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# Flowering phenology and floral yield of four cultivated *Jasminum* species in Indonesia

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**Abstract.** *Mayesti PA, Kurniawati A, Krisantini. 2025. Flowering phenology and floral yield of four cultivated* Jasminum *species in Indonesia. Biodiversitas 26: 6047-6055.* Jasmine is one of the most important flowers in Indonesia and Asia, used mainly for fresh flowers, flavoring ingredients, and can be processed into cosmetics and essential oils. Despite the rich diversity of Indonesian jasmines, there are limited studies on the growth and flowering of various jasmine types. Understanding the characteristics of each type is crucial as a foundational step for the development and commercialization of jasmine. This study examined the morphology, flower phenology, and production of four types of jasmine: *Jasminum sambac* "Telur", a local Java jasmine, "Emprit Bandar Arum", and Bintang (*Jasminum multiflorum*). The study was conducted in an open field in East Java, Indonesia, at an elevation of 348 m above sea level. Each type of jasmine consists of 50 plants. Observations and measurements were conducted on leaf and flower morphology, flower phenology, and production cycles. The four types of jasmine showed diversity in fragrance, leaf arrangement, number of flowers, flower arrangement, and productivity. The local jasmine has single corollas, whereas jasmine "Telur" has multiple. *Jasminum sambac* "Telur" has the most significant and heaviest flower (595 mg), but produces significantly fewer flowers. *Jasminum multiflorum* Bintang flower weighs 24 mg, but produces 11 flowers per plant. The local jasmine and Emprit Bandar Arum flowers fall within the mid-range, i.e., 49-62 mg flower weight, and produce 11-17 flowers per plant. The flowering phenology of the four jasmines spans 7-14 days, with flower bud appearance and development taking 8-10 days, followed by enlargement and swelling for 2-4 days before anthesis. Flowers at anthesis are the most fragrant in all four types of jasmine, with local Jasmine standing out in floral fragrance and production. This information would be useful for identifying different jasmine types, determining the best uses, and the commercial production of these four types of jasmines.

**Keywords:** Cultivar diversity, essential oil, flowering cycle, *Jasminum sambac*

## INTRODUCTION

Jasmine (*Jasminum* sp.) is an important flower in Indonesia and Asia, widely used in floral arrangements, religious and cultural ceremonies, and as a flavoring in tea. It is also processed into cosmetics, essential oils, perfumes, and aromatherapy products. Jasmine flowers are valued for their medicinal properties, including analgesic, antidepressant, antiseptic, anti-inflammatory, sedative, and aphrodisiac effects (Rani et al. 2017; Mani and Sivaraj 2021). It is essential oil is particularly used to treat depression, fatigue, skin irritation, headaches, and coughs (Rassem et al. 2018), making it highly sought after in the health and wellness industries.

In Indonesia, jasmine cultivation has increased significantly. In 2019, the area planted with jasmine reached 11,779,405 m², a 44.72% increase from 2018 (BPS and Direktorat Jenderal Hortikultura 2019). The main production centers are in Central Java, East Java, and South Kalimantan. In 2020, Central Java produced 23,619,301 plants, followed by East Java with 2,254,169 and South Kalimantan with 1,165,761 plants (BPS 2020). This increase reflects both the growing demand for jasmine and its potential as a sustainable crop.

Globally, numerous varieties of jasmine are cultivated, with Indonesia hosting nine main species: *Jasminum sambac* (White jasmine), *J. multiflorum* or *J. pubescens* (Gambir jasmine), *J. officinale* var. *grandiflorum* (Casablanca or Spanish jasmine), *J. nobile* (Royal jasmine), *J. parkeri* (Pot jasmine), *J. mesnyi* (Primrose jasmine), *J. revolutum* (Italian jasmine), *J. simplicifolium* (jasmine bintang), and hybrid jasmine (Julianto 2016; Yohanan et al. 2020). Notable cultivars of *J. sambac* in Indonesia include "Telur", "Ratu Ebuh" from Madura, and "Emprit Bandar Arum" from East Java, with the latter being registered under No. 6036/Kpts/SR.120/12/2012 (Musalamah 2021).

Despite the extensive cultivation of jasmine and its significance in local economies and global markets, scientific studies on jasmine biology, cultivation practices, and production techniques remain limited. Some studies have focused on flower production and cultivar characterization, such as for "Ratu Ebuh" and "Emprit Bandar Arum" (Shintia et al. 2024). Wibowo (2024) showed that pinching can increase flower production in several jasmine cultivars. Since jasmine flowers develop terminally, treatments that promote branching can improve yield. The application of benzylaminopurine (BAP) has been shown to induce branching in jasmine plants for up to four weeks, enhancing flower production (Syarafina 2023). In India, pruning practices have also been found to affect flower production. Pruning *J. sambac* to 50 cm in December resulted in about 1,216 mg of flowers per plant

(Pawar et al. 2019), while moderate pruning (40 cm) accelerated flowering and increased yield compared to heavy pruning (20 cm) (Makwana et al. 2024).

Understanding the growth, morphology, and phenology of jasmine is crucial for improving its commercial and ecological management. Flowering phenology, which marks the onset of reproduction, is essential for determining the best harvest times for flowers and essential oils (Jiang et al. 2021; Williamson et al. 2025). For example, in Cananga odorata, peak oil content occurred at 50% flowering in the Cipanas accession (0.92%), while the Kediri accession peaked later (0.61%) (Naimah et al. 2024). Phenological events, such as flowering timing, also reflect ecosystem responses to temperature and rainfall changes (Martins et al. 2021), providing valuable indicators for seed collection and conservation planning.

Jasmine's floral fragrance attracts pollinators, including bees, butterflies, and moths, linking flowering behavior to pollination networks and ecosystem health. Studying the relationship between jasmine's flowering patterns and pollinator activity can provide insights into its ecological role and contribute to biodiversity conservation.

Knowledge of flowering patterns and production rates per unit time is important for identifying cultivars best suited for various commercial applications, whether for fresh flowers or essential oil extraction. The present study aims to analyze the morphology, flowering phenology, and productivity of four jasmine cultivars to support their optimal utilization and commercial development. This research will contribute to advancing both the ecological understanding of jasmine and its practical applications in the commercial sector, offering valuable data for improving cultivation techniques and enhancing its use in the global market.

