Flower morphology and inflorescence of Andaliman (Zanthoxylum acanthopodium DC.) from Dairi, North Sumatera

B L Siregar 1,2*, L A M Siregar3, T C Nisa3 and L A P Putri3

1 Doctoral Program of Agricultural Sciences, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.
2 Program Study of Agroecotechnology, Faculty of Agriculture, Universitas HKBP Nommensen, Medan, Sumatera Utara, Indonesia.
3 Program Study of Agrotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.

E-mail: *benedicta.siregar@gmail.com

Abstract. Andaliman (Zanthoxylum acanthopodium DC.) is a spice plant typical of North Sumatra. Biological information on andaliman flowers is still limited. Therefore, the purpose of this observation is to study morphology of andaliman flowers and inflorescence arrangements that can be useful in understanding andaliman flower biology. The research was conducted on plants in one of the centres of andaliman production in Dairi District. Flower of andaliman is axillary inflorescence, determinate flowers, dichasium, generally glomerate, the number of flowers in one peduncle varies greatly. The time blooming of the flowers in each rachis is quite varied. Flower andaliman small and hermaphrodite with its parts, sepals 5-7 free, pale yellow colour, 5-6 stamens, anther is reddish, pollen sticky, and 3-4 pistils, and sometimes 5 pistils, apocarps. Information obtained from this study can be used in subsequent studies related to pollination, fertilization, fruit set, and seed set. The variation of flower blossom in one peduncle is one of the factors contributing to the maturity of the fruit as a source of seed should be studied.

1. Introduction

Andaliman (Zanthoxylum acanthopodium DC.) is a spice plant typical of North Sumatra. The fruit is used in various traditional Batak cuisine. Some studies have proved that andaliman fruit contains aromatic compounds with some physiological activities. Based on its chemical content and physiological activity [1-12], andaliman can be used not only for cooking ingredients, but also for preservatives, medicinal and supplementary ingredients, and botanical pesticides [13-14].

On the other hand, until now the complete publication of the botanical aspect is still limited. The flower morphology of Zanthoxylum acanthopodium was described [15-18]. Zanthoxylum acanthopodium plants have hermaphrodite flowers [15]; staminate flowers and carpellate flowers [15, 17]. However, flowers of Zanthoxylum acanthopodium are not well-known in their morphological aspects, including in one of the productions centres in Dairi District. It is necessary to conduct a study
on flower morphology and its inflorescence development of *Zanthoxylum acanthopodium*, because there is a relationship between the character of flowers or inflorescence arrangements with pollination [19-22], fruit set [23] and seed set [19]. Biological information on andaliman flowers is still lacking. Therefore, the objective of this observation is to study morphology of andaliman flowers and inflorescence arrangements that can be useful in understanding andaliman flower biology. Information obtained from this study can be used in subsequent studies related to pollination, fertilization, fruit set, and seed set of andaliman.

2. Materials and Methods

Materials used in this study include andaliman plants, flowers andaliman, preparatory glass, plastic bags, label paper, millimetre paper, paper bags, yarn, copper wire, and stationery. The necessary tools include GPS, loops, light microscopes, cameras, lamps, plastic presses, tweezers, and glassware.

The study was conducted on plants in Lingga Raja II Village, in Dairi District, North Sumatera (2°50’32.5”N, 98°24’45.4” E, 1300 meters above sea level). This research began with the selection of plants used as a source of flowers. The plants used as samples were andaliman plants which were identified as Simanuk species based on interviews with local farmer and existing publications [16, 24].

For observing the development of flower blooms, the number of plants observed were 2 plants, with a total sample of 10 flower clusters (inflorescence). Some inflorescence was also marked for morphology and photographed in the flower phase and fruit phase. Each sample was labelled to facilitate observation and avoid the sample from being disturbed or harvested. Some inflorescence on the branches were picked to be observed under a light microscope. Branches were cut and immediately put into a container filled with water to maintain freshness until taken to the laboratory. The first date of flower bloom was the date of the first flowers in each peduncle bloom (buds develop into flowers). Observations were stopped when the number of flowers that bloom did not increase anymore. Data on the number of flowers blooming in 10 inflorescences are shown in the form of images. Terminology to determine the morphology of flowers and inflorescence according to Radford [25].

