

Seeds Capacity of Kranji (*Pongamia pinnata* Merrill.) Tree as Renewable Energy

Dharmawati F. Djam'an^{a*} and Danu

^aForest Tree Seed Technology Research Centre, Jl Pakuan Ciheuleut PO BOX 105 Bogor, Indonesia

ABSTRACT: *Pongamia pinnata* Merrill. (kranji / Mabai / pongam) is a coastal plant that seeds to produce bio-diesel and wood energy, spread from Sumatra to the Moluccas islands there are Kulur Laut (Central Bangka); Sukarame, Carita (Banten), Batukaras, Ciamis (West Java), National Park Alas Purwo - Banyuwangi (East Java), Kalibukbuk (North Bali); Sambelia, East Lombok (West Nusa Tenggara) Berau, Kulkar and Paser (East Kalimantan) and West Seram (Maluku Islands).

The aim to get the character of tree, fruit distribution and potential kranji oil supply that can last all year. Because of the requirements to be a source of renewable energy is sustainable fruit production (raw material of bio-diesel). Naturally, this plant has a generative nature (flowering and fruiting) different between individuals than are affected by environmental conditions.

The results of the census data collection in a single plot observation in August 2009 in the National Park Alas Purwo, the character generative growth there between stands have a different that is 5 finished fruiting trees, 3 young fruit trees, 5 mature fruit trees (ready to harvest) and 3 trees are flowering. While the potential for actual production in the village of Batu Karas (Ciamis) in July 2010, has an average production capacity of as much as 1855 or 2297 pods per tree per tree seed grain, 1000 grain weight of 778.21 grams, the equivalent of 2.45 kg / tree the distance between the nearest tree was 2.49 ± 0.80 m. The plants bear fruit at the age of 3 years.

Planting can broadly be followed by silvicultural management based generative character of the plant so that fruit production can be sustained and followed by oil production management seed production adapted to be effective and efficient. To get the properties of its parent, this plant can be propagated by cutting the middle branch with a density of 25% gives the percent shade shoots grow by 68.4%.

Pongamia pinnata has a high potential to be developed as a plant producing bio-diesel material along the coast and on the results of the test crop can grow well in the area of the former mine (Kota Tua Tunu, Bangka) and on marginal land (Parung Panjang, Kabupaten Bogor). The plant roots can symbiosis with Rhizobium for clicking of N-fixation from the air.

Keyword (kata kunci) : *pongamia pinnata*, potential seed production, distribution

1. Introduction

Kranji *Pongamia pinnata* belong to the family leguminosae is one of a multipurpose species that every part of tree very well that has specific use, such as flower, fruits, seed, leaf, bark, roots can symbiosis with Rhizobium. It can grow on most soil types ranging from stony to sandy to clayey, including verticals. It does not do well in dry sands and It is highly tolerant of salinity.

The important of kranji tree for people is wood energy and containing oil that can produced bio-fuel.

First, in providing two sources of energy are wood as fuel for wood fuel has a calorific 4600kcal/kg, and seeds contain vegetable oil instead of kerosene and lubrication with oil content (kerosene) amounted to 27-39% of seed kernels, similar properties to that of diesel (Heller, 1996). It has gained the importance as bio-diesel and is fast emerging as a viable alternative to fossil fuel. The results of research in the Adilabad

* Corresponding author: Tel: +62 811112639
E-mail: upie_fd@yahoo.com

district rainfall 1100 mm with ground vertisols, *Pongamia pinnata* at age 5, 10, 15, 25 years each can absorb 17, 72, 331 and 347 kg of carbon per plant (Wani et al 2006).

Second for medicine such as dry weight of skin affected by *Leucoderma* and used as a liniment to treat scabies, herpes, and Rheumatism (Burkill, 1966). The leaves are used as animal feed lactagogue, especially in dry areas and also as a green manure. Dried leaves are used in stored grains to repel insects. Leaves are active against *Micrococcus*, their juice is used for cold, cough, diarrhea, dyspepsia, flatulence, gonorrhoea, and leprosy. Flowers are used for diabetes. The bark is known to be the remedy for beriberi. (Muthu et al., 2006).

As alternative to fossil fuel, the main constraint is the supply of biodiesel feedstock supply in addition to technology and policy support despite the ever-increasing demand for biodiesel. Yield potential of kranji fruit each tree has not been known because production is not fixed, which can be calculated during the production was in 1980 on the block without irrigation produce 1000-1200 kg/ha (Wani et al 2006).

The objectives of research is find out of the character of phenology stage of flowering and fruiting, potential for fruit production and distribution site in Indonesia.

Naturally, kranji tree has a generative nature (flowering and fruiting) different between individuals than are affected by environmental conditions. It should solve the problem of continuous produce of raw materials of biofuel. It can be a benefit to meet the needs of sustainable renewable energy sources.

2. Material and Methodology

2.1. Material

Observation of character of trees in Taman Nasional Alas Purwo, Banyuwangi East Java Province and it was conducted in August 2009. Geographically, the study site is located at position 08°39'25" LS and 114°21'40" BT with 43 m above sea level.

