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7

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Profile of *Elaeocarpus grandiflorus* and *Ziziphus mauritiana* as identity plants of Salatiga and Tegal towns, Central Java Province, Indonesia

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Abstract. *Elaeocarpus grandiflorus* J.E. Smith (*rejasa*) and *Ziziphus mauritiana* Lamk. (*bidara*) are declared as identity flora of towns of Salatiga dan Tegal, respectively. The species is local rare. The study aimed to determine the population size, describe the morphology characteristics and propagation mechanisms, analyze the community knowledge about the plant utility, and identify the conservation and cultivation efforts. Explorative study was conducted from Mei to September 2016, through observations, interviews, and literatures reviews. Observation sample areas were determined purposively. Data were analyzed descriptively. Results showed that *E. grandiflorus* and *Z. mauritiana* had very limited number that were 20 and 30 trees respectively throughout Salatiga and Tegal region. Generative propagation through seed germination occurred in a low rate. The knowledge of community about the plants usefulness as well as their efforts of conservation and cultivation were low. Based on the results it was suggested to carry out some activities which could significantly increase the existence of the identity plants. The activities comprise introducing the figure and utility of plants to the wider community and improving breeding technique with an alternative method.

1. Introduction

Indonesian region is divided into provinces, and each province consists of several cities/towns (*kota*) and districts (*kabupaten*). Province of Central Java comprises of six cities/towns and 29 districts. In order to optimize the conservation of plant biological resources, each city/town/district establishes a species as identity plant in their respective regions. The establishment is based on various factors, that are the endemism, the uniqueness, the value of history, the relation with the city/town/district name, or other factors. Through the identity plant establishment the city/town/district was expected to perform significant efforts to cultivate and expand the utility of identity plants. However, it is not performed as expected, even some identity plants are not fully documented (Environment Agency of Central Java Province pers.com.).

In general, the area of a city/town is smaller than that a district (Figure 1). The area of city/town tends as a residential area with a dense population; otherwise the district includes the rural area with a less population than the city/town. Under these conditions allegedly the efforts of conservation and



cultivation of identity plant of city/town are less optimal than that the district. In addition, the potential of utility of plants is also believed affect community participation in the cultivation of plants. Based on a preliminary survey conducted in early 2016, the utilities of identity plants of six cities/towns in Central Java, i.e. Semarang, Salatiga, Surakarta, Magelang, Pekalongan and Tegal, were generally known by the community, except the *rejasa* and *widuran*. The survey also showed that the population size of the two species were smallest compared to the four others.

Based on the survey previously it is necessary to study more about the existence of *rejasa* and *bidara* as identity plants of Salatiga and Tegal. The important aspects will be studied were the size of populations and the factors predicted affect populations size in a region, i.e reproduction mechanism, the community knowledge about the plant utilities, and the efforts of government and community to maintain the existence of identity plants. Therefore this present study aimed to 1) determine the population size, 2) describe the morphological characteristics and reproduction mechanisms, 3) analyze the community knowledge about the utilities, and 4) identify the effort of conservation and cultivation of identity plants of Salatiga and Tegal. The results were expected to give consideration for preparing more detailed and effectively program in order to preserve the identity plants.

14

2. Methods

2.1. Study Area

The study was carried out during Mei - September 2016 in two towns of Central Java Province, Indonesia, namely Salatiga and Tegal (Figure 1). The town of Salatiga is located approximately at $7^{\circ}.17' - 7^{\circ}.27' S$ latitude and $110^{\circ}.27' - 110^{\circ}.32' E$ longitude with an altitude of 750-825 m above sea level. This town covering about 56.78 km² area and a population density of 3,191 people.km⁻². Administratively Salatiga consists of four sub-districts (*kecamatan*), namely Argomulyo, Tingkir, Sidomukti, and Sidorejo, and 22 villages (*kelurahan*).



Figure 1. The six cities/towns and 29 districts of Central Java Province, Indonesia

The town of Tegal located approximately at $6^{\circ}50' - 6^{\circ}53' S$ latitude and $109^{\circ}08' - 109^{\circ}10' E$ longitude along the southern coast of Java with an altitude of about 1 m above sea level. The climate is hot enough with a temperature of 25-32 °C and humidity of 69-86%. This town comprises an area of 39.08 km² and a population density of 6,174 people km⁻². Tegal is administratively divided into four sub-districts, namely West Tegal, Margadana, South Tegal, and East Tegal, and 27 villages.

