

Phenology of Inflorescences of *Dendrobium Antennatum* Lindl

Rari Ingastryan Lilanaya, Edy Setiti Wida Utami, Hery Purnobasuki

Abstract: *Dendrobium antennatum* Lindl. is one of the endemic orchids from Papua categorized as rare plant in Indonesia. They are narrowly distributed in Papua New Guinea, south-eastern Australia, Queensland and surrounding islands. They had a special feature on their twice twisted petals and antenna like form with white labellum and purple lines pattern. The study aim was to observe the flowering process by descriptive observational method. The results showed that the flowers bloomed at 42 to 43 days after shooting (DAS), the scent smell began wafted at 32 to 43 DAS, and the length time of blooming flowers was 10-21 days long. The length time of flowering set was 29-30 days after the appearance of flower buds. Flowering process include three phases: shoots, flower buds and bloom. Sharp tip shoots appear on the stem nodes and growth horizontally forming an angle 90° to stem. The flower bud shapes were right-angled triangle and bow. In the bloom phase, there were changing colours of petals from green to white green with the raised antenna shape like (at 35 DAS) and become twisted (at 38 DAS).

I. INTRODUCTION

Flowering phenology is an important factor in the plant life cycle [1-3]. Bhattacharjee and Duta (2010) had revealed phenological study of flowering that most of 61 orchid species found in Barak Valley have flowering period between April and July [4]. In additions, Tremblay et al. [5] stated that time taken from flower bud formation to flower blooming perfectly in *Leppanthes woodburyana* Stimson, L. *rupestris* Stimson and L. *rubripetala* Stimson was between 11 days and 15 days.

The generative phase of plant is characterized by the flowers formation become fruit and fully mature [6]. There are many changes in the differentiation pattern in the apical meristem. These changes seems to be triggered by biochemical compounds (known as florigen) which transfer from the roots to the plant apex included the leaves [7]. Hence, flowering represented highly specialized complex structure which this structure is very different from vegetative part shape and also different between same species with others [8]. Meanwhile, flowering of *Dendrobium* orchids needed between 3 months and 4 months for flowering phase [9]. *Dendrobium antennatum* Lindl is one of original Indonesian orchids. The orchids were found on Papua Nw Guinea, Southeast Australia, Queensland and surrounding island [10].

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This type of biology is still not widely known especially in terms of flowering and fruit formation. The knowledge of flowering biology and fruit formation can reflect the difficulty level of plant reproduction in the nature which also can reflect the population development, the duration from flowering to the fruit set and morphological changes that plants experienced in each phase of growth. This study aim was to observe the flowering process by descriptive observational method.

II. METHODOLOGY

The study was conducted at DD' Orchid Nursery on East Java and Plant Physiology Laboratory in Department of Biology, Airlangga University within 6 months (January 2013 until June 2013).

In this study, the tools used included Canon EOS 550D 18 megapixels digital camera, stereo microscope, callipers, magnifying glass, pencil and label paper. Meanwhile, the material used was 7 years *Dendrobium antennatum* Lindl orchids.

The flowering process observation was 6 months included morphological aspects and quantitative data measurement of phase included shoot, flower bud and blooming phases. In the budding phase, the parameters observed were mother inflorescence length, mother inflorescence colour, first flower bud appearance time, flower bud colour and flower stalk colour. In flower bud phases, the parameters observed included mother inflorescence length, flower bud, sepal colour, petal colour, labellum colour, labellum pattern, flower stalk length, flower stalk colour and floral aroma. In additions, the parameters observed in blooming phase included mother inflorescence length, dorsal sepal length, sepal colour, petal colour, labellum colour, labellum pattern, flower stalk length, flower stalk colour and flower aroma.

The colour was determined for flower bud, flower stalks, fruit stalks, sepals, petals and fruit peels whether the degradations of white to yellow or degradation of yellow to white based on the colour changes board in Figure 4. There were 8 stages such as white with 100% white composition, green I with green as much as 5% and 95% white, green II with composition of green as much as 15% and 85% white, green III with green composition of 45% and white 55% white, green IV with green composition of 100%, green V with composition of 45% green and yellow 55%, yellow I with composition of 75 yellow and 25% green and yellow II with 100% yellow.