## MATERIALS AND METHODS

### Study area

The research was conducted from October 2021 to July 2022 in Ngariboyo Village, Ngariboyo Sub-district, Magetan District, East Java Province, Indonesia (7.6824°S, 111.3411°E). The location is situated at an altitude of approximately 348 m asl, with an average daily temperature ranging from 26°C to 30°C. Four types of jasmine were used in this study: *Jasminum sambac* "Telur", a local Java type of *J. sambac* (local Jasmine), *J. s.* cv. Jasmine "Emprit Bandar Arum", and *J. multiflorum* "Bintang" (Figures 1.A-D). The plants were grown on a potting mix of manure, coir, and soil in polybags. Jasmine "Emprit Bandar Arum" is a variety developed in Central Java, Indonesia. *Jasminum multiflorum* is native to India and Southeast Asia, and has been introduced to many countries.

### Procedures

The study was conducted in the open field, organized in a single-factor randomized complete block design, with jasmine types as the factor. Each jasmine type consists of five replicates, each with 10 plants, totaling 50 plants per replicate and 200 plants in total. The planting materials consisted of 12-week-old, rooted cuttings of the four types of jasmine, which were planted in polybags measuring 25 cm x 30 cm. The planting medium was a mixture of soil, manure, and husk in a volume ratio of 2:1:2. The plants were spaced 40 cm apart in both directions in the field. They were watered every two days, and weeding was conducted manually as needed. Fertilizers were applied at planting, consisting of 2 g of urea, 2 g of triple super phosphate (TSP), and 1 g of potassium chloride (KCl) per polybag, as recommended by Widyastuti (2018) for jasmine cultivation. Measurements were performed on plant morphology, flower characteristics, time to anthesis, flowering phenology, flowering cycle, and flower production in the four types of jasmine. Observations on the phenology of these inflorescences were made every two days on each sample plant. Jasmine flowers were harvested at anthesis.

Morphological characters at the vegetative (Table 1, Figure 2) and generative (Figures 5-8) stages were recorded based on plant morphological identification guidelines provided by Tjitrosoepomo (2020). Measurements on the flower morphology (Table 2) were conducted on ten flowers per plant for each jasmine type.

### Data analysis

Data analysis of quantitative characters was conducted using a one-way analysis of variance in SAS 9.4 (2020) from SAS Institute Inc. followed by a Tukey test to identify statistically significant differences in means. Data on flower fragrance were analyzed using the Mann-Whitney post hoc test with 20 panelists. Data analysis of qualitative characters, such as morphological traits, was carried out descriptively.

## RESULTS AND DISCUSSION

### Morphological characters

The four types of jasmine showed diversity in leaf arrangement, number of flowers, and flower morphology and arrangement (Figure 1, Table 1). The arrangement of the petals varied depending on the type, such as the single-layer local jasmine and the multiple-layer jasmine "Telur". The fragrance of the flowers is also diverse, with some being extremely fragrant, some moderately fragrant, and others not fragrant at all (Table 2).

Differences are also noted in the arrangement of leaves on the stem. Jasmine "Telur" exhibits two types of leaf arrangement: whorled (verticillate) and cross-faced (opposite) (Figure 2). The other three jasmines have opposite leaf arrangements. The whorled type indicates the presence of three or more leaves in each node, while the cross-faced type indicates only two leaves on each node facing opposite directions (Tjitrosoepomo 2020). The whorled leaf arrangement in jasmine "Telur" is a characteristic unique to this type and not shared by the other three types. This leaf arrangement in jasmine "Telur" is consistent with findings by Yohanan et al. (2020).

**Table 1.** Morphological characters of four types of jasmine

| Parameters | *Jasminum sambac* (Jasmine "Telur") | *Jasminum sambac* (Local jasmines) | *Jasminum sambac* cv. Emprit Bandar Arum | *Jasminum multiflorum* (Jasmine "Bintang") |
|---|---|---|---|---|
| Branching way/type | Simpodial | Simpodial | Simpodial | Simpodial |
| Leaves layout | Opposite-verticillata | Opposite | Opposite | Opposite |
| Leaf shape | Ovatus | Ovatus | Ovatus | Ovatus |
| Shape of leaf base | Rotundatus | Rotundatus | Rotundatus | Rotundatus |
| Shape of leaf tip | Obtusus | Obtusus | Obtusus | Obtusus |
| Type of leaf vein | Penninervis | Penninervis | Penninervis | Penninervis |
| Leaf margin | Integer | Integer | Integer | Integer |
| Flower color | White | White | White | White |
| Type of flower symmetry | Actinomorphic | Actinomorphic | Actinomorphic | Actinomorphic |
| Inflorescence | Cymose dichasial | Cymose dichasial | Single-Inflorescence cymose dichasial | Cymose dichasial |
| Flower canopy | Hypocrateriformis | Hypocrateriformis | Hypocrateriformis | Hypocrateriformis |
| Corolla layout | Imbricate | Imbricate | Imbricate | Imbricate |
| Flower layout | Terminalis | Terminalis | Terminalis-Lateralis | Terminalis |

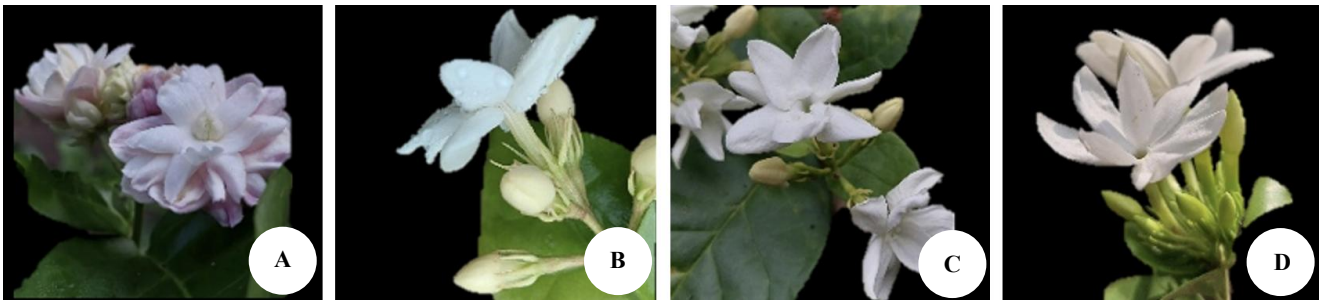


**Figure 1.** Jasmine flower morphology and flower arrangement: A. Telur (Terminalis), B. Local (Terminalis), C. Emprit Bandar Arum (Terminalis), D. Bintang (Terminalis)

