



## Effect of plant size on growth and flower production of *Phaius tankervilleae* (Banks ex L'Hérit.) Blume - an endangered orchid of North-Eastern India

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### ABSTRACT

A pot experiment was conducted at Horticultural Research Station, Kahikuchi, Guwahati, to study the effect of different sizes of plants on vegetative growth and flower production of *Phaius tankervilleae*. Five different plants with varying sizes and numbers of pseudo bulb were adopted as treatments which were replicated 4 times. The flowers bloom from April and the experiment shows T3 produces the maximum number of spikes (2.38) per plant and earliest spike initiation (250.77) days while T5 produces the least number of spikes (0.5) plants and took longest days for spike initiation with (255.13) days. Meanwhile, T1 produce more new pseudo bulbs (4.0) and the least number was seen in T5 with (2.14). But T5 plants produced the biggest new pseudo bulbs (2.85cm diameter). Irrespective of the numbers of the pseudo bulb, plants with bigger pseudo bulb produced a bigger plant, long spike, more spike, bigger and more number of flowers which are a superior trait for a good quality cut flower. Beyond the production of flowers, this experiment further promotes the multiplication of pseudo bulbs, which are necessary for increasing the population of the plants for restoring and conserving the plant population without further exploitation.

### Introduction

*Phaius tankervilleae* commonly known as nun's-hood orchid, Swamp Lily, Greater Swamp-orchid or veiled orchid is a critically endangered terrestrial orchid known to have large, spectacularly, beautiful, and fragrant spikes. It is native to Northeastern states of India and found growing wild in shady, cool, and moist forested areas of Arunachal Pradesh, Manipur (Hengbung, Ukhrul district), Nagaland (Kiphire, Tuensang, and Zunhebeto district) and Assam (Bongaigaon, Darrang, Dhemaji, Golaghat, MNP, Sanitpur) (Deb and Jakha, 2019; Dey *et al.*, 2007; Sadananda *et al.*, 2019). It has been categorized as endangered species, under the Environmental Protection and

Biodiversity Conservation Act. It is also found in Taiwan, the Eastern seaboard of Australia, Indonesia, Malaysia, Sri Lanka, Thailand, Southern China, and India (Shu *et al.*, 2012). The Orchid is a large one, having firm fleshy pseudo bulbs, with several large pleated leaves that favor high temperatures and wet environments (Tsai and Chang, 2009). The inflorescence is a simple raceme that can attain up to 100cm in height, and bear up to 30 large flowers that bloom from April to July. The flower of *P. tankervilleae* is of great ornamental and economic value and is grown as a potted plant, a garden plant, or as cut flowers (Chang and Jian, 2010). In Northeast India, the pseudo bulb of

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*Phaius tankervilleae* has various medicinal uses viz: healing of edema, used as a pain killer, and for treating boils and bone fracture (Medhi, and Chakrabarti, 2009; Kanwal, 2014). However, as a result of unscrupulous harvesting from the wild by plant collectors to be grown as potted plants, deforestation to make way for agriculture, and disturbance of habitat, the population of *P. tankervilleae* has been drastically reduced and is on the verge of extinction. At present, it in small numbers are present only in governmental and university botanical gardens. *Phaius tankervilleae* can be asexually propagated through pseudo bulbs, swollen parts of stems at the base of orchid plants that support leaf growth and a pseudo bulb produces two to three daughter pseudo bulbs every season. A pot experiment was conducted at Horticultural Research Station, Kahikuchi, Guwahati to study the effect of different plants size on vegetative growth and flower production of *Phaius tankervilleae*. This horticultural research can be useful for the production of Pseudo bulbs for propagation, improving the yield and quality of *P. tankervilleae* flowers. This experiment demonstrates the ornamental value and economic potential of this endangered orchid. Besides, it help

promote its conservation, restoration, and expansion as an ornamental plant.

## Material and Methods

### Planting materials

A population of *Phaius tankervilleae* plants was collected and grown in 25cm diameter earthen pot in growing media containing Soil: Sand: FYM @ 1:1:1 and NPK (19:19:19) @ 10gm/m<sup>2</sup> were applied. The experiment consists of 5 different plant types/treatments of *Phaius tankervilleae* which were replicated 4 times. T1 consists of plant having 4 pseudo bulbs (2 old and 2 new), T2 consists of plant having 3 pseudo bulbs (2 old and 1 new), T3 consists of plant having 3 pseudo bulbs (1 old and 2 new), T4 consists of plant having 2 pseudo bulbs (1 old and 1 new) and T5 consist of plant having only 1 new pseudo bulb. All the plants were 2-3 years old when taken and have not been repotted before while the plant with only 1 pseudo bulb was 1 year old freshly harvested plant.

