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Basic Anatomical Study of Pollen, Stigma, and Sheath in Bougainvillea Flowers

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Abstract

It is important to study the basic anatomy of pollen, pistils and midribs of bougainvillea flowers to improve the quality of plant reproduction, breeding and improving varieties, as well as optimizing the use of bougainvillea as ornamental plants. Bougainvillea plants have various varieties, there are three varieties sampled in this research, namely pink paper flowers (*Bougainvillea bambino baby lauren*), orange paper flowers (*Bougainvillea afterglow*), and purple paper flowers (*Bougainvillea barbara karst*). This research aims to determine the anatomical structure of pollen, stigma and midrib of bougainvillea plants. This research method uses descriptive methods. The sampling technique used was purposive sampling and sample measurement under a light microscope with 10x magnification. The results of the research show that three varieties of paper flowers, namely *Bougainvillea bambino baby lauren*, *Bougainvillea afterglow*, and *Bougainvillea barbara karst*, all three have pollen that allows the trichoporate type, with finger-shaped, rather slender, and elongated stigmas. then the long petals are orange, pointed or slightly curved, and layered around the original flower. Furthermore, the stigma of each flower has a color that matches the color of the sheath. This research provides a reference for bougainvillea flower variability, reproductive ecology, and genetics in context and conservation.

Keywords: Bougainvillea flowers, Pollen, Sheath, Stigma

A. Introduction

Bougainvillea or paper flower is a plant originating from Latin America. This plant was discovered by Antonie De Bougenville in 1769-1776 in Brazil (Hannia et al., 2021). This ornamental plant is popular throughout the world which then spread to Southeast Asia and is

widely found in tropical forests such as Malaysia, China, and Indonesia. The distribution of this plant in Indonesia covers almost the entire archipelago, such as Sumatra, Kalimantan, Java, Madura, Bali, Nusa Tenggara, Sulawesi, Maluku, Ambon, and Irian Jaya (Purnobasuki et al., 2014). The importance of studying the basic anatomy of the pollen, pistil, and sheath of *Bougainvillea* flowers includes (a) to increase understanding of the plant reproduction process, (b) breeding and improving varieties, (c) increasing pollination success, (d) improving propagation and cultivation techniques, (e) genetic conservation and diversity, and (f) optimizing the use of *Bougainvillea* as ornamental plants that are more beautiful and long-lasting. In general, soft *Bougainvillea* is found in yards and parks. *Bougainvillea* is known for its bright and attractive flowers, although the actual flowers are small white or yellow flowers, while the bright colors often seen on this plant are bracts or protective leaves. Paper flower plants can usually grow up to 5-10 meters. The texture of the stem is hard and has many branches and is also covered with sharp thorns on the stem and branches. The shape of the flower is small and resembles a trumpet, consisting of petals and covered with a flower sheath (Umaternate et al., 2022). Most of the existing *Bougainvillea* varieties are diploid (2n = 34) and are generally sterile and reproduce through vegetative propagation. The leaves of the *Bougainvillea* plant grow densely, single, shaped like a heart with a round base. Leaves can be dark green, green, and white, and green mixed with yellow (Zhang et al., 2024).

Based on this basis, research that supports *Bougainvillea* flowers is related to identifying the diversity of *Bougainvillea glabra* and *Bougainvillea spectabilis* in Medan Johor (Afrina et al., 2023). Furthermore (Dayatmi et al., 2021) stated that the types of *Bougainvillea* flowers and their characteristics include; (a) *Bougainvillea california gold* flowers have petals ranging from gold to orange with the characteristic of shedding their flowers quickly after blooming, (b) *Bougainvillea bambino baby lauren* have a soft color and are usually more purplish. In general, the character of *Bougainvillea bambino baby lauren* blooms in late spring, early summer, and late autumn, (c) *Bougainvillea afterglow* flowers which have a different uniqueness when they bloom more than once throughout the year. The flower petals are orange, pink, or coral with a smooth texture. (d) *Bougainvillea barbara karst* flowers have a smooth texture and can bloom all year round. The color characteristics range from magenta, and red to scarlet. (e) *Bougainvillea cherry blossom* flowers have pink or pink flowers. The character of the leaves is sturdy and has thorny branches which make it look perfect. The results of this research are the basis for efforts to conserve and sustainably manage plants.

B. Literature Review

The paper flower plant (*Bougainvillea*) is one of the most commonly found ornamental plants in residential yards, schools, and office environments. This plant is favored for its wide range of types and variations, particularly in its bracts. Its distinctive morphological characteristics include colorful bracts, a hard stem, and numerous branches, making it popular for shaping into bonsai (Umaternate et al., 2022). In addition to its vibrant color variations, this plant offers other advantages, including ease of cultivation and the ability to bloom even in dry and barren conditions (Nasrianti et al., 2023).

