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Breadfruit

Breadfruit (*Artocarpus altilis*) is a member of the family Moraceae which is grown throughout the tropics. It is fast growing and beautiful tree which may reach up to 20 m height. The branches spread with dense foliage at their tips. The leaves are evergreen thick, bright-green and glossy, with 5 to 11 pointed lobes. The tree bears a multitude of tiny flowers which develop into compound, oblong or round fruits. The rind is thin. Unripe breadfruits have green skin and have starchy, bitter, firm white flesh. As it ripens, it develops a golden brown exterior and has a yellow, and sweetish pulp. Fruits are rich in carbohydrates (21-29%). Fruits are used more as a vegetable after cooking and may be boiled, baked, roasted, fried or made into soups. It is usually cooked after peeling and slicing, and makes a good delicacy in combination with ingredients like coconut cream or grated coconut meat. Chips and biscuits can be made from it. Breadfruit thrives well in coastal areas of south India and is cultivated in a limited scale in Kerala, Tamil Nadu, Karnataka and few areas in Konkan region of Maharashtra.

Climatic and soil

Hot and humid, tropical climate is suitable for breadfruit cultivation. It requires a temperature range of 15-37°C with average rainfall of 200-250 cm. The relative humidity should be more than 70 to 80%. However, in Southern India, it is cultivated at sea level and humid slopes up to an altitude of 1,000 m with lower humidity. But in these areas irrigation is essential for the growth and fruiting of plants. Young plants grow better under shade but later require full exposure to sunlight. The breadfruit tree requires deep, fertile, well-drained soil. But the plants are also found growing well on sandy coral soils and in freshwater swamps. There is great variation in the adaptability of different strains to climatic and soil conditions.

Varieties

There are more than 200 varieties of breadfruit cultivated in the world. They are classified on the basis of leaf form, shape and quality. Some varieties which

have a wide distribution are Ma'afala, Puaa, Mein iwe, Aravei, Maohi, Paea, Pucro Rare, Rare Aunee, Rare Autia, Tatara, Vai Paere. There is no commercial variety released in India by public institutions. But some private planters have introduced few varieties from South Eastern Asian countries.

Propagation

Breadfruit can be grown from seeds in seeded varieties. The seeds should be sown immediately as they lose viability in a few weeks. But seeds are not preferred because they do not develop true-to-type plants. Some private nurseries in Kerala multiply breadfruit by shield budding technique. Breadfruit can also be grafted using various techniques. Stem cuttings are not used. Vegetative propagation is a must for seedless varieties, and root shoots or root cuttings are the preferred methods for both seeded and seedless varieties.

Propagation by suckers and root cuttings: It is best to collect root suckers and root cuttings after the fruiting season is over and when the tree is in an active vegetative stage, producing new leaves. This generally coincides with the end of the dry season, and root shoots/cuttings should be collected as the rainy season commences. Healthy shoots of at least 20-25 cm height with woody stem and lobed leaves are collected. Depending on the size of the shoot, it may require for 3-6 months to become ready for planting in the field. Success in rooting and shoot growth ranges from 50 to 90%.

Root suckers are not always available in sufficient quantity thus root cuttings can be used for large scale production of planting material. The roots are collected from healthy, vigorous trees by excavating roots present just beneath the surface of the soil. Root 1.5-6.0 cm in diameter and 15.25 cm in length are used for best results. Thicker roots do not give good success. Roots should be washed and treated with fungicides for better results.

The cuttings are transplanted into plastic bags containing a mixture of soil, farmyard manure and sand. Root cuttings should be kept under shade

Breadfruit

and with sufficient moisture. The success of rooting ranges from 75 to 85%. Thereafter shoots emerge and the plant became ready for field planting in 6-9 months.

Air-layering: Best time for air-layering is beginning of the rainy season. Newly developed shoots with 2-4 cm diameter are preferred for air-layering. After 2-4 months of layering, new roots will develop. The air-layers are detached by cutting the branch directly below the roots and are then planted in polyethylene bags. The plants become ready after 3-4 month for planting. Scions can be successfully grafted or budded onto seedlings of wild jackfruit trees.

