Journal of Horticultural Sciences
ISSN: 0973-354X
subbaraman.Sriram@icar.gov.in
Society for Promotion of Horticulture
India

Effect of tree age on fruit characteristics, seed emergence and seedling growth in Rambutan (Nephelium lappaceum L.)

Rashied, Tetteh; Misa Aboagye, Lawrence; Ansah Osafo, Eric; Darko, Robert; Dassah, Augustine; Obirih-Opareh, Jennifer

Effect of tree age on fruit characteristics, seed emergence and seedling growth in Rambutan (Nephelium lappaceum L.)
Journal of Horticultural Sciences, vol. 17, núm. 1, 2022
Society for Promotion of Horticulture, India
Disponible en: https://www.redalyc.org/articulo.oa?id=577073671028
DOI: https://doi.org/10.24154/jhs.v17i1.991

Short Communications

Effect of tree age on fruit characteristics, seed emergence and seedling growth in Rambutan (Nephelium lappaceum L.)

Tetteh Rashied rashbalm@yahoo.com
CSIR-Plant Genetic Resources Research Institute, Ghana
Lawrence Misa Aboagye
1CSIR-Plant Genetic Resources Research Institute, Ghana
Eric Ansah Osafo
CSIR-Plant Genetic Resources Research Institute, Ghana
Robert Darko
CSIR-Plant Genetic Resources Research Institute, Ghana
Augustine Dassah
University for Development Studies, Ghana
Jennifer Obirih-Opareh
CSIR-Plant Genetic Resources Research Institute, Ghana

Journal of Horticultural Sciences, vol. 17, núm. 1, 2022

Society for Promotion of Horticulture, India

Recepción: 10 Junio 2021
Revisado: 18 Mayo 2022
Aprobación: 26 Junio 2022

DOI: https://doi.org/10.24154/jhs.v17i1.991

Redalyc: https://www.redalyc.org/articulo.oa?id=577073671028

Resumen: Rambutan (Nephelium lappaceum L.) is an important exotic fruit from Asia, which is gaining popularity due to its nutritional benefits. The objective of the study was to evaluate the effect of tree age on fruit characteristics, seed emergence and seedling growth of rambutan. The study was conducted at the CSIR-Plant Genetic Resources Research Institute, Bunso, Ghana. Fruits of rambutan were harvested from 8, 10, 25 and 40 years old trees at different locations of the field genebank. For each tree age, three trees were used as replicates. Fruits harvested from trees of different ages were assessed for total fruit weight, pulp weight, pericarp weight, seed weight, percentage seed emergence, seedling plant height and number of leaves at monthly intervals. Fruits harvested from 8, 10, 25 and 40 years old trees did not show significant difference in fruit characteristics and seed emergence. Significant ($p<0.05$) differences were observed in plant height and number of leaves at 5 and 6 months after emergence, respectively.

Keywords: Fruit characteristics, Rambutan, Seed emergence, Seedling growth, Tree age

Rambutan (Nephelium lappaceum L.) is a tropical fruit that belongs to the Sapindaceae family (Wall, 2006). It is closely related to several other edible tropical fruits, including the lychee, longan, pulasan, and mamoncillo (Morton, 1987). It originated in Malaysia and has been widely cultivated in South-East Asia including Thailand, Malaysia, Indonesia, Singapore the Philippines and Sri Lanka (Tindall et al., 1994). The rambutan tree is of medium evergreen height. Thailand is the largest producer of rambutan growing 450,000 tonnes in the world, followed by Indonesia at 100,000 tonnes, and Malaysia, 60,000 tonnes (Le Bellec, 2014).

