STUDIES ON ORCHIDS OF NORTH-EASTERN INDIA : ECOPHYSIOLOGY OF MYCORRHIZA

Abstract

RAJENDRA SINGH KATIYAR

THESIS
SUBMITTED IN FULFILMENT OF THE REQUIREMENT OF THE DEGREE OF
DOCTOR OF PHILOSOPHY

To

DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
NORTH-EASTERN HILL UNIVERSITY
SHILLONG - 793001
INDIA

FEBRUARY, 1986

Survey of mycorrhizal association was carried out in thirty four epiphytic and terrestrial orchids, growing in forests and grasslands of North-Eastern India. All species were found to be mycorrhizal. Different parameters, like hyphal, coils and digestion were used to assess the intensity of mycorrhiza. In case of epiphytic orchids maximum infection was observed in Coelogyne occultata (Hook.f.) and minimum in C. angustifolia (A. Rich). Whereas, terrestrial orchid, Phyllomphax sp. possessed highest infection than other species. It was also observed that the old roots harboured more infection as compared to the new roots. Infection increased from apical to proximal end. Roots of epiphytic orchids exhibited more infection, particularly in localized parts which were in contact with bark of tree species. Aerial roots of epiphytic orchids were devoid of fungal infection. Increased cell area was noticed in infected cell than noninfected ones. Cymbidium macrorhizon (Lindl.) and Spiranthes australis (Lindl.) contained starch granules in the root cells, which showed direct correlation to the mycorrhizal intensity. On the other hand, aerial roots of few epiphytic orchids i.e. Eria coronaria (Reichb. f.), C. anguistifolia (A. Rich.), C. fuscescens (Lindl.), C. prolifera (Lindl.) and Dendrobium fimbriatum (Hook. f.) showed the presence of chlorophyll in cortical region, and such cells were free of mycorrhizal infection.

Sixteen different fungal isolates were isolated from the infected roots of epiphytic and terrestrial orchids. These isolates were mostly sterile mycelia, belonging to form genus Rhizoctonia. Fungal symbionts were exploited to evaluate their infection efficiency and post infection effect on the orchid proto-

corms. Certain mycobionts i.e. RH1, RA5, RH15, RH39, RH45, RH46, RH55, RH58 and RH61 were allowed to infect the freshly germinated protocorms of C. giganteum (Wall.), Thunia alba (Rchb. f.) and Stauropsis undulatus (Benth.). All strains were able to infect the protocorms of the orchid species, while their infection efficiency varied at different developmental stages of the seedlings. The fungal infection took place through the epidermal hairs in C. giganteum forming swollen structure (appressorium) and by direct penetration of epidermal cells in T. alba and S. undulatus. The mycelium later on spread in the tissue of protocorms disorderly and covered them completely.

To study the preference of fungal symbiont, for their nutritional requirement in the form of carbon and nitrogen, a number of experiments were conducted. Significant variation was observed in growth and dry weight allocation of different fungi on different carbohydrates and nitrogen sources. Glucose, sucrose, maltose, fructose and mannitol promoted better colony growth and dry weight of all endophytes. Moderate growth was observed on raffinose, starch, lactose and cellulose. However, sorbose and galactose supported poor growth of all the endophytes. The vitamins; thiamine and biotin supported best growth followed by pyridoxine, nicotinic acid and riboflavin than the basal medium. Mixture of vitamins did not stimulate the growth of endophyte. Addition of amino acids; asparagine, glycine, glutamic acid and aspartic acid in the basal medium had significant effect on accumulation of dry weight in mycorrhizal fungi. Whereas, colony diameter did not vary significantly on the amino acid supplemented medium than the medium free of amino acid. However, mixture of amino acids promoted the colony growth of fungi. Yeast extract did significantly increased the growth of endophyte than any other carbon and nitrogen source. Ammonium ions were poorly utilized by all the isolates than nitrate ions. Urea supported

better fungal growth of all the endophytes. However, ammonium nitrate, ammonium chloride and urea produced more fungal biomass when used with calcium nitrate than with potassium nitrate in the basal medium.

The effect of three light intensities (200 lux, 550 lux and 2500 lux) and five organic amendments (i.e. moss, lichen, charcoal, barks of P. kesiya and Q. griffithii) was carried out to assess the establishment and growth of seedlings in C. giganteum with mycorrhizal fungi i.e. RH1, RA5, RH15, RH39, RH45, RH46 and RH55. The growth of mycorrhizal seedlings was compared to nonmycorrhizal seedlings under natural conditions. Seedlings showed better growth in 2500 lux light intensity. Mycorrhizal fungi enhanced the growth of seedlings than nonmycorrhizal ones. The seedlings inoculated with mycorrhizal fungi developed better even at low light in comparison to nonmycorrhizal ones provided with highest light condition.

Lichen did not show any significant difference in biomass, root and leaf production of mycorrhizal than nonmycorrhizal seedlings, except in root area. Moss promoted highest accumulation of biomass in seedlings, which was followed by the addition of bark of P. kesiya, basal medium, charcoal, Q. griffithii bark and lichen added media. Whereas, Q. griffithii bark accelerated the maximum production of leaf and root number than other substrates. It also supported better growth of seedlings, inoculated with certain endophytes.