**MORPHOLOGICAL TRAITS AND FRUIT QUALITY OF *SYZYGIUM CUMINI*IN NATURAL ECOSYSTEM AND HOME GARDEN**

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**Abstract:***Syzgiumcumini*is a multipurpose tree found in littoral forest of sandy sea shore vegetation, waste land and home garden. It is an underutilized seasonal fruit*in Jaffna and*one of the widely used medicinal plants in the treatment of diabetes. Availability of these fruits in markets is restricted by seasonality and peak season is observed during September to November. This study was aimed to evaluate morphology, fruit quality and harvest calendar of *Syzgiumcumini,* and compare these parameters between the plants found in natural ecosystem and the home garden.

Qualitative morphological traits, leaf blade shape, leaf base shape, leaf colour, leaf apex, leaf arrangement, leaf type, leaf margin and quantitative traits of leaf petiole length, leaf length, leaf breadth and inflorescence length were studied. Among these morphological parameters leaf length, leaf petiole length, and inflorescence length of *Syzygiumcumini*from natural ecosystem were shown statistically significant different (p=0.05) from home garden.

More than 300 fruits were collected from both habitats separately and graded as ripened, mature and non-ripened. Ripened fruits were selected to determine fruit quality. Moisture content, ash content and wax content of fruits collected from natural ecosystem were 85.584%, 3.554%, and 5.284% while these parameters were 82.644%, 2.196%, and 2.05% respectively for fruits collected from home garden. There was significant different (p=0.05) observed for the parameters of total soluble solids (TSS), titratable acidity (TA), pH, ash, wax and weight of seeds collected from natural ecosystem  and home garden. Glossy appearance was observed in fruits collected from natural ecosystem due to high wax content and fruit availability was early in home garden. However, based on the fruit quality parameters including taste, TSS and TA, quality of fruits from both habitats were acceptable. Thus this study suggests the need of growing *Syzygiumcumini* in home gardens to increase the fruit availability.

Key words: Leaf and inflorescence traits, fruit quality, total soluble solids, titratable acidity and wax content

**Introduction**

*Syzygiumcumini*, is an evergreen tropical [tree](https://en.wikipedia.org/wiki/Tree) in the [flowering plant](https://en.wikipedia.org/wiki/Flowering_plant) family [Myrtaceae](https://en.wikipedia.org/wiki/Myrtaceae%20/o%20Myrtaceae).It is widely distributed in the forests of, Sri Lanka, Malayasia and Australia, which is cultivated for its edible fruits . In  north part of srilanka mostly distributed in Killinochi, Mullaithevu, Mannar, and Vavunia and Jaffna district. Cultivation is not in Sri Lanka in India. The seed of the fruit is used in various alternative healing systems like [ayurveda](https://en.wikipedia.org/wiki/Ayurveda%20/o%20Ayurveda) to control [diabetes](https://en.wikipedia.org/wiki/Diabetes%20/o%20Diabetes).*Syzygiumcumini* may reach 30 m tall usually has a multi-stemmed from branching close to the ground (Lazo ,1962).

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*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

Plant morphology is the study of the physical form and external structure of plants. Morphological parameters are useful in the visual identification of plants. A healthy soil ecosystem provides plants with easy access to air, water, and nutrients. As organisms decompose organic matter, nutrients become available to plants. Presence of organic matter and huge number of Micro organism in natural ecosystem leads to high growth rate and productivity. Environmental factors such as availability of light, rainfall, temperature, soil ph, humidity and wind action also determine the growth and development of plant in natural ecosystems and home garden.

fruit quality is essentially defined by shelf-life and firmness.  Fruit size, shape, color and firmness are the first quality traits which attract consumers by visual and tactile stimulation (Baldwin et al. 1998). So evaluation of morphology, fruit quality and harvest calendar of *Syzgium cumini,* and compare these parameters between the plants found in natural ecosystem and the home garden is necessary.

Evergreen leaves have a turpentine smell, and are opposite, 5-25 cm long, 2.5-10 cm wide, oblong-oval or elliptic, blunt or tapering to a point at the apex. In this study leaf length was observed 6.86 cm in natural ecosystem and 5.22 cm in home garden averagely. The leaf length was observed. The leaves which have an aroma similar to turpentine, are pinkish when young, changing to a leathery, glossy dark green with a yellow midrib as they mature. The leaves are used as food for livestock, as they have good nutritional value. The leaf distillates yield an essential oil which is used as fragrance in soaps and is blended with other chemicals to make inexpensive perfumes (Bhuyan, 1996).

