

Diversity of Morphological Characteristics of Kaliandra Flowers (*Calliandra* spp.) in the Highland Forest of Mount Ciremai National Park, Indonesia

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Abstract: Knowledge of the morphological characteristics of kaliandra flowers (*Calliandra* spp.) that live naturally in highland forests in conservation areas can provide an understanding related to their adaptation to the growing environment and support efforts to preserve endemic plants. This study aims to see the diversity of morphological characteristics of red kaliandra (*Calliandra calothyrsus*) and white kaliandra (*Calliandra portoricensis*) flowers in Mount Ciremai National Park. Plant selection was carried out using the purposive sampling method with the following criteria: 1). the position of the plant can be reached, 2). It has good flower morphological conditions, is not deformed, and is dry. Observations were made at 14.00 local time to get good flower conditions, and documented. Then the morphological data was analyzed using the descriptive and visualized qualitative method. The results of the study showed that almost all morphological variables had similarities, but there were different variables in these two types, namely the color of the stamens, the color of the petals and the flower crown.

Keywords: Adaptation, Morphology, Flower, Red Kaliandra, White Kaliandra

1. INTRODUCTION

Kaliandra (*Calliandra* spp.) is a type of plant that belongs to the genus of flowering plants that attracts attention with its unique and brightly colored flower shape. Like pompoms, kaliandra flowers have long, fine pollen that spreads like tiny needles ([Hernández & Gómez-Hinostrosa, 2024](#)). In West Java, many types of these plants are distributed in conservation areas that are influenced by ecological factors and human activities ([Sayfullah et al., 2020](#); [Aminudin & Ismail, 2024](#)). Although environmental factors can significantly affect the development and shape of flowers, the morphology and development characteristics of kaliandra flowers, especially red kaliandra (*Calliandra calothyrsus*) and white kaliandra (*Calliandra portoricensis*), have not been widely studied, especially in Highlandforest environments ([Ismail et al., 2022](#)).

In addition to its unique flower appearance, kaliandra also has an important ecological role as a feed source for pollinating insects and can be used as a fodder crop in agroforestry ([Sinaga, 2022](#); [Sianturi et al., 2024](#)). Then this type is one of the promising sources of biomass energy due to its rapid growth and development ([Pratiwi et al., 2024](#)). This type is also used as an erosion control plant and slope stability due to its strong root system and lightweight canopy ([Zayadi et al., 2023](#)).

Mount Ciremai National Park in West Java, Indonesia, has an incredible biodiversity, including kaliandra species. The Highland ecosystems in this area have large variations in environmental factors such as elevation, humidity, and temperature ([Supartono et al., 2023](#)). Knowledge of the morphology of kaliandra flowers in the forest area of the Highlands of

Mount Ciremai National Park can provide an in-depth understanding of the adaptation of this invasive plant to specific environmental conditions and support efforts to preserve endemic plants in the region from the dominating kaliandra threat. In addition, the existence of kaliandra in this area has the potential to contribute to the agroforestry system and environmental conservation ([Aditya et al., 2023](#)).

Although widely known to have many benefits, research on the shape of kaliandra flowers in their natural habitat is still limited. Previous research has largely concentrated on the use of kaliandra as a shade plant or animal feed, without learning more about the specific characteristics of the flower's morphology and environmental effects on its development. This limitation of information shows that specific research is needed on the variation of the shape of kaliandra flowers, especially those that grow naturally in the Highland environment ([Kosasih et al., 2022](#)).

It is essential to understand the ecological impact and how to control it by knowing the diversity of flower morphology of invasive plant species. Invasive species such as *Plantago major* and various foreign plants in the Lesser Himalayas exhibit large morphological variations influenced by ecological factors, which can affect their distribution and competitive ability ([Keivani et al., 2021](#); [Anjum et al., 2022](#)). In addition, flower morphology is one of the parameters that plays an important role in the process of identifying and classifying a species and makes it easier to assess its level of invasive and potential threats to native species ([Lechowicz et al., 2021](#)). That way, the invasive species traits of flower morphology in which there are mechanisms that can change ecosystem conditions that can ultimately reduce the population of native species can be informed and used for conservation efforts that are important in developing effective ecosystem management practices to be able to reduce the negative effects produced ([Kumar & Nagayya, 2022](#)).

