REPRODUCTIVE BIOLOGY OF ENDEMIC AND ENDANGERED INSECTIVOROUS INDIAN SPECIES *NEPENTHES KHASIANA* Hk.f.

BY

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Dedicated

to

My dear Father

NORTH - EASTERN HILL UNIVERSITY

SHILLONG
JUNE, 2004

DECLARATION

I, *Ningombam Rashi Devi*, declare that the subject matter of this thesis entitled "Reproductive biology of endemic and endangered insectivorous Indian species *Nepenthes khasiana* Hk.f." is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/ Institute.

This is being submitted to the North-Eastern Hill University, Shillong for the award of the degree of Doctor of Philosophy in Botany.

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CHAPTER - 1

Introduction

Plants which catch and digest arthropods and other small animals are termed carnivorous plants. They possess specialized morphological, anatomical, and physiological properties. The earliest allusion to the possibility of carnivory was made about 200 years ago (Llyod, 1942; Heslop-Harrison, 1976). In 1875, Darwin published his work "Insectivorous Plants". Important contribution to the knowledge of anatomical characters has been made in particular by Goebel (1891-1893) and Fenner (1904).

The term "pitcher Plant'' is used for a member of different carnivorous plants with pitcher-like leaves. *Nepenthes* are the tropical pitcher plants. In 1976, Heslop-Harrison classified the pitcher plant (*Nepenthes*) under Group-I in which the glandular faces are immersed in the pitcher fluid.

The unigeneric family Nepenthaceae consists of approximately 74 species (Willis, 1966; Kaul, 1982). In India, the only representative of the genus Nepenthes, *Nepenthes khasiana* Hk.f. is an endemic and endangered insectivorous plant (Hooker, 1886; Jain and Sastri, 1980; Joseph and Mani, 1982), growing in Khasi, Jaintia and Garo hills of

Meghalaya state of North Eastern India. *Nepenthes khasiana* Hk.f. is a dioecious plant. The population of this species is confined in certain regions like Jarain, Sutnga, Jowai, Magheshkola and Lawbah (Haridasan and Rao, 1985; Rogers and Gupta, 1989; Choudhury, 2000). There has not been much study with reference to biotypes and varieties among these populations in sub-species level at various demographically isolated provinces. *Nepenthes khasiana* Hk.f. has a high degree of taxonomic uniqueness and critically endangered species which requires high degree of priority than the less endangered ones. The small populations of each isolated regions of this species facing several threats for its existence and its habitat because of the combined effects of shifting cultivation (Jhumming), timber extraction, mining and quarrying activities of coal and selective removal of this species because of its biological curiosities. Today the pitcher plants are restricted in its occurrence in small pockets and have become endangered by invasive weeds. Thus, the weeds prevent the seed germination and growth of other plants like *Nepenthes khasiana* Hk.f.

'Nepenthe' is derived from the Greek word means 'not and grief'. It was said to cause forgetfulness of sorrows and misfortunes. The potential medicinal uses of *Nepenthes khasiana* still remain unknown. However, the local tribal people have been using the liquid of unopened

pitcher as remedy for stomach pain and cough. Doctors in Noumea (New Caledonia) suggest their patients to take Nepenthes pills to fight stress. The small white pills are manufactured as homoeopathic treatment by a laboratory called Boiron in France (Laurent Legendre, 1999). Many of the secondary products of secretary glands may have varied types of biological activities including insecticidal, pesticidal and role in chemical ecology which lead to better understanding of plant protection mechanisms to crops. This can apparently be done with the study of biochemistry and anatomy of secretory glands.

Conservation over the long term will require management to reduce the risks, including ex-situ population which could support and interact demographically and genetically with wild population. The ultimate goal of ex-situ conservation is to provide support for the survival of species in their natural habitat. It is not alternative, but complementary to, conservation of biotypes in Botanic Gardens.

It is possible to produce enough plants in Botanic gardens and educate the local tribal people to grow it in their garden as a cottage industry i.e. tribal could grow different biotypes and sell them co-operatively at reasonable prices to satisfy all the demands without jeopardizing the limited population in the wild, because each pitcher

plant is said to bring in $800 (Đ500) in USA (Harold Koopowitz and Hilary Kaye, 1990).

The Eastern Himalayan region and North-East India are important repositories of genetic variability of various crops, horticultural and wild plants. Shifting cultivation and invasion of cleared lands by weeds have resulted in a considerable damage to natural ecosystems and rendered the region a 'hot spot' location with reference to the loss of biological diversity (Swaminathan, 1991).

Numerous studies have been published on foliar structure and development (Hooker, 1886; Fenner, 1904; Macfarlane, 1908; Kuhl, 1933; Roth, 1953; Schmid-Hollinger, 1970, 1979), glandular structure and function of the pitchers (Lloyd, 1942; Luttge, 1971; Heslop-Harrison, 1976; Adams and Smith, 1977; Fahn, 1979) and on animal inhabitants and prey in the pitchers (Beaver, 1979; Wirth and Beaver, 1979; Erber, 1979). By contrast, what little is known about the flower and fruits comes from a few studies of cultivated specimens, especially hybrids (Stern, 1917; Daumann, 1930; Kuhl, 1933). Species are usually defined according to their external morphology and anatomical characters, therefore, the study of morphology with anatomy will be helpful to identify the biotypes and sub-species in different regions. Captive breeding and viable population can be maintained over the long

period by understanding the reproductive biology which offers space for supporting population of this endangered and endemic taxon.

Nepenthes species are embryologically little known. The earlier work on the embryology of the family Nepenthaceae was reviewed by Davis (1966). Recently, Lan and Prakash (1973) studied the life history of *Nepenthes gracilis*. In 1982, Kaul observed the floral and fruit morphology of *N. lowii* and *N. villosa* growing in montane of Borneo. Subramanyam et al. (1985) illustrated the reproduction of *N. khasiana*. However, their observations are mainly based upon the one time collection of pickled specimens without observing the life cycle of *N. khasiana* periodically in their natural habitats. However, Johri et al. (1992) emphasized that the Reproductive biology of *Nepenthes khasiana* Hk.f. has not been studied thoroughly. Therefore, the present work has been undertaken with particular emphasis on the following objectives:

- To study the reproductive biology of *Nepenthes khasiana* Hk.f. this includes the different developmental aspects of male and female reproductive organs.
- Pollen germination, fertilization, embryogenesis and endosperm formation.
- Pollen and seed viability.