Flowers are scented, greenish-white, in clusters of just a few or 10 to 40 and are round or oblong in shape and found in dichotomous paniculate cymes. The calyx is funnel-shaped, about 4 millimeters long, and toothed. The petals cohere and fall all together as a small disk. The stamens are numerous and about as long as the calyx. Several types, which differ in colour and size of fruits, including some improved races bearing purple to violet or white coloured flesh and seedless fruits have been developed (Gamble, 1935).  In this study inflorescence length was 7.8cm in natural eco system and 6.4 cm in home garden ecosystem averagely.

S*yzygium cumini* flowers are rich in nectar and are useful in the apiculture for their yield of high quality honey (Patel *et al*., 2012).Fruits ovoid-oblong or elliptical berries, numerous, crowded in clusters, almost stalkless along twigs at the back of leaves; often curved, green at first, turning pink and then finally purple-black, 1-2.5 cm long; pulp greyish-yellow, white or pale violet. The seed in each berry is strongly astringent and slightly bitter, 1-2 cm long; sometimes 2-5 angular, irregularly shaped seeds are compressed together into a mass resembling a single seed. Cotyledons are pale green (Benherlal, 2007).

The seed is used as an alternative natural healing system in the Ayurvedic, Unani and Chinese medicines. Bark of *Syzygium cumini* yields a brown dye due to its high tannin content. The fruit pulp is used to make jams, jellies, juice, vinegar and puddings. Fruits are also used to make wine. (Prince, 1998).The sourness of fruits may be due to presence of gallicacid. The color of the fruits might be due to the presence of anthocyanins. Fruits of *Syzygium cumini* are well known for its nutritional, therapeutic properties.(Bhatia et al 1971).Composition analysis indicated that there are low fat contents in both fruits and seeds of *Syzygium cumini*. It was observed that *Syzygium cumini* seeds contain moisture, crude protein, crude fat, crude fiber, ash and nitrogen free extracts.

*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

**Materials and methods**

plant selection and collection of plant material

*Syzygiumcumini* was selected from Natural ecosystem and home garden from Nagarkovil and Chavakachcheri respectively. More than 100 fruits in three replicates were collected from natural ecosystem and home garden.

Qualitative parameters

Leaf parameters- leaf blade shape, leaf base shape, leaf colour, leaf apex,leaf arrangement, leaf type and leaf margin was observed.

Inflorescence parameters- Arrangement of inflorescence, colour of inflorescence, inflorescence position was observed.

Glossiness of fruit, fruit skin colour, fruit pulp colour was observed. Taste was tested by untrained panel.

Quantitative parameters

Leaf parameters- Ten mature leaves in three replicates were collected.

Leaf petiole length- Average length of ten mature leaves was measured from the stem to the base of leaf blade.

Leaf length- Leaf length was measured by measuring tape.

Leaf breadth was measured by measuring tape.

Inflorescence length- inflorescence length was measured by measuring tape.

Ripen fruits were selected for fruit quality studies.

Fruit weight- Ten fruits were selected randomly and weighed by electronic balance ( Make- Mettle and model-AE 166).

Seed weight- Ten seeds were selected randomly and weighed by electronic balance (Make-Mettle and model-AE 166).

TSS- one drop of fruit juice was placed on the refracto meter (Make- Kyowa Japan and model hand held) and TSS was measured.

**Moisture content**

5g fruit pulp was taken in three replicates and moisture content was determined by oven drying method at 80°C for 48 hours.(AOAC, 1990)(Universal Oven make- Germany and model-UFE-400).

**Ash content**

 5g dry weight of fruit was determined by furnace at 560°C for 6 hours. (Furnace makeDaihan Lab tech.Co. Ltd and model-LEF-215P).

**Wax content**

 5g pulp was dissolved in 10ml of ethanol. It was shaked for 1 hour. Then it was placed in fume hood for evaporation. After 24 hours it was weighed to determine wax content.

**Harvest calendar of Syzygium cumini**

Initiation of flower bud , Flowering,fruit set,Mature fruit, Ripen fruit of *Syzygiumcumini* was observed from May to September and the harvest calendar was compared with natural eco system.

