

GERMPLASM EXPLORATION AND COLLECTION OF MANGO ADAPTABLE TO HIGH RAINFALL SEASON FROM SUMATERA

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SUMMARY

Exploration and collection of germplasm is an important link between the conservation and utilization of plant genetic resources. One of the problems in the development of mango plantation in industrial scale in Sumatera island is the rendering of the cultivars that are grown with climate and soil type on Sumatera. During this time, the mango cultivars originating from the other islands as a source of seeds is failure to bear fruits. To improve the harvest of mango plantations in Sumatera for the foreseeable future, there is a need for exploration and collection of germplasm resources adapted to the high rainfall. The uniqueness of the Sumatran mangoes is the ability to grow, adapt and produce fruit in environments that have high rainfall as well as the diverse habitat types. The interaction with genetic factors will generate the wealth of genetic resources of mango which are different from other areas in Indonesia. The exploration and collection of *Mangifera* germplasm in Sumatera has been done to obtain mango accessions that are adapted to high precipitation and soil moisture content. The mango exploration in Sumatera resulted in 10 species of mangoes grow and adapt to the Sumatran environment namely *Mangifera foetida*, *M. kemanga*, *M. sumaterana*, *M. torquenda*, *M. quadrifida*, *Mangifera sp1* (wild species), *M. odorata*, *M. laurina* (semi-cultivated), *M. indica*, *M. zylanica* (cultivated). The most adaptive mango to high rainfall is *Mangifera odorata* that can grow well at an altitude of 0–800 m above sea level in the west coast of Sumatera.

Keywords : Exploration, germplasm collection, Sumatran manggos, high rainfall, *Mangifera ordonata*

INTRODUCTION

Genetic diversity and genetic material availability is critical for the success of mango breeding program. The uniqueness of mango (*Mangifera* L.) from Sumatera is its ability to grow and adapt to the environment that has high rainfall and diverse habitat types. The interaction with genetic factors will generate the wealth of genetic resources of manggo which are different from other areas in Indonesia.

Diversity of species and cultivars of mango in Sumatera is endangered due to declining forest areas as their natural habitats due to deforestation, habitat alteration, industrialization, the expansion of oil palm plantations and others. With the rate of deforestation in Sumatera at 268,000 ha/ year or 22.8% of the total deforestation in Indonesia (Departemen Kehutanan, 2008), it is expected in less than a quarter of a century, the lost of tens to hundreds of wild mangoes are yet to be explored and identified.

In order to obtain data about the diversity of mango species and in order to minimize the decline of mango diversity in the eastern part of Sumatera, there is a urgent needs to be further study othe diversity (exploration, identification, and characterization). In general, this study aims to obtain accurate information about the diversity of mango in Sumatera.

MATERIALS AND METHODS

Sumatera is Indonesia's second largest island with an area of 435,000km². It extends to over 1.650 km from north to south and 350km from east to west. Owing to a great heterogeneity in the topography, altitude (0–3805 m above sea-level) and climate (temperature for example, on an average ranges from 14°C to 36°C), it harbors diverse habitats. Agro climatically the state is divided into two main distinct zones (Highlands and Mountain and Lowlands area) corresponding to eight provinces, namely 1.

In this island have two type of mango, the first type is a wildtype and cultivated type. Mango distributed from mountain to lowlands area. Usually wildtype mango distributed on highlands and mountain area.

This study uses surveys and direct observation. Sampling in natural forests, national parks, estates and grounds in Sumatera Island. Morphological observation conducted in the field and laboratory Botany Department of Biology, Faculty of Mathematics and Natural Sciences, University of Riau Pekanbaru.

The plant material such as leaves and fruits are taken in all Province in Sumatera Island. The research location are presented in Figure 1. Morphological observation refers to Fitmawati (2008) and mango IPGRI descriptors (2009). Observations were made on the characters found in a tree, leaves, and fruit.

