

RAMBUTAN PRODUCTION GUIDE

R.A. Galindo and M.P. Loquias

Rambutan (*Nephelium lappaceum* Linn.) is a fruit of minor importance but very well known because of its attractive colors and exquisite taste. Over a considerable period, rambutan has acquired immense popularity as a seasonally available fruit in many countries of tropical Asia, and it is widely grown in both home gardens and commercial orchards. It has been cultivated in Thailand and Malaysia and is now one of the leading economic fruit crops of Thailand, the major rambutan producing country in the world (Tindail, 1994).

The rambutan (*Nephelium lappaceum* L.), a tropical fruit tree that belongs to Sapindaceae family includes about 125 genera and more than 1000 species of shrubs and trees which are widely distributed throughout the tropics and warm regions. In the Philippines, this family is represented by about 33 genera and 124 species.

The name rambutan is derived from the Malay word “rambut” which means “hair” and generally describing rambutan as a hairy fruit. In the Philippines, rambutan is also locally known as “usan”, “usau” or “usare”. Lychee (*Litchi chinensis* Sonn.) and longan (*Euphoria longana* Lam.) are common botanical relatives of rambutan that also produce edible fruits.

Rambutan is a native of the Malay archipelago and has spread and distributed in all countries in tropical Asia. It has been introduced in the Philippines in the form of seeds during the prehistoric times and was early found wild in Palawan, Sulu and Basilan. It was once only a wild fruit in the Southern Philippines until good varieties were introduced making this fruit better known in the country. It has been grown mainly as a backyard tree until asexually propagated plants of outstanding cultivars from Jakarta, Indonesia were introduced which then made commercial orchards to be set up in some places, notably Laguna, Davao, Oriental Mindoro and Bukidnon. These cultivars were the “Seematjan”, “Seenjonja” and “Maharlika” which are now grown in commercial scale in many parts of the Philippines.

Recent statistic report revealed that the Philippines has a total area of 5,743.08 hectares planted to rambutan with a volume of production of 12,743.16 metric tons (BAS, 2010). Among the sixteen regions of the country, CALABARZON and SOCKSARGEN ranked first and second, respectively, in terms of area planted and volume of production (Table 1).

Table 1. Area planted to rambutan and volume of production by region, Philippines (BAS 2010).

Region	Area Planted (ha.)	Volume of Production (ton)
CAR	32.00	43.30
Ilocos Region	35.11	69.20
Cagayan Valley	65.00	433.65
Central Luzon	8.00	27.00
CALABARZON	1628.00	4384.35
MIMAROPA	675.00	361.96
Bicol Region	16.00	20.87
Western Visayas	73.12	194.43
Central Visayas	44.60	83.67
Eastern Visayas	17.00	16.56
Zamboanga Peninsula	385.00	923.99
Northern Mindanao	185.75	368.86
Davao Region	739.00	1833.06
SOCCSKSARGEN	1357.00	3844.15
CARAGA	455.00	117.60
ARMM	27.00	20.51
Total	5743.08	12743.16

Botanical Description

The rambutan is a medium-sized tree. Plants of seedling origin grow from 12-20 m high or more and have a mainly erect habit with a straight, high-branched trunk and a dense, relatively compact structure. Asexually propagated trees are much smaller, growing to 4-12 m high and have either erect or lax and spreading forms. The trunk diameter may vary from 40-60 cm. The branches which form a relatively compact crown are covered with numerous lenticels.

The alternate and compound leaves have a robust, reddish brown, much thickened rachis 7-30 cm long and 2 to 4 pairs of leaflets. The leaflets are 10-20 cm long and 2-10 cm wide, sub-opposite or alternate, short-stalked, elliptic to obovate with obtuse or bluntly acuminate apex, thinly leathery, smooth and dark green above and pale green and glaucous beneath. The petioles are thick and 0.4-1.0 cm long. The young leaves are soft, light green or pinkish, and hairy along the veins.

The widely branched, many flowered inflorescences are produced mostly on shoot tips, erect, rusty pubescent, and are 15-20 cm long. The flowers are greenish white, short-petioled, apetalous, faintly odorous, and are covered with very fine short hair. The pedicels are thin, greenish yellow and densely rusty pubescent. The calyx is cup-shaped, 4- to 6-lobed, yellowish green and rusty tomentose outside and beset with short white hair within.

The flowers are either male, with only the stamens being well developed, or the hermaphrodite. The hermaphrodite may be either basically female, with small stamens and anthers which do not dehisce or male, with undeveloped stigmas.