### Plant growth and development

The vegetative and flowering parameters of each plant were studied and recorded, including the growth and development of the new plant (3 months after flowering). Complete Randomized Design was adopted to compare the effects of treatments.

**Table 1: Treatment specification**

Treatment	Specification		
	No. of Pseudo bulb	Mean diameter (old pseudo bulb) (cm)	Mean diameter (new pseudo bulb) (cm)
T1	2 old and 2 new	5.38	6.33
T2	2 old and 1 new	5.53	6.45
T3	1 old and 2 new	5.44	6.49
T4	1old and 1new	5.45	6.50
T5	1 new pseudo bulb	-	6.08

## Results and Discussion

The different sizes of plants significantly influenced the vegetative and flowering characters of *Phaius tankervilleae*. The results obtained from the experiment are discussed below.

### Effect on Vegetative characters of *Phaius tankervilleae*

It can be seen from the data presented in Table 2 that the maximum plant height was observed in plants from T2 (86.31 cm) while the least was observed in T5 (80.29 cm) which was only one 1

year old at the time of the experiment. Plants from T3 (1 old and 2 new pseudo bulbs) recorded significantly greater plant width (92.04 cm), leaf production (14.37 leaves/ clump), and leaf length (73.13 cm). On the other hand, minimum plant width (72.08 cm), leaf production (5.21 leaves/ clump), and leaf length (60.85cm) were all recorded in T5 (1 new pseudobulb) plants. Lastly, maximum leaf width (13.48 cm) was recorded in the T4 (1 old and 1 new pseudobulbs) plants while the minimum leaf width (11.4 cm) was recorded in T5 (1 new pseudobulb).

**Table 2: Effect of plant size on vegetative characters of *Phaius tankervilleae***

Treatment	Plant height (cm)	Plant width (cm)	No. of leaves per clump	Leaf length (cm)	Leaf width (cm)
T1	85.57	98.46	12.45	68.44	11.45
T2	86.31	89.50	13.89	66.83	11.7
T3	84.80	92.04	14.37	73.13	12.5
T4	82.22	87.17	10.32	67.4	13.48
T5	80.29	72.08	5.21	60.85	11.4
S. Ed. (±)	0.02	0.01	0.20	0.02	0.11
C.D.	0.05	0.03	0.45	0.04	0.25

**Table 3: Effect of plant size on flower characters of *Phaius tankervilleae***

Treatment	No. of Spikes/plant	Floret per spike	Spike length (old pseudo bulb) (cm)	Rachis length (cm)	Diameter of fully opened flower (cm)
T1	2.1	11.14	56.75	16.17	8.93
T2	2.0	11.69	54.57	15.86	9.10
T3	2.38	12.14	54.33	14.57	9.30
T4	1.06	11.80	52.25	14.45	9.28
T5	0.5	11.50	45.80	12.00	8.97
S. Ed. (±)	0.21	0.05	0.64	0.08	0.08
C.D	0.47	0.12	1.45	0.17	0.19

**Table 4: Effect of plant size on flower characters of *Phaius tankervilleae***

Treatment	Spike length from new Pseudo bulb (cm)	Days took for the initiation of the spike.	First color showing Days after spike emergence	Days to the opening of the first florets	Days took for the last flower to fade
T1	46.13	255.10	25	18.5	36
T2	48.24	254.54	26	18.8	38
T3	53.77	250.77	23	19.3	41
T4	52.36	252.40	24	19.1	40
T5	52.54	255.13	21	19.25	39
S. Ed. (±)	0.03	0.16	1.03	0.10	0.84
C.D	0.06	0.35	2.33	0.22	1.84

**Table 5: Effect of plant size on characters of the newly developed plant after flowering at Kahikuchi**

Treatment	New plant height (cm)	Leaves/ Pseudo bulb	New pseudo bulbs /Plant	Diameter of new pseudo bulb (cm)
T1	32.75	5.53	4.00	2.55
T2	45.88	5.57	2.00	2.58
T3	48.52	5.64	2.42	2.63
T4	55.43	5.62	2.33	2.75
T5	60.31	5.50	2.14	2.85
S. Ed. (±)	0.03	0.02	0.37	0.02
C.D	0.07	0.04	0.83	0.05

plants. The inferior performance of T5 plants may be because they are the youngest plants. However, the harvest of pseudo bulbs of an orchid diminishes its nutrient and water capital thus lowering the growth and reproduction of the orchids (Zimmerman, 1990).