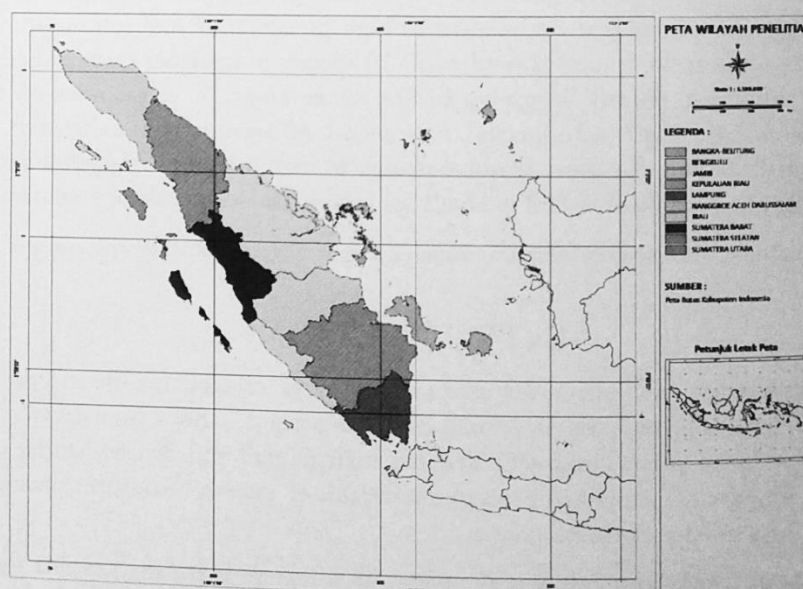


Figure 1. Map of Sumatera Island

Table 1. Rainfall average in Sumatera island based on Province in Sumatera

| Place collection | Rainfall average (mm/year) |
|------------------|----------------------------|
| Aceh | 1000–2000 |
| North Sumatera | 800–4000 |
| West Sumatera | 1500–4000 |
| Riau | 1000–3000 |
| Bengkulu | 1500–2000 |
| Jambi | 1500–2000 |
| South Sumatera | 1000–2000 |
| Lampung | >2000 |

RESULT AND DISCUSSION

Naturally, distribution area of genus *Mangifera* divided into three groups: wild mango groups which is the native flora of Sumatera forest such as *M. foetida*, *M. kemanga*, *M. torquendra*, *M. quadrifida* and *Mangifera sp.* Semi-cultivation groups such as *M. sumatrana*, *M. odorata* and *M. laurina*, also cultivated groups such as *M. indica* and *M. zeylanica*. These three groups have different distribution characteristics. The existence of first groups are depends on the existence of natural dispersal agent such as fruit-eating animal beside ecological factors compatibility, so that these species are generally found in undisturbed highland forests. Natural forest diversion to industrial plantation forest can decrease wild mango habitat in Sumatera forest significantly. This threatens the existence of species of *Mangifera* in Sumatera (Figure 2).

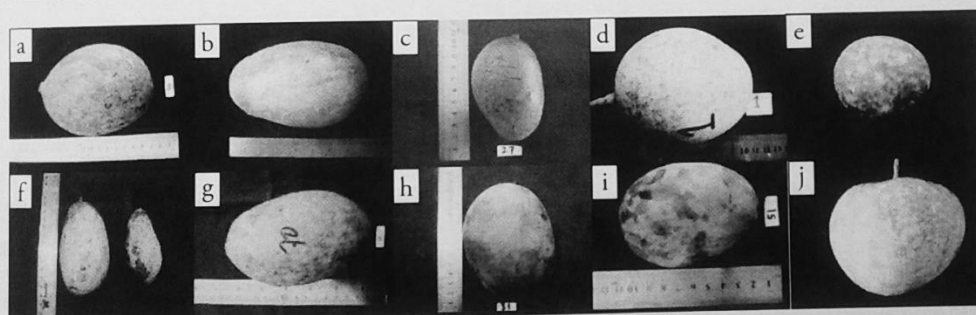


Figure 2. Collection mangoes species from Sumatera island (a) *Mangifera foetida* (b) *Mangifera kemanga* (c) *M. sumatrana* (d) *M. torquendra* (e) *M. quadrifida* (f) *Mangifera sp1* (g) *Mangifera odorata* (h) *Mangifera laurina* (i) *Mangifera indica* (j) *M. zeylanica*