The experiment of seed production was conducted in the village of Batu Karas, District Cijulang, Ciarnis District, West Java Province. Geographically, the study site is located at position 07°43'55 "S and 108°30'00" BT. Topography is generally flat, with altitude of 16.8 m above sea level. The study was conducted in July 2010.

2.2. Methodology

2.2.1. Tree Characterization

By observation of performance of tree that is a appearance of leaf flushing, flower and fruit

2.2.2. Seed Production

Firstly, trunk diameter measurements as high as 0.5 m from ground level. Further classified / grouped by stem diameter divided into 5 groups: hose diameter stem 10-16 cm 17-23 cm 24-30 cm 31-37 cm and over 37 cm. Then selected as many as 30 trees for example, each group is determined diameter 2-9 purposively tree. The Data of estimate of seed production in Batukaras is using model equation $Y = -0,347 + 0,110 D$

2.2.3. Plant Distribution

By visit, check and observe the soil where the plants grow. Identify the distribution of natural or plant a fruit source of information or seed for biodiesel purposes and to determine the production of high quality seeds. Get information by internet and changes information among researchers.

3. Result and Discussion

3.1. Tree Characterization

In the present study at a single plot, contain 18 number of tree, the character generative period of *Pongamia pinnata* located at the National Park Alas Purwo, East Java in August 2009, were recorded there has a different of vegetative and generative stage (Table 1.).

Table 1.

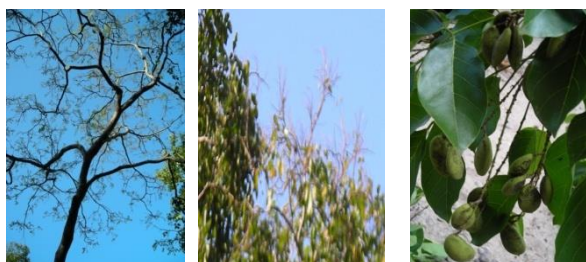
Characteristic Phenology of Kranji on August 2009 (5 of leaf flushing; 2 sprout; 3 flowering; 3 young fruit; 5 mature fruit) in Taman Nasional Alas Purwo.

Character Phenology Plant	Number of Tree				
	1	2	3	4	5
Leaf flushing	■	■	■	■	■
Sprout	■	■	■	■	■
Flowering	■	■	■	■	■
Young fruit	■	■	■	■	■
Mature fruit (green coat)	■	■	■	■	■
Mature fruit (brown coat)	■	■	■	■	■

Djam'an (2009)

The periodicity of genetaive (flowering and fruiting) stage can be difference each tree on the same

area, it was figured that genetic characters is dominant than site environment. At this month, some of tree at the flowering stage and others was leaf flushing and fruiting (Figure 1). Meanwhile, flowering stage to harvest the fruit takes eleven months and the remaining of month for the vegetative stage. The trees produce several inflorescences at a time and an individual tree blooms continuously for about one month period. It was few trees with a large number of conditions mature fruit suggests will produce abundant fruit in September.



a. Sprouting b. Leaf Flushing c. Mature fruit (green skin fruit)

Fig. 1 Actual Phenology Stage on August 2009 in TN Alas Purwo (a. Sprouting; b. Leaf flushing; c. Mature fruits)

Observations in TN Alas Purwo, showed that the character phenologi plant flowering and fruiting phase that kranji plants have a long period of fruit production. According Raju *et al* 2006, of 25 plants were observed in Visakhapatnam district (India), in March leaf flushing and plants start flowering in April-May and some flowering plants longer until june. The second flowering season show in October–November for individual plants (Figure 2.).



Fig. 2 Flowering Phenology of *Pongamia pinnata* Trees in Visakhapatnam , India (Raju *et al* 2006).

Flowering and fruiting phenology of kranji illustrate that individual genetic character is dominant. It has been demonstrated from several study of suren and khaya (Buana 2007, Rika 2008), that there is a correlation

between the character of the mother plant to seed germination.

3.2. Seed Production

Kranji seeds is the most important part because it can produce vegetable oil containing 27-39% oil-b-non-fat food reddish brown, thick and bitter. And complex amino acids, namely glabrin (C₂₁H₄₂O₁₂N₃), 4 furanoflavon: karanjin (C₁₈H₁₂O₄), pongapin (C₁₉H₁₂O₆), kanjon (C₁₈H₁₂O₄), and pongaglabron (C₁₈H₁₀O₅. ½ H₂O), and diketon pongamol (C₁₈H₁₄O₄). These compounds can be removed from the seeds and oil via extraction with alcohol (Soerawidjaja, 2007)

Fruit production at factual time, each branch of the tree has potential of flowering and fruiting in certain conditions. So that ripe fruit will be different on each branches and number of fruits on a particular phase can reach 28 kg of fruit (Djam'an, 2009).

