

## Mangosteen (*Garcinia mangostana* L.): A Potential Crop for Increasing Incomes of Island Farmers

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### Abstract

Mangosteen is popularly known as the 'Queen of Tropical Fruits' owing to its delicious taste. Demand for fruits has increased in recent times and is being met by cultivation in non-traditional areas. An attempt was made to know cultivation suitability of mangosteen in the Andaman and Nicobar islands. Fruits grown in South Andaman and Little Andaman were evaluated for physicochemical parameters. Results revealed that fruit morphological characters varied with collection. Pulp content in island grown fruits varied from 27.3% to 35.7%, while total soluble solids content of pulp was in the range of 16.0 to 22.5 °B. This suggested comparable and even better pulp recovery and sweetness in island grown fruits than earlier reports from abroad. pH of pulp was in acidic range (3.8 to 4.4). Possible bottlenecks in cultivation and initiatives undertaken at authors' institute have been discussed. Further, roadmap for promotion of cultivation of mangosteen in the islands has also been given. Considering the findings, mangosteen could be a potential crop for backyard as well as commercial scale cultivation in the islands.

**Keywords:** fruiting; fruit quality; physico-chemical characters; total soluble solids; tropical fruit

### Introduction

Mangosteen (*Garcinia mangostana* L.), a member of the botanical family Clusiaceae, is one of the most popular fruits in the South East Asia. It is commonly referred to as the 'finest fruit of the world' and the 'Queen of tropical fruits' (Fairchild 1915) owing to its superior taste and exotic appearance. It is found growing in the Tropical Asian countries including Thailand, the Philippines, Indonesia, Sri Lanka, Myanmar, Malaysia, Vietnam and parts of Australia (Sandoet *et al.* 2005). Considering the potential of this exotic fruit, the crop has been successfully introduced in some Indian states (Shree 2016) such as Karnataka, Tamil Nadu, Kerala, Goa and coastal Maharashtra.

Mangosteen is assumed to have evolved from natural cross between *G. hombroniana* and *G. malaccensis* (Ketsa and Paull 2011). Andaman and Nicobar Islands are home to a number of *Garcinia* species (Bohra *et al.* 2019) including *G. hombroniana* (*G. celebica*), which is distributed in both Andaman and Nicobar groups of islands. Further, mangosteen grows well in humid tropical conditions and is suitable as intercrop in coconut gardens

(Shree 2016). Considering these points, there is ample scope for cultivation of mangosteen as backyard as well as commercial crop in the islands.

Farmers in a number of tropical countries are exporting their produce and getting multifold profits. For example, Indonesian farmers are getting 5-8 times higher prices in export markets than the domestic ones (Prabasari 2018). Mangosteen being a climacteric fruit with a shelf life of three weeks at 12-13 °C (Choehomet *et al.* 2003), could be easily transported from the islands to other places including mainland India and abroad. In this report, few important observations on this crop under island conditions have been discussed to know its suitability for cultivation.

### Materials and Methods

Field surveys were conducted in South Andaman and Little Andaman islands and locations with existing mangosteen trees were identified. Flowering and fruiting observations were recorded during 2015 to 2019. Based on availability, mature fruits were harvested from two trees in South Andaman and one tree grown in a farmer's

field in Little Andaman Island. Fruits were brought to authors' laboratory and various parameters were recorded as followed.

Fruit weight (g) was recorded using digital balance, while fruit length (cm) and diameter (cm) were recorded using a digital vernier caliper. Fruits were cut opened and rind thickness (cm) was measured using vernier caliper. Number of segments per fruit, seeds per fruit and seed weight (g) was determined. Pulp (%) was determined in all the collections. Observations were recorded with ten replications. Total soluble solids (TSS) and pH of pulp were determined in triplicate using hand held refractometer (Optics Technologies, India) and bench top pH meter (Hanna). Data was presented as mean  $\pm$  standard error of mean (SEm). Initiatives taken at authors' Institute and roadmap for development of mangosteen as a commercial crop in the islands have also been discussed.