Male trees that bear only the male flowers are not productive and are usually propagated through seeds. The male flowers are borne in clusters on terminal panicles. They are greenish yellow without any petals. There is no functional ovary and flowers with 5, 6 and 7 stamens are found in each panicle. An average sized panicle has approximately 3,000 buds, and at the peak of its blooming period, up to 500 flowers may open each day.

The hermaphrodite flowers are borne on the same panicles as of the male flowers and which are also arranged in same manner but with only 3-5 buds being produced in each node. Each panicle may contain 200-800 flowers. An average panicle may bear approximately 500 flowers and, at peak blooming, approximately 100 flowers may open each day. The predominantly female flowers have a well developed bilocular ovary topped with a bifid stigma.

The fruits are produced in terminal, loose cluster of 10-13 fruits. They are globose or ovoid, about 4-5 cm long and 2.5-3.7 cm wide and turns from green to various shades of yellow or red as they ripen. The fruit is surrounded by short to long, soft spines. The pearly white translucent aril or the edible portion of the fruit varies its flavor from very sweet to distinctly acid, maybe thin or thick, and maybe dry to very juicy. It adheres to the seedcoat which may or may not be easily separated from the seed. The single seed is oblong or ovoid, flattened, 2.5-3.5 cm long and 1.0-1.5 cm wide.

Economic Uses

Rambutan fruit is commonly eaten out-of-hand after merely tearing the rind open, or cutting it around the middle and pulling it off. The peeled fruits are occasionally stewed as dessert. They are canned in syrup on a limited scale. In Malaya, a preserve is made by first boiling the peeled fruit to separate the flesh from the seeds. After cooling, the testa is discarded and the seeds are boiled alone until soft. They are combined with the flesh and plenty of sugar for about 20 minutes, and 3 cloves maybe added before sealing in jars (Morton, J. 1987). However in the Philippines, these can be consumed similarly as fresh or in excess, peeled and placed in a refrigerator to prolong shelf life. The seeds are sometimes roasted and eaten although they are reputedly poisonous when raw. There are traces of an alkaloid in the seed, and the testa contain saponin and tannin. The seeds are said to be bitter and narcotic. The fruit rind also is said to contain toxic saponin and tannin. Rambutan is also rich in nutrition (Table 2).

Table 2. Nutritional composition of rambutan per 100 g edible portion.

Constituents	Quantity	Constituents	Quantity
Water (g)	82.9	Fiber (g)	1.1
Protein (g)	0.9	Vitamin A (IU)	4
Fat (g)	0.1	Vitamin C (mg)	31
Carbohydrates (g)	14.5	Energy (kJ)	264

Source: PROSEA 2 – Edible Fruits and Nuts)

Some parts of the plant such as roots, leaves, fruits and seeds have medicinal uses. Eating five fruits in a day can seriously decrease the chance of cancer. Rambutan fruit is very effective in lowering blood pressure. It is also said to heal dysentery and diarrhea effectively. The leaves are also used as cataplasm that cure headaches and the bark as astringent for treating diseases of the tongue. The roots are boiled and used as medication for fever.

The edible fat or oil contained in the seeds is suitable for culinary purposes and in the manufacture of soap and candles.

The wood is hard, heavy, red to reddish-white and is very durable. It is used in building construction although it is liable to split during drying.

The rambutan tree is an attractive tree – in foliage, flower and fruit – and thus make a beautiful ornamental in the home garden.

Varieties

As mentioned earlier, three outstanding varieties from Jakarta, Indonesia were first introduced in the country such as the ‘Maharlika’, ‘Seematjan’ and ‘Seenjonja’ which adapted well under Philippine conditions and at present are accepted as standard varieties. These varieties are described as follows:

1. **‘Maharlika’** – The tree has a beautiful broad crown and produces medium-sized to large, globose fruits 4.3-5.1 cm long, 3.5-4.6 cm wide and 29-45 g in weight. The red spines are widely spaced, pliable, fine and 1.0-1.2 cm long. The pericarp is thin and remains yellow for a long time, then changes to red. The aril is about 0.5 cm thick, pearly white, firm, medium juicy, subacid to sweet and with rich and very good quality. It is loosely attached to the seed with part of the seedcoat adhering. The edible portion is about 50% of the fruit by weight. The seed is oval to oblong, compressed laterally, about 2.5-2.7 cm long and 1.5-1.8 cm wide.
2. **‘Seematjan’** – The tree has an open crown and long, flexible branches. The fruits are large, dark red when ripe, ovoid or egg-shaped, 4-6 cm long, 3.2-4

cm wide and 35-52 g in weight. The spines are fine and about 1.8 cm long. The pericarp is thin. The aril is shiny, pearly white, thick, firm, very sweet. Medium juicy to slightly dry and separates easily from the seed with greater parts of the seedcoat adhering to the flesh. Quality is excellent. The edible portion is about 48% of the fruit by weight. The seed is oblong to ovoid, slightly compressed laterally and about 2.3-3.0 cm long and 1.3 -1.6 cm wide.