2.2. Procedures

The research consisted of two parts, i.e. a botanical observation and an ethnobotanical survey. The botanical observation aimed to describe the population size, morphological characteristics and propagation mechanisms of identity plants. Population size was counted through interview with village heads or community leaders in each village. To identify and validate the species for interviewees, the researcher showed a plant picture.

Description of the morphological characteristics and reproductive mechanisms were derived by direct observation in the habitat of identity plants and interview with community leaders in each village. The observation and interview were carried out using a guideline which contained some questions about number of plants, environmental condition, morphological characteristics, and propagation technique. The plant organs then were collected and represented to other people to confirm the accuracy of the results. Subsequently, the organs were observed carefully on some individual plants, and then taken photos in place.

Ethnobotanical survey was conducted to analyze the community knowledge about plants utilities and to identify conservation and cultivation efforts that have been conducted. The data were collected by semi-structure interview using interview sheet that contained of question about the utility of plant organs, economical value, participation of community in plant cultivation, and government program in order to conserve the identity plant.

The semi-structure interview was carried out with two informant groups, these were main informants and recommended informants. The main informants were selected by purposive sampling by considering the status and role in community and their adequacy of information about the identity plants. They were including the staffs of Town Environment Agency, village heads, and community leaders over 50 years old or who had lived more than 5 years in each town. The recommended informants were chosen through snowball sampling technique. This technique was implemented by using the recommendation of initial informants considered to other informants who know about the plant. The informants used in this survey were 44 persons and 54 persons in Salatiga and Tegal, respectively.

13

2.3. Data analysis

The data were analyzed using descriptive statistics involved cross-checking, summarizing and synthesizing from different sources, i.e. obtained from interviews and observations to build up a narrative account.

3. Result and discussion

3.1. The Profile of Rejasa at Salatiga Town

Identity plant of Salatiga is *rejasa* (*Elaeocarpus grandiflorus* J.E. Smith) belongs to Elaeocarpaceae Family. The establishment *rejasa* as identity plant of Salatiga is based on the *Phumpungan Inscription* which become a symbol of the birth of Salatiga. The observation result indicated that nowadays mature tree of *rejasa* found only in the yard of a State Senior High School located at Sub-district of Sidorejo as many as 21 trees.

Rejasa plants were found in Salatiga as evergreen tree more than 15 m height. From the tip of each branch arise many flowers (Figure 2A). The trunk erects, on the base there is some buttress roots (Figure 2B). Young leaves reddish, mature leaves green and turn red before dropping. Leaves alternate, simple, lanceolate, serrate, acuminate foliar apex, and acute foliar base (Figure 2C). The flowers arise from the scars of fallen leaves. The flowers are arranged in unbranched racemes, hang downwards (Figure 2D), reddish pinky and cup-shaped sepals, and whitish petals with a fringed edge. Stamens wholly-haired, ovary ellipsoid, located superior (Figure 2E). Fruit green, ellipsoid drupe with a length of about 3 cm (Figure 2F), contains a hard rough seed with slender spines (Figure 2G).

Naturally, *rejasa* is propagated by seed germination. However, the percentage of germination seems very low. Under every tree it was found only 2-3 seedlings, whereas each tree produced a large number of seeds. This fact was presumably because the seed is covered by a woody shell which

inhibits the rate and percentage of germination. During this time *rejasa* has never been propagated by stem cutting.

The results of interviews indicated that community knowledge about the utilities of *rejasa* was very limited. It was predicted due to the *rejasa* only found in small amount in Salatiga. Two employees who had been on duty at the State Senior High School for more than 5 years stated that as long as this time there is no one who utilizes the organs of this tree.

Rejasa have not yet received the full attention from Salatiga authorities. The plant have not been used as component of garden of government office, planted at roadside, or cultivated in plantations. The plant was not widely known by Salatiga community, therefore the attention of community to cultivate this plant is low. As a result, it was hard enough to find the existence of this plant in Salatiga.