Tree age plays an important role in fruit quality, but studies to determine its effect are rare in fruit crops. Ozeker (2000) reported

that 20-year-old trees of 'Marsh' seedless grape fruit produced bigger fruit with thinner rinds compared with 34-year-old trees. Bramlage (1993) observed that Pome fruit harvested from young trees were highly susceptible to postharvest disorders. Lower quality apples were obtained from trees of old age (Smith, 2003). Khalid et al. (2012) in their studies reported that fruits harvested from old trees (35-year-old) had slightly inferior quality as compared to fruit produced from18- year-old trees. However, no studies have been published on the effect of tree age on fruit quality of rambutan. Thus, there is a need for comprehensive research to determine the possible variation in fruit quality in relation to tree age. The present study aimed to assess the effect of tree age on rambutan fruits characteristics, seed emergence and seedling growth.

In this study, fruits of rambutan were obtained from young and mature trees at CSIR-Plant Genetic Resources Research Institute field genebank (N 06o 17.839, W 000o 27.595, Alt 198.3 m above sea level), Bunso, Eastern region, Ghana during the harvesting season in July, 2018. The climate of the area is semi- equatorial type and the vegetation is moist-deciduous rainforest, with mean minimum annual temperature of 21.4oC and a mean maximum annual temperature of 31.3oC (Aboagye, 2005). The area experiences bi- modal rainfall pattern from April to July and from September to the middle of November. It has a mean annual precipitation of 1455 mm; with the dry season starting from the middle of November to March. Physiologically matured fully ripe fruits (Red cultivar) were harvested at maturity at random from trees of different ages at four locations at the same time. These comprised of 8 years old trees, 10 years old trees, 25 years old trees and 40 years old trees. For each tree age, three trees were used as replicates. Thirty fruits were sampled at random from each tree. During seedlings establishment, insect pests such as leaf miners and ants were controlled using K-optimal insecticide (Landa-cyhalothrin 15 g l-1 +Acetamiprid 20 g l-1: EC) at a recommended rate of 40 ml to 15 l of water at two weeks interval. Weeds were controlled using a hoe as and when necessary. Whole fruit weight and its components (i.e. pericap, pulp, aril and seed) were determined using an electronic balance. Thirty fruits were sampled from each tree of different age for all replicates. For fruit dry mass,10 fruits were harvested and separated manually into pericarp, pulp and seed for dry mass determination. Samples were dried at 80OC for 48 hours in an oven and weighed using an electronic balance.

For germination test, fresh seeds extracted from 30 fruits of each rambutan tree were sown in polybags of dimension 15.5cm x 20.5cm filled with topsoil. The completely randomised design was used with three replicates. Seeds sown were watered daily and kept under shade trees. Percentage seed emergence was computed at 21 days after sowing, as a ratio of the total number of seeds germinated to the total number of seeds sown multiplied by 100. Growth of rambutan seedlings was assessed by the number of leaves and plant height at monthly intervals for a period of six months. Plant height was measured with a metre rule in centimetres.

Statistical analyses was conducted using SPSS Statistics 21 (IBM, Chicago, IL, USA). One-way ANOVA was used to test the effects of

treatments. When a significant difference was detected, Tukey's HSD test was performed to identify significant differences among trees of different ages.

The results showed no significant differences ($p>0.05$) in total fruit weight, pericarp, seed and aril fresh weight of rambutan fruits harvested from trees of different ages. Rambutan fruits harvested from 8 to 40 years old trees were in the range of 26.26 to 29.99g in total fresh weight, 12.32 to 14.97g in pericarp weight, 11.40 to 12.86g in aril weight and 2.24 to 2.73g in seed weight while percentage seed emergence was in the range of 94.44 to 96.67%. On rambutan fruit dry weight basis, no significant differences were observed in pericarp, seed and aril from fruits harvested from trees of different ages (Table 2). Averagely, rambutan fruit characteristics on dry weight basis were in the range of 2.29g to 3.08g for pericarp, 1.43g to 1.63g for seed and 0.36g to 0.50g for aril.