*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

**Rate of seed germination**

Twelve healthy seeds were selected from fruits collected from home garden and natural ecosystem separately . ,They were placed in the propagator box  and kept in plant house to observe the rate of germination. numberof germinated seedling were counted up to 18th days.

**Results**

Table 1: Comparison of Leaf and inflorescence parameters.

|  |  |  |
| --- | --- | --- |
| Parameters | Natural ecosystem | Home garden |
| Leaf length (cm) | 6.86±0.28a | 5.22±0.34b |
| Leaf petiole length (cm) | 1.81±0.22a | 1.50±0.32b |
| Leaf blade shape |  Oblong |
| Leaf base shape |  Obtuse |
| Leaf apex shape |  Obtuse |
| Leaf type | Pinnately compound |
| Leaf arrangement |  Opposite |
| Inflorescence length (cm) | 7.8±0.2a | 6.4±0.4b |

*Syzygium cumini* leaf length was observed as 6.86±0.28cm in Natural ecosystem and 5.22±0.34cm in home garden, shape of the leaf blade was Oblong and shape of the Leaf base was Obtuse. Colour of the Leaf was dark green, Leaf apex was Obtuse, Leaf type was observed as pinnately compound leaf with opposite leaf arrangement and entire leaf margin. Leaf petiole length was observed as 1.81±0.22cm in Natural ecosystem and 1.50±0.32cm in Home garden. Inflorescence colour white, leaf colour green and inflorescence position terminal in both ecosystem. *Syzygium cumini* inflorescence length was observed as 7.8±0.2cm. Inflorescence was white in colour with Cyme arrangement and located terminal and axillary.

Measurement of fruit parameters



Natural ecosystem         Home garden

Figure 1: Grading of fruits from natural ecosystem and home garden

Ripen fruits were selected for fruit quality evaluation.

*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

Table 2: Comparison of fruit parameters for natural ecosystem and home garden

|  |  |  |
| --- | --- | --- |
| Parameters | Natural ecosystem | Home garden |
| Weight of fruit(g) | 4.67±0.58 | 4.536±0.34 |
| Amount of juice in fruit pulp (%) | 13.33  | 16 |
| TSS(ºBrix) | 15a | 9.8b |
| Titratable acidity (mol H+) | 2.9x10-4a | 2.05x10-4b |
| Moisture content (%) | 85.584 | 82.644 |
| Ash content (%) | 3.554a | 2.196b |
| Wax content (%) | 5.284a | 2.05b |
| pH | 3.67±0.01a | 3.42±0.01b |
| Appearance | More glossy | Less glossy |

There was significant different (p=0.05) observed for the parameters of total soluble solids (TSS), titratable acidity (TA), pH, ash, wax and weight of seeds collected from natural ecosystem  and home garden.

**Seed germination**

92% of germination was observed in seeds from home garden fruits while 100% of germination was observed in seeds from natural ecosystem fruits.

Harvest calendar

Initiation of flower bud- May

Flowering- June

Fruit set- July

Mature fruit- September

Ripen fruit- September

Initiation of flower bud in natural ecosystem - 6 weeks later from home garden.

**Discussion**

Size of leaves present in natural eco system was larger (6.86±0.28cm) than home garden leaves (5.22±0.34cm) due to high amount of nutrients and other growth factors were favorable in natural ecosystem (Table 1). Leaves are entire with narrow transparent margin broad, opposite, thick, coriaceous, glabrous, broadly obovate, elliptic or elliptic-oblong, upper surface dark green, lower surface yellowish and dull (Greger, 2007).The [flowers](https://en.wikipedia.org/wiki/Flower) of *Syzygium cumini* are fragrant and small and white or pink in colour. Calyx with 4 white, rounded, concave petals, more than 2 mm long. Fruits resemble large [berries](https://en.wikipedia.org/wiki/Berry_%28botany%29), succulent with seeds.

Fruits ovoid, numerous, crowded in clusters, almost stalk less along twigs at the back of leaves green at first, turning pink and then finally purple-black. The seed in each berry is strongly astringent and slightly bitter, Cotyledons are pale green (Greger, 2007). Fruit diameter range from 0.7-1.5cm.