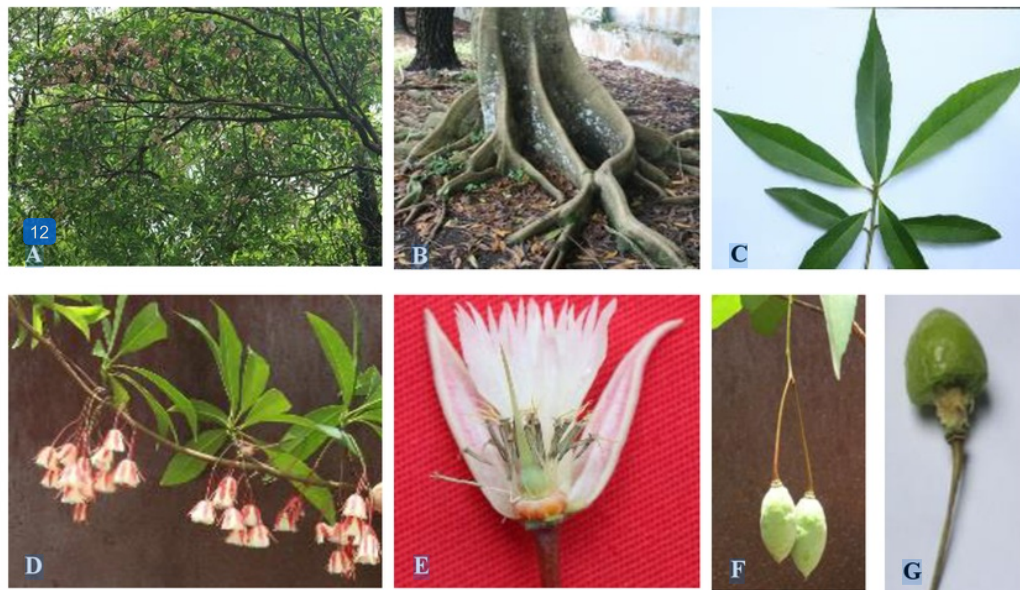


Figure 2. The characteristic of organs of *E. grandiflorus*. A. Flowers on the branch tips. B. The unique buttress root. C. The simple leaves. D. Flowering branch. E. The longitudinal section flower showed the orange receptacle, superior ovary and some stamens. F. The ellipsoid drupe fruit. G. Hard rough seed in a fruit

3.2. The Profile of Bidara at Tegal Town

The identity plant of Tegal is *bidara* (*Ziziphus mauritiana* Lamk.), belongs to the Rhamnaceae Family. Based on observations and interviews, at this time a total of 30 trees only were recorded at Tegal. Most of them grew in coastal areas, namely Village of Panggung, Muarareja, Tegalsari, and Pesurungan Kidul. The Panggung Village is part of the East Tegal, whereas the other villages are parts of the West Tegal Sub-District. In general, *bidara* grew on the yard of house (Figure 3A) and roadsides.

Bidara were spinose tree with a height between 5-10 m, young branches spread and often dangle (Figure 3B). The branches slope upwards with 1-2 erect stipular spines in young (Figure 3C) and reduced in mature branch. Leaf simple, alternate, petiolate, ovate or oblong. Leaf shiny green and hairless above; and dense, whitish, soft hairs underneath; with three vein form base prominent abaxially. Base asymmetric, sub-rounded, margin crenulate, and apex sub-rounded.

Flowering in auxiliary cymes, containing 5-15 flowers (Figure 3D). The flowers are small, 2-3 mm diameter, greenish-yellow, with 5 triangular sepals inserted to the disc. Petals 5, creamy white,

initiated along with stamen. The flowers are protandrous. Stamens pentandrous, ovary bicarpellate, styles short, immersed in disc. Fruit globular shape, about 2-4 cm in diameter. Smooth-skinned, green when it is young and yellowish orange after ripening. The fruit flesh whitish to yellowish, juicy, subacid to sweet. Seeds are enclosed by the irregular grooved shell (Figure 3E).

Nowaday the organs of *bidara* were rarely used by the community. Sometimes the leaves was used as a component in a traditional wedding and spiritual ceremony, or for bathing the corpse because when were kneaded with water the leaves produce a foam like soap. Occasionally the fruits were eaten fresh fruit or after being processed into sweet or pickle (Figure 3F). At about 10 years ago, the young leaves are eaten as a vegetable, while the older leaves are used as animal feed. The leaf decoction is taken as herbal medicine. The wood often used to make household appliances, such as handles of knives, furnitures, and farm tools.