Cultivation

Planting: Nine to twelve month old well established plants are planted in 1 m × 1 m × 1 m size pits, dug at 10 × 10 m distance before rainy season. Pits are filled with the top soil mixed with equal quantity of organic manures. The planting is done in June and July in Karnataka and Kerala while October-November is best time of planting in Tamil Nadu.

Nutrition: There is no exclusive fertilizer recommendation for breadfruit. Organic manure @ 25 kg/tree can be applied. Depending upon the age of the plant, NPK mixture (7:10:5) @ 1-2 kg/plant can be applied. Standard mixtures of NPK can also be applied seasonally. When the trees reach bearing age, then each receive, in addition, 2 kg superphosphate per year to increase the size and quality of the fruits.

Training and pruning: The training and pruning is generally not practiced. It is recommended to prune the fruited branches and disease and dead branches.

This stimulates new shoot production and also helps to restrict tree size.

Diseases and pests

Soft-scales and mealy bugs have been reported on breadfruit trees and ants infest branches that die back after fruiting. In southern India, the fruits on the tree are subject to soft rot. This fungus disease can be controlled by two sprays of 1% Bordeaux mixture at one month interval during fruiting season.

Harvesting and post-harvest management

Vegetative propagated plants start yielding from third year and remain productive up to 50 years. In some countries, the trees produce fruits more or less continuously round the year. In India, breadfruit trees flower in March, and the fruiting season lasts from June to July. The fruits mature in 60 to 90 days after emergence of inflorescence. In breadfruit, maturity is indicated by the appearance of small drops of latex on the surface. Ripe breadfruits are mildly aromatic and soft to touch. Harvesting depends on the use of the fruits. The ripe fruits are harvested to make desserts, purees and puddings, and while green, immature fruits are harvested to make cooked, savory dishes. Harvesting is done manually. A fully grown tree can yield about 500 to 2,000 fruits weighing 1 to 4 kg each. The productivity is less in dry regions. Fully ripe fruits wrapped in polyethylene bags, can be stored for 10 days in storage at 12°C. At lower temperature, the fruits show chilling injury. Slightly unripe fruits that have been caught by hand when knocked down can be maintained for 15 days under the same conditions. ■

Rambutan

Rambutan (*Nephelium lappaceum* var. *lappaceum*) belongs to the Sapindaceae family, and is indigenous to the Malay Archipelago. It is widely cultivated throughout South-east Asia. It is also grown in India and Sri Lanka. It is an evergreen tree growing to a height of 12 to 20 m. Rambutan trees bear male, female, or hermaphrodite flowers. The fruit resembles litchi fruit in appearance and texture but fruit skin carries numerous long, thick, yellow or pink and red color hairy growth. The fruit is a round to oval drupe, borne in a loose pendant cluster of 10–20. The flesh (aril) is white or rose-tinted, translucent, juicy, acidic, sub-acidic or sweet, 0.4–0.8 cm thick, adhering to seed. The seed is oblong and flattened, glossy brown, 2–3 cm long. Fruits are sweet, juicy and delicious with a pleasant flavor and aroma. Fruit is a good source of sugars, vitamin C and other vitamins and minerals. Fruits can be used as a fresh dessert fruit or can be processed into different items.

In India rambutan is cultivated in home gardens of Thrissur, Pathanamthitta, Kottayam and Ernakulam districts of Kerala, Nagercoil, Courtallam, the Nilgiris districts of Tamil Nadu; and Dakshina Kannada and Kodagu districts of Karnataka. The actual area and production of rambutan in India is estimated to be less than 1,000 acres with most plantations having less than 20 plants. There is a good potential of expansion of this crop in Kerala, Tamil Nadu and Karnataka.

Climate and soil

Rambutan is adapted to warm tropical climate. It is grown commercially within 12°–15° of the equator. The tree grows well up to 700 m above mean sea-level. It requires around 22–30°C temperature for optimum growth. It is very sensitive to low temperature and growth of plant is severely affected at temperature less than 10° C. The lower temperature causes defoliation and affects panicle emergence and fruiting. The higher temperature (>40°C) affects the growth and development of plants. The lower humidity affects the development of fruits. The plant requires good rainfall of 200 to 500 cm, well distributed throughout the year but a short spell of the dry period is essential for initiation

of floral bud formation. The heavy rainfall during maturity period causes cracking of fruits.