Differences in morphological characters were also observed in the arrangement of the flowers. Jasmine "Emprit Bandar Arum" flowers are found both in the terminal (terminalis) position and in the axil (lateralis), whereas the flowers of the other three jasmine types are mainly terminal (Figure 1). However, Kalaiyarasi et al. (2018), who examined the morphology of *J. sambac* in several genotypes, reported that the flower position can be both terminal (terminalis) and in the axil (lateralis). We did not observe flowers in the axils of jasmine "Telur" and the local jasmine. Flowers born at the apex tend to be compound, while those borne in the axil are single-flowered (Figure 1). This indicates that the majority of jasmine flowers have a compound inflorescence, as also reported by Rukmi (2017).

The four types of jasmine have similar ovate leaves, except for jasmine "Telur", which has more rounded leaves compared to the other types (Figure 3). The shape of the leaf base, leaf tips, leaf veins, and leaf margins also exhibits similarities. A rounded leaf base (rotundatus) indicates that the base of the leaf is rounded, while a blunt leaf tip (obtusus) means that the edge of the leaf at the tip forms an obtuse angle (>90°). The penninervis leaf vein pattern shows leaves with only one central vein running from base to tip, with branching veins, and an entire leaf margin indicating a flat leaf margin (Tjitrosoepomo 2020). The differences in leaf shapes can be influenced by the developmental stages of growth (heteroblasty), environmental conditions, and gene expression, all of which contribute to the formation of specialized leaves (Nakayama 2024). However, the relationship between the variations in leaf shape and size and oil content has yet to be established (Wahid et al. 2016). Jasmine "Bintang" leaves are smaller in size compared to other types (Figure 3).

The morphological characteristics of the four types of jasmine exhibit differences primarily in leaf arrangement, the number, and layout of flowers. Whorled leaf arrangement (verticillate) is unique to jasmine "Telur". In contrast, the presence of single flowers and the arrangement of flowers at the end and in the axil are exclusive to jasmine "Emprit Bandar Arum".

All four types of jasmine have white flowers, a dominant color in almost all jasmine varieties. The uniform flower color challenges jasmine identification (Qur'ania and Sarinah 2017). Jasmine flowers typically exhibit only two colors: white (*J. sambac, J. polyanthum, J. azoricum, J. elongatum, J. multiflorum, J. nitidum,* and *J. grandiflorum*) and yellow (*J. humile* and *J. mesnyi*) (Akhtar et al. 2021). The flower shape of local jasmine and jasmine "Emprit Bandar Arum" is very similar, likely because they belong to the same species, *J. sambac*. Jasmine "Telur", also included in *J. sambac*, has whorled corollas. Jasmine "Bintang" has slightly more elongated corollas than the other three types, which tend to be rounded (Figure 8). The

flower shape of the four types of jasmine is hypocrateriformis (trumpet), and the corolla layout is imbricate (Figure 8). Generally, jasmine flowers are multi-flowered (inflorescentia cymosa), but the axil (lateralis) flowering buds only have a single flower. Inflorescentia cymosa dichasial indicates that two opposite stalks emerge from the central flower stalk (Tjitrosoepomo 2020).

Morphological diversities in tropical plant species are very high, as reported in *Syzygium aromaticum* (also known as cloves) (Wattimena et al. 2023), *Tacca chantrieri* (Ajisyahputra et al. 2017), and *Coelogyne pandurata* (Heriansyah et al. 2025). Ecosystems with higher plant diversity are more resilient, enabling them to recover more quickly from both biotic and abiotic stresses. Plant diversity supports multiple ecosystem functions simultaneously, including nutrient cycling and water regulation.

**Flower characteristics**

The four types of jasmine exhibited diversity in floral characters (Table 2). Jasmine "Telur" displayed more corollas and a higher weight of flowers with whorled-type corollas ranging from 5-7. In contrast, the other three types of jasmine only had one layer of whorled corollas with 8-9 corollas in each stack. This number surpasses the average number of jasmine corollas, typically 5 per lobe (Rukmi 2017). Jasmine "Bintang" had the longest corolla, measuring 1.75 cm, while jasmine "Emprit Bandar Arum" had the shortest, measuring 1.3 cm. The corolla length of jasmine "Bintang" exceeded the average length of jasmine corollas, which typically range from 0.8-1.5 cm and have an ovoid or oval shape (Rukmi 2017). Jasmine "Telur" had fewer flowers compared to the other types. The number of flowers in the other types remained stable per stalk throughout the observation period, whereas jasmine "Telur" exhibited an increase over time.

Jasmine "Bintang" exhibits greater bud length, flower diameter, corolla tube length, and corolla length. The corolla tube length of jasmine "Telur", measuring 2.09 cm (Table 2), exceeds the average length of the corolla tube in jasmine, which typically ranges from 7-15 mm (Rukmi 2017). Jasmine Bintang's flowers are thinner and longer, with oval-shaped buds. The flower's star-like shape also contributes to the larger and longer corolla. However, this type has the smallest corolla width compared to the other three types, attributed to the elongated oval shape of the jasmine "Bintang" corolla.