3. **'Seenjonja'** – The tree is smaller than the other 2 varieties and has a lax crown. The fruits are small, 3.8-4.2 cm long, 2.5-3.5 cm wide and 18-23 g in weight and nearly ovoid. The pericarp is thin, dark wine red with fine spines about 0.8-1.0 cm long. The aril is translucent, rather thin, very sweet, juicy, melting and adheres very firmly to the seed. Quality is good. The edible portion is about 40% of the fruit by weight. The seed is oblong, about 2.6 cm long and 1.3 cm wide.

Other outstanding varieties introduced in the Philippines from Thailand which originally came from a seedling tree from Penang, Malaysia and are now popularly and widely grown in the country:

1. **'Rongrein'** – The tree is medium-sized, with a rounded crown, leaves oval in shape, short and thin, with rounded apex and short petiole. The fruits are relatively large, 50-55 mm long; 38-40 mm wide and weigh 40-50 g, the shape is ovoid to globose (Fig. 1). The pericarp is thin, with long, coarse spinterns which changed from green to dark red at ripening, remaining green at the tips. The aril is pearly white, thick with a good flavor and easily separates from the seed. The single seed is oblong to elliptic and laterally compressed. The total soluble solids ranged from 18-21°Brix.
2. **'Sri Chompoo'** – The tree has a dense crown and develops a large canopy. Leaflets are elliptic and larger than those of Rongrein. The globose fruits are large, 50 mm long and 39 mm wide and weigh 28-35 g (Fig. 2). The pericarp is thin and pink to pinkish red or dark when ripe. The aril has a good flavor and the seed coat separates easily from the seed. The total soluble solids vary from 18-20°Brix.

Listed below are outstanding selections of rambutan varieties found in the country and registered in the Philippine Seed Board (PSB) or presently called as the National Seed Industry Council (NSIC), to wit:

1. **Aguilar 1 (NSIC 2003 Rm 07)** – This variety was owned by the Aklan State University, Banga, Aklan. The tree is strong with a spreading growth habit. It bears fruit annually from September to October with an average yield of 225 kgs for full grown trees. The globose to ovoid fruit is large, 4.7 mm long, 3.9 mm wide, and weighs 32.3 g. The tough and leathery pericarp or skin is thin at 2.88 mm, weighs 14.18 g and turn reddish orange when ripe. The aril is pearly white, smooth and firm, thick, juicy, sweet and has a superior eating quality. It has 21.9 °Brix total soluble solids. The slightly flat seed is small, 2.3 mm long, 1.3 mm wide and weighs 3.42 g. The fruit has an edible portion of 45.54%.

