Leaf Morphology and Ontogeny Kembang Semangkok (Scaphium Macropodum) From Gunung Leuser National Park (TNGL)-North Sumatra

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Abstract. Scaphium macropodum or malvanut or locally known as Kembang semangkok was member of Sterculiaceae those well adapted under closed canopy stratum. The species was targeted for illegal logger due to its valuable seed that has many benefits for medicinal purposes and the wood for building and construction. This extraction causing Kembang semangkok classified at least concern according to IUCN redlist. Lack information on the existence and morphology on Kembang semangkok in North Sumatra, causing confusing identification in the field. Therefore, our research was conducted to identify leaf morphology and assumed ontogeny of Kembang semangkok originated from Gunung Leuser National Park. The research was conducted through survey method on 9 (nine) plot of Kembang semangkok. Observation and measurement for morphology were carry out on leaf organ those were leaf shape, leaf arrangement, leaf composition, leaf margin, leaf base, leaf blade and leaf apex. Our research showed that ontogenic change was found in Kembang semangkok due to their respond to survival and plant growth. The changes can be identified by leaf shape from entire (under 50 cm height) into palmed- parted leaf (taller than 50 cm) and returned onto entire after 12 m height.

1. Introduction

Scaphium macropodum or locally known as Kembang semangkok or malva nut belongs to Sterculiaceae family and commonly shade-tolerance emerged tree of tropical rainforest [1]. The genus of Scaphium consists of 8 species distributed in South East Asia from Burma, through Thailand, Cambodia, Malaysia, Singapore, Sumatra, and Bangka to Borneo [2]. In Indonesia, the species performed disjunctive distribution in Sumatera and Kalimantan Island [3].

S. macropodum has been reported to possess medicinal properties. Pharmacologically, both in vitro and in vivo studies have indicated that Kembang semangkok seed exhibits a variety of pharmacological activities, including antihypertensive, antimicrobial, analgesic, anti-inflammatory, antipyretic, weight-losing and laxative [4-7]. The seeds are known to contain a large amount of mucilaginous substance and have been used as a traditional medicine in South-East Asia. The jelly made from malva nuts is consumed as dessert, but its principal use is for relief of canker sores and cough [8]. The wood of Kembang semangkok also utilize for building purpose [9]. Due to many
utilization of its wood and seed, these species became targeted for illegal logger every year.

As shade tolerance emerged tree, Kembang semangkok have special physiological response called ontogeny. Ontogeny refers to the development of an organism through a series of discrete stages. For plants, ontogenetic stages include seeds, seedlings, juveniles, matures and senescent individuals [10]. Based on early study, Kembang semangkok leaf and crown shape changes at different stage. This phenomenon was identified as one of ontogeny change [1]. Another ontogeny changes also have been reported on Macaranga gigantea [11] and on Acacia [12]. This research purpose was to identify leaf morphology and ontogeny of Kembang semangkok originated from Gunung Leuser National Park.

2. Materials and Methods

Samples of Kembang semangkok materials for study on their morphology and ontogeny was conducted at the Sikundur Monitoring Center of Gunung Leuser National Park, Besitang District, Langkat Regency, North Sumatra Province. All Kembang semangkok tree was observed of nine plot (100 m x 100 m) in Sikundur Monitoring center by census method.

Observation and measurement on leaf morphology and ontogeny was conducted using non-experimental descriptive method by collecting field data through observing the morphological appearance all Kembang semangkok individuals in plot for all growth stage. Color observations were made using the Munsel Color Chart application. Observation of morphological characters was carried out on the leaf phenotype characters which included leaf shape, leaf arrangement, leaf composition, leaf margin, leaf base, leaf blade and leaf apex refers to [13-14].

3. Result and Discussion

3.1. Leaf morphology and ontogeny

Based on observation, complete growth stage of Kembang semangkok was found in nine observation plots those were seedling (Figure 1a), sapling (figure 1b), poles (figure 1c) and trees (figure 1d). Sapling and poles identified with a height of less than 12 m do not have branches, and the leaves gather at the end of the stem. The leaves change from entire to palmate parted along with increasing of tree size [1].

