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Evaluation of rambutan (*Nephelium lappaceum*) accessions for yield and fruit quality

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The rambutan (*Nephelium lappaceum* L.), a tropical fruit closely related to the lychee and longan is considered to be native of the Malay Archipelago, which includes Indonesia, Malaysia and Southern Thailand (Tindall 1994). The fruit is a round to oval with numerous long, thick yellow or pink and red coloured hairy growths, the flesh (aril) is white or rose tinted, translucent, juicy, and delicious with a pleasant flavour and aroma and a good source of sugars, vitamin C (Wall 2006). Considerable variations existed in rambutan with respect to growth pattern, leaf size, number, and color; flower type and number per inflorescence; fruit pericarp, splinter colour, thickness and length; aril colour, thickness, texture, brix and acidity and adherence to testa; seed size; susceptibility to pest and diseases and tolerance to cold and drought (Tindall 2010). Eventhough it is highly adapted to tropical humid western peninsular India, its germplasm has not been exploited to its full potential despite of its economic value (Karunakaran *et al*. 2017). Therefore, a cultivar selection programme for fruit shape, size, small seed and high flesh ration, skin colour, aril texture, crispiness, compact low canopy and suitability of fresh fruits for processing industry is needed. Work on genetic improvement of rambutan started at IIHR-Central Horticultural Experiment Station, Chettalli, Kodagu, Karnataka during the early and mid-2000s to collect the prevailing diversity from its growing areas of the Kerala, Tamil Nadu and Karnataka led to the development of more than 1000 open pollinated progenies of rambutan which were evaluated for useful horticultural traits. So far numerous cultivars have been selected from open pollinated progenies for high yield and fruit quality traits in rambutan (Hernandez-Arenas *et al*. 2010). Thus the study was undertaken to determine variations for selected horticultural traits among promising rambutan selections.

Ten promising selections of rambutan collected from its growing areas of Kerala, Tamil Nadu and Karnataka were used in the present study. The budded trees were planted in randomized block design (RBD) with three replicates and four plants in each replication in 2002 at Central Horticultural Experiment Station (ICAR-IIHR), Chettalli, Kodagu, Karnataka, located on the eastern slopes of the Western Ghats has a humid tropical climate throughout the years. Tree spacing was maintained at 5 m × 5 m. The trees were managed with all cultural and plant protection practices according to standard local commercial practices.

Tree height, canopy volume and tree spread were recorded annually after fruit harvest from 2017–21. Tree spread (m^2) was estimated as:

Plant spread (N-S) × Plant spread (E-W))/2

The canopy volume (m^3) was calculated as:

Tree spread × plant height × 0.85

Scion trunk circumference was measured 10 cm above the bud union to calculate trunk cross-sectional area (TCSA, cm^2) (Kumar *et al*. 2008). Fruit yield (kg/tree), fruiting density per cm^2/TSCA (Robinson and Watkin 2003) and tree yield by canopy volume (kg/m^3 tree volume) were also analyzed. In September, which is the commercial harvesting season of rambutan in Coorg, 25 fruits per plant were selected for quality analysis. All fruit samples were assessed for fruit weight (g), skin weight, seed weight (g), and aril recovery (%) using standard procedures. Total soluble solids (°Brix), acidity (%) and ascorbic acid (mg/100 ml pulp) were estimated using procedures described by Ranganna (1986).

The mean data of five years were subjected to analysis of variance (ANOVA) and differences among the treatment means were determined for significance at $P<0.05$. Analysis of variance (ANOVA) was carried out using Statistical

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Table 1 Growth and fruiting density of different promising lines of rambutan (average 2017–21)

Accession	Plant height (m)	TCSA (cm^2)	Tree spread (m^2)	Canopy volume (m^3)	Fruiting density/ cm^2/TCSA	Skin colour
CHES-R-1/1	3.78^{ab}	297.62^{bc}	3.98^{a}	61.66^{a}	2.83^{de}	Red
CHES-R-26	3.77^{b}	329.89^{a}	3.73^{ab}	59.09^{abc}	3.27^{bc}	Red purple
CHES-R-I/3	3.44^{d}	289.34^{c}	3.40^{cd}	48.84^{de}	2.77^{de}	Red
CHES-R-III/9	3.77^{b}	323.33^{ab}	3.91^{a}	60.47^{ab}	2.80^{de}	Red
Arka Coorg Arun	3.80^{ab}	306.81^{abc}	3.93^{a}	60.84^{a}	3.01^{b}	Red
CHES-R-14	3.76^{b}	282.63^{c}	3.53^{bc}	53.90^{cd}	3.09^{cd}	Yellow orange
CHES-R-IX/10	3.61^{c}	297.91^{bc}	3.19^{d}	48.81^{de}	2.26^{e}	Red
CHES-R-X/7	3.76^{b}	250.26^{d}	3.98^{a}	58.56^{abc}	3.70^{bc}	Red
Arka Coorg Peetabh	3.86^{a}	224.91^{d}	2.87^{e}	45.33^{e}	4.63^{a}	Yellow orange
CHES-R -XIII/4	3.78^{ab}	282.47^{c}	3.48^{bc}	55.19^{bc}	3.27^{bcd}	Red purple
SEM ±	0.09	10.55	0.09	1.88	0.26	
CD (P=0.05)	0.08	30.61	0.28	5.46	0.75	

software WASP 2.0 (Web Based Agri Stat Package) developed by ICAR-CCARI, Goa.

