

STUDY ON FLOWERING DEVELOPMENT BIOLOGY OF *Sapindus rarak* DC.

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ABSTRACT

Sapindus rarak is saponin producing plants belongs to the family Sapindaceae. *Sapindus rarak* has not been cultivated and grows wild in the woods. Utilization of lerak fruit skin includes traditional detergent, biopesticides, and for health purposes. Lerak plants have a potential to be developed. However, the seed production of lerak is very low. An effort to increase the seed production of plants required a basic knowledge on reproductive biology. Descriptive exploratory study was conducted to observe the morphology of flower development of lerak. Observations were conducted on the number of individual flower bloom, the sex of flowers, and the flower arrangement. The length and width of the flower buds on one individual trees with 3 inflorescence were measured. After the bud reach the length of 0.2 mm, observation was carried out every day for 1 week, then once every 2 days until the flowers bloom (35 days). The results showed that lerak inflorescence is a panicle, terminal, erect, conical, and 19-40 cm long. The panicle development can be grouped into four stages: 1) the induction phase of the inflorescence takes 9-10 days; 2) the initiation stage of flowers on the inflorescence was achieved within 15 days; 3) stage of flower differentiation was reached within 30 days; and 4) anthesis stage takes 35 days. The mean percentage of blooming flowers on the inflorescence covers 55.94% of male flowers, female flowers are 26.42%, 9.20% hermaphrodite flowers, and 8.44% of flowers buds did not bloom. The growth rate showed sigmoid pattern.

Key words: *Sapindus rarak*, inflorescences, floral biology

Introduction

Sapindus rarak DC. has the local name lerak (Indonesia) also known as rerek (Sunda), klerek, werak (Java) or lamuran (Palembang) (Kasahara & Hemmi, 1986). Lerak belongs to the family Sapindaceae, similar family with rambutan (*Nephelium lappaceum* L.), kelengkeng [*Euphoria longan* (Lour.) Steud], lychee (*Litchi sinensis* Sonn.), and kiara payung [*Filicium decipiens* (W. & A.) Thw .]. Another species within similar genus with *Sapindus rarak* is *S. mukorosi*, *S. emarginatus*, and *S. saponaria*. Lerak habitus is trees shaped with an average height of 10 m, although it can reach 42 meters with the diameter of 1 m. It has hard fruit, circular shaped, 2-2.5 cm midline, on the ventral side is flat, and has a hard seed coat (Backer and Bakhuizen van den Brink, 1965). The colour of ripe outer pericarp is dark or blackish brown, with the smooth or shiny fruit surface. The pericarp is a little bit slimy and has fragrant aroma (Udarno, 2009). In Indonesia lerak has never been cultivated, it grows as home gardener trees rather than as the main plant with the population of about 1-2 trees..

Lerak fruit pericarp contains saponins which produce foam, while the seeds contain oil. The saponins is mostly found in the pericarp (Sunaryadi, 1999 & Stoffels, 2008). Based on the existence of saponins, lerak pericarp is used as a natural washers, biopesticides, and in health.

Lerak pericarp as traditional detergents have been utilized by the people of Indonesia, especially for washing clothes and lightening the color of batik fabric that is durable and does not fade (Herman, 2007; Stoffels, 2008). Vegetable soap made from lerak fruit (pericarp) which is one example of environmentally friendly soap, providing more benefits in terms of environmental protection, compared to artificial chemical soap. Botanists classify lerak as biopesticides, as the saponin content of the fruit skin can be used for killing insects such as mosquitoes and cockroaches, as well as earthworms exterminator (Nunik, 1998). Saponins from *Sapindus rarak* also have moluscicidal activity (Hamburger et al., 2007).

Saponin in the pericarp of lerak can be used to treat acne, eliminating head lice and rheumatism drugs (Kasahara & Hemmi, 1986). Saponins in the lerak pericarp can also be used as a male and female contraceptive, because they have anti-implantation, estrogenic and anti spermatogenesis effects (Winarno & Sundari, 1997). Arulmozhi et al. (2005) states that the pericarp of lerak has also been used in traditional medicine to cure emetic or vomiting, chlorosis, epilepsy, antimigraine, and a contraceptive.

The saponin content of lerak can increase the potential benefits of local flora Indonesia. The plants lerak increasingly overlooked, this must be the cultivation of lerak. Since Lerak plants have a potential prospect to be developed, it is important to ensure the availability of lerak seed. In an effort to increase the production of plants required a basic knowledge of reproductive biology. Flowers play an important role in crop production. This research aims to study the morphology of flower development of lerak. The results of this study can add information about the reproductive biology of plants of lerak in efforts to increase fruit production.

