J. Orchid Soc. India, 26 (1-2): 25-29, 2012

ISSN 0971-5371

SEED MORPHOMETRIC STUDIES IN SOME ORCHIDS FROM MANIPUR

Jennifer Tongbram, A Nageshwara Rao, and S P Vij

Centre for Orchid Gene Conservation of Eastern Himalayan Region (COGCEHR), Hengbung-795 129, Senapati District, Manipur, India

Abstract

The paper deals with seed morphometry of 10 orchid species from Manipur. Volume wise, the seeds were largest in *Cymbidium iridioides* (15372.8 $\mu m^3 \times 10^3$) and smallest in *Taeniophyllum glandulosum* (159.35 $\mu m^3 \times 10^3$). The embryo measured the maximum in *Paphiopedilum hirsutissimum* (3069.3 $\mu m^3 \times 10^3$) and minimum in *Taeniophyllum glandulosum* (82.4 $\mu m^3 \times 10^3$). The air cavity accounted for 90.5% seed volume in *Cymbidium iridioides* and only 4.9% in *Aerides odorata*. The air cavity adds to the buoyancy of seeds, and seems to influence the distribution range in different species.

Introduction

THE ORCHIDS have the smallest of seeds among the flowering plants. They are highly reduced and produced in large numbers. An orchid capsule is estimated to contain several hundreds to millions of dust-like and non-endospermic seeds, each of which comprises an undifferentiated embryo suspended within a membranous and often transparent, but at times pigmented seed coat (Kupper and Linsenmaier, 1961). The orchid seeds vary in shape from ovoid or ellipsoid to fusiform, winged and filiform, and the air space within may account for up to 90% of the total seed volume. While, the air space in orchid seeds is directly related to their dispersal potential (Arditti and Ghani, 2000; Barthlott (1976); Pathak *et al.*, 2011; Pridgeon *et al.*, 1999; Vij *et al.*, 1992), the data envisioned the taxonomic utility of orchid seeds at the sub-tribal and tribal levels.

In India, the orchids are represented by nearly 1300 species, but seed morphometric studies have remained rather meager in these plants (Krishna Swamy *et al.*, 2004; Rani *et al.*,1993; Vij *et al.*, 1992). With a view to bridging this information gap, studies were initiated on seed morphometry of Manipur orchids. This paper reports the details in 10 species.

Material and Methods

Ten species of orchids representing both the terrestrial and epiphytic habits were included under the scope of present studies (Fig. 1 a-j). Their source is given in Table1. The mature fruits (capsules) were harvested in each species. These were split opened using a surgical blade, and the seeds extracted in water in a test tube. Two to three drops of a weak detergent (Tween 20) were added to the seed solution. Later, a drop of the seed solution was placed on a clean slide, covered with a cover slip, and observed under a microscope. Photomicrographs were taken using a digital camera (Cybershot DSC W120, Sony, Japan).

Data on size, shape, and surface features of seeds were recorded for each species. The length and breadth were

Table 1. Orchids selected for investigation; their source and fruiting period.

Species	Source with altitude	Fruiting time
Aerides odorata	Dailong Cemetry, Tamenglong. 1029 m	June
Ascocentrum himalaicum	Willong, Yangkhulen. 1740 m	October-November
Cymbidium iridioides	Sadim Pukhri, Sadim. 1567 m	October- December
Dendrobium crepidatum	Sadim Pukhri, Sadim. 1485 m	April-May
Hygrochilus parishii	Willong Khunou, Willong. 1028 m	June-July
Paphiopedilum hirsutissimum	Khajinglok, Willong. 1446 m	April-May
Papilionanthe vandarum	Willong Khunou, Willong. 1028 m	June-July
Rhynchostylis retusa	Dailong Rangaan, Tamenglong. 999 m	June
Taeniophyllum glandulosum	Hengbung, Senapati. 1180 m	February- May
Vanda coerulea	Sadim Pukhri, Sadim. 1485 m	August- December

Received : May 10, 2012; Accepted : August 24, 2012

measured at the longest and widest axis of the seed with the help of a micrometer. Seed volume was calculated by using the formula $2[(W/2)^2(L/2)\ \ /3]$, where W=width, L=length, /3=1.047, as done earlier (Arditti *et al.*, 1980). The embryo volume was calculated using the formula 4/3 ab^2, where a=1/2 its length and b=1/2 its width.