Tree growth and fruiting density: The average maximum plant height was recorded in Arka Coorg Arun (3.86 m), which was significantly on par with Arka Coorg Arun, CHES-R-I/1 and CHES-R-XIII/4, while it was lowest in CHES-R-I/3 (3.44 m) (Table 1). Significant differences in vegetative growth, expressed as trunk cross-sectional area (TSCA) (cm^2) was recorded maximum in CHES-R-26 (329.89 cm^2) followed by CHES-R-III/9 (323.33 cm^2), however it was significantly lower in Arka Coorg Peetabh (224.47 cm^2). The increase in TSCA in CHES-R-26 could be possibly due to higher canopy formation during tree growth. Similar trend was reported by Hernandez-Arenas *et al.* (2010) while working with rambutan. Further canopy volume which indicates tree vigour was significantly higher in CHES-R-I/1 (61.66 cm^3) followed by Arka Coorg Arun (60.84 cm^3), while it was lowest in Arka Coorg Peetabh (45.33 cm^3). The results on vegetative growth parameters indicated that the accessions, viz. CHES-R-I/1, Arka Coorg Arun, CHES-R-26 and CHES-R-III/9 were found to be vigorous compared with other accessions. The fruiting density is a valuable trait which is a measure of distribution of fruits across the canopy. Arka Coorg Peetabh (4.63/ cm^2 TCSA) excelled over other accessions by having higher fruiting density followed by CHES-R-26 (3.27/ cm^2 TSCA). The accessions, viz. CHES-R-IX/10, CHES-R-I/3, CHES-R-III/9 and CHES-R-1/1 indicated lower fruiting density, which could be probably due to lower plant canopy. Our findings are in agreement to those of Embree and Myra (2007), who also have reported significant negative correlation between crop load and plant canopy, while working on effect of crop load on growth and yield in 'Honeycrisp' apple. However, some of earlier reports hypothesized that apart from TCSA, other tree growth variables including cultivar, type of rootstocks, age of tree

Table 2 Yield and fruit quality characters of different promising lines of Rambutan (average 2017–21)

Accession	Yield (kg/tree)	Yield (kg/ m^3 tree volume)	Fruit wt. (g)	Fruit volume (ml)	Aril recovery (%)	Skin wt. (%)	Seed wt. (%)	TSS (^{0}B)	Titrable acidity (%)	Ascorbic acid (mg/100 g pulp)
CHES-R-1-1	31.12^{c}	0.51^{d}	33.48^{cd}	34.75^{bcd}	33.41^{c}	15.16^{b}	4.30^{c}	16.35^{ab}	0.83^{bc}	26.52^{b}
CHES-R-26	52.78^{b}	0.97^{bc}	48.84^{c}	36.50^{bc}	38.44^{bc}	17.51^{b}	4.95^{bc}	18.72^{a}	1.05^{a}	39.76^{a}
CHES-R-I-3	29.68^{c}	0.61^{cd}	33.34^{cd}	$34.25b^{cde}$	39.52^{bc}	17.88^{b}	4.26^{c}	15.97^{bc}	0.97^{ab}	18.09^{f}
CHES-R -III/9	33.35^{c}	0.56^{d}	27.30^{ef}	27.51^{de}	37.64^{bc}	17.41^{b}	6.17^{a}	16.40^{bc}	0.82^{bc}	25.06^{bc}
Arka Coorg Arun	51.80^{a}	0.98^{b}	46.67^{b}	49.08^{a}	52.32^{b}	26.50^{a}	5.18^{b}	16.81^{ab}	0.62^{d}	37.03^{ab}
CHES-R -14	30.58^{c}	0.55^{cd}	27.20^{ef}	29.25^{cde}	41.91^{abc}	17.17^{b}	4.96^{bc}	17.82^{ab}	0.75^{cd}	21.52^{de}
CHES-R -IX/10	23.52^{c}	0.48^{d}	25.34^{f}	27.03^{e}	36.02^{bc}	16.01^{b}	4.87^{bc}	16.83^{ab}	0.91^{abc}	24.75^{bc}
CHES-R -X/7	32.28^{c}	0.54^{d}	31.02^{cde}	39.52^{b}	35.88^{c}	16.24^{b}	5.09^{b}	17.62^{ab}	0.76^{cd}	23.02^{cd}
Arka Coorg Peetabh	56.48^{a}	1.24^{a}	54.31^{a}	55.04^{a}	53.28^{a}	27.76^{a}	5.45^{b}	14.75^{c}	0.75^{cd}	38.25^{a}
CHES-R -XIII/4	32.24^{c}	0.59^{cd}	29.79^{def}	31.25^{cde}	37.07^{bc}	17.52^{b}	4.91^{bc}	16.28^{bc}	0.77^{cd}	19.51^{ef}
SEM ±	3.60	0.07	2.09	2.55	1.98	0.98	0.09	0.25	0.03	1.28
CD (P=0.05)	10.45	0.21	4.75	7.40	4.96	ns	ns	1.83	0.18	2.55