## Results and Discussion

During the surveys, four trees were observed in a temple premise in South Andaman, which are growing since a few decades. Of these trees, three were regular yielders while Tree No. 2 came into bearing for the first time during 2018. Being protected in the territory of a religious monument, trees are growing in natural condition without any external interference. One mature tree was observed in a farmers' field at Rabindra Nagar village of Little Andaman. This tree, being cultivated, was provided with irrigation during dry period, manuring and mulching with coconut husk. All the studied trees were under open conditions.

Observations were recorded during different stages of flower and fruit development. Flowering and harvesting was observed comparatively earlier in Tree No. 1. Fruits started ripening between May to July in Tree No. 1, while fruits came to harvesting during July to late August in Tree No. 3 and Little Andaman collection. Mangosteen

fruit development takes place without pollination and fertilization (Ketsa and Paull 2011). During initial stages of development, fruit rind was light green in colour with purple stigmatic lobes. However, on attainment of full maturity, fruit colour changed with development of red spots which covered the complete fruit surface. Fully ripe fruits were attractive dark purple in colour with four attractive green calices (Fig. 1). Fruit development takes about sixteen weeks for attaining harvestable stage after flowering.



**Fig. 1. Fully developed ripe fruits of mangosteen ready for consumption**

Size of fruits varied amongst trees and each fruit weighed between 54.3 to 69.9 g (Table 1). In case of Tree No. 1, it varied between years of collection as fruit weight varied between 54.3 g (2016) and 62.4 g (2019). Being grown under natural conditions, such variations are expected. Fruits of Tree No. 3 weighed to 69.9 g, while those collected from Little Andaman weighed an average of 67.7 g. Fruit length and diameter were not influenced by year in Tree no. 1, while these values varied amongst the collections studied. Fruit length varied between 4.1 cm (Tree No. 1) to 4.8 cm (Little Andaman). Fruit diameter varied between 4.9 cm (Tree No. 1) to 5.3 cm (Tree No. 3).

**Table 1. Fruit physicochemical parameters in mangosteen collections grown in ANI**

Parameters	South Andaman		Little Andaman	
	Tree No. 1		Tree No. 3	
	2016	2019	2018	2019
<b>Harvesting period</b>	May - July		July- August	July- August
<b>Fruit weight (g)</b>	54.3 ± 2.73	62.4 ± 3.98	69.9 ± 4.77	67.7 ± 2.43
<b>Fruit length (cm)</b>	4.1 ± 0.14	4.1 ± 0.09	4.5 ± 0.10	4.8 ± 0.09
<b>Fruit width (cm)</b>	4.9 ± 0.12	4.9 ± 0.13	5.3 ± 0.14	5.0 ± 0.06
<b>No. of segments per fruit</b>	6.1 ± 0.23	6.1 ± 0.18	6.1 ± 0.23	5.9 ± 0.23
<b>No. of seeds/ fruit</b>	0.9 ± 0.29	1.6 ± 0.18	1.3 ± 0.21	1.3 ± 0.21
<b>Mean total seed weight (g)</b>	0.4 ± 0.04	1.3 ± 0.24	0.6 ± 0.09	0.6 ± 0.14
<b>Rind thickness (cm)</b>	0.7 ± 0.03	0.6 ± 0.02	0.9 ± 0.03	0.6 ± 0.02
<b>Pulp (%)</b>	32.6 ± 0.69	34.7 ± 0.8	27.3 ± 0.80	35.7 ± 1.71
<b>TSS (°B)</b>	21.3 ± 0.17	17.2 ± 0.6	22.5 ± 0.16	16.0 ± 0.32
<b>pH</b>	4.0 ± 0.04	4.4 ± 0.00	3.8 ± 0.06	4.0 ± 0.09

Standards have been developed for trade of mangosteen by different countries and organizations e.g. CODEX (CODEX 2005), ASEAN (2008), Philippine National Standards, PNS (2005) etc. In all these standards, parameters such as fruit colour, fruit weight, fruit diameter, freedom from blemishes and pests/ pathogens are considered as important criteria. In all the studied locations, no pests/ diseases were reported. Considering sizes of fruits, fruits grown in the ANI were classified into Size Code 4 as per ASEAN standards, while they were categorized in Class B as per CODEX standards. As per Philippine National Standards, fruits were classified under Small category (51 to 75 g).