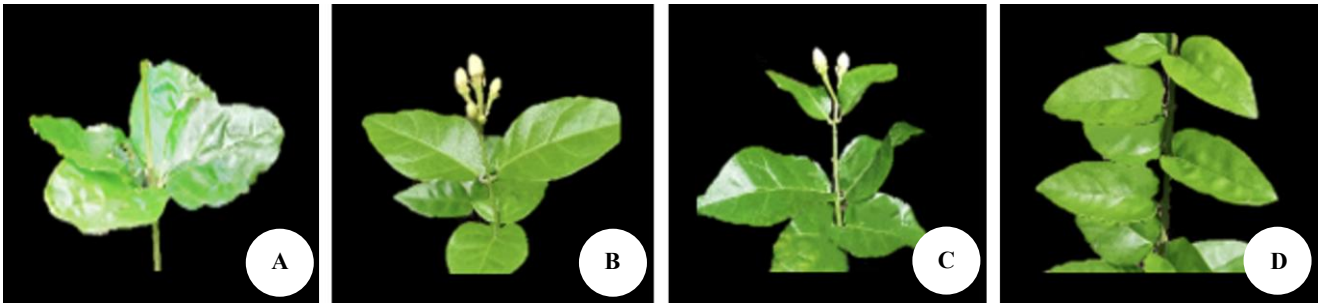


**Figure 2.** Leaf arrangements of the four jasmine types: A. Telur (Verticillata), B. Local (Opposita), C. Emprit Bandar Arum (Opposita), D. Star (Opposita)

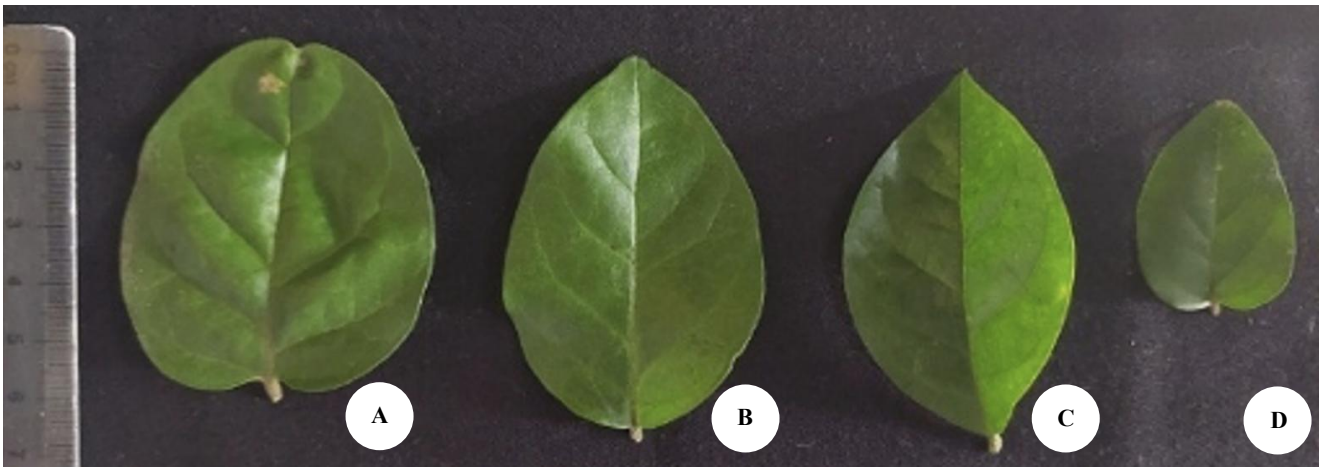


**Figure 3.** Leaf morphology of the four types of jasmines: A. Telur, B. Local, C. Emprit Bandar Arum, D. Bintang. All jasmine types have oval leaves

The floral characteristics of local jasmine and jasmine "Emprit Bandar Arum" do not significantly differ in almost every aspect. The only notable difference is in the corolla length, with local jasmine exhibiting longer corollas (Table 2). These two types of jasmine share similar flowers and belong to the same species, *J. sambac*. It is worth noting that jasmine "Emprit Bandar Arum" is a cultivated jasmine cultivar grown in Batang, Central Java, Indonesia.

*Jasminum sambac* "Telur" has the largest and heaviest flower (>450 mg) but only has 1-2 flowers per inflorescence (Table 2). On the contrary, *J. multiflorum* Bintang flower weighs only 24 mg, but has higher flower production. The local jasmine and Emprit Bandar Arum flowers are in the mid-range, i.e., 49-62 mg flower weight, and 11-17 flowers per plant (Table 2).

Based on the organoleptic study, the fragrance of the four types of jasmine consistently increases as the flower phase progresses, with the most intense aroma at anthesis (Table 2). The mechanism of essential oil release in roses is attributed to the rupture of oil glands, which allows oil to be released from the plant matrix (Yuniati et al. 2021). As flowers develop, plant cells enlarge, ultimately leading to the rupture of the glands and the release of fragrance. The most pungent aroma of jasmine flowers occurs when the flowers have fully bloomed; the strength of the scent is influenced by the amount of emission of α-farnesene when the flowers are in bloom (Yu et al. 2017).

The fragrance of jasmine flowers at the bud phase showed no significant difference among the four types of jasmine. The enlargement stage (Figure 8) serves as an indicator of jasmine flower harvesting for the extraction of essential oil using the distillation method. At this phase, there is a significant difference in fragrance levels among the four types of jasmine (Table 2). Mann-Whitney's post hoc tests revealed that during this phase, local jasmine exhibited only slight fragrance, whereas at anthesis, "Telur" and local jasmines were the most fragrant (Table 2). Flower morphology is closely linked to ecological factors, influencing interactions with pollinators, adaptation to environmental stressors, and resource allocation strategies (Farhan and Albahadly 2023). Floral traits such as color, shape, size, petal number, and scent determine the efficiency and specificity of pollinator attraction, influencing reproductive success within a particular habitat. For jasmines, they are adapted for nocturnal or low-light pollination by moths or night-active pollinators (Farhan and Albahadly 2023).

**Flowering phenology**

Flowering phenology spans 7-14 days, with flower bud appearance and development taking 8-10 days, followed by enlargement/swelling for 2-4 days before anthesis (Figure 4). The duration of flower development from bud to anthesis is a critical factor influencing potential yield in terms of cultivation effectiveness. The results of the F-test indicated that the duration from floral bud initiation to anthesis of the four types of jasmines was similar (Figures 5-7). Jasmine "Telur" has the most extended cycle (13 days after the first visible flower bud) and is followed by jasmine "Bintang", local jasmine, and jasmine "Emprit Bandar Arum". In this study, large flower size was reported to take a longer time to develop, as observed in Raphanus (Lehtila and Brann 2017). Jasmine "Telur" flowers are the largest and the heaviest (Table 2), and they took the longest to develop compared to other jasmine types. "Emprit Bandar Arum" is a jasmine cultivar that was developed in East Java, which has a warmer and drier climate compared to West Java. This short flowering cycle trait may correlate with the ecology in which the jasmines were developed.