*Syzygium cumini* is a tropical fruit, widely known as black plum is an indigenous plant (Shalaby,2011). The plant was demonstrated to contain substantial hypoglycemic, anti-inflammatory and anti cancerous activities (Muruganandhan*et al.*, 2001). A fully grown seedling tree can yield 50-60kg fruits/year whereas; Three distinct phases of fruit growth in *Syzygium cumini* were recorded. Fruit set of *Syzygium cumini* from home garden was observed in July and it took 10-11 weeks to mature. Fruit size was highly increased from 2nd week of August to 3rd week of September and this was second phase.

Samant ,(2013) reported that during the first phase (15 - 52 days after fruit set), the rate of growth was slow; In the second phase (52 - 58 days after fruit set), the rate of development was quite rapid and the third and last phase (58 - 60 days after fruit set) comprised comparatively slow growth with little addition of the fruit weight. The length and diameter of fruit showed a continues increase with advancement of maturity. Fruit set of *Syzygium cumini* from home garden was observed in July and it took 10-11 weeks to mature. Fruit size was highly increased from 2nd week of August to 3rd week of September and this was second phase.

Weight of the fruit was Slightly (4.67±0.58g)in natural ecosystem than home garden  (4.536±0.34g) because of high available nutrients from environment(Table 2) but amount of juice from 30g fruit pulp was high in home garden (4.536±0.34g) because of high available nutrients from environment (Table 2) but amount of juice from 30g fruit pulp was high in home garden than natural ecosystem because of the presence of large seed and less pulp in natural ecosystem (Table 2).Total soluble solids(TSS) was high in Natural ecosystem (15º Brix) and it was low in fruits collected from waste land(9.8º Brix) due to this fruits in natural ecosystem had excellent taste than home garden fruits (Table 2).

Titratable acidity was high (2.9x10-4mol H+) in natural eco system fruits than home garden fruits (2.05x10-4mol H+). Fruit collected from natural eco system have high pH (3.67±0.01) than fruits collected from home garden (3.42±0.01) due to high amount of H+ ions (Table 2).

Ash content high in Natural ecosystem due to the presence of mineral nutrients. Fruits collected from Natural ecosystem were glossy or shiny due to the high wax content(5.284) Fruits collected from Natural ecosystem were observe to be good quality compare to fruits collected from wasteland due to TSS, PH, moisture content and Ash content.

Seed germination can be accelerated by acid scarification for 10 minutes duration results in better germination percentage both in diffused light and dark 92% of seeds were germinate after 18th dayand 100 % of seed germination was observed in natural ecosystem fruits.Polyembryony in this native multipurpose tree can be utilized in plant breeding techniques and in turn used for various reclamation programs (Stason*et al* ,1966).

Four embryos were observed when dissecting *Syzygiumcumini* seed (Figure 3). Poly embryonicis the occurrence of more than one embryo in a seed which consequently results in the emergence of multiple seedlings. The additional embryos result from the differentiation and development of various maternal and zygotic tissues associated with the ovule of seed (Scalbert*et al*, 2005).

**Conclusion**

A fully grown seedling tree can yield 50-60 kg/year . The length and diameter of fruit showed an increase with days of maturity. Fruits in natural ecosystem had excellent taste than home garden fruits. High pH value was observed in Natural ecosystem fruits than home garden so the amount of NaOH for titratable acidity also high because of the presence of high amount of H+ ions.

*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

*Syzygium cumini* had high traditional medicinal value to treat diabetic. 92% of seeds germinate after 18th day at ambient temperature in home garden while 100% of seed germination was observed in natural eco system .*Syzygium cumini* shows polyembryonic nature while dissect the seed four sections were observed.

Ash content high in natural ecosystem due to the presence of mineral matter. Based on the fruit quality parameters including taste, TSS and TA, quality of fruits from both habitats were acceptable. Natural ecosystem fruits were sweeter than home garden fruits. The fruit should picked immediately after ripen stage.

Organize orcharding is still lacking mainly due to lack of proper information on cultivation practices and poor marketing opportunity. Cultivation in home garden and used as life fencing are also possible in Jaffna. By increasing the market availability we can increase the economy of poor farmers. And also by having the knowledge about the harvest calendar and method of cultivation and post-harvest practices we can reduce the losses and increase the productivity. Consumption of fruits is good for healthy life.

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*N.Thasajini/ Morphological traits and fruit quality of syzygium cumini in natural ecosystem and home garden*

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