Results and Discussion

Seed morphometrics were studied in 10 species. The results, summarized in Table 2, are illustrated (Fig. 2) and briefly discussed as follows:

The seeds range from light green to dark brown in colour. These are pale yellow in *Rhynchostylis retusa*, light green in *Taeniophyllum glandulosum*, and various shades of brown in *Aerides odorata*, *Ascocentrum himalaicum*, *Cymbidium iridioides*, *Dendrobium crepidatum*, *Hygrochilus parishi*, *Paphiopedilum hirsutissimum*, *Papilionanthe vandarum*, and *Vanda coerulea*.

The seeds in *Aerides odorata* are crescent-shaped. They are small and globular in *Ascocentrum himalaicum* and *Rhynchostylis retusa* , whereas in *Cymbidium iridioides* they are transparent, spindle-shaped with a centrally located embryo (Fig.2e) in accord with similar seed structure in *Cymbidium bicolor* (Krishnaswamy *et al.*, 2004). The seeds in *Dendrobium crepidatum* are also small and spindle-shaped with a medium-sized embryo (Fig. 2g). The seeds of *Vanda coerulea* are small and fusiform with longitudinally oriented testa cells. In *Taeniophyllum glandulosum* ,the seeds are very small and ovoid (Fig. 2q). The seeds of *Papilionanthe vandarum* are also spindle-shaped with both ends pointed. The seeds of *Hygrochilus parishii* and *Paphiopedilum hirsutissimum* are oblong to elongate in shape.

Among the presently investigated species, the maximum seed length is observed in *Cymbidium iridioides* (1001.2 μm) and minimum in *Taeniophyllum glandulosum* (200 μm).The maximum seed width is observed in *Cymbidium iridioides* (240 μm) and minimum in *Taeniophyllum glandulosum* (55 μm). According to Arditti *et al.* (1979), the seed volume in orchids is a reflection of the size of