Fig. 1 shows the number of leaves per plant of rambutan seedlings recorded at monthly intervals after seed emergence. No significant difference was observed in number of leaves at 1, 2, 3, 4 and 5 MAE. At 6 MAE, the number of leaves differed significantly among seedlings established from trees of different ages. Rambutan fruits harvested from 10 years old trees had the highest number of leaves at 6 MAE, but Effect of tree age on fruit characteristics, seed emergence and seedling growth

Table 1
Rambutan fruit characteristics and percentage seed emergence

(years)	Total fresh weight	Pericarp	Aril	Seed	emergence
8	26.26 (2.08)	12.32 (1.31)	11.40 (0.86)	2.53 (0.17)	94.44 (1.92)
10	28.99 (7.40)	14.97 (4.47)	11.61 (2.60)	2.41 (0.46)	95.56 (5.09)
25	28.36 (2.40)	13.46 (1.89)	12.17 (0.60)	2.73 (0.13)	95.56 (1.92)
40	27.28 (2.53)	12.49 (1.71)	12.86 (1.40)	2.24 (0.06)	96.67 (3.33)
ANOVA	n.s.	n.s.	n.s.	n.s.	n.s.

Each value is the mean of three replicates and the standard deviation is shown in parentheses. One-way ANOVA: n.s= not significant.

Table 2
Rambutan pericarp, seed and aril dry weight.

	Pericap	Seed	Aril
8	2.44 (0.26)	1.62 (0.18)	0.44 (0.26)
10	3.08 (0.83)	1.63 (0.21)	0.36 (0.17)
25	2.16 (0.10)	1.61 (0.02)	0.37 (0.03)
40	2.29 (0.28)	1.43 (0.13)	0.50 (0.07)
ANOVA	n.s.	n.s.	n.s.

Each value is the mean of three replicates and the standard deviation is shown in parentheses. One-way ANOVA: n.s= not significant.

was not significantly different from trees which were 8 and 25 years old. Rambutan seedlings from 40-year- old trees obtained the lowest number of leaves. Leaves are the principal photosynthetic organs of plants (Wright et al, 2004). The production of leaves represents an increase

in the photosynthetic surface area for plants. Koch et al. (2004) and Tozer et al. (2015) reported that the size of leaves (e.g., leaf surface area, leaf dry mass and leaf length) profoundly affects a variety of biological processes, for instance, plant growth, survival, reproduction, and ecosystem function. In the present study, the increase in number of leaves indicates a higher photosynthetic activity in seedlings from fruits harvested from 10 years old trees. Besides, the increase in number of leaves in seedlings from 10 years old rambutan trees could also impact on plant-water relations and nutrient uptake positively.

