

## VARIETAL EVALUATION AND REHABILITATION STUDIES ON RAMBUTAN (*Nephelium lappaceum* L.)

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### ABSTRACT

A number of rambutan (*Nephelium lappaceum* L.) cultivars were introduced to Sri Lanka from Southeast Asian countries in 1940 and later in 1983 to select cultivars with the best combination of fruit quality and yield. Five Javan cultivars, four Malayan cultivars and seven local selections were used for this evaluation. Out of these 16 cultivars, Malwana selection 1 (Malwana special) was identified as the best entry and its fruits had high fruit weight, high aril percentage and thickness, a brix value of 20, characteristics of free stone and attractive red colour. Average yield was 115 kg/tree and average number of fruits/kg was 28. However, Alagiyawanna, Malayan red, Malayan yellow, Java special and Java Labukabola showed consumer preference. For clonal characterization, fruit characters such as size, shape, colour, texture and taste of aril, aril percentage, peeling quality of aril and length of bristles are important. Rehabilitation was approached in three ways: i) poorly maintained old budded trees grew extremely tall and make harvest difficult without postharvest losses and also difficult to control diseases. Twenty trees at Eraminigolla were severely pruned and then trained to induce a strong and shorter canopy. These rehabilitated trees were shorter and gave average yields of 50 kg /tree in 3-4 years after pruning. ii) Male and unwanted cultivars were rehabilitated through pruning and grafting with Malwana. These trees gave 10 kg /tree yield after 3- 4 years, depending on the number of grafted branches. iii) Weak rootstocks were rehabilitated by inarching with several rootstocks to lengthen the life span of the tree for better production.

**KEY WORDS:** Evaluation, Characterization, Rehabilitation and Selection, Rambutan cultivars

### INTRODUCTION

Rambutan, *Nephelium lappaceum* L., (Sapindaceae) is indigenous to the Malay Archipelago, especially West Malaysia and Indonesia. It has been successfully introduced to the Philippines, Sri Lanka, Central America, India and Australia (Hobmann, 1984). Rambutan is presently grown in many countries in the ASEAN region, especially Thailand the leading producer of the fruit.

Many Rambutan cultivars have been introduced to Sri Lanka from Malaysia and Java by the Department of Agriculture in the 1940s (Anon, 1965) and subsequently in 1983 from Malaysia under the FAO fruit project. Apart from these introductions, variation also exists in seed propagated rambutan plants especially in home gardens. In Sri Lanka, Malwana village in the wet zone is well known for its rambutan and the cultivar Malwana is named after it.

The commercial cultivation of rambutan is based on vegetative propagation. This keeps the cultivar true to type and also maintains sexual homogeneity since the rambutan tree can have either bisexual or male flowers (Whitehead, 1959). An acceptable rambutan cultivar must have characteristics that satisfy the grower, consumer, retailer and processor. Therefore, introduced and locally selected cultivars were characterized and evaluated to determine the cultivars with the best combination of fruit quality and yield.

Cultivation of the rambutan crop with proper cultural practices has not been seriously attempted in Sri Lanka until very recently. Therefore, these trees are allowed to grow extremely tall which makes it difficult to harvest fruit without postharvest losses. Keeping the trees short also makes harvesting more cost-effective and disease control (especially powdery mildew) easier. Unlike mango and other crops, hardly any rehabilitation studies have been made on rambutan. A successful rejuvenation programme in mango with five pruning severity levels (Lal *et al.*, 2000) and another rejuvenation trial of an old and overcrowded Alphonso mango orchard were recorded in India (Burondkar *et al.*, 2000). Using the experience and knowledge of rambutan, an experiment was started to induce stronger and shorter canopy plants with quality fruits. The unproductive male and poor cultivars were rehabilitated to have productive trees and weaken rootstocks rehabilitated to lengthen the life span of the tree for better production.