**Effect on flowering characters of *Phaius tankervilleae***

The yield and quality of flowers produced in *Phaius tankervilleae* are greatly influenced by the size of the planting materials, as is evident from Table 3 and Table 4. T3 produces the maximum number of spikes (2.38) per plant and it was at par with T2 and T1 (2 and 2.1 spikes/plant)

respectively. However, the least number of spikes (0.5) was recorded in T5. Longest Spike and Rachis lengths (from old pseudo bulb) were found from the T1 plants, with the length of 56.75 cm and 16.17 cm respectively while the shortest were from T5 plants, where the spike length is 45.8 cm and Rachis length is 12. However, from the new pseudo bulb, the longest spike was recorded from T3 (53.77 cm) and the shortest from T1 (46.31). The maximum number of florets/ spike (12.14) and biggest flower diameter (9.30 cm) were recorded from T3 plants and the minimum from T5 plants with a record of (11.14) floret per spike and (8.93 cm) flower diameter. Earliest spike initiation (250.77 days from planting) was recorded from T3 plants while T5 plants took maximum duration (255.13 days from planting) for spike initiation. Among the treatments, flower bud color was first observed in T5 (within 21 days after spike initiation) followed by T3 and T4, taking 23 and 24 days, respectively. On the other hand, T2 took the longest duration (26 days) for flower bud color initiation. The first floret to open and the first plant to fade all floret were all recorded from T1 with 18.5 days and 36 days respectively. While the last floret to open and the Last plant to fade all floret were from T3 with 19.3 days and 41 days respectively.

#### **Effect on newly developed plants**

The morphological characteristics of the newly developed plants were studied 3 months after flowering. The height of newly developed plants was significantly influenced by the size of the pseudo bulb. T5 produced significantly taller plants (60.31 cm), followed by T4 (55.43 cm). The smallest plants with 32.75 cm plants height were observed in T1 which had the maximum number of pseudo bulbs. However, the maximum number of newly developed leaves (5.64) and (5.62) emerged from treatments T3 (1 old and 2 new pseudo bulbs) and T4 (1 old and 1 new pseudo bulbs) respectively meanwhile the minimum number of leaves (5.50) was from T5. It was observed that new pseudo bulbs had started to grow from the mother plants. A significantly higher number (4.0) of new pseudo bulbs were found in T1 (mother plant with 2 old and 2 new pseudo bulbs). Meanwhile, the least number (2.14) could be seen in T5 (mother plant with 1 new pseudo bulb) which was at par with T2,

T3, and T4 producing 2.0, 2.42, and 2.33 numbers of new pseudo bulbs respectively. The smallest mother plant T5 (1 new pseudo bulb) produced the biggest new pseudo bulbs (2.85cm diameter) and it was followed by T4 and T3, recording 2.75 cm and 2.63 cm diameter respectively.

#### **Conclusion**

Pseudo bulbs are involved in innumerable physiological processes that are important for the growth and survival of *Phaius tankervilleae*. Plants from T3 recorded significantly greater plant width (92.04 cm), leaf production (14.37 leaves/ clump), leaf length (73.13 cm), maximum number of spikes (2.38) per plant, longest spike (53.77 cm), maximum number of floret/spike (12.12) and biggest flower diameter (9.30 cm) while the plants from T5 recorded the least. Where *Odontioda* Orchids, with a greater pseudo bulb diameter produces better plants and the occurrence of floret/spike was positively correlated ( $P \leq 0.01$ ) to pseudo bulb diameter. Similarly in the newly developed plant after flowering T5 with biggest size pseudo bulbs (2.85) produces the tallest plant (60.31) meanwhile T1 plants with smallest pseudo bulbs (2.55) produces the smallest plant (32.75) although it produces maximum number of new pseudo bulbs. From this experiment, it can be concluded that the presence of more number pseudo bulbs did not improve vegetative growth and flower production. The bigger size of new pseudo bulbs resulted in bigger plants, earlier spike emergence, bigger size of spikes, more florets per spike compared to smaller bulbs. This is because pseudo bulb can store water, mineral, and carbohydrates and mineral allocation to pseudo bulbs constitutes an important source of reserve for the subsequent development of the inflorescence and new shoots. So, the larger the pseudo- bulb better the performance of the plant. Meanwhile, diseases like black spots with water-soaked patches were observed on the leaves of the old pseudo bulb plants while the newly emerged leaves and leaves from the new pseudo bulb were devoid of diseases. Apart from being plants which has economical and medicinal importance, the leaves and flowers of *Phaius tankervilleae* are also used to yield natural dyes and produce indigo colour.

#### **Conflict of interest**

The authors declare that they have no conflict of interest.

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