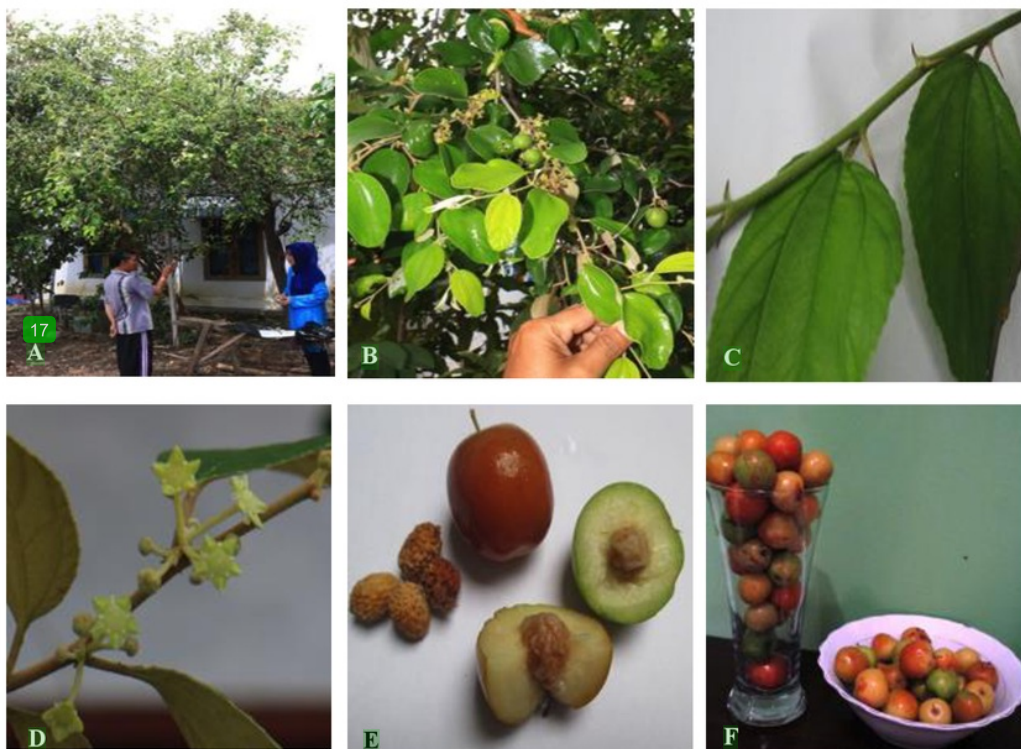


Figure 3. The morphology characteristics of *bidara* organs. A. The tree grown at a yard of house. An informants explain about the *bidara* usefulness. B. Some branches showed leaves, flowers and fruits. C. Stipular spines appeared on young branch. D. Flowering branch. E. The seeds and the young and ripening fruit. F. The pickles processed from *bidara* fruits

The role of the community in *bidara* cultivation was very low. Even many trees were felled due to the lands where they grew were converted to residential houses, schools, offices, roads and other public facilities. Actually, the town government already had some plans to replant the *bidara*, but the plan still faced some obstacles, especially the lack of availability of seeds.

3.3. Discussion

Determination *rejasa* as identity plant should encourage governments Salatiga to develop planting program of *rejasa* on a large scale, either planting in public spaces, unused land or yard of houses. *Rejasa* is a suitable tree for the tropical garden. The flowers are very beautiful and the root buttres is unique morphology. As the reforestation plants, *rejasa* is very suitable because it needs a little maintenance to optimal life. This plant able to survive well in low nutrient and dry soils, except sands and waterlogged areas, and in a variety of lighting conditions, either in the shade or under direct sunlight. *Rejasa* also plays a role in maintaining environmental balance, the flowers attract many butterflies. As a result it ensures the continuity of butterfly life [1].

Only a few people pay attention to the *rejasa* existence. This is believed because the community did not well understand about the utilities and breeding techniques. Whereas, some communities in other regions have been used the *rejasa* as medicine, construction materials and reforestation plants. The bark and leaf extracts are used as a general tonic to improve appetite. The infusion of the bark is used for fever and persistent ulcers. The bark is also a compound of a traditional herb medicine for women's diseases. Crushed young leaf is applied on forehead to treat headaches. Extract of leaves is an ingredient of a traditional medicine against syphilis because have proven as anti-HIV-1 protease [2], and anti-bacterial activities as well as stem extract [3]. Extract of leaves also possesses antidiabetic activity [4]. The seed is a common ingredient in many traditional 'jamu' with mild diuretic properties. It contains alkaloids, flavonoids, glycosides, tannins, and fatty acid [5]. Wood is often used for interior construction and components plywood, and used for make particle board, fiber board and pulp. In addition the tree is also used for reforestation and ornamental plants.