Materials and Methods

Descriptive exploratory study of flower development of lerak was conducted in September 2015 to November 2015. The pattern of inflorescence was determined by observing 5 inflorescences of 6 individuals (Muhibbudin, 1992) with inflorescence length of 25 cm. Observation was conducted on the lerak tree that grows in Materia Medica Batu and Malang. Observation was carried out against the number of flower buds bloom, the sex of flowers, and flower arrangement. Observations of the development of flower morphology was done by measuring the length and width of the flower buds of 3 inflorescence on one individual trees. Having obtained the bud with a length of 0.2 mm observation was carried out every day for 1 week, then once every 2 days until the flowers bloom (35 days).

Results and Discussion

The inflorescence arrangement of lerak is panicle located in the terminal part of the plant (Figure 1). The inflorescence has a main stalk which has many branches, and each branch produces some branches again in the same way as the main stalk. The length of branches from the bottom to the top is getting shorter to form a cone-shaped inflorescence. The flowers that appear on the branches of the inflorescence is cymosa. The length of the inflorescence ranging in size from 19 cm to 40 cm. The most prevalent size (78% of the inflorescence) is 30-35 cm. Panicle inflorescence types is also found in other Sapindaceae family like in *Euphoria longan* (Lour.) Steud, *Paranephelium macrophyllum* King, *Litchi sinensis* Sonn., and *Sapindus saponaria* (Muhibbudin, 1992; Keng, 1969; Saucó & Menini, 1989; Hodel, 2012).

Figure 1. Patterns of inflorescence panicle on Lerak



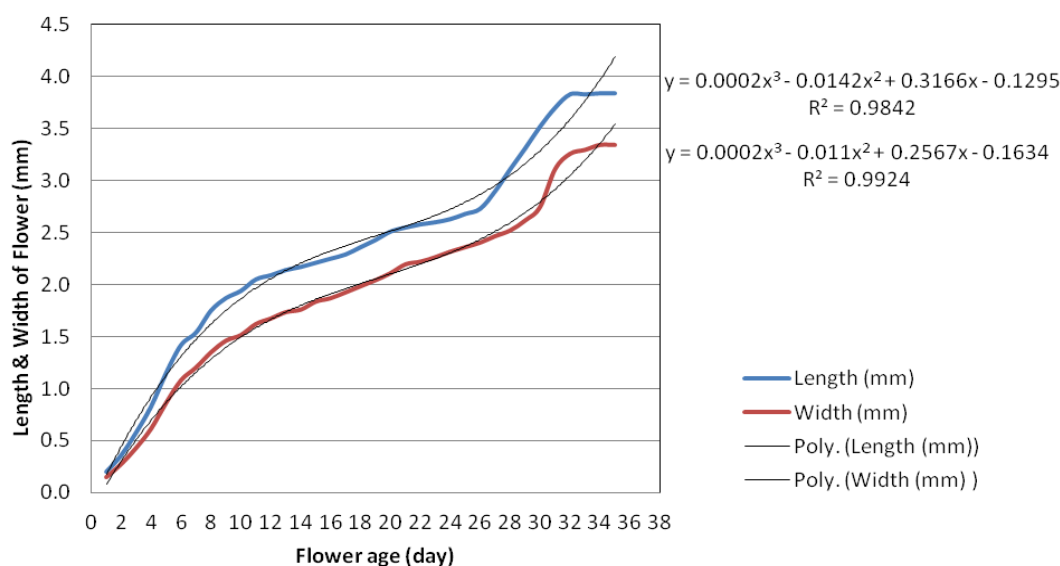
Flower developments occurred during the 35 days of induction of flowering until the floral anthesis. Lerak panicle development can be grouped into four stages: 1) the induction phase of the inflorescence takes 9-10 days; 2) the initiation stage of flowers on the inflorescence is required 15 days; 3) stage of differentiation of flower required 30 days; and 4) anthesis stage takes 35 days. The period of lerak flower development is different from *Euphoria longan* flower development which takes 13-14 days (Muhibbudin, 1992) and is almost equal with the development *Syzgium pycnanthum* for 26-31 days (Muhdiana & Ariyanti, 2010).

At each panicle there are buds in various stages of development. The number of growing flower buds ranged from 467 to 783 pieces with a mean of 605.5 ± 79.7. The flower buds developing in panicle consists of male flowers, flowers hermaphrodite and female flowers. The size of hermaphrodite flowers and female flowers were similar, and they can be found at the end of the twigs. The number of male flowers that develop in each panicle more than the hermaphrodite and female flowers. The male flowers,

female flowers and hermaphrodite flowers that reach blooming stage was 55.94%, 26.42% and 9.20% respectively. Flower buds that were not reach blooming stage and subsequently wither and fall was 8.44%. The three kinds of lerak flowers were found on one tree. Saucó & Menini (1989) reported that *Litchi sinensis* has three types of flowers on each inflorescence in the tree (polygammonoecious). These three types of flower were distinct in the level of sexual development, namely male flowers, hermaphrodite flower type that serves as a female flower and hermaphrodite flower type that serves as male flowers. *Nephelium lappaceum* has two types of flowers which are male and hermaphrodite flowers on separate trees (Lan, 1984). Sex variation is also shown in *Euphoria longan* which has three types of flowers, male flowers, female flowers and hermaphrodite flowers which are found on the same or different tree (Sunanto, 1990).