## MATERIALS AND METHODS

### Evaluation and characterization

Five Javan cultivars, four Malaysian cultivars and seven local selections (Table 1) were used for evaluation and characterization. Three grafted plants were prepared using the scion wood of the above cultivars. These were planted at the Horticultural Crop Research and Development Institute (HORDI), Gannoruwa during 1989-1991.

Table 1. Rambutan cultivars evaluated at HORDI, Gannoruwa

<i>Malaysian Cultivars</i>	<i>Javan Cultivars</i>	<i>Locally Selected Cultivars</i>
*Che Embon	Java Seedless	Alagiyawanna
Malayan Red	Java Labukabola	Dadigama
Malayan Yellow	Java Sinjonjan	Dharmadasa
*R -170	Java Simadjan	Kumaragala
	Java Special	Malwana selection 1
		Malwana selescion 2
		Pasyala

\* Introduced in 1983

Gannoruwa is located in the mid country wet zone (WM<sub>3</sub>) and its climatic conditions are shown in Figure 1. The rainfall pattern is bimodal and well distributed; RH is around 75- 80 % and the soil is a well-drained Reddish Brown Latosolic.

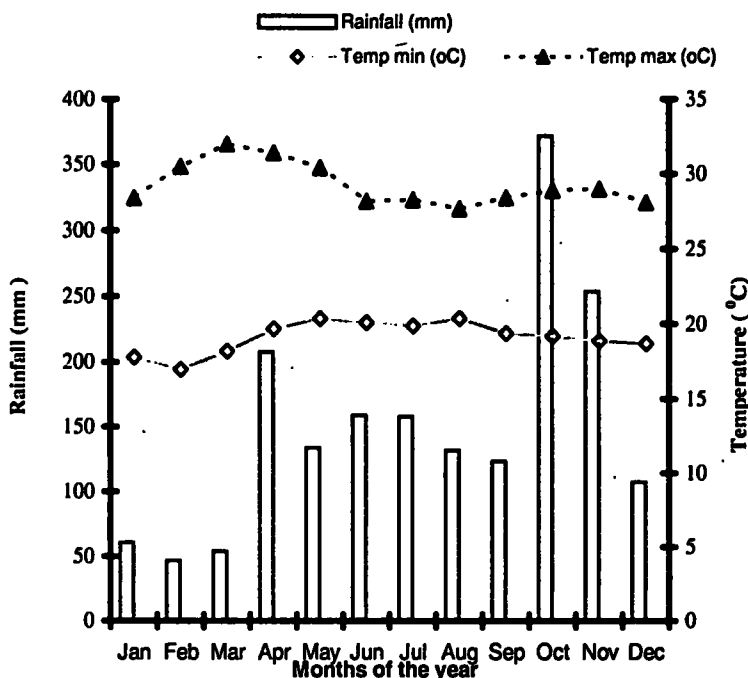


Figure 1. Average monthly rainfall and maximum and minimum temperatures for a ten year period (1987-1996) at Peradeniya  
Source : Natural Resources Management Center, Peradeniya

The plants were maintained over 13 years by training, pruning, fertilization and weeding. Fertilizer was applied twice a year according to the recommendation of the Department of Agriculture (DOA). Supplementary irrigation was not used and weed control was done by slashing. The pruning operation consisted of removal of dead, broken, diseased branches and water shoots. This was done normally after the main fruiting season around September.

Yield, premature fruit dropping and bearing habits were studied in three consecutive years starting from 1994. Twenty randomly selected fruits from each cultivar were used for the following assessments: weight, weight of fruit components, physico-chemical characters (brix, fruit length and breadth, colour *etc.*). Measurements of fruits were taken using vernier caliper. The fruit weight data were analysed using one-way ANOVA considering varieties as treatments and mean separation was done using Duncans Multiple Range test. Characteristics of leaf and seeds of different varieties were also recorded.

### Rehabilitation

The rehabilitation programme was carried out by three methods: (i) rehabilitation of old-budded plants (ii) rehabilitation of male and poor cultivars (iii) rehabilitation of weakened rootstocks.