The rambutan is grown successfully in wide range of soils. Well drained sandy loam to clay loam soils with good organic matter are most suitable for optimum growth and yield. It can be grown successfully in red laterite soil if adequate organic and inorganic fertilizers are applied. The optimum soil pH is 4.5 to 6.5. The rambutan is sensitive to water-logging. The orchard in slight sloppy land performed better. The soil should be rich in zinc and iron otherwise yellowing of leaf as a result of the nutrient deficiency is commonly observed.

Varieties

There are over 200 cultivars developed from selected clones available throughout tropical Asia. Most commercial cultivars are hermaphroditic. The Central Horticultural Experiment Station (IIHR), Chettalli, has identified several promising lines after extensive survey in Kerala, Karnataka and Tamil Nadu. Some of the promising lines are described as follows:

Arka Coorg Arun: This is a promising selection and an early maturing variety. The tree is medium in size and semi-spreading in nature. Fruits are dark red. Average fruit weight is 40 to 45 g. Fruits are free stone type. The aril is white, thick, firm and dry and sweet (TSS- 20°Brix) with recovery of about 42%.

Arka Coorg Peetabh: This is a high-yielding promising selection. The trees are semi spreading type and regular bearer. This is a mid-season variety. Fruits are yellow. Average fruit weight is 25–30 g. The aril is white, juicy, sweet (TSS -21°Brix) with an aril recovery of 41%.

E 35: This variety was identified by Home grown Nursery and Farms, Kanjirapally, Kerala. This is a high-yielding yellow covariant, and its average fruit weight is 30 g with 21° Brix TSS. Aril is easily separated from the seed, and is juicy.

N 18: This variety was identified by Home grown Nursery and Farms, Kanjirapally, Kerala. This is a high-yielding, red and its average fruit weight is 50 g. with 20° Brix TSS. Aril can be easily separated from the seed,

and has good shelf-life. The edible portion is 42%. It is rich, luscious and easily detachable from the seed. The seed is the smallest among all the accessions evaluated. The outer rind is very thick; hence has more shelf-life (5 to 7 days).

Propagation

Rambutan is propagated by seed, budding, grafting and layering. Seed propagation is easy and is not recommended for commercial multiplication as more than 50% plants produced only male flowers. The seedlings are used for rootstock purpose. Rambutan seeds, after removal from the fruit and thorough washing, should be planted horizontally with the flattened side downward in order that the seedling will grow straight and have a normal, strong root system. Seeds were sown in the nursery bags and it took around 25–28 days for germination. The seeds lose their viability very soon. Thus, they should be sown immediately after removing the aril. The germination of 2-day-old seeds is 87–95% as compared to 50–60% in 1-week-old seed. Sun-drying for 8 hr and oven-drying at 30° C kills seeds within a week. The storage of fresh seeds can be done in moist sawdust, sphagnum moss or charcoal for 3–4 weeks. The seedlings become ready for grafting in 9–10 months.

Vegetative propagation: Vegetative propagation is essential as rambutan seedlings take long time for fruiting and female to male trees ratio is 4/5:7. Cuttings have been rooted experimentally but the technique is not practised. Rambutan can be vegetatively propagated by approach grafting (inarching), air layering, budding and grafting.

Among various budding methods, patch-budding and T budding have been found successful. The budding is done in the well-grown 8 to 12 months old rootstocks in May or July. The budwood selection is important for the success of the budding. A one-year-old budwood of 1.5 to 2 cm diameter is found more suitable. The removal of leaves 1 week prior to budding provides better success.

Cultivation

Planting: The seedling trees of rambutan are vigorous and spreading type and require more space for growth. These need to be planted at 10 m × 10 m to 12 m × 12 m distance, to avoid overlapping of trees after 10–15 years. The vegetatively propagated trees are smaller in size and can be planted at a spacing of 8 m × 8 m or 8 m × 6 m. Close planting (6 m × 6 m) trees may need pruning to control the tree size. The planting is done in pits of 1 m × 1 m × 1 m size which are dug 2 to 3 weeks ahead of planting and filled with a mixture containing three parts of top soil and one part of compost. Planting is done preferably during June–July

after the onset of monsoon so that the plants are well established at the end of the monsoon.

