EXPERIMENTAL TAXONOMY OF *PAPHIOPEDILUM* Pfitz. OF NORTH EASTERN REGION OF INDIA

ABSTRACT

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The North-Eastern region of India is one of the richest geographical zone of India for orchid with its diverse topography: altitude, climate and many other phytogeographical factors. This region has got immense treasure of orchid taxa which grow in profusion and also at the zenith with regard to their ornamental importance (Joy et al., 1994). However, various destructive activities and ruthless exploitation by the inhabitants disturb the delicately balanced natural habitat of orchids. Several orchid species have become extinct, many are at the verge of extinction and some are endangered.

Orchids are of tremendous horticultural interest, very promissing as well as challenging for various botanical investigations because of their characteristic and unique mode of life and reproduction. The genus Paphiopedilum is commercially most immportant group of orchids, with marvellous, beautiful, long lasting and large flowers.

In India, all the species of Paphiopedilum except P. druryi are found in North-Eastern region between 60-2220 m altitude. These are terrestrial or occassionally epiphytic, sympodial herbs with horizontally spreading thick roots. Leaves are conduplicate, oblong, elliptic, distichous, two to seveal, coriaceous, green or green mottled with light green or purple markings. Inflorescence terminal, terete. Flowers one or two per inflorescence, waxy in apprearance. Dorsal sepal erect, large, lateral sepals, united to form a synsepalum. Petals spreading, horizontal or pendent. Lip is slipper shaped, side lobes incurved. Column horizontal short with fleshy staminode at

apex infront of two fertile, ventral anther; pollinia two, glutinous. Stigma large, ventral, fleshy, short stalked, more or less hidden by side lobes of lip.

North-Eastern region of India is a trijunction - a meeting place of (a) Himalayan element, high altitude, (b) South, South-East Asian and far-east flora and (c) Peninsular India. Out of the seven existing species, six are confined to North-East, whereas P. druryi is only found in the Travancore hills of South India. This shows a discontinuous distribution of the species. Various ecological and adaphic factors could be the possible reasons for the distribution pattern of these species.

There are eight species reported from this region, viz., P. charlesworthii, P. fairrieanum, P. hirsutisimum, P. insigne, P. spicerianum, P. venustum, P. villosumand P. wardii. Out of these species, P. charlesworthii and P. wardii are supposed to be extinct from the nature. Every species has got distinct characteristics for identification, such as size and colour of leaf, leaf apex, lip and dorsal sepal. There are many variations and varieties among each species of Paphiopedilum of this region. Species diversity can be defined with satisfaction, the same may not be true in case of ecosystem diversity. Still, the ecosystem diversity/regional diversity can be identified on the basis of the increase or decrease in the number of species. Among all the species of Paphiopedilum, P. venustum showed the maximum number of variations, especially within the populations of Meghalaya. Hence, it may be suggested that Meghalaya could be considered as the centre of origin and dispersion of P. venustum.

The incessant sequence of biological diversity and gene pool should be efficiently utilized for the conservation of these species. The increasing importance of in vitro multiplication and perpetuation of species requires pure/natural species (biodiversity) for basis breeding stock.

Phenological observations are pre-requisite for sceintific multiplication and hybridization. The concept and significance of phenological investigations have been discussed in detail by Lieth (1970), Lieth and Radford (1971). Most of the characteristics are found species specific. The leaf apex may be considered as a very distinguishing character of species, for the identification even in vegetative stage. Various genetical as well as ecological factors influenced the phenology of **Paphiopedilum** species of this region. Out of six species studied, five species except **P. hirsutissimum** has got the flowering season from October-March i.e., from autumn to the end of winter. The floral longivity was minimum in **P. hirsutissimum** (blooming, March-June). This observation indicate that temperature, atomospheric humidity, intensity of light etc., have the direct impact on the flowering and longivity. Less relative humidity, high temperatue, high intensity of light have a negative impact on the floral longivity of **Paphiopedilum** species. The periodicity of different phenophases reflects seasonal distribution of specific kind of resources such as flower, pollen, fruit, seeds etc. Regular seasonal pattern observed in all the species may be due to the conducive climate of the

region. This kind of informations would be a great help in implementing sceintific multiplication/developmental programmes, proper utilization and management of resources in the orchid industry as well as for the conservation of the species. Since, the **Paphiopedilum** species are facing threat to their survival in nature, propagation and conservation of the species are the need of the time.