**Rehabilitation of old budded trees:** An experiment was conducted on 34-year-old Rambutan trees, cultivar Malwana, at Eraminigolla Research Station in the wet zone. These trees had grown extremely tall making harvesting difficult, with high percentages of postharvest losses. Out of ninety-seven plants a block containing twenty plants was subjected to rehabilitation. Pruning was done in November 1994 shortly after harvest at one severity level. The plants were cut 2-3 feet above ground level and over the graft union. The cut was made at a 5-10° angle and was coated with "candazan". This keeps the stump decay-free, allowing the callus to be over the cut surface.

The emerging shoots on pruned stems were gathered with a coir rope to protect them from wind damage. After 3-4 weeks shoots were trained in 4-6 directions by hanging weights or with strings. Extra branches were removed and fertilizer was applied as for 3-year-old plant.

**Rehabilitation of male and poor cultivars:** Seed-propagated trees may have a 50 % chance of being a male plant. Some trees may also have low quality fruits. Two trees from each type were rehabilitated at HORDI, Gannoruwa. Primarily severe pruning was done as indicted in the method (i). 2-3 emerging shoots of pencil thickness were patch-budded with the cultivar Malwana and extra shoots were removed.

**Rehabilitation of weakened rootstock:** In addition to the scion, the rootstock or bottom part of the tree, which had decayed was also rehabilitated. Primarily decayed portions were well cleaned and filled with cement mixture (sand, cement 5:1). Two rambutan seedlings were planted on either side of the weak tree and inarched at pencil thickness to the weakened root stock.

## RESULTS AND DISCUSSION

### Evaluation and characterization

Fruit colour, appearance and taste are the most important characters considered for fresh consumption. However, high percentage of aril, character of free-stone, good flavour and texture are also to be considered for evaluation (Tables 2, 3 and 4). Malayan Red, Malayan Yellow, Alagiyawanna and R-170 fruits are long and the rest of the cultivars are almost round. Java special had the highest brix value (22), but its flesh cannot be easily separated from the seed. Java Seedless, Java Sinjonjan, Dharmadasa and Kumaragala have significantly small fruits when compared to other cultivars (Table 3). Java seedless is the smallest fruit having a higher number of fruits per panicle and a higher percentage of premature droppings. Out of these cultivars, Malwana selection 1 was found to be the best as this has high fruit weight, size, aril percentage, flesh thickness, a brix value of 20, the characteristic of free-stone and attractive red colour. However, the Alagiyawanna, Malwana selection 2,

Malayan Red, Malayan Yellow, Java special and Java Labukabola showed consumer preference.

Desirable characters contributing to postharvest handling and processing are thick skin or pericarp, which is not easily bruised or dehydrated, long storage life, preferred sugar/acid ratio and the character of unobjectionable testa. The bristles of Malayan yellow and Darmadasa selections (yellow fruits) become brown in colour within a short period of time after harvest, hence the market product becomes unattractive. Java Special has the longest bristles and the shortest are found in Java Seedless. Java Simadjan, Java Labukabola and Dadigama selection have a good blend of sugar and acid and the aril does not cling to the seed coat; they may be useful for processing purposes. But Thai canners buy fruits on the basis of minimum size and not by other characteristics (Watson, 1981).