Figure 1. Kembang semangkok on different growth stage: seedlings (a), saplings (b), poles (c), and trees (d)
Morphological appearance observation on leaf organ showed that Kembang semangkok changes the leaf shape and size during different growth stage and tree age. The change was resulted from dramatic ontogeny change that in related with plant growth and survival. The changes correlated with the plant age, the increasing plant age will decreased the leaf size, especially on leaf margin [1]. Seedling and sapling stage (under 50 cm) had ovate shape with entire leaf only (figure 1a), but after plant reaching its height more than 50 cm, the leaf changes into palmate-parted leaf (figure 1b) and the number of lobed increased with the tree height. On pole and tree stage taller than 12 m, the leaf shape returned into entire margin with ovate shape (figure 2d). The ovate shape with entire margin and palmate-parted leaf can be seen on figure 2. Local people considered the differences of leaf shape as two different species growing in same location, so they identified the palmed lobed leaf edge as Kembang semangkok jantung, while the ovate shape with entire leaf edge as Kembang semangkok bulat.

![Figure 2. Kembang semangkok leaf: (a) palmate lobed, (b) ovate with entire margin](image)

The same phenomenon also found in Kembang semangkok in Borneo [1]. They stated that the ontogeny leaf changes as a form of plant adaptation during their life cycle. To sustain the plant life, some plant shape changes according to the ability to adapt to the environment. On rubber, the ontogeny change was a result of the faster transition from sink to source phase as a respond of new leaves to environmental stress and pathogens [15]. So that ontogeny development of leaves can be used as an early marker of adaptability to the environment and pathogens [11]. Visual observations of leaf samples (table 1) showed variations in leaf morphological characters including composition, arrangement, margin, apex, bases and leaf blade. The leaf surface of Kembang semangkok commonly dark green, but some of them was green with curved petiole.

| Tree  | Leaf composition | Leaf arrangement | Leaf shape | Leaf margin | Leaf apex | Leaf base | Leaf blade |
|-------|------------------|------------------|------------|-------------|-----------|-----------|-----------|
| KS1   | Single           | Alternate        | Lanceolate | Entire      | Acuminate | Rounded   | Glabrous  |
| KS2   | Single           | Alternate        | Ellipse    | Entire      | Acute     | Rounded   | Glabrous  |
| KS3   | Single           | Alternate        | Cordate    | Entire      | Acute     | Cordate   | Glabrous  |
| KS4   | Single           | Alternate        | Ovate      | Entire      | Acute     | Rounded   | Glabrous  |
| KS5   | Single           | Alternate        | Ovate      | Entire      | Acute     | Roundate  | Glabrous  |
| KS6   | Single           | Alternate        | Elliptical | Entire      | Acuminate | Rounded   | Glabrous  |
| KS7   | Single           | Alternate        | Ellipse    | Entire      | Acute     | Cordate   | Glabrous  |
KS8 Single Alternate Ovate Entire Acuminate Obtuse Glabrous
KS9 Single Alternate Ellipse Entire Retuse Rounded Glabrous
KS10 Single Alternate Ellipse Entire Acute Cordate Glabrous
KS11 Single Alternate Lanceolate Entire Acuminate Rounded Glabrous
KS12 Single Alternate Ellipse Entire Acute Truncate Glabrous

Kembang semangkok leaf shape changes with the increasing tree size. The changes of leaf on developmental stage may influence the photosynthesis rate through two mechanism [16]. The first is changes the diffusive pathway in and out leaf, which creates the resistance to gas exchange in leaf. The second, the changes will increase the total amount of light capture by the crown.

3.2. Canopy development
The leaf change development due to ontogenetic will result in changes on branching and canopy form. Our observation found that, at seedling stage (lower than 1 m) Kembang semangkok had no indication of the rhythmic growth, while the taller trees has the rhythmic growth pattern. The tree lower than 12 m (figure 3b) had no branches and arranged their leaf in rosette on monoaxial stem with the variation on canopy form those were oval, rounded and irregular (figure 3).

Figure 3. The canopy shape of Kembang semangkok (a) oval (b) rounded and (c) irregular

Crown characteristics develop and change during ontogeny by the structural response of each species to different environments [17]. The ability monoaxial growth of stem on juvenile stage enables quick vertical elongation on tree height commonly on canopy gap. On Kembang semangkok, the mono layer canopy with shape variation showed that this species has plasticity to adapt with different light condition [18]. The rounded (umbrella shape) was the most effective assimilation under closed canopy. The umbrella shape canopy on Kembang semangkok contributed to more efficient assimilation and survival under closed canopy than multilayer crown.

4. Conclusion
Kembang semangkok has ontogeny changes on leaf shape during the development stage. The changes can be identified from leaf shape which ovate with entire margin (on seedling under 50 cm) into palmate-parted leaf after 50 cm in height. When the tree is taller than 12 m, the leaf returned into ovate shape with entire margin. The ontogeny phenomenon might be respond to plant growth and survival.

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