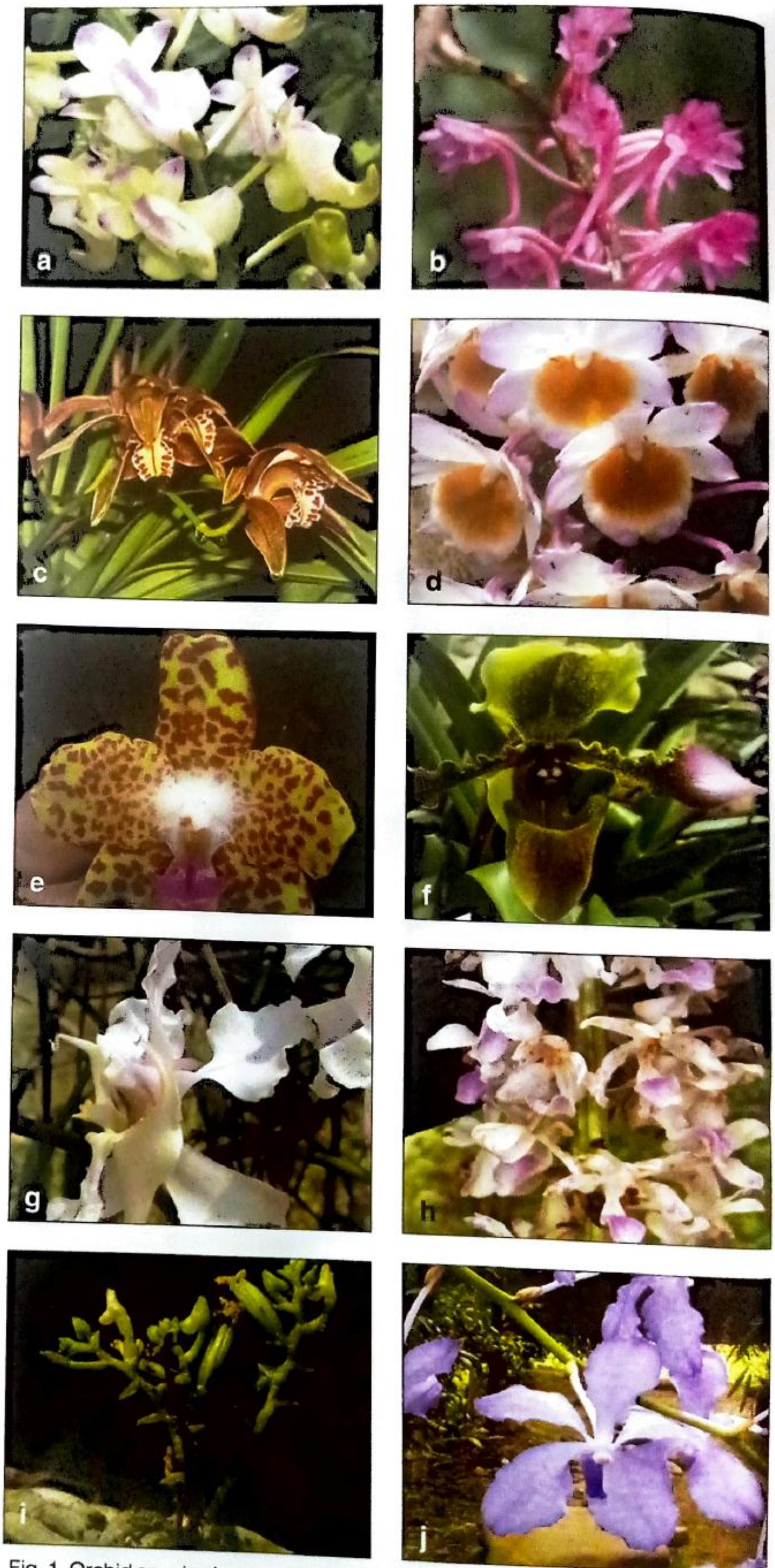

Fig. 1. Orchid species investigated: a, *Aerides odorata*; b, *Ascocentrum himalaicum*; c, *Cymbidium iridioides*; d, *Dendrobium crepidatum*; e, *Hygrochilus parishii*; f, *Paphiopedilum hirsutissimum*; g, *Papilionanthe vandarum*; h, *Rhynchostylis retusa*; i, *Taeniophyllum glandulosum*; j, *Vanda coerulea*.

Fig. 2. Seed shape and surface pattern in orchids: a-b, *Aerides odorata*; c-d, *Ascocentrum himalaicum*; e-f, *Cymbidium iridioides*; g-h, *Dendrobium crepidatum*; i-j, *Hygrochilus parishii*; k-l, *Paphiopedilum hirsutissimum*; m-n, *Papilionanthe vandarum*; o-p, *Rhynchostylis retusa*; q-r, *Taeniophyllum glandulosum*; s-t, *Vanda coerulea*. Bar=100 μm.

Table 2. Morphometric details in orchid seeds.