Number of stigmatic lobes present on the fruits was equal to number of edible segments present inside the fruits. It means even without cutting the fruit, number of segments could be made out. Further, thickness of each lobe was proportionate to plumpiness of segment. Number of segments in a fruit varied between 5.9 and 6.0 (Table 1). In general, seeds were present only in segments which were enlarged, while other segments were either seedless or had underdeveloped seeds. Number of seeds per fruit varied between 0.9 and 1.6 in Tree No. 1; while

in other two collections it was 1.3. Rind thickness varied between 0.6 and 0.9 cm and thickest rind was observed in fruits of Tree No. 3. Presence of thick rind also makes the fruits amenable for long distance transportation with appropriate packaging and handling (Choehomet *al.* 2003). Earlier report suggested thickness of 0.82 to 0.94 cm in mangosteen grown in Philippines (Anabesa 1992).

Pulp is the economic part and in all the collections, it was found to be white with pleasant aroma. Recovery of pulp varied from 27.3% (Tree No. 3) to 35.7% (Little Andaman). This recovery is much higher than mangosteen cultivated in the Philippines, which was 17.75 to 24.85% (Anabesa 1992). Total soluble solids content was in the range of 16.0 to 22.5 °B, while pH of pulp was in acidic range (3.8 to 4.4). Earlier report suggested soluble solids content of 17.2 to 17.9% in fruits grown in Thailand (Palapolet *al.* 2009), while those grown in the Philippines had TSS content of 19.18-20.79 °B (Anabesa 1992). This suggested comparable and even better sweetness in fruits grown in ANI.

Without much management, mangosteen trees in the islands were able to produce good quality fruits. It has been reported that, major share of the mangosteen in the

world market comes from the backyard trees (Wiebleet *al.* 1992) and forests in the Southeast Asian countries (Sobiret *al.* 2013). Hence, inclusion of a few trees in the backyard could fetch the farmers considerable income. Further, major area of island agriculture is under coconut plantations, most of which are under monocropping. Mangosteen could be successfully grown in such plantations on commercial scale. Andaman and Nicobar Islands being a popular tourist destination, marketing of this exotic fruit would not be difficult.

Various initiatives were taken up at authors' institute for promotion of its systematic cultivation in the islands. Improved variety *viz.* K-100 was introduced from Homegrown Nurseries, Kerala and a demonstration block was established. Various awareness programmes were conducted to popularize the crop among the island farmers. Seedlings are being produced in the Horticultural Plant Propagation Unit of the Institute for supply to the farmers. Translucent pulp and Gamboge disorder (exudation of yellow latex), which are major bottlenecks in mangosteen growing countries (Ketsa and Paull 2011), were observed to some extent in the ANI, which could be addressed by scientific management of crop especially by judicious watering. Further, rind hardening was observed as a result of impact injury to fruits while harvesting.

### Conclusions

Based on the above findings following points have been suggested for promoting cultivation of mangosteen in the ANI:

- Improved varieties with better fruit size and less juvenility should be promoted in the islands.
- Demonstration blocks of mangosteen as intercrop in coconut gardens should be established.
- Considering slow growth and absence of root growth in ANI, suitable rootstocks should be identified from native *Garcinia* species for commercial exploitation.
- Planting material should be produced on large scale, preferably in the islands, for distribution to island farmers.

- Packaging and storage facilities should be created for promotion of trade to mainland and export purposes.
- Community gardens should be established and provision for pooling of farm produce from different islands should be done.
- Cultivation practices such as shade provision (during vegetative phase), nutrient management, irrigation management etc. should be adopted.
- Development of harvester for safe harvesting of fruits to avoid impact injury while harvesting.

Considering the performance of crop in the islands and quality of fruits produced, it is evident that mangosteen could prove a profitable commercial crop for the island farmers.

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