Therefore the city authorities should disseminate the identity of this plant and its benefits to general community. Such efforts can be realized through the dissemination of information by means of the social organization, the government web, billboard on highways, or is used as a gift for competitive events, and so forth. In addition to increase the motivation of people, a planting program needs to be supported by seedling availability as well as the effective and efficient maintenance techniques. The results of observation found that seeds can germinate naturally but the percentage was very small. It was found 2-3 seedling only under each tree observed.

To improve seedling availability it need to find the rapid germination techniques. Because the seeds have a hard shell it needs scarification that can be done through filing down or cracking the shell in order to allow imbibition. It must be conducted carefully and do not damage the seed. The other way to increase seed germination is stratification. Seed must be stored for 3 months in warm subsequently cold condition and then are dipped for 4 hours in 500 ppm thio-urea. Finally the seeds are sowed in containers in shade. It is germinate in about 7-10 days. In addition to the seed germination, the seedlings can also be obtained through cutting. Cuttings of ripe shoots can be carried out in a sandy soil and the leaves should be left on the stem. Grafting and root-suckers are also used for vegetative propagation but show limited success. Tissue culture is currently being used for fruit cultivar.

Salatiga Town is suitable for growth of *rejasa*. This town is located on an altitude of 750-825 m above sea level with a cool climate. This species grows best at in areas with an altitude of 1000-1200 m above sea level, in an area with full sun light intensity of up to shade 50%.

As *rejasa*, population size of *bidara* in Tegal was also very limited. This is because of the decreasing of economic values of *bidara*. This condition cause the community motivation to cultivate *bidara* turn low. Actually, as a source of medicinal compound *bidara* have a high economic value. The active compounds of the organs have been extracted commercially and utilized broadly in the maintainance of health, immunity and treatment of some diseases. The usefulness as medicine had been clinically proven. The extract of leaves or boiled leaves have strong immuno-stimulatory activity for treat chronic fever [6], enhance the glucose tolerance in diabetic patient, and when mixed with flowers extraxt it can reduce eye inflammations. The seeds decrease the symptoms of gout and rheumatism and possess a potency as an antioxidant against cancerous cells [7]. Root and barks made into a powder can be applied to old wounds and ulcers [8]. Phenolic compounds and related

antioxidant activities were investigated during the ripening fruits [9]. Therefore the town authority should develop cooperation with the pharmaceutical industry as a supplier of medicine. It is predicted will increase the economic value of *bidara*. The high economic value was expected will improve the motivation of community to cultivate *bidara*.

Diversification of fruit processing also needs in order to increase the sale value. In other countries, ripe fruit powder used to make jam and bread. Moreover, in terms of environmental conservation *bidara* services erosion control, provides shading, wind breaker, and retain heat. Min addition, *bidara* tree is well suited for homegardens [10].

Because of the many benefits of *bidara*, the planting program in great scale reasonable to do. Tegal town also suitable for *bidara* growth. It is already known that *bidara* well adapts to various environmental conditions, such as salinity, drought and waterlogging. The optimal altitude is 1 to 500 m, the mean annual temperature: 7-13 to 37-48 ° C [10]. Tegal city located on the coast with a temperature of 25-32 °C is suitable for *bidara* growth. This plant grows well especially in areas that have a dry season, but also resistant to flooding. The best quality fruits are obtained when grown in a rich sunshine and quite dry, but at the vegetative stage where branches and leaves develop, *bidara* have to get enough water, as well as during fruit ripen [10].

4. Conclusion

Based on the results it can be concluded that populations of *rejasa* and *bidara* as plant identity in Salatiga and Tegal were very low, 20 and 30 trees respectively in all areas of the towns. *Rejasa* and *bidara* tree form the distinctive flowers and fruit, and propagated by seeds. The seed germination was occurred in low rate and percentage because of the hard seed coat. The community knowledge about the benefits and usefulness of both of these trees were relatively limited compared to a large number of benefits and usefulness that have been studied in other countries. *Rejasa* and *bidara* are useful as medicinal plants and ornamental or reforestation plants. *Bidara* fruits were edible. The community participation in conservation and cultivation activity have not yet optimal. The role of city government in realizing *rejasa* and *bidara* as identity species also must be improved. It was suggested that the government of the two towns should carry out some activities which could significantly increase the existence of the identity plant.

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