Species	Seed			Embryo			Air cavity	
	length (μm)	width (μm)	volume (μm³×10³)	length (μm)	width (μm)	volume (μm³×10³)	volume (μm³×10³)	percent
Aerides odorata	265.0 ±3.63	77.5 ±2.50	422.1 ±29.8	180.0 ±3.33	65.0 ±2.50	400.3 ±28.5	21.7 ±4.5	4.9 ±1.0
Ascocentrum himalaicum	248.7 ±8.42	90.0 ±3.11	529.7 ±36.6	188.7 ±3.46	68.7 ±2.79	468.8 ±33.9	60.8 ±12.9	11.2 ±2.2
Cymbidium iridioides	1001.2 ±39.5	240.0 ±8.70	15372.8 ±1398.8	221.2 ±15.3	100.0 ±6.18	1238.3 ±191.5	14134.5 ±1505.3	90.5 ±2.0
Dendrobium crepidatum	552.5 ±13.7	138.7 ±5.72	2849.5 ±275.4	250.0 ±8.74	95.0 ±2.76	1216.9 ±75.0	1632.7 ±274.9	53.6 ±5.0
Hygrochilus parishii	238.7 ±2.91	81.2 ±2.79	416.5 ±29.5	162.5 ±2.63	55.0 ±2.04	259.9 ±19.7	147.5 ±16.6	37.6 ±1.8
Paphiopedilum hirsutissimum	831.2 ±24.8	196.2 ±7.22	8506.9 ±676.1	312.5 ±20.7	135.0 ±6.12	3069.3 ±320.9	5437.5 ±502.9	64.1 ±2.8
Papilionanthe vandarum	302.5 ±10.1	106.2 ±2.79	897.8 ±56.9	207.5 ±4.63	83.7 2.66	727.6 ±62.02	170.2 23.6	19.5 ±2.9
Rhynchostlylis retusa	275.0 ±4.56	81.25 ±2.79	479.4 ±33.4	186.2 ±3.46	67.5 ±2.04	447.4 ±29.8	32.0 ±6.2	6.4 ±1.1
Taeniophyllum glandulosum	200.0 ±3.72	55.0 ±2.04	159.3 ±10.9	85.0 ±3.63	42.5 ±2.04	82.4 ±9.4	76.9 ±5.3	49.2 ±3.0
Vanda coerulea	233.7 ±5.07	67.5 ±1.84	281.7 ±17.4	158.7 ±5.34	52.5 ±1.50	230.1 ±15.1	51.5 ±11.6	17.6 ±3.0

the seeds. The highest seed volume is observed in *Cymbidium iridioides* (15372.8 μm³ × 10³) followed by *Paphiopedilum hirsutissimum* (8506.9 μm³ × 10³), while minimum seed volume was observed in *Taeniophyllum glandulosum* (159.3 μm³ × 10³). Species like *Vanda coerulea*, *Hygrochilus parishii*, *Arides odorata* and *Rhynchostylis retusa* have lesser seed volumes with 281.7 μm³ × 10³, 416.5 μm³ × 10³, 422.1 μm³ × 10³ and 479.4 μm³ × 10³ respectively (Table 2).

Dressler (1993) classified orchid seeds into 21 different types based on structure. Among the present species, *Aerides odorata, Ascocentrum himalaicum, Hygrochilus parishii, Papilionanthe vandarum, Rhynchostylis retusa, Taeniophyllum glandulosum* and *Vanda coerulea* may be categorized under the 'Vanda Type'. Here, the seeds are oblong, yellowish, but usually brown or blackish brown and range in length from 300 to 500 μm. Testa cells are always so strongly elongate that the longitudinal anticlinal walls are in contact with the surface of the seed. *Cymbidium iridioides* may be categorized under the 'Cymbidium Type', in which the seed length ranges from 500 to 1000 μm. Testa cells are polygonal or slightly elongate; the cell border is not visible; the cell corners are strongly raised, and each is covered with a small or large wax hood; the anticlinal and periclinal walls are densely covered by parallel, longitudinal thickenings. *Dendrobium crepidatum* can be categorized under the 'Dendrobium Type'. Seeds are short or oblong with a total length of 300 to 500 μm; testa cells all of same size and quite elongate. The surface of the seed is always dull and velvety, i.e., covered by very fine warts. *Paphiopedilum hirsutissimum* can be categorised under the 'Epidendrum secundum Type'. In this, they are thread like upto 6.0 mm long, thus they are among the largest known orchid seeds; the medial sector is inflated; about 300-400μm wide. The testa cells in *Taeniophyllum glandulosum* are very unique in the sense that their cells have rounded ends while all the other species have pointed ends.

