Phenology of the bunga bangkai (Amorphophallus gigas) in North Padang Lawas, North Sumatra Province, Indonesia

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Abstract. The “bunga bangkai” is a compound interest with spadix and solitary inflorescences. Amorphophallus gigas is one of several species of Amorphophallus which is endemic to Sumatra. One of the original habitats for A. gigas is found in North Padang Lawas and is found in bloom almost all year round. This study aimed to observe the phenology of A. gigas in North Padang Lawas Regency, precisely in Bargottopon Village which was found on a rubber agroforestry land in one of the communities. Observations were made every 3 days, starting from the buds being found to the wilted state. Observations were made since it was discovered on February 25th, 2020, with a height of 58 cm with a shape that is still bud to wither (broken appendix and spathe withered) March 14th, 2020. From the time it was found to wither it only lasted 19 days. There are 6 species of animals found when the “bunga bangkai” blooms, including flies (Musca domestica), fleas (Tribolium confusum), forest mosquitoes (Aedes albipictus), ants (Camponotus sp), beetles (Plagiodera sp), and moths (Scania olivares).

1. Introduction
Amorphophallus initially found in tropical regions from Africa to the Pacific islands, and then spread to temperate regions such as China and Japan [1]. Eight species of Amorphophallus are recorded endemic to Sumatra, namely: A.asper, A. beccarii, A. forbesii, A. gigas, A. gracilis, A. hirsutus, A. manta, and A. titanium [2]. Species of yams those that are truly authentic to Indonesia are still relatively neglected. The iles-iles group (Amorphophallus spp.) [3] is one among them. Amorphophallus gigas is perhaps one of the more than 200 species of Amorphophallus in the world. The Amorphophallus gigas is the second largest carcass after Amorphophallus titanium, but has the highest inflorescence among the Amorphophallus genus [4].

The characteristics of Amorphophallus gigas are single-leaf herb, dark green leaf stalk with small to large spots, pale green, 3-4 m long, 11-20 cm in diameter, 4 m wide. The length of the stalk reaches 4 m [4]. To date, the authors found it in Halongonan District, North Padang Lawas Regency. Based on interviews local community it is known that the flower of A.gigas has existed since ancient times but has not been documented. The “bunga bangkai” in the North Padang Lawas area has the local name "Atturbung". Its population in the wild is increasingly being decreased due to various factors, mainly due to habitat degradation. This species is included in the list of protected species by Indonesian law.

Phenology is the study of the period of phases that occur naturally in plants. The occurrence of these phases is strongly influenced by environmental conditions, such as the duration of exposure,
temperature and humidity [5]. The purpose of this study was to determine the development of corpse flowers from the time they were discovered (buds) until they wilted and the types of pollinators found in carcass flowers.

2. Methodology
Observation of \( A. \) gigas flower phenology is modified of Arianto [6]. This observation was carried out at the location of Bargottopong Julu Village, Halongan District, North Padang Lawas Regency. The phenological data collection of the flowers (Figure 1) is as follows:

a. Observing the development of flowers, this is done every day until the flowers bloom until the flowers wither.

b. The period of bud, including the time when buds appear, the growth in diameter and height of buds (spatha, appendix), changes in color, and the length of time for flower buds to wilt. This observation is carried out every day until the flowers wither and rot.

c. The bloom period. The parameters observed were the length of the flower bloom (days), the size of the parts of the flower at bloom (cm), the aroma or smell of flowers, the color of the flowers when they bloomed.

d. The time it takes for a “bunga bangkai” to wither, includes, when the flower begins to wither, the order of the flower's organs withering, and the color of the flower when it withers.

![Figure 1. The organ of the \( A. \) gigas](image)

3. Results and discussion

3.1 Phenology of \( A. \) gigas
According to observations made since February 25\(^{th}\), which were found in a state of bud to wither on March 14\(^{th}\), 2020, the flowering phase of the “bunga bangkai” was 19 days. The life cycle of \( A. \) titanum consists of several phases, namely the leafy phase (vegetative phase) and the flowering phase (generative phase). Between the two phases, the sleep phase (dormancy phase) is punctuated [6]. The “bunga bangkai” is a compound interest with a spadix type of flower. Solitary inflorescence with short inflorescences [6]. On the end of the cob has a cone (appendix) which is a sterile part [7].
Figure 2 and Table 1 show the development of the corpse flower, starting from being found in a bud to wither with the explanation is as follow:

1st observation is February 25, 2020. Phase Buds. New early buds appear 58 cm high. The color of the buds is light purple with green spots. These carcass flower buds usually appear during the rainy season. In this phase, the stems and potential flowers cannot be distinguished, white bulbs. Usually this carcass flower appears during the rainy season.

2nd observation is February 29, 2020. Bud phase. In this phase, the peduncle is clearly visible, but the spatha and appendix are still united because they are still buds. However, spatha is still a bud. Total height is 166 cm, peduncle height is 110 cm and appendix height is 56 cm. Diameter of peduncle is 7 cm. There was a height increase of 108 cm in 4 days.

3rd observation is March 2nd, 2020. The appendix has started appearing. In this phase, the purple-yellow Appendix has begun to appear. Spatha still buds with a purplish green color. The total height in this phase is 181 cm. Peduncle height is 115 cm. The bottom peduncle diameter is 7 cm. Increase in height by 15 cm.