The research on the diversity of floral morphological characteristics of kaliandra flowers (*Calliandra* spp.) aims to look at the diversity of floral morphological characteristics in species of kaliandra that live in Mount Ciremai National Park and is expected to make a significant

contribution in the fields of ecology, conservation, and agroforestry. From an ecological perspective, information about kaliandra morphology can help us understand how plants adapt to the environment in the Highlands. This can also help interested parties as a basis in recommending strategies for the management of the Mount Ciremai National Park conservation area. In addition, understanding the diversity of kaliandra morphology can help conservation-based agroforestry programs.

2. RESEARCH METHOD

This research was conducted in the Karangsari Block, Mount Ciremai National Park. The materials used include red kaliandra flowers (*Calliandra calothyrsus*) and white kaliandra (*Calliandra portoricensis*) obtained from the Karangsari research station which is administratively located in Karangsari Village, Darma District, Kuningan Regency, West Java, Indonesia. Then the tools used include cameras, tissues, cotton, and magnifying glass.

The selection of kaliandra flowers (*Calliandra* spp.) was carried out by the Purposive sampling method on plant conditions that can be reached and have a good, non- deformed, and dry flower morphology to avoid fungi that attack the flowers. Flower observation was carried out at 2 p.m. to get good flower conditions and measurements were made of the length of the inflorescences from the base of the stem to the tip of the stem, namely from the appearance of flower bunches to the last flower bunch, and then flower documentation was carried out. The observation results were then analyzed using descriptive and visualized qualitative methods.

3. RESULTS AND DISCUSSION

Observations carried out in the Karangsari Research Station Area of Mount Ciremai National Park found 2 types of kaliandra (*Calliandra* spp.), namely Red Kaliandra (*Calliandra calothyrsus*) and White Kaliandra (*Calliandra portoricensis*) (Figure 1 and Figure 2). The two types are identified with flower morphological characteristics based on variables, such as: Inflorescence Type, Inflorescence Pattern, Flower Shape (*Floret*), Flower Stem (*pedicle*), Stamens, Petals, Flower Crown, and Protective Leaves (*bractea*). The morphological characteristics of

kaliandra flowers (*Calliandra* spp.) are presented in Table 1.

Table 1. Morphological Characteristic Variables of Kaliandra Flower (*Calliandra* spp.)

Variable	Type	
	<i>Calliandra calothyrsus</i>	<i>Calliandra portoricensis</i>
Inflorescence Type	Small flower group (<i>Capitulum-like</i>)	Small flower group (<i>Capitulum-like</i>)
Inflorescence Pattern	Racemose (<i>Unlimited</i>) with flowers blooming from the base to the end of the stalk	Racemose (<i>Unlimited</i>) with flowers blooming from base to stem number less
Flower Shape (<i>Floret</i>)	Tightly arranged in capitula with an abundant number of flowers and homogeneous	Tightly arranged in capitula with fewer flowers and homogeneous
Flower Stem (<i>pedicle</i>)	Long and slender braids and green in color	It is long and slender (slightly smaller) and green in color
Stamens	Long in size with a striking red color	Long in size with white to bright yellow color
Petals	Brownish green to dark brown	Yellowish green to pale yellow
Flower Crown	Slightly pale pink and covered in stamens	Yellowish white slightly pale and covered with stamens
Protective Leaves (<i>braktea</i>)	Small in size, brownish-green in color and serves as a protector of <i>young florets</i>	Small in size, yellowish-green in color, and serves as a protector of <i>young florets</i>