This plant belongs to the Nyctaginaceae family and contains various compounds, including flavonoids, glycosides, phenols, alkaloids, saponins, steroids, tannins, and terpenoids. Besides its beauty, bougainvillea also offers health benefits (Olivina & Koamang, 2015). The anti-inflammatory compounds in *Bougainvillea* flowers can help alleviate digestive issues such as diarrhea, acid reflux, and stomach pain. Drinking hot *Bougainvillea* tea can relieve stomach aches and reduce high stomach acid levels (Rastogi et al., 2019).

Bougainvillea is included in the hermaphrodite flower type, namely flowers that have male and female reproductive parts in one flower (perfect flower), The difference between complete and incomplete flowers is if one of them does not have a pistil or stamens. In this plant, the parts involved in sexual reproduction are pollen, stigma, and sheath. These three parts play an important role in the process of fertilization and seed formation, which will continue the generation of plants (Zahrina et al., 2017). Pollen is a part of the stamen that functions as a male gamete in the pollination process. Inside the pollen are male sex cells that are needed for fertilization. In *Bougainvillea*, pollen is produced in the anthers located at the end of the stamen stalk. The stigma is the uppermost part of the pistil that functions to catch pollen during the pollination process. The stigma on paper flowers is usually located in the center of the flower and has a structure that allows for maximum contact with pollen. The style is the part of the pistil that

connects the stigma to the ovary. Its function is to support the stigma and provide a path for pollen to the ovary during fertilization (Palupi et al., 2018).

C. Methodology

1. Research Design

This research was conducted on June 21, 2024, at the Indraprasta PGRI University Laboratory, Jakarta. *Bougainvillea* sampling was carried out using the purposive sampling method, which is a random sampling methodology where the sample group is targeted to have certain attributes. Observations of pollen, stigmas, and bougainvillea sheaths were carried out using a light microscope with a magnification of 10× and using section preparations, which is a method of making microtechnical preparations to observe plant tissue and cells under a microscope by thinly slicing the part to be observed.

2. Instruments

In this study, the tools and materials used consisted of a light microscope, cutter, petri dish, object glass, cover glass, dropper pipette, pink paper flowers (*Bougainvillea bambino baby lauren),* orange paper flowers (*Bougainvillea afterglow*), purple paper flowers (*Bougainvillea barbara karst*), and distilled water. The observation procedure for pollen, stigma and bougainvillea sheath is carried out in several stages, namely: (1) preparing all the necessary tools and materials; (2) cutting as thinly as possible on the pollen, stigma, and *Bougainvillea* sheath vertically; (3) placing the sample slices to be observed on the object glass; (4) adding a little aquadest on the object glass that already contains the sample using a dropper; (5) covering the object glass with a cover glass; (6) observing alternately under a light microscope until the anatomical structure of pollen, stigma and *Bougainvillea* sheath is visible. The sampling technique uses a prepared section by thinly slicing the part of the sample to be observed to make it easier to observe the structure and cells in the sample.

3. Technique of Data Analysis

At the time of the research, the data analysis technique used was a qualitative descriptive analysis model, where the model was included in the type of qualitative research which then explained the results of the research descriptively. Qualitative research methods emphasize the aspect of in-depth understanding of a problem or problem rather than seeing problems to be generalized. Descriptive research is a form of research aimed at describing existing phenomena, both natural and man-made phenomena. The phenomenon can be in the form, of activity, characteristics, changes, relationships, similarities, and differences between one phenomenon and another (Rusandi & Rusli, 2022). In this case, it explains the basic anatomical study of pollen, stigma, and sheath in *Bougainvillea* flowers that have been observed descriptively.

D. Results and Discussion

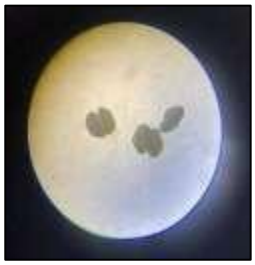
1. Results

The results of observations of three different varieties of paper flowers, namely: pink paper flowers (*Bougainvillea bambino baby lauren*), orange paper flowers (*Bougainvillea afterglow*), and purple paper flowers (*Bougainvillea barbara karst*) focused on the anatomy of pollen, stigma, and flower sheath. The results of the observations can be seen in Table 1.

a)*Bougainvillea bambino baby lauren* (b) *Bougainvillea after glow* (c) *Bougainvillea barbara karst*