In our study, jasmine flower development can be divided into the first visible floral bud, bud enlargement, and anthesis (Figure 5). Deng et al. (2016) categorized the phases of flower development into seven stages: small green buds, small white buds, bulging buds, elongated buds, maximum buds, partial bloom, and anthesis. This classification of flowering stages is based on indicators for harvesting jasmine flowers for essential oils.

Jasmine "Bintang" tends to reach anthesis in the afternoon, while the other three types bloom in the morning. The buds, 1-2 days after flowering, have petals covering them because they are longer. This observation aligns with the study by Deng et al. (2016) on *J. sambac* Aiton, where in the initial phase, the buds are small and green, and the corolla size is less than half the length of the petals.

Over time, the buds will lengthen and enlarge, so that in the final phase, the buds will be longer than the petals and will be accompanied by the appearance of the corolla tube containing the pistil and stamen. According to Deng et al. (2016), the stamen is longer than the pistil in the early phase. The pistils begin to lengthen and exceed the size of the stamens during the bulging bud phase. Then, the stamen lengthens along with the pistil at the maximum bud phase.

**Flowering cycle**

Time to flower is a crucial trait in the commercial cultivation of jasmine, directly impacting the economic value for growers. Early-flowering types are preferred, as they contribute to higher productivity and market readiness. Stems that bear flowers typically have a diameter of at least 8 mm and a circumference of at least 20 mm. Our study revealed that stems with a diameter of less than 5 mm and a circumference of less than 10 mm, exhibiting a green coloration, do not produce flowers.

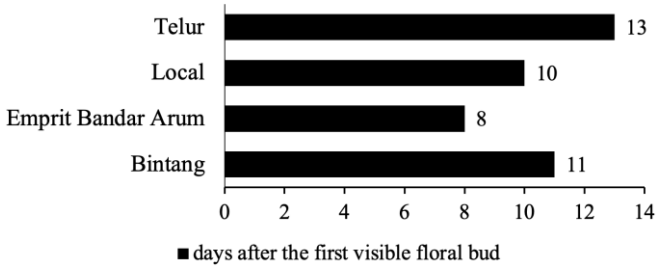


**Figure 4.** Duration from the first visible floral bud to anthesis of the four jasmine types

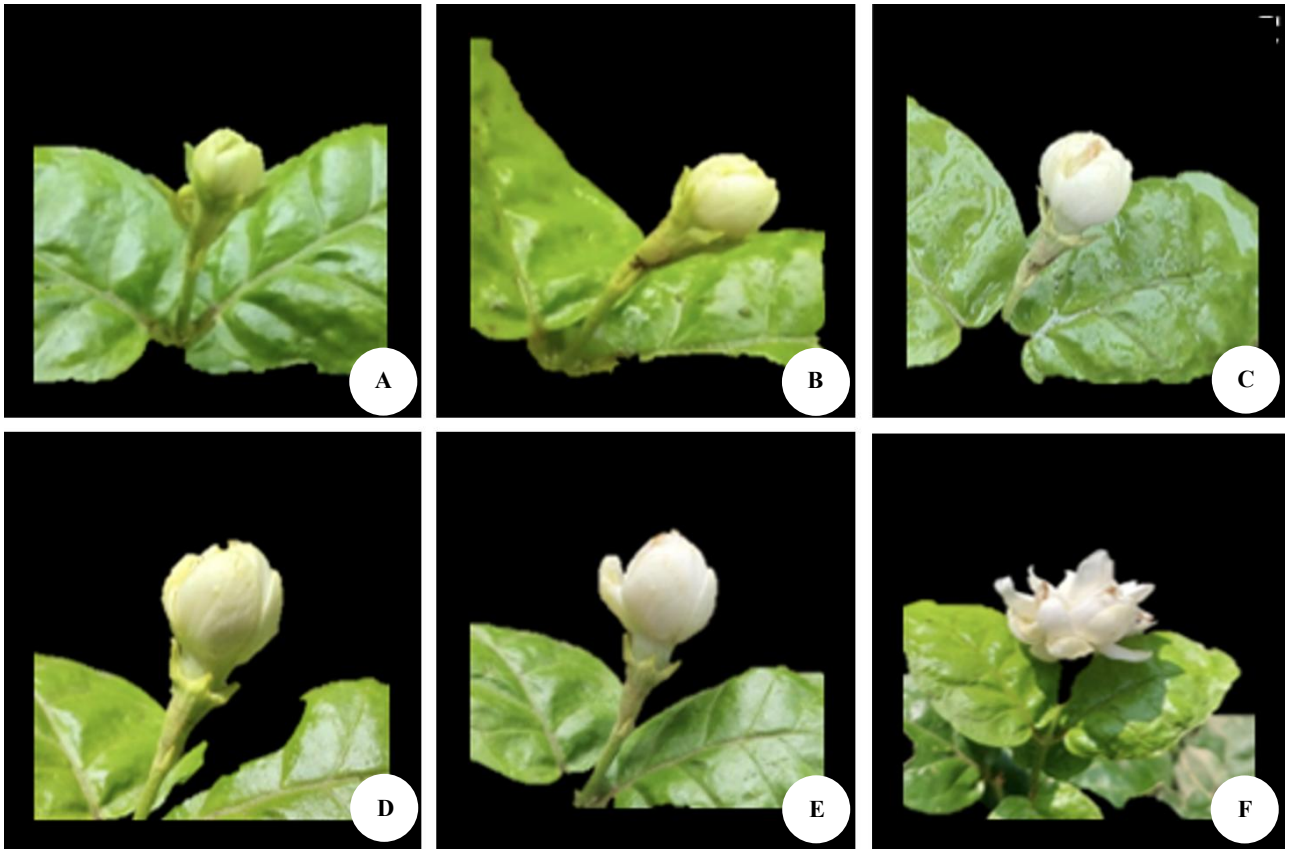


**Figure 5.** Flower phenology of jasmine "Telur": A. Floral buds at 1-2 days after the First Visible Floral Buds (FVFB); B. Floral buds at 3-4 days after FVFB; the petal length is about 6 mm; C. Floral buds at 7-8 days after FVFB; the petal length is about 9 mm; D. Floral buds at 9-10 days after FVFB, the petal length is about 10 mm and started to bulge; E. Floral at 11-12 days after FVFB, the petal length is about 12 mm, and the outer petal has begun to open; F. Anthesis is at 13-14 days after FVFB