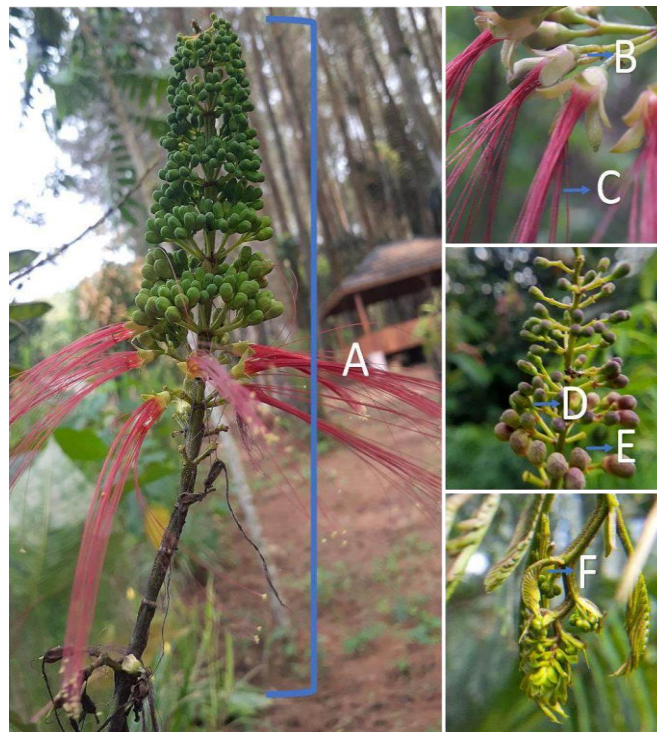


Figure 1. Morphological Characteristics of Red Kaliandra (*Calliandra calothyrsus*). A). Inflorescence type, inflorescence pattern, flower shape (*floret*), B). Flower Shape (*pedicle*), C). Stamens, D). Petals, E). Crown of Flowers, and F). Protective Leaf (*bractea*)

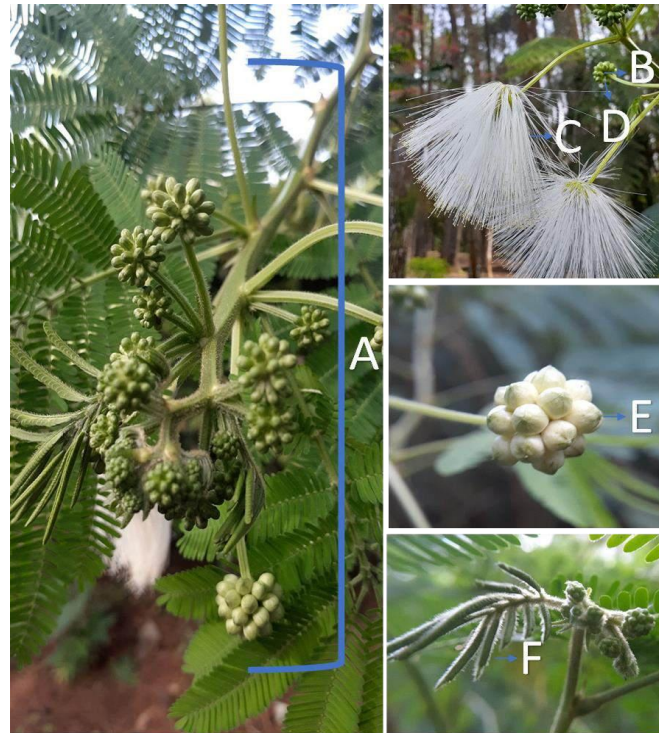


Figure 2. Morphological Characteristics of White Kaliandra (*Calliandra portoricensis*). A). Inflorescence type, inflorescence pattern, flower shape (florete), B). Flower Shape (pedicle), C). Stamens, D). Petals, E). Crown of Flowers, and F). Protective Leaf (breactea)

Overall, the morphological characteristics of Red Kaliandra (*Calliandra calothyrsus*) and White Kaliandra (*Calliandra portoricensis*) have similarities. The differences that can be seen are found in several variables, including the color of the stamens, the color of the petals and the flower crown. There are differences in the color of the stamens in these two types, namely in red kaliandra, the stamens are red, while white kaliandra is white to bright yellow. The striking colors have a role as a pollinator insect attracter to visit the flowers ([Adawiyah et al., 2020](#)).