III. RESULT AND DISCUSSION

The bud phase included the inflorescence bud until first flower appearance. Flowering began with the mother inflorescence bud which appeared on the stem node, grew horizontally to form 90° toward the stem, green colour with ±0.5cm on second day and tapered tip. The buds experienced increment of ±2.3cm (lt), grew upright so that angle formed between the inflorescence buds and stem narrowed to 5°, green, tapered tip and node presence in the inflorescences stalk at 7 days later. At 21st days, mother inflorescence stalks reached length of 16.8cm, first flower bud (kd) grew on the mother's nodes ±0.6 cm with flower stalk of 0.6cm, flower buds and flower stalks are both green

I, flower bud tip is tapered, and flower stalk grew upward 5° toward mother inflorescence stalk.

The flower bud phase is divided into two stages such as bud stage and breakout stage. The bud stage occurred after 26 days of mother inflorescence bud appearance, mother inflorescence stem of 21.7cm, flower bud (kb) of 1.1 cm. All flower parts were still protected by sepals. The dorsal and lateral sepals are fused so that did not explode and there were vertical lines on the sepals. The flower buds shaped triangles with legs rounded based on front view and right triangle shaped based on front view. The flower buds and flower stalks were green I, flower stalks grew downwards so flower buds droop and flower stalks were 1.25 cm.



Fig. 1 Flowering bud stage. (A) mother inflorescence bud stalks, bar= 0.5 cm (B) mother inflorescence stems at 7th day, bar= 1cm (C) first flower bud appearance, bar= 1cm. kb=flower bud, no=node, it= mother inflorescence stalk, tb= flower stalk, T.it= mother inflorescence stalk bud

Based on Figure 2, the bud was ruptured at 27th day after mother bud appearance, stalk length of 22.6cm, stalk length was 1.28cm and flower bud were 1.2 cm which torn of 0.3 cm on the right and left from flower bud base. The sepal torn increased by 0.5cm on 30th day, flower buds reached at 1.46cm, flower stalk length was 1.56 cm, flower bud and flower stalks were green I. At 31st day, mother stem appearance, flower bud length of 1.6cm, flower stalks length was 1.71cm, torn at the sepal base length was 1 cm. The torn sepal showed the petals with green II, the dorsal sepals and

lateral sepals could be distinguished, there were 5 vertical stripes on each sepal and flower buds appeared slightly large compared previous stage. At 32th day, the flower buds was 1.69 cm and flower stalks was 1.8cm. As widening torn sepal, the dorsal and lateral sepals are opened but the edge are still attached from front side and petal is appeared as green II which is getting clearer, curved and flower buds bulge and shorten. Meanwhile, labellum was white with purple line as in Figure 2.

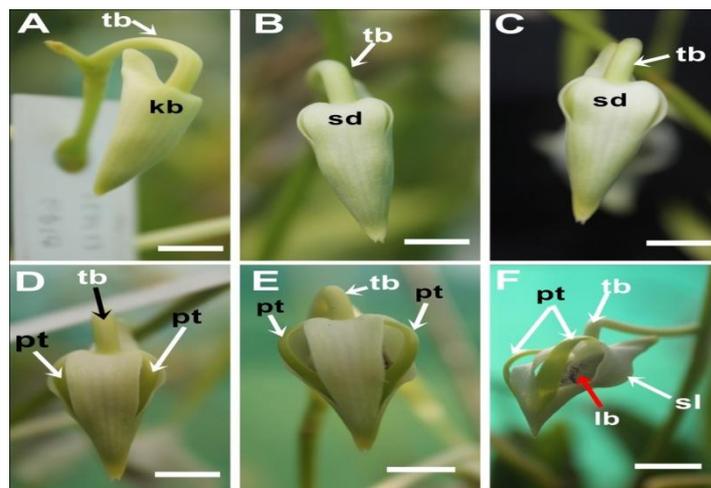


Fig. 2 Flower bud phase. (A) bud stage, bar= 0.5cm and (B-E) the ruptured bud stage, bar= 0.5cm. kb= flower bud, lb= labellum, sd= dorsal sepal, sl=lateral sepal, pt=petal.