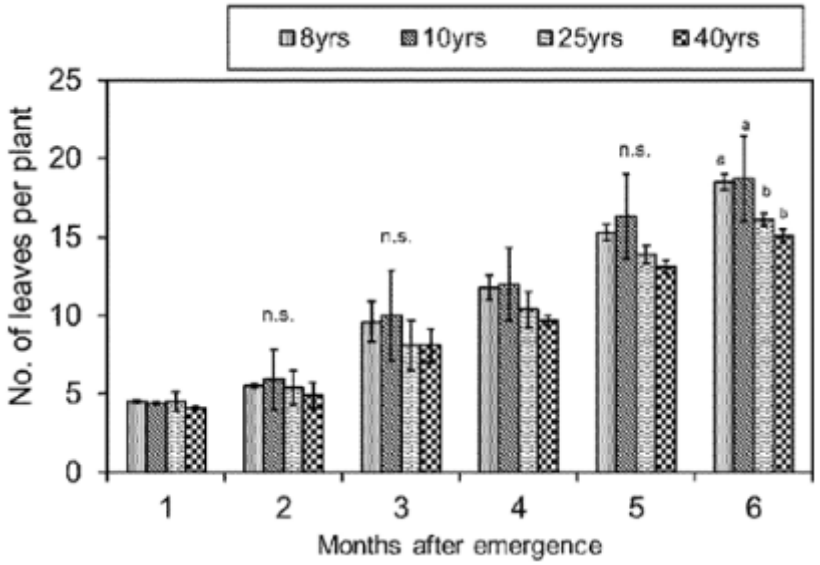

Fig. 1

Number of leaves per plant of rambutan seedlings at months after emergence from trees of different ages. Each value is the mean of three replicates and the vertical bars indicates standard error. One- way: *p<0.05, n.s.=not significant. When a significant difference was detected, Tukey's HSD test was performed to identify significant differences among the 4 treatments. Different letters above the bar indicate significant difference.

Rambutan seedlings plant height at monthly intervals after seed emergence obtained from fruits harvested from different tree ages is shown in Fig. 2. No significant difference was observed in plant height at 1, 2, 3, 4 and 6 months after emergence. However, at 5 MAE, a significant difference (p<0.05) was observed. Rambutan fruits harvested from 10 years old trees had the highest plant height at 5MAE, but was not statistically different from tress which were 8 and 25 years old. Rambutan fruits sampled from 40 years old trees obtained the lowest plant height at 5MAE. The increase in seedling plant height from fruits harvested from 10 years old trees may be attributed to the increase in number of leaves observed in the present study. Similarly, Lyngdoh et al. (2014) indicated that seedling attributes after 12 months showed that seedlings obtained from young and

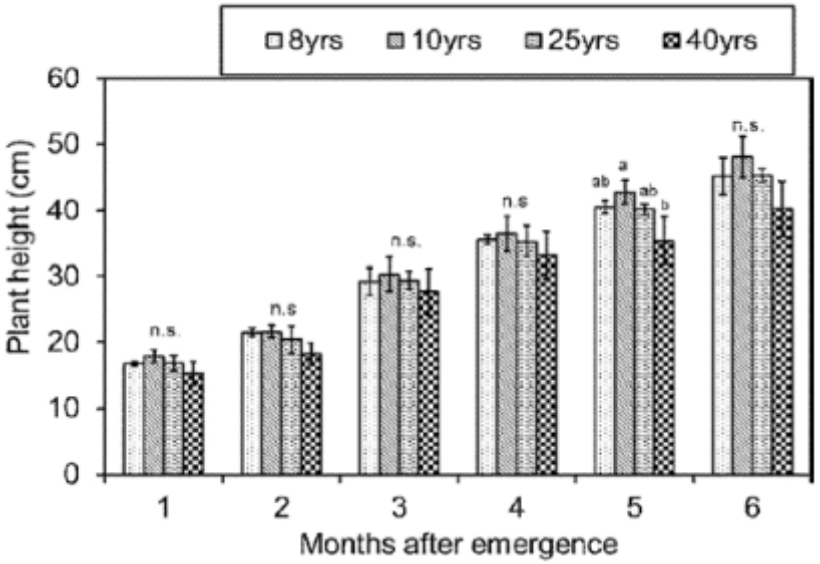

Fig. 2

Plant height of rambutan seedlings at months after emergence form trees of different ages. Each value is the mean of three replicates and the vertical bars indicates standard error. One-way: *p<0.05, n.s.=not significant. When a significant difference was detected, Tukey's HSD test was performed to identify significant differences among the 4 treatments. Different letters above the bar indicate significant difference.

middle-aged plantations of Livistona jinkensiana (between 18 to 45 years) performed better than those beyond 50 years. Raja et al. (2004) also found that seeds collected from middle-aged trees of Areca nut which were 45 years old consistently had highest shoot length, root length, number of roots, seedling dry weight and vigour index compared to seeds collected from trees aged 7,14,21 and 28 years. Mao et al. (2014) reported a significant effect on relative height growth rate by altering their biomass allocation among Pinus thunbergia seedlings obtained from different age classes.