Figure 1. Bougainvillea flowers

Table 1: Anatomy of pollen, pistil, and sheath of bougainvillea

No.	Varieties *Bougainvillea*	Picture Pollen	Picture Head of Pistil	Picture Sheath
1.	Pink paper flower (*Bougainvillea bambino baby lauren*)			
		Trichoporate type aperture pollen.	The stigma is finger-shaped, rather slender, and elongated.	The long sheath is pink, pointed or slightly curved, and layered around the true flower
2.	Orange paper flowers (*Bougainvillea afterglow*)			
		Trichoporate type aperture pollen.	The stigma is finger-shaped, rather slender, and elongated.	The long sheath is orange, pointed or slightly curved, and layered around the true flower
3.	Purple paper flower (Bougainvillea barbara karst)			
		Trichoporate type aperture pollen.	The stigma is finger-shaped, rather slender, and elongated.	The long sheath is purple, pointed or slightly curved, and layered around the true flower

Source: Personal documentation

2. Discussion

The pink paper flower (*Bougainvillea bambino baby lauren*) has trichoporate-type aperture pollen, with the stigma being finger-shaped, rather slender, and elongated. Then the long sheath is pink, pointed or slightly curved, and layered around the true flower. It is known that the stigma of *Bougainvillea bambino baby lauren* has a pink stigma following the color of the flower sheath. (Yuliani et al., 2024; Zahrina et al., 2017). At the time of observation, the stigma of this variety was still in a closed condition, which was possibly caused by several factors such as internal factors including early stages of development, genetics, and hormones in the plant. Apart from that, there are also external factors including: environmental temperature, light intensity, environmental humidity, nutrient availability, water intake, air pollution, pest or disease attacks, and mechanical damage. The sheath of this variety has the same function as all other *Bougainvillea* varieties, namely as a modified leaf which functions as the main protection and decoration of the flower. The sheath of *Bougainvillea bambino baby lauren* is pink due to the presence of anthocyanin pigment which produces a pink color in the flower sheath of this variety. The anthocyanin pigment produces a pink color because the pH content of the cells in this plant has a fairly acid level in the range of 5.0-6.0 (Parrish et al., 2024; Wartini et al., 2024;

Rusita, & Hastuti, (2022).

The orange paper flower (*Bougainvillea afterglow*) has trichoporate-type aperture pollen, with the stigma is finger-shaped, rather slender, and elongated. Then The long sheath is orange, pointed or slightly curved, and layered around the true flower. It is known that the stigma of *Bougainvillea afterglow* has an orange stigma following the color of the flower sheath. At the time of observation, the stigma of this variety was still in a closed condition, which was probably caused by several factors such as internal factors including early stages of development, genetics, and hormones in the plant (Datta, 2023). Apart from that, there are also external factors including environmental temperature, light intensity, environmental humidity, nutrient availability, water intake, air pollution, pest or disease attacks, and mechanical damage. The sheath of this variety has the same function as all other *Bougainvillea* varieties, namely as a modified leaf which functions as the main protection and decoration of the flower. Bougainvillea after glow sheaths have orange sheaths which are caused by a mixture of two pigments in this plant, namely: carotenoid pigments or pigments that produce yellow, orange, and gold and anthocyanin pigments that produce orange (Datta, 2023).

The purple paper flower (*Bougainvillea barbara karst*) has trichoporate-type aperture pollen, with the stigma is finger-shaped, rather slender, and elongated. Then the long sheath is purple, pointed or slightly curved, and layered around the true flower. It is known that the stigma of *Bougainvillea barbara karst* has a purple stigma following the color of the flower sheath (Zhang, et al., 2024; Wu et al., 2022; Zahrina et al., 2017). At the time of observation, the stigma of this variety was already in an open condition because various factors could influence it, namely internal factors including early stages of development, genetics, and hormones in the plant, then there were also external factors including environmental temperature, light intensity, environmental humidity, nutrient availability, water intake, air pollution, and environmental stress, as well as interactions with pollinators (Javidan et al., 2024). The sheath of this variety has the same function as all other bougainvillea varieties, namely as a modified leaf which functions as the main protection and decoration of the flower. The flower sheaths of this variety have purple sheaths which are caused by the presence of anthocyanin pigments with a derivative pigment, namely cyanidin, which produces a fairly deep purple color on the flower sheaths of this variety (Parrish et al., 2024).

E. Conclusion

Conclusion of research results conducted on three varieties of paper flowers, namely *Bougainvillea bambino baby lauren*, *Bougainvillea afterglow*, and *Bougainvillea barbara karst*, all three have trichoporate type aperture pollen, with the stigma being finger-shaped, rather slender and elongated. Then The long sheath is orange, pointed or slightly curved, and layered around the true flower. It is known that the stigma of each flower has a color that matches the color of its sheath.

Suggestions for further research are to conduct further research on the anatomical variability of pollen, stigma, and sheath in various other varieties of paper flowers. Because, by comparing anatomical structures between varieties, we can better understand the adaptations that occur and how this affects fertility and reproductive success. In addition, further research can investigate the interaction between paper flowers and natural pollinators, because understanding how anatomical structures affect pollinator behavior can provide valuable insights in the context of ecology and conservation.

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