The second group are semi-cultivated plants which are considered minor fruit and mostly located at outskirts of the forest, this group is very vulnerable to land clearing, agriculture and land conversion into residential. While the third group are generally found in yard of a house or plantation area. Currently the distribution of cultivated mangoes are highly dependent on the activity of human anthropocentric. Mangoes are widely cultivated by people generally spread not far away from the settlement, vice versa because lack of economic value. *M. indica* was mostly distributed in residential areas. *M. indica* is the most widely cultivated by the people, so that its

existence can not be separated from human activity as an agent dispersers. *M. laurina* was found in residential areas and plantations. *M. odorata* was spread in the plantations. Most of people in eastern part of Sumatera was still cultivate this type of mango. *M. odorata* was easily cultivated because of the suitable environment, so that its presence was very abundant. *M. foetida* was an unwanted mango because it lacks of economic value, so that these mango was distributed in residential areas, plantations, upland farming to shrubs. Environmental factor such as altitude also affects the existence of mango species (Table 2.)

Table 2. Collection mango from Sumatera Island

| Place Collection | Latitude | Longitude | Geomorfology | Manggo's collected |
|------------------|----------------------|-----------------------|-----------------------------------|---|
| Aceh | 2° - 6° LU | 95° - 98° BT | Lowlands region | <i>M. indica</i> , <i>M. zeylanica</i> |
| | | | Northern Mountains region | <i>M. laurina</i> , <i>M. odorata</i> , <i>M. quadrifida</i> |
| | | | Central Mountains | <i>M. laurina</i> , <i>M. foetida</i> , |
| | | | region or Gayo | <i>M. odorata</i> |
| | | | South Mountains | <i>M. foetida</i> , <i>M. Indica</i> , |
| North Sumatera | 1° - 4° LU | 98° - 100° BT | region or Alas | <i>M. quadrifida</i> |
| | | | Lowland region | <i>M. indica</i> , <i>M. laurina</i> |
| | | | Fold region | <i>Mangifera</i> sp, <i>M. indica</i> , |
| | | | | <i>M. foetida</i> , <i>M. odorata</i> |
| West Sumatera | 0° 54' - 3° 30' LU | 98° 36' - 101° 53' BT | Mountains region | <i>M. laurina</i> , <i>Mangifera</i> sp2 |
| | | | Volcanic mountain region | <i>M. laurina</i> , <i>M. foetida</i> |
| | | | Tertiary hilly region | <i>M. odorata</i> , <i>M. laurina</i> |
| | | | Lowland region | <i>M. indica</i> , <i>M. laurina</i> , |
| Riau | 01° 05' - 02° 50' LU | 100° - 105° 05' BT | | <i>M. zeylanica</i> |
| | | | Swamp region | - |
| | | | Lowlands area | <i>M. indica</i> , <i>M. laurina</i> , |
| | | | | <i>M. zeylanica</i> |
| | | | Hills region | <i>M. kemanga</i> , <i>M. quadrifida</i> , |
| Bengkulu | 2° 16' - 3° 31' LS | 101° 1' - 103° 41' BT | | <i>Mangifera</i> sp1, |
| | | | | <i>M. torquendra</i> , <i>M. Foetida</i> |
| | | | Lowland regions | <i>M. indica</i> , <i>M. laurina</i> , |
| | | | west coast | <i>M. zeylanica</i> |
| | | | Lowland regions | <i>M. foetida</i> , <i>M. laurina</i> , |
| | | | east coast | <i>M. odorata</i> |
| | | | Part of the Jalur Semangko region | <i>M. foetida</i> , <i>M. Indica</i> , |
| | | | Bukit Barisan | <i>M. quadrifida</i> |
| | | | region east side | <i>M. indica</i> , <i>M. laurina</i> , |
| | | | | <i>M. odorata</i> |

Table 2. Collection mango from Sumatera Island (Cont.)