Average production capacity is 1855 or 2297 pods per tree per tree seed grain, 1000 grain weight of 778.21 grams, the equivalent of 2.45 kg / tree the distance between the nearest tree was 2.49 ± 0.80 m and content 2.50% crude oil (Aminah *et al*, 2012). Whereas, fruit production is based on trunk diameter classes in Batukaras, has the potential to produce between 0.711 ± 0.582 ± 4.213 kg up to 3,587 kg. the condition of the tree stand has a diameter between 10 cm - 37 cm (Danu and Kurniawati, 2012).

3.3. Distribution of Potential Tree

Along 4 years of our research, kranji population in Indonesia is on the island of Bangka, Java, Bali, Lombok, Seram and East Kalimantan. On the island of Java found in Ciamis, Banyuwangi, and Banten. Kranji fruit-producing potential areas in Java show the map (Figure 2.). Based on the criteria in place to grow kranji Batukaras and Pangandaran Beach (Ciamis), Carita beach (Banten), and Alas Purwo (Banyuwangi), GIS analysis shows that the potential of this type of land on the island of Java, an area of 849,316.51 ha (Danu 2012). It assessment of potential land for planting kranji does not include regions such as settlements, roads, rivers, lakes, fields

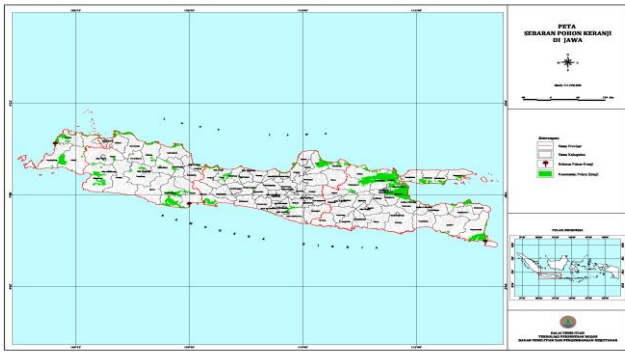


Fig. 3 Map of Distribution and Potential Kranji Crop Land in Java (Danu 2012)

Kranji can be grown with adequate soil conditions (Table 2.), Type of kranji site is argillaceous sand and dust, so the roots are very deep and includes

Tabel 2
Growing Site Conditions of Kranji in TN Alas Purwo (East Java) and Batukaras (West Java)

No.	Location	pH (H ₂ O)	Rasio C/N	Cation exeche	KB (%)	Texture class	Salinity (‰)
1.	Alas Purwo (west Java)	7,3	6.0	19.2	100	Dusty clay	1.0
2.	Batu Karas beach (Ciamis)	6,1	12.2	8.2	64.7	Argillaceous sand, dusty	1.0

Source : Djam'an 2009

3.4. Planting test plot

For Pongamia block-planting, a spacing of 5m x 5m or 6m x 6m, moreover mixed planting of Pongamia and food crop alignment of rows in the east-west direction

plants that can capture free nitrogen directly (Nitrogen Fixing Tree Species) (Daniel, 1997) in addition it includes the intolerance that is resistant to shade, as seen plants this growth is always together with other crops, although higher than other plants. The salinity (1.0) ‰ is a marker that the salt content is low for TN Alas Purwo and Batukaras.

Naturally, the character of land in Batu Karas with pH slightly acidic (6.1) and C/N ratio is quite high (12.2), while the lower value of C / N ratio showed more mature organic matter available (TN Alas Purwo 6.0). This data has show that plants are easily to adapt in following site conditions, so that kranji has potential to developed planted widely. It will cover the potential area in Java, and improved livelihoods and environmental protection

is suggested. Planting test plot carried out in Kota Tua Tunu Bangka island and experimental garden in Parungpanjang, west Java. Geographically, the plantation plot is located at position 06°20' LS and 106°30' BT with 51,75 m above sea level (Fig. 4).



6 month in poor soil
(Parungpanjang-West Java)



6 month in Mined
(Kota Tua Tunu-Bangka)

Fig. 4 Block Test Plantation in Parungpanjang (Poor Soil) West Java and Kota Tua Tunu (Mined Soil) Bangka Island.

Although in the former mining areas planted with mixed patterns, growth is better than a homogen. It is in accordance with Wani *et al* 2006 that a spacing of 6m x6m for Pongamia and 3m x3m for Jatropha is desirable. The recommended size of the pit is 30 cm x 30 cm x 30 cm for Jatropha and 45cm x 45cm x 45cm for Pongamia.

4. Conclusion

The cropping pattern and appropriate silvicultural systems (plant selection based on character) for planting of kranji tree, then the vegetable oil from the kenels seed can be premises produced a long time could instead be produced throughout the year.

With an average production of 2.45 kg per tree at 35 cm diameter plant, tree kranji potential to support renewable energy programes and can be facilitate the provision of fuel for fishing boats.

Acknowledgements

Especially for College directorate. Ministry of Education and Ministry of Research and Technology that already provide incentive funding the research (KNRT/PKKP) completly. Our reseach team: Aam, Nurmawaty, Ratna, Danu and head office of Balai Penelitian Teknologi Perbenihan (Tree Forest Seed Technology Reasearch Centre) Bogor

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