Training and pruning: Rambutan trees exhibit strong apical dominance and have a tendency to produce long, upright growth. Early pruning and training to form an open center tree is recommended. After harvesting, fruited twigs are pruned back to stimulate new growth of up to four new side shoots, of which 22% of the shoots bear fruits in the following season. Dead branches and water suckers should be removed regularly.

Nutrition: A fertilizer dose of 200 g N, 25 g P and 100 g K/tree/year of age is recommended for rambutan. For the first four years, the fertilizers should be applied in four equal dressings, every three months. After four years 200 g N, 25 g P and 130 g K/tree/year of age is recommended. The dose should be increased up to twelve years and 2,400 g N, 300 g P and 1,560 g K should be given to 12-year-old trees and should remain constant thereafter. For fruiting trees, one-fourth of the yearly fertilizer should be applied four weeks after fruits set, half the amount should be applied immediately after harvest and the remaining one-fourth at nine weeks after harvest. Additionally, 0.4 kg of dolomite per tree per year of age, maximum at 10 years and constant thereafter, is applied during slow growing months. In nursery beds for raising rootstocks/seedlings, 20 g N, 2 g P and 20 g K and micronutrients should be applied.

Irrigation: Irrigation is given as needed in dry seasons. Rambutan trees should be sheltered from strong winds, which can cause damage during flowering and fruiting period. In order to induce flowering of full-grown plants, there is a need to allow the rambutan plant to pass through a period of drought for about 21–30 days. Irrigation is given to induce floral bud initiation. The rambutan plant so treated will start to bloom within 10–15 days after water manipulation.

Inter-culture: Mulching is essential during establishment and dry periods. No mulching should be applied prior to flowering. At any stage, glyphosate should not be used near irrigation lines or near the tree basin as it could cause severe yellowing and abscission of the lower leaves.

Pollination and fruit set: Three types of flowers are observed in rambutan-staminate (m), hermaphrodite functional female (hff), and hermaphrodite functional male (hfm). The hermaphrodite cultivars that produce only functionally female flowers require the presence of male trees. Male trees are seldom found because vegetative selection has favored hermaphroditic clones that produce a high proportion of functionally female flowers and a much lower number of male flowers that produce pollen. Peak flowering season in Coorg was

Rambutan

noticed in March. In the hfm type, cross pollination is essential for fruit set.

Diseases and pests

Several insect pests attack rambutan in various growing areas but only few of them have epidemic potential. Rambutan is a new crop for our country and limited research work has been carried out on the insect pests and diseases. So far very less insect pest damage has been noticed. Mealy bugs, beetles, bugs are major pests while twig blight, stem cankers, powdery mildew are noticed diseases. Although their infestation/infection is very low.

Leaf blight or leaf scorch: The leaf blight or leaf scorch is one of the major problems of rambutan in south-east Asian countries. So far this disease has not been noticed in our country. The symptoms of the disorder appear on leaves and flowers, and they tend to dry and shrivel. This disorder is very prominent in poor drained clayey soils. The soils with poor drainage, high level of fertilizer application, waterlogging, salinity, deficiency of potassium are associated with this disease. This disease can be managed by providing proper drainage facilities, avoiding high clay and saline soils and judicious use of fertilizers.

Harvesting and post-harvest management

Rambutan grafted trees start bearing fruits fourth year onwards. It may take up to five months for the fruits to develop into ripe fruits after fruit set. In South-east Asian countries, rambutan produces fruits twice a year, the first and the main crop is in June and the lesser one is in December. But in India it gives only one crop per year. The fruits usually ripen in July–October. Harvesting is done by shears or sharp knives by cutting the inflorescence stalk. Thereafter, the fruits are individually cut off and packed. Fruits should not be allowed to fall directly on the ground as these get easily bruised and have a limited shelf life. An average tree may produce 5,000–6,000 fruits (60–70 kg). However, yield may vary from year to year because the rambutan exhibits alternate bearing. Keeping the harvested fruits within a plastic film of sufficient thickness to avoid water loss at a temperature of 13–15°C prolongs the shelf-life. The rambutan fruit stored at a low temperature acquires a firmer texture and more translucent appearance. The sucrose content has been reported to increase during storage. Storage temperatures lower than 7°C cause chilling injuries to the peel and hairs.



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