**Figure 6.** Flower phenology of the local jasmines: A. Floral buds at 1-2 days after the First Visible Floral Buds (FVFB); B. Floral buds at 5-6 days after FVFB; the petal length of the central flower is about 8 mm; C. Floral buds at 8 days after FVFB, the petal length of the central flower is about 12 mm; D. Anthesis of the central flower at 10 days after FVFB

The four types of jasmine studied have reached the flowering stage, characterized by brown, woody main stems with multiple secondary branches and numerous fully expanded leaves (typically 2.5-10 cm long and 1.5-6 cm wide). Observations revealed that flowers predominantly emerged on the secondary branches, with fewer occurrences on the tertiary branches. The flowering cycle of jasmine is detailed in Table 3, with jasmine "Telur" flowers lasting 4 weeks longer than those of the other three types. The variation in flowering time among the jasmine types is attributed to genetic factors inherent to each variety. Jasmine "Telur" typically initiates flowering at 10-11 months, whereas local jasmine and "Emprit Bandar Arum" commence flowering between 6-12 months (Department of Agriculture 2015). Jasmine flowers are suitable for year-round harvesting. In this study, once flowering commenced, the flowers could be continuously harvested until the end of the study period, typically lasting around 12 weeks. This aligns with jasmine harvesting standards, which permit multiple harvests throughout the

year, typically lasting 12 weeks (3 months) (Department of Agriculture 2015).

**Flower production**

Flower production per plant, measured as the total number of flowers per plant and the total flower weight for 12-week periods, is in Table 4. Jasmine "Telur" has, on average, only one flower per plant, whereas the local jasmine has the most flowers, 17 per plant. Jasmine "Telur", however, has the most significant and heaviest flowers, weighing 595 mg per flower, followed by "Emprit Bandar Arum", at 62 mg per flower, the local jasmine, at 49 mg per flower, and "Bintang", at 24 mg per flower. This shows the diverse nature of the different jasmine flowers.

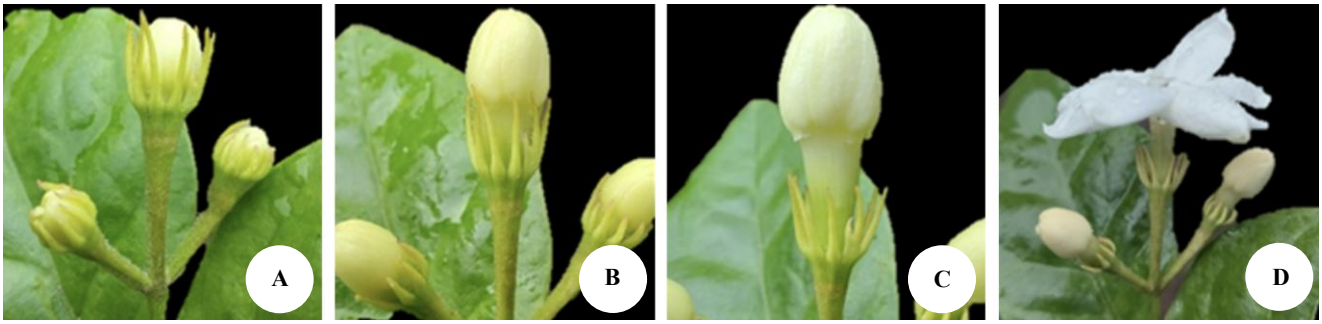


**Figure 7.** Flower phenology of the jasmine "Émprit Bandar Arum": A. Floral buds at 1-2 days after the First Visible Floral Buds (FVFB); B. Floral buds at 5-6 days after FVFB; the petal length of the central flower is about 8 mm; C. Floral buds at 7 days after FVFB, the petal length of the central flower is about 12 mm; D. Anthesis of the central flower at 8 days after FVFB


**Figure 8.** Flower phenology of the jasmine "Bintang": A. Floral buds at 1-2 days after the First Visible Floral Buds (FVFB); B. Floral buds at 5-6 days after FVFB; the petal length of the central flower is about 10 mm; C. Floral buds at 9-10 days after FVFB, the petal length of the central flower is about 12 mm; D. Floral buds elongated to 15 mm in the morning, and reached anthesis at 11 days after FVFB

**Table 2.** Flower characteristics of the four types of jasmine

| **Parameters** | ***Jasminum sambac*** **(Jasmine "Telur")** | ***Jasminum sambac*** **(Local jasmines)** | ***Jasminum sambac*** **cv. Emprit Bandar Arum** | ***Jasminum multiflorum*** **(Jasmine "Bintang")** |
|---|---|---|---|---|
| Number of flowers per stalk | $1.60^{b}$ | $2.90^{a}$ | $2.80^{a}$ | $3.30^{a}$ |
| Length of flower bud (cm) | $1.18^{b}$ | $1.14^{b}$ | $1.16^{b}$ | $1.47^{a}$ |
| Flower diameter (cm) | $2.57^{c}$ | $2.85^{b}$ | $2.91^{b}$ | $3.50^{a}$ |
| Length of corolla tube (cm) | $0.64^{c}$ | $1.34^{b}$ | $1.42^{b}$ | $2.09^{a}$ |
| Number of corollas | $36.10^{a}$ | $7.90^{b}$ | $9.00^{b}$ | $8.30^{b}$ |
| Corolla length (cm) | $1.37^{b}$ | $1.30^{b}$ | $1.30^{c}$ | $1.75^{a}$ |
| Corolla width (cm) | $0.84^{a}$ | $0.87^{a}$ | $0.80^{a}$ | $0.68^{b}$ |
| Flower weight (mg) | $457.50^{a}$ | $197.80^{b}$ | $190.70^{b}$ | $113.90^{c}$ |
| Fragrance level of the floral buds | $1.00^{tn}$ (Not fragrant) | $1.10^{tn}$ (Not fragrant) | $1.05^{tn}$ (Not fragrant) | $1.00^{tn}$ (Not fragrant) |
| Fragrance level of the bulging flower | $1.20^{b}$ (Not fragrant) | $1.55^{a}$ (Slightly fragrant) | $1.15^{bc}$ (Not fragrant) | $1.00^{c}$ (Not fragrant) |
| Fragrance level at anthesis | $3.30^{ab}$ (Fragrant) | $3.55^{a}$ (Fragrant) | $2.90^{b}$ (Slightly fragrant) | $1.85^{c}$ (Not fragrant) |