Based on Figure 3, in 6th stage, 38th days after inflorescence bud appearance, dorsal sepal length was 1.95cm and white colour, flower stalk length was 2.8 cm with white and dorsal sepal rotated backward at angle of 315 °, while the petal was twisted toward opposite direction. The twisted of petals was not always in the opposite direction, there were chances for right petal was twisted to the right and vice versa or two petals were twisted in the same direction. In additions, the petal colour also changes of green II and white. If 3rd to 5th stages, the green II comparison, white were 3/4 and 1/4. In 6th stage, the comparison between green II and white was unchanged which was 1/2 green II and 1/2 bottom is white.

Furthermore, second blooming phase occurred on 39th days to 43rd day after the appearance of inflorescence buds. The first stage in the second blooming phase is when lateral sepal is open on 39th day after inflorescence appearance, dorsal sepal was 2.04cm in diameter and white, flower stalk was 2.8 cm and white, petal colour was green II and white and labellum was clearly visible. In first stage, the dorsal sepal rotated as much as 360 ° and lateral sepal is open at 45° so that the flower look like an equilateral triangle.

In 2nd stage that occurred at 41st day after inflorescence buds, the right and left petals were twisted for second time, the dorsal sepals were 2.23cm and rotated for second time,

lateral sepals were increased to the rear side, so that angle formed narrows to 30 ° and angle formed by petal position was narrowed to 45 °. In this stage, the petal colour was green II and white, while the dorsal sepal and lateral sepal were white. Meanwhile, 3rd stage was full blooming stage which is on 42nd to 43rd day after inflorescence buds appearance, where the dorsal sepal length was 2.26-2.32 cm, flower stalk was 2.9cm, the sepal and flower stalk were white, right and left petal were twisted upright which parallel to green II and white. In flowering of *Dendrobium antennatum* Lindl, scent began had presented during bud stage, 32nd day until second blooming phase on 43rd day after inflorescence bud appearance.

Phenology observation of flowering started from mother flowering stem bud indicated changes and increased in size in the mother inflorescence stalk, flower bud size and flower stalk size (potential fruit). This observation had took place in DD Orchids which is located at altitude of 680-1200 meters above sea level with green house environment that had relative humidity (Rh) of 79.9%, light intensity of 2430.30 λ and air temperature of 24 °C. Overall changes in flowering phases are not directly affected by certain environment stimuli, whether humidity, light intensity and temperature. In this study, the surrounding environment tends to be constant.

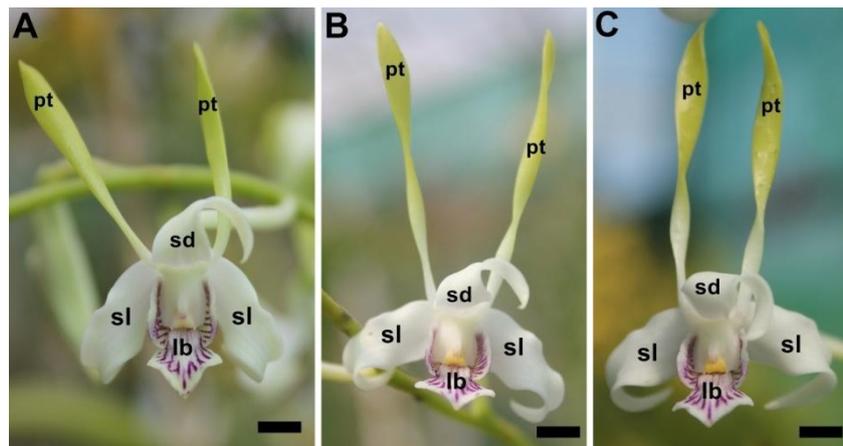


Fig. 3 Blooming phase II (A) first stage, bar= 0.5cm (B) second stage, bar= 0.5cm and (C) 3rd stage, bar= 0.5cm. lb= labellum, pt=petal, sd=dorsal sedal, sl= lateral sepal.