and climatic conditions affect the fruiting density (Embree and Nichols 2005).

Fruit yield: Fruit yield and its variable are the key indicators in identifying or selecting a particular variety. The fruiting behaviour of 10 promising accessions of rambutan differed significantly ($P \leq 0.05$). Significantly higher fruit yield was recorded in Arka Coorg Peetabh followed by CHES-R-26 and Arka Coorg Arun (Table 2). Similarly, the yield efficiency (kg/m^3 tree volume) was also higher in Arka Coorg Peetabh compared with Arka Coorg Arun and CHES-R-26 which could be attributed to higher fruit number in Arka Coorg Peetabh. Further, lowest fruit yield and yield efficiency was noticed in CHES-R-IX/10. The average fruit weight was ranged from 25.34–54.31 g with significantly higher in Arka Coorg Peetabh followed by CHES-R-26, Arka Coorg Arun, CHES-R-I-1 and CHES-R-I-3. However, it was significantly lower in CHES-R -XIII/4 followed by CHES-R-14 and CHES-R -IX/10. Similar trend was also reported by Ricardo and David (2011) while evaluating the performance of eight rambutan cultivars for the fruit numbers and yield. In general, rambutan fruits vary greatly with respect to their shape and color. In our study, all the accessions selected, possesses oblong or ovoid fruit shape with fruit colour varies from red, red purple to yellow orange (Table 1). For rambutan, fruit weight of 30 g or more is prerequisite for the export in international markets (Solis-Fuentes *et al*. 2010). In the present study, all accessions had the average fruit weight more than 30 g except, CHES-R-XIII/4, CHES-R -14 and CHES-R -IX/10.

Fruit quality: Fruit quality attributes–Aril recovery, total soluble solids, skin weight, seed weight, ascorbic acid content and acidity are the major variables which influences consumer preference in rambutan. The recommended desirable fruit quality characteristics for fresh rambutan are 35% aril recovery, 16°B total soluble solids, low acidity (0.3%) and ascorbic acid content (20 mg/100 g pulp). In the present study, we noticed that among the accessions under study, Arka Coorg Peetabh, Arka Coorg Arun, CHES-R-26, CHES-R-14 and CHES-R-I-3 were found superior with respect to aril recovery, total soluble solids, acidity and ascorbic acid content. All the accessions differed significantly with respect to fruit quality variables except skin weight and seed weight. Among the different accessions studied, Arka Coorg Peetabh recorded maximum aril recovery (53.28%), while it was lowest in CHES-R-1-1 (33.41%), which could be due to lower average fruit weight in CHES-R-1-1. Total soluble solids were at par in all accessions except Arka Coorg Peetabh, which recorded the lower total soluble solids followed by CHES-R-I-3. Similar trend was also reported by Tripathi *et al*. (2021), where they reported lower TSS in Arka Coorg Peetabh. While significant differences in ascorbic acid content were found among the studied selections; a maximum of 39.76 mg/100 g of pulp in CHES-R-26 and a minimum of 18.09 mg/100 g in CHES-R-I-3 were observed. Differences noted among the different accessions with respect to fruit quality, are in agreement with the report of Nor Hanis Aifaa *et al.* (2013) and Hernandez-Arenas *et al.* (2010) suggesting that the prevailing environmental conditions particularly temperatures during the fruit growth and development also have the marked effect on fruit quality. Further, Jahurul *et al*. (2020) opinioned that microstructures qualities of rambutan pulp differs markedly with genotypes, age of tree and geographic locations.

Data from present study suggests that the accessions under study differed significantly with respect to tree growth, yield and fruit quality, which offers the selection of superior genotypes with respect to fruit yield and quality, as they were obtained in other rambutan genotypes. Summarizing, the accessions studied have both physical and chemical characteristics on par with the most widely accepted rambutan cultivars in the world. Four accessions (CHES-R-26, CHES-R-I-3, CHES-R-III-9 and CHES-R-III-4) were found equally superior with Arka Coorg Arun and Arka Coorg Peetabh in terms of yield and fruit quality. The inferences of the above study could be important for selecting or breeding new cultivars in rambutan.