Among the studied taxa, maximum embryo length is observed in *Paphiopedilum hirsutissimum* (312.5 μm) and minimum in *Taeniophyllum glandulosum* (85.0 μm). Maximum embryo width is observed in *Paphiopedilum hirsutissimum* (135.0 μm) and minimum in *Taeniophyllum glandulosum* (42.5 μm). Maximum embryo volume is observed in *Paphiopedilum hirsutissimum* (3069 μm³ × 10³) and minimum in *Taeniophyllum glandulosum* (82.4 μm³ × 10³). See Table 2.

Again, maximum volume of air cavity is found in *Cymbidium irididides* (14134.5 μm³ × 10³) and minimum in *Rhynchostylis retusa* (32.02 μm³ × 10³). In the present work, seeds with high percentage of air space are noticed in *Cymbidium iridioides* (90.5%) and *Pahiopedilum hirsutissimum* (64.1%). Both these species are expected to be widely distributed. The seeds with smaller year cavity appear to be adapted to short range dispersal their as those with larger air cavity are attuned for long range dispersal. Significantly, contrary to this generalization, *Rhynchostylis retusa* having seeds with smaller air cavity is more widely distributed than *Cymbidium iridioides*, which has the maximum air cavity. Such a behaviour may be attributed to the posibility that *Cymbidium iridioides* seeds don't get congenial conditions for germination, whereas, *Rhynchostylis retusa* seeds seem to adapt to a wider amplitude of environmental conditions and can germinate readily under the prevalent conditions along the range.

Acknowledgement

We are grateful to Department of Science and Technology, New Delhi for financial support. We also thank Dr. Y. Nanda Devi and Ms. K.S.Thithila for help. We are also thankful to Mr H. Kipgen, President FEEDS /KVK-Sylvan, Hengbung for logistic support and encouragment.

References

Arditti, J., J. D. Michaud, and P. L. Healey 1979. Morphometry of orchid seeds.I. *Paphiopedilum* and native California and related species of *Cyprepedium*. *Amer. J. Bot.*, **66** : 1128-37.

Arditti, J., J.D. Michaud, and P. L. Healey. 1980. Morphometry of orchid seeds. II. Native California and related species of *Calypso, Cephalanthus, Corolloriza* and *Epipactis*. *Amer. J. Bot.*, **67** : 347-65.

Arditti, J. and A. K. A. Ghani. 2000. Numerical and physical properties of orchid seeds and their biological implications. *New Phytol.*, **145** : 367-421.

Dressler, R. 1993. *Phylogeny and Classification of the Orchid Family*. Cambridge University Press, Cambridge.

Krishna Swamy, K., H. N. Krishna Kumar, T. M. Ramakrishna, and S. N. Ramaswamy. 2004. Studies on seed morphometry of epiphytic orchids of Western Ghats of Karnataka. *Taiwania*, **49** (2): 124-40.

Kupper, W. and W. Linsenmaier. 1961. *Orchids*. Thomas Nelson and Sons Ltd., London.

Pathak, Promila, A.Bhattacharya, and K.C. Mahant. 2011. Seed morphometric studies in three medicinally important orchid species of genus *Malaxis* from Shimla hills (H.P.). *Research Bull. Panjab Univ.*, **61**(1-4):1-10

Pridgeon, A.M., P. J. Cribb, M.W. Chase, and F. N. Rasmussen. 1999. *Genera Orchidaceraum*. Vol. 1. Oxford University Press Inc. New York.

Rani, U., S. G. Singh, S. Gupta, and V. Garg. 1993. Morphometry of orchid seeds in epidendroidae as revealed by SEM. *Adv. Plant Sci.*, **6** : 128-33.

Vij, S. P., P. Kaur, S. Kaur, and P. S. Kaushal. 1992. The orchid seeds: taxonomic, evolutionary and functional aspect. *J. Orchid. Soc. India.*, **6** : 91-107.