Note: Values followed by the same letters within the same row are not significantly different based on the Tukey test, α: 0.05. Levels of flower fragrance: 1: Not fragrant, 2: Slightly fragrant, 3: Fragrant, 4: Very fragrant

**Table 3.** Flowering times of four types of jasmine between December 2021 and April 2022

| Types of jasmine | Age (WAP) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | December | | | | January | | | | March | | | | April |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Telur | | | | | | | x | | x | x | x | x | x |
| Local | | | x | x | x | x | x | x | x | x | x | x | x |
| Emprit Bandar Arum | | | x | x | x | x | x | x | x | x | x | x | x |
| Bintang | | | x | x | x | x | x | x | x | x | x | x | x |

**Table 4.** Flower production per plant, total flower weight, and individual flower weight of the four jasmine types

| Types of Jasmine | Flower production per plant | Total flower weight (mg) | Weight of individual flower (mg) |
|---|---|---|---|
| Telur | 1.00[c] | 595.40[b] | 595.40[a] |
| Local | 17.17[a] | 849.30[a] | 49.47[b] |
| Emprit Bandar Arum | 11.27[b] | 698.70[b] | 62.01[b] |
| Bintang | 11.40[b] | 281.70[c] | 24.70[c] |

Note: Values followed by the same letters within the same column are not significantly different based on the Tukey test, α: 0.05

The local jasmine has significantly higher flower production per plant compared to the other types of jasmine (Table 4). Local jasmines are predominantly used in the production of essential oils, tea, and floral arrangements. Jasmin “Telur” is also potentially used as a raw material for essential oil due to its high fragrance (Table 2), but further studies should be conducted to increase the flower production of this jasmine type. Jasmine “Telur,” distinguished by its whorled corolla, is also suitable for ornamental potted plants or landscaping. Lastly, with its attractive leaf morphology and unique, relatively prolific flowering habit, jasmine “Bintang” is well-suited for use as a decorative potted plant.

In conclusion, the four jasmine types in this study demonstrated various morphologies. In terms of flower phenology, “Emprit Bandar Arum” has the fastest flower development time, followed by the local jasmines, "Bintang" and "Telur”. Based on the high fragrance levels, local jasmines and “Telur” can be used as raw materials for essential oil. Jasmine '“Telur” has the potential to be developed as a flowering potted plant due to its large flowers. The results of this study will be beneficial for the identification, conservation, and management of genetic resources, as well as the scheduling of commercial production of different types of jasmines for various purposes.

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## REFERENCES

Ajisyahputra NR, Palupi ER, Krisantini K, Wiendi NMA, Mulyono J. 2017. Evaluation of growth, flowering, and seed morphology of batflower, *Tacca chantrieri* Andre. J Trop Sci 4 (2): 64-69. DOI: 10.29244/jtcs.4.2.64-69.

Akhtar N, Hafix IA, Hayat MQ, Potter D, Abbasi NA, Habis U, Hussain A, Hafeez H, Bashir MA, Malik SI. 2021. ISSR-based genetic diversity assessment of genus *Jasminum* L. (Oleaceae) from Pakistan. Plants 10 (1): 1270. DOI: 10.3390/plants1011270.

Badan Pusat Statistik (BPS) and Direktorat Jenderal Hortikultura. 2019. Luas Panen Tanaman Hias di Indonesia, Tahun 2015-2019. www.pertanian.go.id. [Indonesian]

Badan Pusat Statistik (BPS). 2020. Produksi Tanaman Florikultura (Hias) 2020. BPS, Jakarta. www.bps.go.id. [Indonesian]

Deng Y, Jia X, Liang L, Gu C, Sun X. 2016. Morphological anatomy, sporogenesis, and gametogenesis in the flowering process of jasmine (*Jasminum sambac* Aiton). Sci Hort 198: 257-266. DOI: 10.1016/j.scienta.2015.11.036.

Department of Agriculture. 2015. Jasmine (*Jasminum officinale*). Department of Agriculture, Yogyakarta. www.distan.jogjaprov.go.id. [Indonesian]

Farhan TW, Al Bahadly ZK. 2023. Comparative morphological study of *Lavandula angustifolia* and *Jasminum officinale* in Iraq. Iraq Sci Acad J 50 (2): 601-607. DOI: 10.52866/esj.2023.12.25.21.

Heriansyah P, Aziz SA, Sukma D, Nurcholis W. 2025. Dynamics of nutrient concentrations, endogenous hormones, photosynthetic capacity, and phenological changes in black orchid (*Coelogyne pandurata* Lindl.) from the vegetative to generative phase. J Trop Sci 12 (1): 215-234. DOI: 10.29244/jtcs.12.01.215-234.

Jiang Y, Li B, Yuan Y, Sun Q, Zhang T, Liu Y, Li Y, Li R. 2021. Divergent shifts in flowering phenology of herbaceous plants on the warming Qinghai-Tibetan plateau. Agric Forest Meteorol 307: 108444. DOI: 10.1016/j.agrformet.2021.108444.

