STUDIES ON ORCHIDS OF NORTH-EASTERN INDIA : INFLUENCE OF ECO-PHYSIOLOGICAL FACTORS ON ASYMBIOTIC AND SYMBIOTIC GERMINATION

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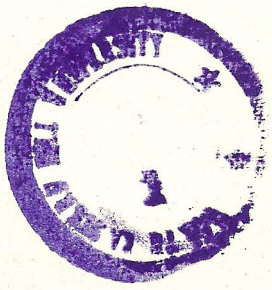

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We certify that the thesis entitled **Studies on orchids of north-eastern India : Influence of eco-physiological factors on asymbiotic and symbiotic germination** submitted by Mr. **Avadh Naresh Raghuwanshi**, for the **Degree of Doctor of Philosophy** of the North-Eastern Hill University, Shillong, embodies the record of original investigation carried out by him under our supervision. He has been duly registered and the thesis presented is worthy of being considered for the award of the **Ph.D. Degree.** This work has not been submitted for any Degree of any other University.

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INTRODUCTION.

Orchids are no doubt the most beautiful and wondrous among all the flowering plants in the world. These extraordinary plants are economically important primarily due to their horticultural and floricultural appeal. Orchids as plants of ornamentation were known to ancient India. The flowers of Aerides and Rhynchostylis were used to be associated with the festivals and adorned by the ladies as "Draupti pushapa" and "Sheta pushapa" (Hegde, 1985). Some of the orchids were also used in "Ayurvedic" system of medicines, and also as food. Orchids, taxonomically represent the most highly evolved family among monocotyledons. They comprise of 800 genera and 35,000 species, distributed throughout the world world (Bose and Bhattacharjee, 1980). Perusal of literature reveals the existence of 925 Indian orchid species (Jain and Mehrotra, 1984). Out of 925 species, 284 are categorised as endemic, 30 have become extinct and 105 are endangered (Hegde, 1985). Six hundred orchid species are reported from the North-Eastern India, which represent about 65% of Indian and 1.7% of world orchid population.

Orchids are distributed in various forests, grasslands and agro-ecosystems. The North-Eastern region of India is rich in tropical wet evergreen, semi-evergreen, moist deciduous, subtropical broad leaved and alpine forest types, which provides conducive environment for the establishment and growth of epiphytic and terrestrial orchids due to varied climate, soil, vegetation and topography.

The North-East India is mainly inhabited by tribals, who commonly practise 'Jhum' cultivation. Besides, the increased population pressure coupled with other human activities, i.e. deforestation, construction of roads, dams, extraction of wood for fuel and furniture, have fastened the process of orchid depletion at a higher rate from their natural habitats.

Orchids are perennial with epiphytic or saprophytic habit in nature. The vegetative parts show great variations. The majority of flowers of orchids are not pollinated, their ovules are not fertilized and capsules are rarely formed. But where there is pollination a large number of seeds are produced which may range from 5000-1,00,000 per capsule. However, their germination is very poor (3-5%) under natural conditions, because of the particular fungal requirement.

Role of mycorrhizal fungi in orchids is emphasised in converting the complex reserve food in seed-coat into simpler forms (Harvais and Hadley, 1967b) which is made available to the germinating seeds and it helps in early development of seedlings (Arditti, 1967, 1979). In nature the growth of protocorms is arrested as long as infection by suitable mycobiont is achieved (Meyer, 1966). Efficiency of fungi in hydrolysing and mobilising the starch and other complex carbohydrates has been shown by some workers (Purves and

Hadley, 1975). The enhanced growth at early stage of seedling development is also assigned to its increased enzymatic activity in root region due to mycobiont which may also provide vitamins and other growth factors (Harvais and Pekkala, 1975).

Mycorrhizal fungi might produce some growth hormones like auxins, cytokinins, etc.. It was postulated that such growth regulators might not only facilitate the infection of cells, but may also stimulate cell elongation, mobilization of sugars and even cell division (Hayes, 1969). Various media have been used for symbiotic germination and seedling growth of orchids. Clements (1979) found Oat medium most suitable for symbiotic seed germination. Linden (1980) studied a number of media for aseptic germination of seeds of orchids and found Burgeff's and Fast's media to support good germination and growth. The asymbiotic germination of seeds can take place if the medium is exogenously supplied with growth hormones, vitamins and trace elements (Harvais, 1982; Nakamura, 1982).

Harvais and Hadley (1967a) studied the symbiotic relationship between fungal symbiont and orchid hosts. Further, these authors (1967b) observed that the seedling development in Orchis purpurella was better in symbiotic cultures under low light and low temperature conditions than

in asymbiotic conditions.

A major benefit of fungus root association is the enhanced absorption of nutrients by the roots from non-fertile or moderately fertile soils. Absorption of phosphorus appears to be particularly enhanced by the mycorrhizal system. The fungal-symbionts capacity to produce acid phosphatase appears to be an important part of mycorrhizal absorption of phosphorus (Bowen, 1973). Gianinazzi (1978) has reported that mycorrhizal specific phosphatase activity is closely linked with the development of both mycorrhizal infections and the infected host plant. Infection of roots by mycorrhizal fungi may also be influenced by phosphatase concentration.

Orchid population is mainly influenced by the factors like temperature, light, pH of the soil and bark, amount of rainfall, humidity, type of soil and vegetation, etc. in the natural conditions (Hegde, 1985).

Most of the studies on orchids are related to the effect of growth hormones, vitamins, nitrogen sources, and complex additives (Knudson, 1922; Quednow, 1930; Meyer, 1943; Noggle and Wynd, 1943; Mariat, 1952; Withner, 1959a; Fonnesbech, 1972; Mead and Bulard, 1975). However, work on the effect of some environmental factors, i.e., light, substrate pH, and temperature on seed germination of orchids, is meagre (Ueda and Torikata, 1972). And the role of mycorrhizal

fungi in phosphorus uptake and phosphatase metabolism in orchids has not been worked out in detail. Similarly, not much investigations have been done on the growth hormones production by mycorrhizal fungi of orchids. However, some information is available on the growth regulators production by some ectomycorrhizal fungi (Ulrich, 1960; Crafts and Miller, 1974; Ng et al., 1982) and by vesicular arbuscular mycorrhizal fungi (Barea and Aguilar, 1982).

Therefore, the following work was undertaken to study the effect of some eco-physiological factors on in vitro cylture of orchids both in asymbiotic and symbiotic conditions and some aspects of their metabolism. The present investigations have been categorized as follows:

i. Studies on the effect of temperature, pH and light on asymbiotic seed germination and subsequent seedling growth of orchids.

ii. Studies on the effect of temperature, pH and light on symbiotic seed germination and subsequent seedling growth of orchids.

iii. Growth hormones production by mycorrhizal fungi of orchids.

iv. Phosphorus uptake and phosphatase activity in mycorrhizal seedlings of orchids.