2. **Roja (NSIC 2003 Rm 06)** – This variety was owned by Mr. Mario Tenorio of Calauan, Laguna. The tree is strong with semi-erect growth and a prolific bearing habit. It bears fruits annually from July to September with an average yield of 70-80 kgs. The oblong fruit is large, 50.40 mm long, 45.60 mm wide, and weighs 45.85 g (Fig. 3). The pericarp that turns red when ripe is leathery and thin (2.7 mm) with long spines. The white flesh is smooth, sweet and juicy. It has a total soluble solids (TSS) of 20.88 °Brix. The oblong seed weighs 3.61 g with a length of 29.35 mm and a diameter of 16.25 mm. The fruit has a an edible portion of 55.94%.
3. **Amarillo (NSIC 2003 Rm 05)** – This variety was owned by Dr. Ponciano Batugal of UPLB, College, Laguna. The tree is strong with a semi-upright growth habit and has a prolificacy of bearing. It bears fruit annually from July to December and yielded 50-60 kgs at 10 years old. The oblong fruit weighs 34.12 kgs with 52.65 mm length and 36.89 mm diameter (Fig. 4). The attractive yellow skin is thin and leathery with long spines. The white flesh is smooth, sweet and juicy. It has a total soluble solids (TSS) of 22.25 °Brix. The oblong seed weighs 2.32 g with 25.40 mm length and 14.60 mm diameter. The fruit has an edible portion of 60.67%.
4. **Maharlika (PSB 1992 Rb 03)** - Fruit is globose, medium-sized to large, 4-5 cm long and 3.5-4.5 cm wide, and weighs about 30-45 g (Fig. 5). Skin is thin, with short fine spines and turns from yellow to wine red when ripe. Flesh is pearly white, firm, thick, medium juicy, sweet, and with rich flavor and very good eating quality. It separates readily from seed but with a greater part of the seed coat adhering to the flesh. Seed is oval to oblong and is compressed laterally.
5. **JMG-R3 (NSIC 1995 Rm 01)** – The tree which came from seed of unknown source was originated by Mr. Jaime M. Goyena, Sr. of Lamot II, Caluan, Laguna. At 15 years old the tree is 7 m tall, strong with spreading growth habit and prolific. It bears fruits regularly on July to September. The ovoid fruit is large, 5 cm long, 3.9 cm wide, and weighs 41.3 g (Fig. 6). The skin that turns red when ripe is tough and leathery, 3.3 mm thick and has shorter spines. The thick, pearly white flesh is smooth and firm, very sweet, juicy and easily separates from the seed. Its total soluble solids (TSS) is 27.2 °Brix. The seed weighs 2.8 g with 2.5 cm length and 1.5 cm diameter. The fruit has an edible portion of 42.2%.
6. **JMG-R5 (NSIC 1995 Rm 02)** - The tree was originated from seed of unknown source by Mr. Jaime M. Goyena, Sr. of Lamot II, Caluan, Laguna. At 15 years old the tree is 7 m tall, strong with spreading growth habit and very prolific. It bears fruits regularly on July to September. The ovoid fruit is large, 5.5 cm long, 4.4 cm wide, and weighs 50.0 g (Fig. 7). The very attractive skin that turns deep red when ripe is tough and leathery, 3.8 mm thick and weighs 25.4 g. The thick, pearly white flesh is smooth and firm, very sweet, very juicy and easily separates from the seed. Its total soluble solids (TSS) is 26.0 °Brix. The flat seed weighs 2.9 g with 2.6 cm length and

1.6 cm diameter. The fruit has an edible portion of 43.4%.

7. **Goyena R13 (NSIC 2002 Rm 04)** - The tree was originated from a seedling by Mr. Jaime M. Goyena, Sr. of Lamot II, Caluan, Laguna. At 15 years old the tree is 10 m tall, strong with spreading growth habit and very prolific. It bears fruits regularly on July to October. The fruit is ovoid in shape, 47.0 mm long, 40.2 mm wide, and weighs 36.9 g (Fig. 8). The deep red skin when ripe is tough and leathery, 3.81 mm thick and weighs 17.0 g. The thick, pearly white flesh is smooth and firm, sweet, moderately juicy and easily separates from the seed. Its total soluble solids (TSS) is 20.94 °Brix. The seed is oblong, weighs 2.69 g with 22.8 mm length and 15 mm diameter.
8. **Acc. Sp. (NSIC 1996 Rm 03)** - This variety was originated through seed by Mr. Cirilo R. Balagapo, Jr. of Tacloban City. The tree is very prolific and high yielding. At 4 years old, it yielded 220 kgs per year. It has a high edible portion and the testa does not adheres to the flesh (Fig. 9).
9. **DES 1548 (PSB 1992 Rb 07)** - This variety is a local selection of the Bureau of Plant Industry's Davao Experiment Station (DES) which is now the BPI-Davao National Crop Research and Development Center (DNCRDC). The fruit weighs 27 g with an edible portion of 37% and a total soluble solids (TSS) of 18.00 °Brix (Fig. 10).
10. **DES 1550 (PSB 1992 Rb 04)** - This is a selection of BPI-DES or BPI-DNCRDC introduced from Thailand. The fruit weighs 30 g with an edible portion of 49% and a total soluble solids (TSS) of 16.00 °Brix (Fig. 11).
11. **DES 1551 (PSB 1992 Rb 05)** - This is a selection of BPI-DES or BPI-DNCRDC introduced from Thailand. The fruit weighs 30 g with an edible portion of 52% and a total soluble solids (TSS) of 19.00 °Brix (Fig. 12).
12. **DES 1554 (PSB 1992 Rb 06)** - This is a selection of BPI-DES or BPI-DNCRDC introduced from Thailand. The fruit weighs 35 g with an edible portion of 49% and a total soluble solids (TSS) of 18.00 °Brix (Fig. 13).
13. **Seematjan (PSB 1992 Rb 02)** - This variety originally came from Indonesia and was registered in the Philippine Seed Board through Mr. Rodrigo F. Dizon of Bago Oshiro, Davao City in collaboration with BPI-DNCRDC. The fruit is large, 38 g in weight with an edible portion of 43%, and sweet with a total soluble solids of 19.00 °Brix (Fig. 14).