Flowering process in *D. antennatum* which began with mother inflorescence stalk bud until flower blooms perfectly (anthesis) took 42 days to 43 days, 12 days for shoot phase, 7 days for bud phase and 11-12 days for the blooming phase. This duration was shorter compared to flowering phases in *Dendrobium rumphianum* which took 29-41 days from bud to perfect blooming and *Paphiopedilum glaucophyllum* J.J.Sm var *glaucophyllum* which took 31 days until 32 days from flower bud appearance toward full blooming [11]. The flower buds growth to full blooming experienced steady increment which was characterized by morphological changes and average flower bud growth reached average of 0.1 cm per day.

The pollination is process in mating the male and female through the fruit formation. A tool for flower reproduction or gynandrium called column consisted male and female genital which is located above the labellum. The fruit selfing was aims to maintain its sustainability since orchid species are decreasing in the number. Meanwhile, pollination was

carried out on different types or known as crosses aims to produce new types that are healthier and have better flowers species which match with the crosses.

Fruit set is developmental process that is unique to the plant and transition from ovary to prospective fruit which is an important process in sexual reproduction of flowering plants. In *Dendrobium antenatum* Lindl, the fruit set stage began with the fertilization phase which marked by the swollen of the flower stalk which developed into fruit. The swelling is accompanied by changes in the flower stalk colour from white to green. In the fertilization phase, flower stem swelling began to appear at the tip and base which into the middle at last.

Furthermore, the fruit development stage is non uniform process since each fruit had different level of cell size and required variety of time.

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In *Dendrobium antennatum* Lindl, the fruit development stage could be observed in the cell enlargement phase which occurred between 30th and 98th days after the pollination that indicated by the increment in fruit length and diameter significantly.

The fruit ripening is process that occurred with biochemical event such as discoloration, sugar content, acidity, texture and aroma. The colour changes in

Dendrobium antennatum Lindl from green to yellow occurred on 99th days to 111th day after pollination. Fruit skin discoloration which occurred during maturation stage is accompanied by cell size development but insignificantly as happened in the cell enlargement phase. In addition, skin colour changes in each fruit have different characteristics. Table 1 presents the Morphological changes in flowering of *Dendrobium antennatum* Lindl.

Table. 1 Morphological changes in flowering of *Dendrobium antennatum* Lindl

Mother inflorescence stalk length	Morphology changes in flowering						
	Flower stalk length	Flower bud length	Pattern	Dorsal/latera l sepal colour	Petal colour	Flower stalk colour	Aroma
Maximum length was \pm 36.3 cm on 45th day after inflorescence bud appearance	The flower stalk grew on 19 th day after inflorescence appearance and reached maximum length of \pm 2.9 cm on 43 rd day after inflorescence bud appearance.	The flower bud grew on 14 th days after inflorescence bud appearances, when mother stalk reached 7.8cm and reached \pm 2.32 cm on 43 rd day after inflorescence buds.	There were vertical stripes visible from 25 th to 43 rd day after inflorescence bud appearance.	The dorsal sepal and lateral sepal was in green I from 14th day to 43th after inflorescence bud appearance.	On 32th to 35 th days after inflorescence bud appearance was in green II. Meanwhile, petal was green II on 36 th until 43 rd day.	The flower stalk was green I from 19 th until 39 th days after inflorescence bud appearance. From 40 th until 43 rd days, the inflorescence bud appearance turned white colour.	There was scent from 32 nd day until 43 rd days after inflorescence bud appearance

IV. CONCLUSION

In conclusions, inflorescence stage of *Dendrobium antennatum* Lindl included three phases (shoot, flower buds and blooming phases). Sharp tip shoots appear on the stem nodes and growth horizontally forming an angle 90° to stem. The flower bud shapes were right-angled triangle and bow. In the bloom phase, there were changing colours of petals from green to white green with the raised antenna shape like (at 35 DAS) and become twisted (at. 38 DAS).

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