
KJ 368	Sri. Mohan. A	Anandh(H), Madhur P.O	Madhur
KJ 369	Sri. Suresh Babu	Devatheertha, Munnad P.O	Kuttikkol
KJ 370	Sri. Narayaniamma	Mundot (H), Munnad P.O	Kuttikkol
KJ 371	Sri. Narayanan Nair	Mundot (H), Munnad P.O	Kuttikkol
KJ 372	Sri. Pathmanabhan Nair	Mundot (H), Munnad P.O	Kuttikkol
KJ 373	Sri. Manichan	Kanakkalil (H), Kunnumkkai	West Eleri
KJ 374	Sri. Kunjambu Nair T	Maruthokara (H), Munnad P.O	Bedadukka
KJ 375	Sri. Aboobakkar	Kanakur (H), Kodlamogaru	Vorkkadi
KJ 376	Sri. Arun Kumar	Paivalika	Paivalika
KJ 377	Sri. Symon Dizuzza	Vorkkadi	Vorkkadi
KJ 378	Sri. Raghunatha Naik	Kodlamogaru	Vorkkadi
KJ 379	Sri. Ramayya Naik. K	Barike, Kodlamogaru	Vorkkadi
KJ 380	"	"	"
KJ 381	Sri. Muhammad Kunji	Chadiparambu, Kodambar P.O	Meenja
KJ 382	Sri. Cheriyen. P. U	Peroth (H), Mandapam P.O	West Eleri
KJ 383	"	"	"
KJ 384	"	"	"
KJ 385	"	"	"
KJ 386	"	"	"
KJ 387	Thressiamma. T.U	Nallaparambath (H), Mandapam P.O,	West Eleri
KJ 388	Sri. Vargheese. P	Tharappel (H), Mandapam P.O	West Eleri
KJ 389	"	"	"
KJ 390	Thressiamma. T.U	Nallaparambath (H), Mandapam P.O,	West Eleri
KJ 391	Sri. Jojo George	Attupuram, Kottodi P.O	Kallar

KJ 392	"	"	"
KJ 393	Sri. Kesava Bhatt	Kanadhenu Farm, Ramdas Nagar P.O, Kudlu	Mogral Puthur
KJ 394	"	"	"
KJ 395	"	"	"
KJ 396	"	"	"
KJ 397	"	"	"
KJ 398	Sri. Rajan.A.George	Alackaparambil House, Panathadi P.O	Panathadi
KJ 399	Sri. Vargheese. P.O	Puthanpally (H), Padiamaruth	Kallar
KJ 400	"	"	"

## APPENDIX II

### Card for organoleptic scoring

College of Agriculture Padannakkad  
Department of Pomology and Floriculture (M.Sc. Hort. Programme)  
Identification and characterization of jackfruit types in Kasargod district

Jackfruit type number:

Date:

Sensory evaluation of jackfruit (Hedonic Scale)-**Please tick in appropriate column**

Score	Taste	Flavor	Colour	Texture	Sweetness	Appearance	Overall acceptability
Like extremely							
Like very much							
Like moderately							
Like slightly							
Neither like nor dislike							
Dislike slightly							
Dislike moderately							
Dislike very much							
Dislike extremely							