HERE IS THE LIST OF NSIC ACCREDITED RAMBUTAN VARIETIES. PLEASE REFER TO THIS LIST

NSIC 2003 Rb 07

Aguilar 1

Aklan State College of Agriculture, Banga,
Aklan

PSB 1992 Rb07

DES-1548

Alfonso Abad, Los Amigos, Tugbok, Davao City

PSB 1992 Rb03

Maharlika

Cionito Villacorta, Bago Oshiro, Davao City

NSIC 2011 Rb 08	Angel Sweet	Danilo E. Abayon, Balete, Aklan
NSIC 1996 Rb 03	'Acc. Sp.'	DA-Region No. 8, Tacloban City
PSB 1992 Rb04	DES- 1550	Dr. Carlota Sandique, Sto Niño, Makilala, N. Cotabato
PSB 1992 Rb05	DES-1551	Dr. Carlota Sandique, Sto Niño, Makilala, N. Cotabato
PSB 1992 Rb06	DES-1554	Dr. Carlota Sandique, Sto Niño, Makilala, N. Cotabato
NSIC 1995 Rb 01	'JMG-3	Jaime Goyena, Sr., Lamot II, Calauan, Laguna
NSIC 1995 Rb 02	'JMG-5W'	Jaime Goyena, Sr., Lamot II, Calauan, Laguna
NSIC 2002 Rb 04	'Goyena R-13'	Jaime Goyena, Sr., V
NSIC 2003 Rb 06	'Roja'	Mario Tenorio, Calauan, Laguna
NSIC 2003 Rb 05	'Amarillo'	Ponciano Batugal, Calauan, Laguna
PSB 1991Rb 02	Seematjan	Rodrigo F. Dizon, Bago Oshiro, Davao City
PSB 1991 Rb01	Lebak Bulus	UPLB

Culture and Management

Soil and Climatic Requirements

Rambutan can be grown successfully in a wide range of soil but thrives well on deep, clay-loam or rich well-drained sandy loam rich in organic matter with soil pH ranging from 4.5-6.5. Areas with an evenly distributed rainfall and short dry season is generally preferred. Good soil drainage is essential. Hot regions with temperature ranging from 22-30°C is favorable. It grows well in an elevation of 500-600 m above sea level.

Preparation of Planting Materials

Select well-developed seeds from mature ripe fruits for rootstock. Remove mucilage by rubbing with fine sawdust, ash or old newspaper, wash and air dry. Sow seeds using coco coir, sand, or saw dust or loamy soil in seed beds. In 24 days, the seeds germinate and having two false leaves is appropriate for pricking in 7"x11" or 10"x 8"x 002 polyethylene bags. Put shading materials in open area to avoid stress and water regularly or as the need arises. Apply 20-30 g of Urea fertilizer or starter solution one month after transplanting. Rootstocks are ready for asexual propagation or cleft grafting in 6-8 months.

Asexual Propagation

Cleft grafting is the most popular method of asexual propagation in rambutan used among propagators in the Philippines as it is less wasteful of propagating materials and requires lesser mastery of techniques than inarching, marcotting and budding.

Steps in cleft grafting:

1. Chose a healthy seedling rootstock about 6-8 months old or 7-10 mm in stem diameter.
2. Cut off the shoot of the rootstock and make a vertical cut about 2.0 – 2.5 cm. to make a V-shaped opening for the scion.
3. Get a scion from selected outstanding tree with stem size approximately matching that of the rootstock.
4. Cut the basal end of the scion into a gently sloping wedge about 2 cm long.
5. Insert the scion onto the opening of the rootstock.
6. Wrap the graft union and the budstick with thin plastic strip and cover with ice candy wrapper.
7. Six months after grafting the plant is ready for field planting.

Can the author provide illustration?

Land Preparation

For backyard planting, dig a hole large and deep enough to accommodate the root system of the planting material. For medium to large scale operation where the land has been previously cultivated, the land should be thoroughly prepared - one plowing and one harrowing is usually enough. For areas that have not been planted before, clear or underbrush and remove all tree stumps, woody shrubs, perennial weeds and large stones. Plow and harrow the area several times to loosen the soil, however, doing twice or thrice maybe enough. Complete the plowing and harrowing operations several months before planting.

Planting

Lay-out and stake at a distance of 10 m between hills and 10 m between rows with a plant population of 100 trees per hectare or at a distance of 8 x 10 m with 125 trees per hectare following either the square or triangular system of planting. Prepare holes 30 cm in diameter and 30 cm in depth. In each prepared hole, place 1 kg of organic fertilizer or composted animal manure 1-2 months before planting. Plant the seedlings by slowly removing their plastic bags without breaking the ball of soil and then set in the previously prepared holes with their stems straight and properly aligned with the other plants in all directions. Carefully cover the hole with top soil and press gently. Plant at the onset of the rainy season to ensure that sufficient water is available to the plants for a longer period. Water the plants immediately after planting if no rain is expected.