| Place Collection | Latitude | Longitude | Geomorfology | Manggo's collected |
|------------------|--------------------------|---------------------------|---------------------------|---|
| Jambi | 0° 45' LU - 2° 45' LS | 101° 10' - 104° 55' BT | Swamp region | - |
| | | | Lowland region | <i>M. indica</i> , <i>M. laurina</i> , <i>M. zeylanica</i> , <i>M. kemanga</i> , <i>M. Guadrifida</i> |
| | | | Volcanic region | <i>M. foetida</i> , <i>M. laurina</i> |
| | | | Swamp region | - |
| South Sumatera | 1° - 4° LS | 102° - 106° BT | Folds inland region | <i>M. foetida</i> , <i>M. laurina</i> |
| | | | Volcanic region | <i>M. foetida</i> , <i>M. laurina</i> |
| | | | Outside the crease region | <i>M. indica</i> , <i>M. laurina</i> |
| | | | Lowland region | <i>M. indica</i> , <i>M. laurina</i> , <i>M. zeylanica</i> |
| Lampung | 50° 20' - 50° 30' LS | 105° 28' - 105° 37' BT | Swamp region | - |
| | | | Volcanic region | <i>M. foetida</i> , <i>M. laurina</i> |
| | | | Semangko break region | <i>M. odorata</i> |
| | | | Mountains region | <i>M. foetida</i> , <i>M. laurina</i> |

Altitude of a place was very determine the existence of a plant species. A vegetation affected by climate change on the different heights. Temperatures in line with the increased height (Ewusie 1990). Anwar *et al.* (1987) states that the rate of temperature drop is generally about 0.6°C on the each additional height of 100 m, but it varies depending on the place, season, time, content of water vapor in the air and so forth. This led to the distribution of any type of mango vary by adaptation of any type of mango with the environment.

M. indica have a wide adaptability so that by conditioning of cultivation, it can grow well in a variety of heights and land conditions up to 1000 meters above sea level altitude. While *M. laurina* was found from 0–1700 meters above sea level. One sub-species of *M. laurina* which grew in Toba lake became glory mango from this area. *M. odorata* has a unique distribution related with altitude. This type of mango was distributed from 0–800 meters above sea level altitude, if this type of mango grew on the 800 meters above sea level altitude, it could decrease the ability of fruiting. Adaptability on the humid areas causing the existence of this mango is very abundant in eastern part of Sumatera. A total of 318 spots from 685 spots were collected was *M. odorata* spots. This type of mango are often found on the west coast of Sumatera, especially in the area of Meulaboh and Nagan Raya. *M. foetida* distribution was varies greatly. This type of mango can be found in areas with altitude 0–1200 meters above sea level.

CONCLUSIONS

Exploration in Sumatera retrieved 10 species of mangoes grow and adapt to the environment have in Sumatera are namely *Mangifera foetida*, *M. kemanga*, *M. sumaterana*, *M. torquenda*, *M. quadrifida*, *Mangifera sp1* (wild species), *M. odorata*, *M. laurina* (semi-cultivated), *M. indica*, *M. zeylanica* (cultivated). The most adaptive mango to high rainfall is *Mangifera*

ordorata which are developed well at an altitude 0–800 mdpl in west coast of Sumatera. *M. indica* is distributed in residential area and plantation area. *M. laurina* was found from 0–1700 meters above sea level. *M. foetida* can be found in areas with altitude 0–1200 meters above sea level.

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REFERENCES

- Anwar JS, Damanik N, Hisyam, Whitten AJ. (1987). *Ekologi Ekosistem Sumatera*. Yogyakarta:UGM Press.
- Departemen Kehutanan. (2008). Statistik Kehutanan Indonesia 2008. www.dephut.go.id/indekx.php/news/details/6494.
- Ewusie JY. (1990). *Pengantar Ekologi Tropika*. ITB. Bandung
- Fitmawati. (2008). *Biosistematika Mangga Indonesia*. [Disertasi]. IPB. Bogor.
- Fitmawati, Anggi S, Nery S, Herman. (2013). Analisis kekerabatan morfologi Mangifera dari Sumatera Tengah. *Floribunda* 4(7) 2013.
- IPGRI. (2009). *Descriptors for Mango (Mangifera indica)*. International Plant Genetic Resources Institute, Roma. Italia.