Epidermal and cuticular characters of the leaf have remarkable value in the field of palaeobotany, palaeoecology, pharmacognosy and taxonomy (Stace, 1966; Hardin, 1979; Wurdack, 1986; Singh and Dube, 1991). **Paphiopedilum** species under present investigation has got specific characteristics of leaf surface morphology. The cuticular sculpturing was different in all the species. The sculpturing of cuticle may be corelated with the light intensity of the environment. Absence of epidermal hairs observed in all the species is a general feature of Orchidaceae. Hyperstomatic chamber as well as lack of stomates on upper surface of the leave observed in the present study may function as water reservoir. The structural pattern of stoma present in all the species of **Paphiopedilum** supporting the premitive nature of the group. The overall similarity observed in the structure and only one type of stomata (elliptical) suggest that the group represent one phyletic line and might have evolved under a common environmental factors. Cuticular sculpturing, presence/absence of glandular hairs or trichomes, distribution, size , shape and structure of stomata, stomatal opening etc., are much significant in elucidating the phylogeny of the species. Leaf topology could

be used as a secondary or supporting characteristic in tracing out the taxonomic position/phylogeny of Paphiopedilum species along with the available information from other aspects of botany.

Orchid seeds are smallest among the seeds produced by the flowering plants and Paphiopedilum seeds are very small devoid of endosperm. Usually the number of seeds per capsule is ranging from 1,300 to 10,00,000. In the case of Paphiopedilum species this number is in the range of 42,150 to 1,03,250. Seeds of all the species studied are of floating nature.

The viability test is usually conducted by germinating the seeds. In the present study, a standradised staining method with Triphenyl Tetra Chloride and Malachite green has been described for the viability test of the Paphiopedilum species. With this method, the red stained embryos with green reticulations are considered as viable; whereas the wholly green stained ones are considered to be sterile.

Seeds of Paphiopedilum species were viable even after 4-6 months of bursting the capsule. This may be due to the appropriate maintenance of optimum temperature (4 C) required for the viability of seeds. Seeds are variously adapted with their structure to perform the function of propagation in nature. However, the rate of germination in nature is very meagre, because of non-availability of the specific fungal requirements and suitable atmospheric conditions. Singh (1992) reported that only 0.2%-0.3% of the seeds germinate in nature. Hadley (1970),

Harvais (1974), Arditti et al., (1981), Fast (1982) reported that the terrestrial orchids are very difficult to germinate.

The *in vivo* germination of **Paphiopedilum** species in the present study has only been partially successful with a very low percentage of germination. This may be due to the lack of proper endomycorrhizal association (an essential requirement) or various other factors like soil and atmospheric conditions. Other possible reasons may be the presence of germination inhibitors, onset of dormancy and the light intensity. These aspects are need to be further investigated to have a better conclusion. However, propagation through *in vivo* seed germination if followed properly will be of great advantage.

Cytology of **Paphiopedilum** species was very fascinating but a difficult task. Chromosomes of different species of **Paphiopedilum** showed a striking resemblance. The genus has got a basic chromosome number, n = 13. *P. fairrieanum*, *P. hirsutissimum*, *P. insigne* and *P. villosum* are represented by 2n = 26; whereas *P. spicerianum* has got 15 pairs of chromosomes (2n = 30) and *P. venustum* has 21 pairs of chromosomes (2n = 42). The karyotype of each species showed very distinct characteristics in the shape as well as position of centromeres. Chromosomes of all the species are large and distinct. However, *P. hirsutissimum* and *P. villosum* have quite large and distinct chromosomes out of all the six species studied.

There are lot of variations and varieties among each species of **Paphiopedilum** of North-Eastern region and have many natural

hybrids. This incessant series of biological diversity and gene pool should be properly utilized in various multiplication, propagation and conservation programmes. The knowledge of germ plasm, distribution, phenology, leaf topology, seed viability and germination, and cytologyetc., are the remarkable requirements for the scientific approach to the conservation of the species. The present study on **Paphiopedilum** species of North-Eastern region of India is a modest attempt to contribute some relevant informations towards the academic as well as applied venture.