3. Results and Discussion

Andaliman flower is axillary inflorescence (Figure 1), the same as previously described [15-16] [18]. The flowers of andaliman are arranged as determinate inflorescence, which have the central flower maturing first and generally glomerate (Figure 1). The inflorescence with oldest flower at the end of the main axis. Andaliman flowers were arrange as determinate inflorescence with *dichasium* type [16]. On the other hand, inflorescence type of andaliman flower were paniculate to racemose, which belongs to the type of indeterminate inflorescence [15]. Andaliman inflorescence had characteristic as follows: 0.5–2 cm, long and generally glomerate [15].

![Figure 1. Inflorescence of andaliman.](image1.png)
presented in Figure 3. The blossoming of flowers on 10 rachis, from the first flowers to the last took 31 days.

Figure 2. The number of flowers in one peduncle varies

![Figure 2](image)

Figure 3. The increase in the amount of bloom flower on 10 rachis.

![Figure 3](image)

The variety of flowers blooms, causing varying fruit formation and ripening of fruit in one rachis (Figure 4). Even there are still flowers blooming after fruit was formed. Andaliman flower in the anthesis phase is presented in Figure 5a. Flowers andaliman with its parts, sepals, stamens, and pistils, are presented in Figure 5b. *Zanthoxylum acanthopodium* plants has hermaphrodite flowers [15]; staminate flowers and carpellate flowers [15, 17]. *Zanthoxylum acanthopodium* has perfect flowers, only in Sumatran specimens, about 3 mm long [15]. Andaliman flower is small; base of flattened flower or cone shape; sepals 5-7 free, pale yellow colour; hermaphrodite [16]. Andaliman flowers are hermaphrodite flowers, 3 to 5 cm flower stalk, smooth hair; petals sticking together, 1–2 mm, pushing, yellow to reddish yellow, with 6-8 petals, pale greenish yellow petals, lanset, 1.5 mm [18].

Generally, on one flower there are 5 stamens (Figure 6a), and there are 6 stamens (Figure 6b) with reddish anther, and anther purple reddish before the flower blooms. Anther has two bears (Figure 6c and 6d). The pollen is sticky and yellow (Figure 6e). Pedicess and perianth segments as in stamina flowers; stamens 3-6, about 3 mm long, otherwise as in stamina flowers [15]. There are 5-6 stamens sit on the base of flowers, anther is reddish [16-18].
Figure 4. One peduncle with varied blooming flowers, fruit set, and ripening of fruit.

Figure 5. Flower of andaliman in the anthesis phase (a) and prior to anthesis with its parts (sepals, stamens, and pistils), magnification 10x4 (b).

Figure 6. Stamen of andaliman flower with its part (a) flower with five stamens; (b) flower with six stamens (c) flower, magnification 10x4, (d) anther, magnification 10x10, (e) anther, magnification 10x40.
In each flower there are three to four pistils, and sometimes five pistils (Figure 7). Gynoecium with 2-4 carpellate, sparsely hirsute, apocarp to semicarp, otherwise as in carpellate flowers [15]: 3-4 pistils, with apocarps fruit [16]; carpels 2–5, rarely hairless until bald [18]. Gynoecium in female flowers 2–5 carpelled [17].

Figure 7. Flower andaliman with three (a), four (b), and five (c) pistils, magnification 10x4.

4. Conclusions
Flower of andaliman is axilliary inflorescence, determinate flowers, generally glomerate, the number of flowers in one peduncle varies greatly. The time blooming of the flowers in each rachis is quite varied. Flower of andaliman is small and hermaphrodite with its parts, sepals 5-7 free, pale yellow colour, 5-6 stamens, anther is reddish, pollen sticky, and 3-4 pistils, and sometimes 5 pistils, apocarps. Information obtained from this study can be used in subsequent studies related to pollination, fertilization, fruit set, and seed set. Furthermore, it is expected to be useful in obtaining the process of preparing fruit for seeds. The variation of flower blossom in one peduncle is one of the factors contributing to the maturity of the fruit as a source of seed should be studied. Basic research is needed for studying the physiology maturity of fruit seeds.

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