Care and Maintenance

1. Shading

Provide temporary shade to the newly field planted rambutan seedlings to protect them against the intense heat during dry period until such time they are already well-established. Coconut fronds supported with four stakes arranged in a square around the plant is adequate.

2. Intercropping

During the early years, cultivate the spaces between trees in newly established rambutan orchards by intercropping with annual food crops. This has the advantage of producing a profitable yield before the rambutan trees bear fruits and at this early stage of the orchard, food crops such as beans, leafy vegetables and rootcrops will not compete with the young rambutan trees. Aside from the added income that will be generated, the intercrops also serve as shade to the young trees. Rambutan trees can also be profitably grown under coconut and may also be intercropped with coffee and cacao.

3. Cover-cropping

When it is no longer feasible to grow food crops as intercrops, due to the development of the tree canopies, leguminous cover crops such as the tropical kudzu or the *Centrosema pubescens* can be planted. Establishment of cover crops between rambutan trees gives the orchard several benefits: soil erosion is prevented; soil moisture is retained and the trees will benefit from the additional nitrogenous compounds formed due to the activity of the nitrogen-fixing *Rhizobium* and other bacteria; reduce orchard maintenance cost; prevent the growth of weeds; and reduce pest infestation.

4. Mulching

The application of dried weeds, grasses and other organic residues as a mulch around the base of both young and mature rambutan trees is a common means of retaining soil moisture, preventing weed growth, reducing soil temperature and through incorporation of decayed residues, soil fertility is increased. Place the mulches around the base of the tree 10-15 cm deep, leaving the area around the base of the trunk without mulch.

5. Irrigation and Drainage

Rambutan is a drought sensitive plant that requires plenty of water during its growing period. Water the plant constantly during the first dry season after planting for this is the most critical period of the plant. Provide irrigation even if the trees are already established and bearing, especially during the dry season for leaf necrosis which is a characteristic of potassium deficiency is aggravated by moisture stress. Plant cover crops and apply mulches for these are helpful means of conserving moisture in the soil.

6. Fertilization

Prior to crop establishment, it is important that the field or the area to be planted will be analyzed for its soil fertility so as to know the appropriate fertilization scheme of a certain crop. Get soil samples, air dry and pulverized, then submit to the Bureau of Soils for analysis. However, in the absence of soil analysis, the following fertilization schedule can be applied to rambutan (Table 3).

Table 3. Fertilization schedule for rambutan.

Year	Kind of Fertilizer			
	Organic	Complete (14-14-14)	Urea (45-0-0)	Muriate of Potash (0-0-60)
1	1kg/tree	50 g/tree	200 g/tree	
2	4 kgs/tree		300 g/tree	
3	10 kgs/tree	500 g/tree		
4	20 kgs/tree	700 g/tree	200 g/tree	200 g/tree
5	30 kgs/tree	1 kg/tree	300 g/tree	300 g/tree
6	30 kgs/tree	2 kgs/tree	500 g/tree	500/g tree
7	30 kgs/tree	2 kgs/tree	700 g/tree	700 g/tree
8 and onwards	30 kgs/tree	2 kgs/tree	1 kg/tree	1 kg/tree

Prior to field planting, apply organic fertilizer basally on prepared holes. Based on the fertilization schedule presented in Table 3, side-dress organic fertilizer such as chicken dung or cow manure at least once a year and inorganic fertilizers in two equal installments. Start the application of inorganic fertilizers one month after planting and every 6 months thereafter. Fertilization rates are increased gradually as the trees grow bigger.

7. Training and Pruning

Generally, matured rambutan trees rarely require extensive pruning, however, they have a tendency to form a dense central crown if unpruned. Thus, in the early stages of growth, it is essential to ensure that the eventual framework of the branches will grow in a manner which will produce optimum yields. Train the young trees to develop a strong framework by allowing 2 or 3 wide-angled branches in the main trunk, and later allow lateral branches to develop from these main branches.

A popular system of training used particularly in Thailand and Malaysia is yearly pruning of the dominant or apical shoots and lateral branches during the early stages of growth resulting to a formation of a very compact and relatively low-growing bushy tree. By this system, harvesting is relatively easy and wind damage to the branches is rare.