**Table 2. Fruit Characteristics of different rambutan cultivars**

<i>Cultivar</i>	<i>Pericarp Colour</i>	<i>Cling or Freestone</i>	<sup>1</sup> <i>Colour of Bristles</i>	<i>Testa Objectionable</i>	<i>Aril Crispy/Juicy</i>	<i>Taste</i>
Java Labukabola	Orange red	Freestone	Green tips	Moderate	Crispy	Freestone
Java Seedless	Dark red	Medium	Dark green tips	Moderate	Medium	Sweet
Java Simatjan	Orange red	Freestone	Green tips	Moderate	Crispy	Sweet and slightly acidic
Java Sinjonjan	Dark Red	Cling	Green tips	Not	Juicy	Sweet and moderately acidic
Java Special	Pinkish Red	Medium	More green	Moderate	Medium	Very sweet
Che Embon	Dull Red	Freestone	More green	High	Crispy	Sweet
Malayan Red	Red	Freestone	More green	Moderate	Crispy	Sweet
Malayan Yellow	Orange yellow	Freestone	Green over all	Moderate	Crispy	Sweet
R-170	Dull red	Freestone	Green tips	Moderate	Crispy	Sweet
Alagiyawanna	Dark red	Medium	Green tips	Not	Medium	Sweet
Dedigama	Orange red	Freestone	Green tips	Moderate	Crispy	Sweet and slightly acidic
Dharmadasa	Yellow	Freestone	Green over all	Slightly	Crispy	Sweet
Kumaragala	Red	Freestone	Green tips	Slightly	Crispy	Sweet
Malwana sec.-1	Red	Free	Green tips	Moderate	Crispy	Sweet
Malwana sec.-2	Red	Medium	Green tips	Moderate	Crispy	Sweet
Pasyala	Red	Free	Green tips	Moderate	Crispy	Sweet

<sup>1</sup> Except where indicated the color of the base of bristles is same as the pericarp skin

**Table 3. Fruit weight, brix value and aril of different rambutan cultivars**

<i>Cultivar</i>	<i>Mean Fruit Weight (g)</i> <sup>1</sup>	<i>Mean no. of Fruits /Panicle</i>	<i>Brix Value</i>	<i>Mean Aril % by Weight</i>
Java labukabola	27 b*	12	18.0	42.0
Java seedless	16 c	22	19.6	42.3
Java simatjan	36 a	20	19.0	38.5
Java sinjonjan	15 c	12	19.7	32.8

table 3 continued ...

<i>Cultivar</i>	<i>Mean Fruit Weight (g)</i> <sup>1</sup>	<i>Mean no. of Fruits /Panicle</i>	<i>Brix Value</i>	<i>Mean Aril % by Weight</i>
Java special	26 b	14	22.5	41.8
Che Embon	28 b	10	18.0	41.3
Malayan Red	30 b	11	19.6	44.5
Malayan Yellow	30 b	13	19.8	42.2
R-170	27 b	11	19.5	38.5
Alagiyawanna	34 ab	14	20.0	40.0
Dadigama	35 a	20	19.0	38.5
Dharmadasa	22 c	20	19.5	38.0
Kumaragala	22 c	21	20.0	35.0
Malwana Sel. 1	37 a	15	20.0	46.0
Malwana Sel 2	36 a	14	20.0	40.0
Pasyala	33 ab	14	19.6	40.0

<sup>1</sup> Values followed by the same letters do not differ significantly

Table 4. Selected fruit characteristics of different rambutan cultivars

<i>Cultivar</i>	<i>Mean Fruit Size L/B (mm)</i> <sup>1</sup>	<i>Fruit Shape</i>	<i>Mean Pericarp Thickness (mm)</i>	<i>Mean Aril Thickness (mm)</i>	<i>Mean Length of Bristles (mm)</i>
Java Labukabola	43/36	Round	3.2	5.0	12
Java Seedless	33/30	Round	2.9	6.0	8
Java Simatjan	42/34	Round	3.5	5.0	16
Java Sinjonjan	35/28	Round-oblong	3.8	4.0	12
Java Special	42/35	Round	3.3	5.0	23
Che Embon	40/35	Round	3.0	5.0	15
Malayan Red	54/35	Oblong	3.0	7.0	14
Malayan Yellow	51/37	Oblong	3.2	6.0	16
R-170	47/36	Oblong	3.2	5.0	15
Alagiyawanna	49/35	Oblong	3.5	6.0	15
Dadigama	42/34	Round	3.5	5.0	16
Dharmadasa	40/34	Round	3.2	4.0	14
Kumaragala	41/33	Round	3.0	4.0	14
Malwana Sel. 1	47/41	Round	3.8	7.0	15
Malwana Sel 2	47/42	Round	3.5	6.0	15
Pasyala	40/34	Round	3.1	5.0	14