4th observation is March 4th, 2020. The appendix increases in height and the diameter of the spatha increases. In this phase the Appendix grows taller and has a purplish yellow color. The total height during this phase is 205 cm, peduncle height is 117 cm. The height of the appendix is 72 cm. Spatha still buds surround the appendix. The diameter of the peduncle is 7.3 cm.

5th observation is March 6th, 2020. The appendix increases in height and the diameter of the spatha is enlarged. In this phase, the Appendix increases with a purplish yellow color. The total height during this phase is 211 cm; peduncle height is 119 cm. Spatha still buds surround the appendix. The diameter of the peduncle is 7.3 cm.

6th observation is March 8th, 2020. The appendix increases in height and the diameter of the spatha increases. In this phase, the appendix increases with a purplish yellow color. The total height during this phase is 228 cm, peduncle height is 121 cm. The height of the appendix is 83 cm. Spatha still buds surround the appendix. The diameter of the appendix and spatha has begun to grow to 16.87 cm. The diameter of the peduncle remains 7.3 cm. The lids of the upper spatha begin to open.

7th observation is March 10th, 2020. In Perfect Bloom. The peak bloom occurs two days after the petals begin to open. Total height is 230 cm, peduncle height is 121 cm, peduncle diameter is 7.3 cm. Diameter spatha is 35.98 cm. When it blooms, a pungent odor appears. The animals that appear include flies, mosquitoes, and rice lice. The foul odor on the flowers will invite the animals to come with the aim of rather perfect pollination. The number of days from when the “bunga bangkai” was found in the bud to bloom lasts for 17 days.

8th observation is March 12th, 2020. Starting to wither. In this phase the petals begin to wilt, the flower cobs remain upright and the flower stems are still upright. The diameter of the spatha has shrunk to 23 cm because the spatha have withered. Appendix growth is maximal.

9th observation is March 14th, 2020. Withered. In this phase the spatha (petals) and appendix wither. The male and female flowers in spatha that have withered are getting bigger.
25th February 2020 (Bud)

29th February 2020 (Bud)

2nd March 2020 (The appendix started appearing)

8th March 2020 (Appendix rises higher)

6th March 2020 (Appendix rises higher)

4th March 2020 (Appendix rises higher)

10th March 2020 (Flower peaks bloom)

12th March 2020 Flower begin to wilt

14th March 2020 (wither)

**Figure 2.** Phenology of *A. gigas*
Table 1. Phenology data of A. gigas

| No. | Date of observation | Appendix high (cm) | Female and male high (cm) | Spatha high (cm) | Spatha diameter (cm) | Peduncle high (cm) |
|-----|---------------------|--------------------|--------------------------|-----------------|---------------------|-------------------|
| 1.  | 25th February 2020  | 56                 | 0                        | 5               | 3                   | 110               |
| 2.  | 29th February 2020  | 60                 | 6                        | 56              | 6.3                 | 115               |
| 3.  | 2nd March 2020      | 72                 | 16                       | 59              | 11                  | 117               |
| 4.  | 4th March 2020      | 73                 | 19                       | 61              | 14                  | 119               |
| 5.  | 6th March 2020      | 83                 | 23                       | 63              | 16.87               | 121               |
| 6.  | 8th March 2020      | 85                 | 24                       | 70              | 35.98               | 121               |
| 7.  | 10th March 2020     | 85                 | 24                       | 70              | 23                  | 121               |
| 8.  | 12th March 2020     | 85                 | 24                       | 70              | 23                  | 121               |
| 9.  | 14th March 2020     | 85                 | 24                       | 70              | 23                  | 121               |

3.2 Pollinators of A. gigas

Table 2. Pollinators founded in A. gigas

| No. | English name | Scientific name     | Family            |
|-----|--------------|---------------------|-------------------|
| 1.  | Flies        | Musca domestica     | Muscidae          |
| 2.  | Fleas        | Tribolium confusum  | Tenebrionidae     |
| 3.  | Forest mosquitoes | Aedes albipictus | Culicidae       |
| 4.  | Ants         | Camponutus sp      | Formicidae        |
| 5.  | Beetles      | Plagiodera sp      | Chrysomelidae     |
| 6.  | Moths        | Scania Olivares    | Noctuidae         |

There are 6 species of animals as pollinator of A. gigas found when the “bunga bangkai” blooms, including flies (Musca domestica), fleas (Tribolium confusum), forest mosquitoes (Aedes albipictus), ants (Camponutus sp), beetles (Plagiodera sp), and moths (Scania Olivares) (Table 2). After a few days usually the spatha and appendix will dry out this will then fall off. The male flowers that are on top of the female flowers also wither after pollination, which is assisted by insects trapped in the spatha, so that the female flowers will appear purple seeds and enlarge until they are green.

4. Conclusions

The flowering phase of the A. gigas was 19 days. There are 6 species of animals as pollinator of A. gigas found when the “bunga bangkai” blooms, including flies (Musca domestica), fleas (Tribolium confusum), forest mosquitoes (Aedes albipictus), ants (Camponutus sp), beetles (Plagiodera sp), and moths (Scania olivares).
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