Once the main framework of the tree has been established, pruning is limited on removal of water sprouts, infested and dead branches or twigs, those that are crossing with other branches and those low-lying branches which are likely to bend in the ground as they become heavy with fruits. After harvesting, prune the remaining panicle to induce a vigorous canopy regrowth.

6. Weed Control

Weeds are serious problem in many orchards as they compete with young trees in the nutrients and moisture available in the soil. They can be controlled by mechanical and chemical means. Use mechanical grass-cutter, grasshook, sickle or slashing bolo to underbrush the orchard. Maintain tree sanitation by regular

ring-weeding. Use of herbicide is the fastest way of controlling weeds, however, it may lose the essential microorganisms in the soil. Cover-cropping and mulching are also very effective means of controlling weeds and besides they can enhance the fertility of the soil.

Pest and Disease Management

Insect Pests

Fruit Borer (Cacao Pod Borer), *Conopomorpha cramerella* Sn. This is known as the most serious pest of cacao in South-East Asia which is also found infesting the rambutan fruits. No external symptom could be seen in a fruit but when the rind is removed, the aril and sometimes the seed are seen to be covered with unsightly larval exudates. The insect laid eggs singly on the surface of the fruit and hatch within a week. The larvae penetrate on the fruit skin and feed on the rind, the aril and occasionally on the seed. The usual point of entry is near the top of the fruit, close to the peduncle. The larvae are sometimes found tunneling between the rind and the aril. Infestation is likely to increase as fruit ripening progresses.

As the fruits reach maturity, spray at intervals of 14 days, trichlorphon, carbaryl or pyrethrins at a concentration of 1%. At least 2 weeks should elapse between the final spray application and consumption (Shamsudin and Chettanachitara, 1987).

Leaf-eating Loofer (Catterpillar), *Oxyodes scrobicula* Fabr. This is an important pest in many rambutan producing areas. Leaves and young shoots are eaten by the young caterpillars. Mature caterpillars eat both the young and the mature leaves. Control the pest by spraying with insecticides such as Malathion, Carbaryl or Pyrethrin.

Thrips (*Thrips* spp.). This pest makes young shoots stunted and young leaflets become curled, florets often fall and severely reduces fruit setting. When young fruits are attacked, the spinterns are stunted and turn brown. Severe thrip infestations usually occur early in the dry season. Control the pest using systemic insecticides that will not damage the inflorescences.

Mealy Bug (*Planococcus citri* Risso or *P. lilacinus* Ckll.). This pest is common on rambutan in the Philippines. The young mealy bug (crawler) feeds on the sap exuded by the fruit. At maturity, they become fairly static, secreting a white, floury mass which covers the body surface and gradually spreads over the surface of the fruit skin and spinterns. The white secretions later become blackened due to the proliferation of the Sooty Mould fungus (*Meliola nephelii*) which feeds on the secretions. This can be controlled or prevented by good cultural practice but chemical application to control ants which promote the spread of the mealy bugs is necessary if the infestation is severe. This includes white oil emulsion and lime-sulfur (Shamsudin and Chettanachitara, 1987).

Mites (*Tetranychus* spp.). Development of clusters of yellow spots on both the

upper and underside surfaces of the leaves is a symptom and damage caused by the minute green and the red mites. Inflorescences may also be infested affecting fruit set. Leaves turn red, wither and fall. Spraying with pesticide such as Dimethoate is necessary only when infestation is severe.

Diseases

Powdery Mildew (*Oidium nepheli* Hadwidjaja). This is a common disease of rambutan that usually infects the plant in all stages of growth, particularly the young and actively growing vegetative and reproductive parts which are more susceptible compared to those matured ones. The spores are air-borne that particularly infect the young leaves, inflorescences and young fruits. The mycelia appear as a white-yellow dusty deposit on the leaves and inflorescences. Floret drop may follow infection of flowers. Infected fruits also exhibit a white dust-like deposit due to mycelial growth on the skin, and stunted spinterns that later become brown. Normally, infected fruits do not drop but remain on the tree in a stunted condition.

Follow good orchard management including pruning and effective weed control, for penetration of air and sunlight within the tree canopy and removal of possible host plants, can reduce the incidence. Spraying with fungicides such as Benomyl and Mancozeb are effective control of the fungus especially when applied during the early stages of infection.

Vein Necrosis (*Xanthomonas nepheliae* Barr.). Affected trees have either dried leaves or are leafless. Infected trees can be easily recognized by the presence of dark necrotic areas along the veins and angular spots on the leaf blades. Leaf buds and young leaves are particularly susceptible. Outbreak of the disease generally coincide with wet periods. Affected trees should be uprooted and burned.

