

Short Communication

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

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ABSTRACT

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 from 18-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 06° 17.839, W 000° 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 21.4°C and a mean maximum annual temperature of 31.3°C (Aboagye, 2005). The area experiences bimodal 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. pericarp, 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 80°C 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

Table 1. Rambutan fruit characteristics and percentage seed emergence

Age (years)	Fresh weight (g)				% Seed emergence
	Total fresh weight	Pericarp	Aril	Seed	
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.

Age (years)	Dry weight (g)		
	Pericarp	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.

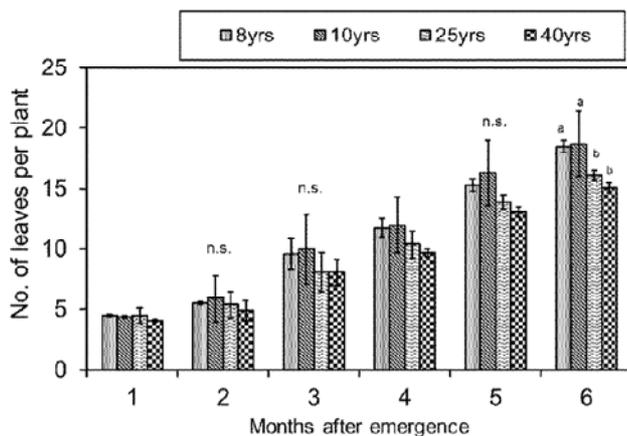


Fig. 1. Number of leaves per plant of rambutan seedlings at months after emergence from trees of different ages. Each value is the mean of three replicates and the vertical bars indicates standard error. One-way: * $p < 0.05$, n.s.=not significant. When a significant difference was detected, Tukey's 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 trees 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

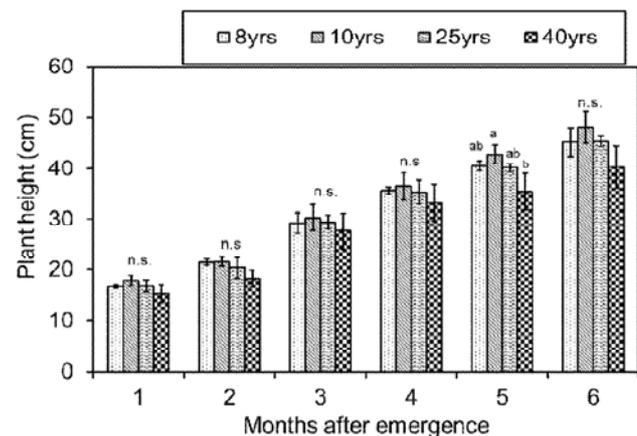


Fig. 2. Plant height of rambutan seedlings at months after emergence from trees of different ages. Each value is the mean of three replicates and the vertical bars indicates standard error. One-way: * $p < 0.05$, n.s.=not significant. When a significant difference was detected, Tukey's HSD test was performed to identify significant differences among the 4 treatments. Different letters above the bar indicate significant difference.

middle-aged plantations of *Livistona jenkinsiana* (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.

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