Morphological character of raja clove (*Syzygium aromaticum* L. Merr & Perry.) native from Ambon Island

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**Abstract.** The objective of the study is to investigate the morphological character of the Raja clove, which is the original accession of Maluku. This paper reports the morphological characteristic of the Raja clove on each organ like leaves, flowers, fruit and seeds. The research was conducted in April - September 2018 in the villages of Mamala and Morela. The study was an exploratory method done at ten productive Raja cloves maintained by the local farmers. The age of the Raja cloves trees were > 10 years. The character of the Raja clove is an aggregate of cultivated cloves and wild type cloves, namely forest cloves. Flowers and aromas have similarities to forest cloves. Fruit, leaves and trees have similarities to cultivated cloves such as Tuni clove. This morphological character can be used to generate a new variety in the future.

1. **Introduction**

Clove are aromatic plants that member of the family Myrtaceae. It belongs to the genus Syzygium [1,2]. Syzygium is the largest genus of the family Myrtaceae [3]. One species of the Syzygium genus that has outstanding economic value is cloves. Cloves are known by the scientific name *Syzygium aromaticum* [4].

The main products of cloves are flowers, widely used as raw materials for the cigarette industries and spice. Other products are oil and oleoresins, which can be distilled from flowers or leaves [5]. Also, it can be used for medicine. Indonesia is a major supplier of clove oil for the India and Saudi Arabia markets. Madagascar and Sri Lanka also supply a lack of needs in those countries. Indonesian clove oil is also marketed to Vietnam, Pakistan, Bangladesh, America and the United Emirates Arab [6]. The main content of clove oil is eugenol. Eugenol compounds can be used as anti-bacterial, antifungal, antiseptic agents [7], antioxidants and anti-virus [8].

Since long ago, Maluku is the largest producer of spices in the world. It is a centre of origin for several spice plants that spread on several islands. One of them is Ambon island. Ambon Island is
located in Maluku Province, Indonesia. The area is 761 km$^2$. The island has a tropical climate that is influenced by the circulation of the monsoon which moves from and towards the equator. Maluku, the islands of spice, has attracted worldwide attention since the 1400s. The Portuguese were the first European come to Maluku to look for spices, then followed by the Dutch. Maluku clove commodities are in demand in the spice commodity market due to the distinctive aroma of eugenol it contains. In Maluku, there are three different types of cloves with different qualities, which are sequentially from high to low quality are cloves Tuni, Raja cloves, and Forest cloves [9]. Tuni varieties generally dominate clove cultivation in Maluku. Tuni from South Buru Regency has been released as a superior variety [10]. Raja cloves and Forest cloves have not been studied further.

One of the native clove varieties in Maluku that needs to be developed is the Raja clove. Variety development must be done by exploring germplasm first. The aims to get a description of accessions that can be used for patterns of cultivation and crossing for new superior varieties.

The objective of the research is to examine the morphological character of the Raja clove, which is the native accession of Maluku. This paper will report the morphological characteristics of the Raja clove on each plant organ such as leaves, flowers, fruits and seeds. So far, there has never been reported the clove morphological character of the Raja clove in Maluku.

2. Methods
The research was carried out in Ambon, Maluku, Indonesia (2° 30’- 9° 00’S, 124°–136°E). The study was conducted in May - July 2018 in the villages of Mamala and Morela. The study used a survey method and samples were randomly selected. The study was an exploratory method conducted at ten productive Raja cloves maintained by the local farmers. The age of the Raja cloves trees were > 10 years. From each tree ten leaves and ten flower clusters were collected purposively from 1 m$^2$ quadrants according to the method employed by Tresniawati and Randriani (2011) [11]. The criteria for the selected leaves are healthy, 4th leaf from the shoot apex [12].

3. Results and discussion
The Raja clove tree is upright with a single main stem or no dividing. Plant height 8-10 meters with pyramidal canopy. The branching direction is straight low with an angle of 45° (figure 1A). Leaf elliptic to elliptic-oblong, 11-16.5 x 4.4 - 7.5 cm. The stem length is 1.5 - 2.2 cm in brownish green (figure 1B). The surface of the leaves is rather rough, dark green (141B), and has a light reddish-green colour on young leaves (figure 1C). Apex acuminate and basal cuneate, margin slightly revolute and pinnate and intramarginal vein. Leaf attaches the opposite and leaf even-pinnate organization. Thenumber of flowers per series 7-15 (figure 1D).

![Figure 1. (A) Raja clove tree, (B) leaf, (C) young leaf (D) flower arrangement](image-url)
Young flowers are light green, and the flowers are yellowish-green or cream-milky (154D). Flower length is 2.1 - 3.3 cm, diameter 0.5 - 0.6 cm and weight of ripe flowers 0.4 - 0.5 g/part (figure 2B). The ripe fruit is dark red (53C), and young fruit is green, 3.2 - 3.7 x 0.9 - 1.5 cm. Weight 2.04-2.57 grams/part and long conical shape (figure 2A). Raja clove fruit is unique because many of its fruits do not have seeds (sterile) (figure 2D). The seeds are pink (47D) with a length of 3.2 - 3.7 cm, width 0.7 – 0.9 cm and weight 0.36 - 0.86 gram/seed (figure 2C). The potential for wet ripe flower production is 80 kg/tree/year, and dried flowers are 25 kg/tree/year.

Figure 2. (A) Ripe fruit, (B) flower Bud, (C) seed, (D) fruit without seed

Raja clove grows in Mamala and Morela villages on Ambon Island at 100 - 250 m elevation. Raja Clove grows well inland that contains organic matter, optimum pH of 5.5- 6.5 [13]. Ideal rainfall ranges from 500-3500 mm per year, which is spread evenly, optimum temperature of 22-32°C and optimum humidity of 60-80% [12]. The initiation period of flowers occurs in April and harvests in June. The fruit ripening process occurs until September. The phenological pattern of the Raja cloves is like forest cloves, namely bud sprouting, flower buds in inflorescence, fully opened flowers, perianths and anthers already dropped, unripe green fruits and ripe fruits [14].

Figure 3. The climatic condition of Ambon Island

The Raja cloves have similarities to the cultivation of cloves in the shape of the leaves, fruit and trees. However, the flowers are similar to forest cloves. Forest clove fruit does not have a groove in the middle [14] while the Raja clove has a groove in the middle. Raja clove does not have a strong
aroma, just like forest cloves [14] but is different from cultivated cloves which have a strong eugenol aroma. Based on this, the Raja clove is estimated to be a cross between cultivated varieties and forest cloves. Natural cross-pollination between forest cloves and cultivated cloves produces Raja clove, which has a variety of morphological characteristics between them [15]. Information on the agro-morphological character of the Raja clove is needed as an initial step in developing varieties. This information is needed, primarily when registering new varieties [16] as well as providing a database of clove plants in an area. At present, the Raja clove is still in the form of accession and has not been released as a variety and has the opportunity to be released as a new variety in the future.

4. Conclusion
The character of the Raja clove is a combination of cultivated cloves and wild type cloves, namely forest cloves. The flower and aroma parts have similarities to forest cloves. Parts of fruit, leaves and trees have similarities to cultivated cloves like Tuni varieties. This morphological character can be used for the development of varieties in the future.

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