Sooty Mold (*Meliola nephelii*). This is a fungal infection came after insect damage and often transmitted by wind. The leaves and fruits damaged by the sucking insects such as mealy bugs, scales and red mites may become infected with the fungus. Both leaves and fruits develop a black, sooty mold on the surface because the fungus uses the sugars in the “honeydew” excreted by the insects as food. The fruit aril is not affected but the external quality of the fruit is not good and unacceptable in the market.

Good cultural practices can reduce the level of insect infestation. However, for serious outbreaks, chemical spraying to control ants, scales, mites, and mealy bug infestation using carbaryl and mineral oil supplemented with benomyl and other fungicides is effective.

Leaf Spot (*Phomopsis* sp.). Necrotic spots with yellow margins appear on the leaves which later turn brown. The lower mature leaves are most likely to be infected. Control the disease by spraying with fungicides such as mancozeb.

Through integrated pest and disease management approach, these pests and diseases problems on rambutan can be controlled or prevented.

1. **Cultural control** - Regular pruning or removal of dead twigs and branches, and water sprouts to allow air sunlight to penetrate within the tree canopy so as to minimize or prevent the incidence of pests. Maintain the cleanliness or sanitation of the tree by regular weeding to eliminate weeds that may become hosts of insect pests.
2. **Biological control** - This is the use of biological control agents or beneficial insects that may help protect the plants against harmful insect pests. An example are the ladybird beetles which are voracious predators of aphids, mites, scales, mealybugs, whiteflies and small caterpillars.
3. **Chemical control** - Apply chemical control whenever necessary. Make sure that chemicals or pesticides to be sprayed are safe to the environment, compatible or not harmful to the beneficial insects present in the orchard, for they might kill or eradicate those biological control agents. Carefully apply chemicals with well calibrated spray equipment to avoid crop damage, excess residues and off-site pollution, and rotate the kinds of chemical to be used to avoid pests resistance.
4. **Monitoring** - Regular monitoring on the status of the crop is very important to determine when the pests problem occurred and the damages done, and so that immediate action would be undertaken.

Harvesting and Postharvest Handling

Asexually propagated trees may start to bear fruits 3-4 years after planting while seedling trees on the other hand, may take 5-6 years.

Rambutan fruits are already ripe when they change their skin color from green to yellow or red. However, determination of the optimum time for harvesting is complicated by the fact that fruit maturity of rambutan is not uniform since clusters on the same tree and even fruits within a cluster do not ripen evenly. On any given tree, a period of 30 days is required for all the fruits to attain maturity. Thus, harvesting is done selectively or by priming which may give the advantage of extending the market season and avoiding surplus of fruits of mixed maturity. For a medium-sized rambutan orchard, harvesting 3 times per week is usually practiced.

For short trees, harvest rambutan fruits manually by cutting the clusters using a sharp knife or pruning shear and for tall trees use a long pole with a hook on the top end. Gather harvested fruits in kaing or big bamboo basket and bring to a shaded area where they will be sorted. Sort out or grade the fruits based on size and degree of ripeness. Pack fruits in ventilated carton boxes or kaing lined with banana leaves or old newspapers.

Storage

Ripe rambutan fruits under ordinary room condition are highly perishable and seldom remain marketable after 3 days from picking. To prolong the marketability of the fruits for about 8 days, place them in a sealed or perforated polyethylene bags. However, fruits may still be marketable for 12 days in sealed polybags and 10 days for perforated ones if placed in a storage temperature of 50°F. Lower temperatures cause chilling injury of the pericarp and spines although eating quality remains acceptable. A relative humidity of 95% is best for the storage of rambutan since lower relative humidities may cause the fruits to shrivel and decay.

Marketing

Rambutan is usually marketed as fresh fruits in by weight basis from the farmers/fruit growers to the wholesalers/traders, retailers and consumers. Since rambutan fruits are highly perishable, these are commonly sold in the local markets.

The most common practice of marketing rambutan fruits is by contract wherein the contract buyer is either responsible in managing the rambutan trees while fruits are still unripe until such time they are harvested, or contract buyer buys only the fruits when ripe and also takes charge of the harvesting operation. By these systems of marketing, the tree or orchard owner does not incur any harvesting and marketing costs. Other marketing options are to sell the fruits directly to traders or wholesalers who came to the farm at farmgate price; deliver the fruits in fruit stands at wholesale price; or the owner market or retail the fruits directly to the consumers.

Costs and Return

Tables 4 and 5 show the estimated volume of production and the estimated costs and returns of a one-hectare rambutan orchard for a period of ten years. Appendices 1a and 1b show the establishment and management operation costs from preparation of planting materials up to marketing.

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