<sup>1</sup> L/B – Fruit Length and breadth

The time of harvest was almost the same in all the cultivars except for a slight variation in Java Seedless, Malayan Red and Malayan Yellow. A low percentage of unfilled fruits were observed in Malayan Red. Seed and leaf characteristics may be considered as less important, but could serve as supplementary characteristics. Some variation found on leaf and seeds are shown in Table 5. It is stated that fruit characters such as fruit shape, colour of skin, taste of aril, aril thickness and peeling quality are highly heritable and hence could be used for clonal characterization (Laxmi, 1979). This study also revealed that those are the most important characters for clonal characterization. The average annual yield of Malwana was recorded as 115

kg/tree after the 8<sup>th</sup> year of planting. But the number of fruits/panicle was low when compared to other cultivars.

**Table 5. Prominent leaf and seed characters of different rambutan cultivars**

<i>Character</i>		<i>Cultivar</i>
<i>Leaf</i>		
Leaf shape	Elliptic	Labukabola, Java Seedless
	Narrowly elliptic	Rest of the cultivars
Leaf apex	Obtuse	Java Seedless
	Acuminate	Rest of the cultivars
Leaf colour	Dark green	Labukabola, Seedless
	Medium	Rest of the cultivars
	Light green	Malwana selection 1 and 2
Leaf size	Small	Labukabola
	Medium	Rest of the cultivars
<i>Seed</i>		
Seed length / width ratio	High	Malayan Red, Malayan Yellow, Alagiyawanna, R-170
	Low	Rest of the cultivars
Seed size	Small	Java Seedless
	Medium	Rest of the cultivars

### Rehabilitation

On severely pruned trees, uniform and profuse flushes occurred shortly (2-3 weeks) after pruning. These were trained in several directions and it induced a stronger and shorter canopy. Flowering was delayed in the pruned trees by 2-3 years. The average yield recorded is given in Table 6.

**Table 6. Average yield of rehabilitated plants (cultivar Malwana)**

<i>Year</i>	<i>No. of Bearing Trees</i>	<i>Av. Yield (kg)</i>
1996	9	10.5
1997	19	41.5
1998	19	49.0
1999	19	Not recorded
2000	19	63.5

Although yield was not recorded during first 2 years, yield were obtained with an increasing trend in subsequent years. Rehabilitated trees have shorter canopy which make harvesting easier. The trees should be properly pruned at every harvest to form a strong and short canopy to make harvesting easier without postharvest losses. This makes the control of diseases easier too.

Male and poor cultivars were rehabilitated successfully with the cultivar Malwana. These plants yielded 3-4 years after grafting. Average yield at the 3<sup>rd</sup> year was 10 kg/tree but this may vary depending on the number of branches grafted.

Seedlings were successfully inarched to the weakened rootstock and supported the scion well. The aim of this is to lengthen the life span of the tree for better production.

### CONCLUSIONS

It was observed that fruit characters are the most important for clonal characterization rather than the leaf and seed characters. Of the sixteen introduced and local cultivars evaluated Malwana selection 1 (Malwana Special) had high fruit weight, high aril percentage and thickness and a brix value of 20. It gave an average yield of 115 kg/tree and an average of 28 fruits/kg. Male and poor trees could be rehabilitated and made more productive using Malwana. Old budded plants could be rehabilitated through severe pruning followed by training. The emerging branches of these were induced to give a shorter and stronger canopy and gave average yields of 50 kg/tree during 2- 3 years after pruning. Weakened or decayed rootstocks could be successfully rehabilitated for better production.

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