Julianto TS. 2016. Minyak Atsiri Bunga Indonesia. Deepublish, Yogyakarta. [Indonesian]

Kalaiyarasi A, Dhananjaya MV, Nair SA, Kumar R, Yoheesja HS, Munikrishnappa PM, Devappa V, Pavithra S. 2018. Studies on floral morphology in different genotypes of *Jasminum sambac*. Ind J Agric Sci 88 (11): 1789-1793. DOI: 10.56093/ijas.v88i11.84932.

Lehtila K, Brann KH. 2007. Correlated effects of selection for flower size in *Raphanus raphanistrum*. Can J Bot 85 (2): 1-8. DOI: 10.1139/B07-007.

Makwana RJ, Rathva VD, Panchal BH. 2024. Flowering in Mogra (*Jasminum sambac*) var. local is influenced by time and the severity of pruning. Intl J Adv Biochem Res 8 (1): 588-590. DOI: 10.33545/26174693.2024.v8.i1h.444.

Mani T, Sivaraj R. 2021. Screening of anti-peptic ulcer activity of *Jasminum sambac*. J Fac Pharm Ankara 45 (1): 57-69. DOI: 10.33483/jfpau.754297.

Martins AE, Camargo MGG, Morellato LPC. 2021. Flowering phenology and the influence of seasonality in flower conspicuousness for bees. Front Plant Sci 11: 607255. DOI: 10.3389/fpls.2020.607255.

Musalamah. 2021. Budidaya dan Pemasaran Bunga Jasmine. www.litbang.pertanian.go.id. [Indonesian]

Naimah NMR, Kurniawati A, Krisantini. 2024. Comparison of morphological characters, flowering phenology, and essential oils of two accessions of Cananga (*Cananga odorata* var. *fruticosa*). Biodiversitas 25 (2): 801-810. DOI: 10.13057/biodiv/d250240.

Nakayama H. 2024. Leaf form diversity and evolution: A never-ending story in plant biology. J Plant Res 137: 547-560. DOI: 10.1007/s10265-024-01541-4.

Pawar R, Bhatt ST, Bhatt D. 2019. Influence of time and level of pruning on flowering yield in *Jasminum sambac* var. *baramasi* under South Gujarat condition. J Pharmacog Phytochem 8 (2): 1975-1977.

Qur'ania A, Sarinah I. 2017. Identification of jasmine flower (Jasminum sp.) based on the shape of the flower using Sobel edge and K-nearest neighbour. IOP Conf Ser Mater Sci Eng 332 (1): 012008. DOI: 10.1088/1757-899X/332/1/012008.

Rani B, Yadav M, Pachauri G, Abid M, Kazmi S, Chharang H, Maheshwari RK. 2017. Awesome medicinal benefits of the jasmine plant. J Biol Chem Res 34 (2): 918-922.

Rassem HH, Nour AH, Yunus RM. 2018. Analysis of bioactive compounds for jasmine flower via gas chromatography-mass spectrometry (GC-MS). Malay J Fund Appl Sci 14 (2): 198-201. DOI: 10.11113/mjfas.v14n2.884.

Rukmi N. 2017. Uji Aktivitas Anti Bakteri pada Ekstrak Daun Jasmine (*Jasminum sambac* L.) terhadap Pertumbuhan Bakteri *Staphylococcus aureus*. [Report]. Universitas Muhammadiyah Banjarmasin, Banjarmasin. [Indonesian]

Shintia M, Krisantini, Kurniawati A. 2024. Plant description, growth, and flowering of two Indonesian jasmines. Pertanika J Trop Agri Sci 47 (4): 1-10. DOI: 10.47836/pjtas.47.4.01.

Syarafina JA. 2023. Aplikasi BAP untuk Menginduksi Percabangan Melati Grand Duke of Tuscany (*Jasminum sambac* L.). [Thesis]. Institut Pertanian Bogor, West Java. [Indonesian]

Tjitrosoepomo G. 2020. Morfologi Tumbuhan. Universitas Gajah Mada Press, Yogyakarta. [Indonesian]

Wahid N, Chkicheckh A, Bakry M. 2016. Morphological traits and essential oil yield variation of three *Myrtus communis* L. populations: Implications for domestication. Direct Res J Agric Food Sci 4 (7): 199-207.

Wattimena AY, Mahulette AS, Makaruku MH, Lating MFA. 2023. Morphological character of clove "Raja" (*Syzygium aromaticum* L.), endemic to Maluku, Indonesia. J Trop Crop Sci 10 (1): 71-78. DOI: 10.29244/jtcs.10.1.71-78.

Wibowo YA. 2024. Regulasi Percabangan dan Pembungaan Tiga Jenis Melati (*Jasminum sambac* L.) Pot dengan Pemangkasan Pucuk. [Thesis]. Institut Pertanian Bogor, West Java. [Indonesian]

Widyastuti T. 2018. Teknologi Budidaya Tanaman Hias Agribisnis. Mine, Yogyakarta. [Indonesian]

Williamson DR, Prestø T, Westergaard KB, Trascau BM, Vange V, Hassel K, Koch W, Speed JD. 2025. Long-term trends in global flowering phenology. New Phytologist 2025: 70139. DOI: 10.1111/nph.70139.

Yohanan R, Jeyarani NJ, Devipriya V, Rather SA, Kasana S, Thakur J, Dwivedi MD, Pandey AK. 2020. Evaluating genetic diversity within genus *Jasminum* L. (Oleaceae) using intersimple sequence repeats (ISSR) markers. Biol Sci 90 (3): 531-540. DOI: 10.1007/s40011-019-01124-7.

Yu Y, Lyu S, Chen D, Lin Y, Chen J, Chen G, Ye N. 2017. Volatiles emitted at different flowering stages of *Jasminum sambac* and expression of genes related to α-farnesene biosynthesis. Molecules 22 (4): 546. DOI: 10.3390/molecules22040546.

Yuniati Y, Putri SN, Sambawa PRR, Bhuana DS, Mahfud M. 2021. Ekstraksi minyak atsiri dari bunga mawar (*Rosa hybrida* L.) dengan metode solvent-free microwave extraction. J Chem 9 (2): 43-47. DOI: 10.18860/al.v9i2.11511. [Indonesian]