Tree age had no significant effect on rambutan fruit characteristics and seed emergence. However, seedlings established from fruits harvested from trees of different ages showed significant differences in number of leaves per plant and plant height. Fruits harvested from 10 years old trees exhibited better seedling growth. Seedlings obtained from rambutan fruits from middle-aged trees can be considered for nursery establishment.

Agradecimientos

The authors acknowledge the Council for Scientific and Industrial Research-Plant Genetic Resources Research Institute (CSIR-PGRRI) for the plant material and facilities. We are also grateful to Mr. Nicholas Badger, Benjamin Kwakye Adu and all staff at the seed store of CSIR-PGRRI for their support during the study.

REFERENCES

Aboagye, L.M., 2005. Variation in yield of Nutmeg (*Myristica fragrans* HOUTTI) in relation to temperature and rainfall in Ghana. *Ghana J. Hort.*, 4: 12-18.

Bramlage, W.J., 1993. Interaction of orchard factors and mineral nutrition on quality of pome fruit. *Acta Hortic*., 326:15–28

Khalid, S., Malik, A.U., Saleem, B.A., Khan, A.S., Khalid, M.S. and Amin, M. 2012. Tree age and canopy position affect rind quality, fruit quality and rind nutrient content of 'Kinnow'mandarin (*Citrus nobilis* Lour× *Citrus deliciosa* Tenora). *Sci. Hort.*, 135:137-144.

Koch, G. W., Sillett, S.C., Jennings, G.M. and Davis, S.D., 2004. The limits to tree height. *Nature,* 428: 851–854.

Le Bellec, F., 2014. "Rambutan". *FruiTrop*, 223: 28–33.

Lyngdoh, N., Kumar, M., Kumar, N. and Pandey A.K., 2014. Effect of age of plantation on seed characters and growth performance of Tokopatta (*Livistona jinkensiana* Griff.) seedling. *J. Appl. Nat. Sci.,* 6:672-676.

Mao, P., Han, G., Wang, G., Yu, J. and Shao, H. 2014. Effects of age and stand density of mother trees on early *Pinus thunbergii* seedlings establishment in the coastal zone, China. *Sci. World J.*: 1-9.

Morton, J.F. 1987. "Rambutan", in Fruits of Warm Climates". Center for New Crops & Plant Products, Purdue University Department of Horticulture and Landscape Architecture, W. Lafayette, IN. pp 262–265.

Ozeker, E. 2000. Determination of fruit characteristics of 'Marsh seedless' grapefruitcultivar in Izmir (Turkey). *Pakistan J. Biol. Sci*., 3:69–71.

Raja, K., Palanisamy, V. and Selvaraju, P. 2004. Effect of palm age on seed germination and seedling vigour in areca nut (*Areca catechu* L.). *Madras Agric. J.,* 91: 326-328.

Smith, T.J., 2003. Apple orchard blocks evaluation. https://extension.wsu. edu/ chelan/douglas/ agriculture treefruit/horticulture apple_orchard_block_ evaluation.

Tindall, H.D.1994. Sapindaceous fruits: Botany and horticulture. *In Horticultural Reviews*. Vol. 16, edited by Janick, J. London: John Wiley & Sons. pp 143-196.

Tozer, W. C., Rice, B. and Westoby, M. 2015. Evolutionary divergence of leaf width and its correlates. *Am. J. Bot.*. 102: 367–378.

Wall, M.M. 2006. Ascorbic acid and mineral composition of longan (*Dimocarpus longan*), lychee (*Litchi chinensis*) and rambutan (*Nephelium lappaceum*) cultivars grown in Hawaii. *J. Food Compos. Anal.*, 19: 655-663.

Wright, I.J., Reich, P.B., Westoby, M., Ackerly, D.D., Baruch, Z., Bongers, F., Cavender-Bares, J., Chapin, T., Cornelissen, J.H., Diemer, M. and Flexas, J. 2004. The worldwide leaf economics spectrum. *Nature*, 428: 821–827.