The color of the petals in both types of kaliandra has differences, the color of the red kaliandra petals is slightly darker compared to the white kaliandra. The color of the petals that is slightly darker is one of the ways plants adapt to be able to increase the temperature of flowers so as to accelerate the reproductive process in environmental conditions that have low temperatures. The darker color of the pigment can absorb more sunlight and accelerate the development of pollen and ovulum. Based on research conducted by [Ismail et al \(2022\)](#), the time

needed from the flower initiation stage to the emergence of flowers in red kaliandra (24 days) is shorter than that of white kaliandra (26 days).

The flower crown of the kaliandra type at the research site has different colors, namely a slightly pale pink color for red kaliandra and a slightly pale yellowish white color for white kaliandra. This variation in flower color is influenced by biosynthesis and regulation of pigments such as anthocyanins and flavonoids. Complex biochemical pathways produce these pigments, and their expression is regulated by various genetic factors and environmental factors. Variations in gene expression, mutations, and the presence or absence of certain pigments can also contribute to differences in flower color ([Domenico, 2023](#); [Guo et al., 2023](#); [Monniaux, 2023](#)).

Species kaliandra (*Calliandra* spp.), namely red kaliandra and white kaliandra from several studies in various locations in Indonesia or in other countries, show relatively uniform flower morphology, so factors such as the location of the place where they grow do not significantly affect

the morphology of flowers (Abo & Afieroho, 2021; Baskorowati *et al.*, 2021; Widyastuti *et al.*, 2023). Then the flowering phenology of species has a relatively equal and consistent time which shows the ability to develop under diverse conditions (Ismail *et al.*, 2022). This is because kaliandra (*Calliandra* spp.) has a strong adaptation mechanism that allows coexistence with local species that can potentially interfere with its existence (Jardeleza *et al.*, 2022; Fontanari *et al.*, 2023).

By prioritizing the use of Kaliandra in the context of ecology, conservation, and agroforestry, efforts to control it as an invasive species can be well managed. Kaliandra species offer many management benefits, especially in agricultural applications and biomass energy production. It is an excellent candidate for biomass energy sources due to its rapid growth and high caloric value. With ideal distance treatment, significant biomass production and energy productivity (Siarudin & Indrajaya, 2020; Maulana *et al.*, 2021). Then kaliandra leaves can also be used as an additive for poultry feed, increasing poultry body weight, and increasing the profile of broiler chicken carcasses, this shows the many benefits of this species for livestock management (Lalisuk *et al.*, 2022). The species is also well-known for its ability to increase soil fertility by nitrogen fixation, which promotes the growth of companion crops and helps to realize sustainable agricultural systems (Yusro *et al.*, 2022). Overall, kaliandra (*Calliandra* spp.) is considered useful for sustainable management practices due to its adaptability and multifunctionality. So, by implementing this control effort, the population of this species can be controlled, especially in the wild.

4. CONCLUSION

The diversity of kaliandra flowers (*Calliandra* spp.) in Mount Ciremai National Park, namely Red Kaliandra (*Calliandra calothyrsus*) and White Kaliandra (*Calliandra portoricensis*) from several variables of overall flower characteristics have similarities. There are several variables that distinguish between these two types of plants, including the color of the stamens, the color of the petals and the crown of the flower. In addition to genetic factors, environmental conditions also affect these

differences in characteristics so that kaliandra undergoes an adaptation process to accelerate the growth and development of flowers. Kaliandra (*Calliandra* spp.) is thought to be beneficial for sustainable management techniques because of its versatility and multipurpose nature. Therefore, the population of this species, particularly in the wild, can be managed by putting this management effort into action.

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