SUMMARY

Ten promising accessions of rambutan were evaluated for five years (2017–21) to study the differences for selected horticultural traits. The accessions studied differed significantly with respect to tree growth, yield and fruit quality. The fruiting density was maximum in Arka Coorg Peetabh followed by CHES-R-26 and Arka Coorg Arun. Similarly, Arka Coorg Peetabh also recorded significantly higher fruit yield, yield efficiency and average fruit weight as compared with other accessions studied. The accession CHES-R-26 excelled in fruit quality variables (total soluble solids, titratable acidity and ascorbic acid content) as compared with Arka Coorg Peetabh and Arka Coorg Arun. Further, three accessions (CHES-R-I-3, CHES-R-III-9 and CHES-R-III-4) were also found superior in terms of yield and fruit quality. The results on vegetative growth parameters indicated that the accessions, viz. CHES-R-I/1, Arka Coorg Arun, CHES-R-26 and CHES-R-III/9 were found to be vigorous for tree spread and canopy volume. These variations among accessions studied may prove relevant in selecting or breeding new cultivars in rambutan.

REFERENCES

Embree C G, Myra M T D, Nichols D S and Wright A H. 2007. Effect of blossom density and crop load on growth, fruit quality, and return bloom in 'Honeycrisp' apple. *HortScience* **42**(7): 1622–25.

Embree C G and Nichols D S. 2005. Bio-regulators improve fruit size and color and reduce crop load and annual bearing of Honeycrisp apples. *Canadian Journal of Plant Science* **85**: 453–55.

Hernandez-Arenas M G, Angel D N, Damian M T M, Ortiz D T, Diaz C N and Martinez N B. 2010. Characterization of rambutan (*Nephelium lappaceum*) fruits from outstanding Mexican selections. *Revista Brasileira de Fruticultura* **32**(4): 1098–04.

Jahurul M H A, Nee S S, Norazlina M R, Hasmadi M, Sharifudin M S, Patricia M, Lee J S, Shihabul A, Amir H M S, Jumardi

R, Noorakmar A W and Norliza J. 2000. Changes in microstructures of rambutan seed and the quality of its fat during drying. *SN Applied Sciences* **2**: 841–49.

Karunakaran G, Tripathi P C, Ravishankar H, Sankar V, Sakthivel T and Senthilkumar R. 2017. Scope and potential of rambutan cultivation in Western Ghats. Success story of farmers. *(In) Proceeding of National Conference on Horticultural Crops of Humid Tropics-Diversification for Sustainability*, Madikeri, May 20-21, pp 121–24.

Kumar D Pandey V, Anjaneyul K and Nath V. 2008. Relationship of trunk cross-sectional area with fruit yield, quality and leaf nutrients status in Allahabad Safeda guava (*Psidium guajava*). *Indian Journal of Agricultural Sciences* **78**: 337–39.

Nor Hanis Aifaa Y, Semiah R, Md. Radzi M, Johari S and Latifah M N. 2013. Quality evaluation of six rambutan hybrids stored at 25 and 10°C. *Acta Horticulturae* **1012**: 865–72.

Ranganna S. 1986. *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. Tata Mc Grow Hill Publishing Company Ltd, New Delhi.

Ricardo G and David J. 2011. Yield and fruit quality traits of rambutan cultivars grafted onto a common rootstock and grown at two locations in Puerto Rico. *Hort Technology* **21**(1): 136–40.

Robinson T L and Watkins C B. 2003. Crop load of 'Honeycrisp' affects not only fruit size but many quality attributes. *New York Fruit Quarterly* **3**: 7–15.

Solís-Fuentes J A, Camey-Ortíz G, HernandezMedel M d-R, Pérez-Mendoza F and Duran-deBazua C. 2010. Composition, phase behavior and thermal stability of natural edible fat from rambutan (*Nephelium lappaceum* L.) seed. *Bioresource Technology* **101**: 799–803.

Tindall H D. 2010. Sapindaceous fruits: Botany and Horticulture. *Horticultural Reviews*, 16th edn, pp. 143–96. Jainck J (Eds). Wiley Online Library, New York, United States.

Tindall H D. 1994. *Rambutan Cultivation*, p 163. FAO, Rome, Italy.

Tripathi P C. 2021. Rambutan. *Tropical Fruits*, pp. 542–75. Ghosh and Sharma (Eds). Jaya Publishing Company, New Delhi.

Wall M M. 2006. Ascorbic acid and mineral composition of longan (*Dimocarpus longan*), lychee (*Litchi chinensis*) and rambutan (*Nephelium lappaceum*) cultivars grown in Hawaii. *Journal of Food Composition and Analysis* **19**: 655–63.