At the same stage of development, the female and hermaphrodite flowers have the same shape and size. The growing period of lerak flower since 2 mm length to flowers bloom lasts for 35 days. The average length and width of the three types of flowers at blooming stage was 3.84 mm and 3.34 mm, respectively (Figure 2).

Figure 2. The growth of flowers lerak



It appears that the growth of lerak flower follow the pattern of the sigmoid curve. Sigmoid pattern of growth was also reported on the increase of the length and width of flowers *Euphoria longan* (Muhibbudin, 1992) and *Litchi sinensis* (Saucó & Menini, 1989).

Conclusion

1. Lerak inflorescence is panicle with cymosa flowers branches, terminal, erect, like a cone.
2. Development of lerak panicle can be grouped into four stages: 1) the induction phase of the inflorescence takes 9-10 days; 2) the initiation stage of flowers on the inflorescence required 15 days; 3) stage of differentiation of interest required 30 days; and 4) anthesis stage takes 35 days.
3. The male flowers, female flowers and hermaphrodite flowers that reach blooming stage was 55.94%, 26.42% and 9.20% respectively. Flower buds that were not reach blooming stage and subsequently wither and fall was 8.44%. The growth curve showed sigmoid pattern.

References

- Arulmozhi, D.K.; Veeranjanyulu, A.; Bodhankar, S.L.; Arora, S.K. (2005). Effect of *Sapindus trifoliatus* on hyperalgesic in vivo migraine models. *Brazilian Journal of Medical and Biological Research*. 38 (3): pp. 469–475.
- Backer, C.A. & Bakhuizen van den Brink, R.C. (1965). *Flora of Java, Vol. 2*. The Netherlands- Groningen N.V. P. Noordhoff.
- Hamburger, M.; Scalanin, I.; Hostettmann, K.; Dyatmiko, W. & Sutarjadi. (2007). *Acetylated saponins with molluscicidal activity from Sapindus rarak: Unambiguous structure determination by proton nuclear magnetic resonance and quantitative analysis*. <http://onlinelibrary.wiley.com/doi/10.1002/pca.2800030507/abstract>. Accessed 2 April 2012.
- Hermawan, E. (2007). Rerak and saponin able to repel the golden snail. *Agrotek Magazine*. 28 June.
- Hodel, D.R. (2012). Trees in the landscape, Part 6: *Sapindus saponaria*. Winter: Western Arborist.
- Kasahara, S. & Hemmi, S. (ed.) (1986). *Medicinal Herb Index in Indonesia*. Jakarta: PT. Eisai Indonesia.
- Keng, H. (1969). *Order and Families of Malayan Seed Plants*. Singapore-Kuala Lumpur: University of Malaya Press.

- Lan, L.A. (1984). The Reproductive Biology of Rambutan (*Nephelium lappaceum*). *The Gardens Bulletin Singapore* 37 (2): 181-192.
- Muhdiana, D. & Ariyanti, E. (2010). Flower and Fruit Development of *Syzygium pycnanthum* Merr. *Biodiversitas Journal*: 124-128.
- Muhibbuddin (1992). *Development Morphology of Flower & Fruit Euphoria longan (Lour.) Steud.*. Graduate Thesis. Not published. Bandung: ITB.
- Nunik, S.A. (1988). The use of fruit lerak *Sapindus rarak* de Candolle as an insecticide. Jakarta: *Center for Research and Development of Health Ecology*.
- Sauco, V.G. & Menini, U.G. (1989). *Litchi Cultivation*. Roma: Food & Agriculture Organization of The United Nations.
- Stoffels, K. (2008). *Soap Nut Saponins Create Powerful Natural Surfactant*. Personal Care Magazine (Jeen International Corporation).
- Sunanto, H. (1990). *Cultivation Litchi and Economics Aspect*. Yogyakarta: Kanisius.
- Sunaryadi (1999). *Extraction and Isolation of Saponins Fruit Lerak (Sapindus rarak) as well as Testing Defaunation Resources*. Graduate Thesis. Not published. Bogor: IPB.
- Udarno, L. (2009). Lerak (*Sapindus rarak*) an Industrial Plant a Substitute for Soap. *News Research and Development an Industrial Plant (Warta Penelitian dan Pengembangan Tanaman Industri)*. Volume 12 (2): 7-8.
- Winarno, M. W. & Sundari, D. (1997). Information of Medicinal Plants to Traditional Contraception. *The Mirror Medicine (Cermin Dunia Kedokteran)*. No. 120. Research and Development Center of Pharmaceutical, Agency for Health Research and Development. Jakarta: The Ministry of Health of the Republic of Indonesia.