

Mycorrhizas in the Ferns of North Eastern India

R R MISHRA, G D SHARMA and A R GATPHOH

Department of Botany, School of Life Sciences, North Eastern Hill University,
Shillong 793 014

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The incidence of mycorrhiza and the occurrence of endogonaceous spores were investigated in the roots and rhizosphere of forty fern species from north eastern India. All the fern species possessed vesicular-arbuscular mycorrhiza. The endophytes belonged to the genera *Glomus*, *Gigaspora*, *Acaulospora* and *Sclerocystis*. *Sclerocystis* was found to be associated with all the fern species except *Athyrium bentamense*, *Pteris quadrianrita* and *Lygodium japonicum*. Infection level ranged from 63.3 to 92.0%. Different fern species exhibited different stages of fungal invasion ranging from hyphae, arbuscules and vesicles or a combination of all the three.

Introduction

Vesicular arbuscular mycorrhiza is a universal and regular component of almost all the angiosperms, conifers (except Pinaceae), pteridophytes and bryophytes. Mycorrhiza in pteridophytes has been studied and it was observed that phycomycetous mycorrhiza is common phenomenon of this group except in some members of aquatic and epiphytic ferns (Boullard 1957, Burgeff 1938, Kelley 1950, Hepden 1960 and Harley 1969).

Occurrence of vesicular arbuscular mycorrhiza being ubiquitous, very little information is available on the distribution of endogonaceae and variation at ecotype level in India (Gerdemann & Bakshi 1976). However, information on its distribution, development and seasonal variation is available from other countries (Nicolson 1967, Mosse & Bowen 1968, Nicolson & Johnson 1979 and Nicolson & Schenck 1979). The

field survey described in this paper was designed to determine the degree of fungal infection and their development in the ferns of a natural subtropical forested ecosystem.

Materials and Methods

Selection of site and sampling of plants and soil

Five different sites (lower Motinager, Upper Motinagar, Shillong Peak, Happy Valley and Sweet falls) from Khasi hills (Shillong) Meghalaya were selected for the investigations. The altitude of the sites varied from 1500m to 1600m. All the sites were dominated by pine forest in association with some broad leaved tree species. The plants were collected in 1978 by the method of Khan (1974). Effort was made to collect the samples from the plants of approximately same age.

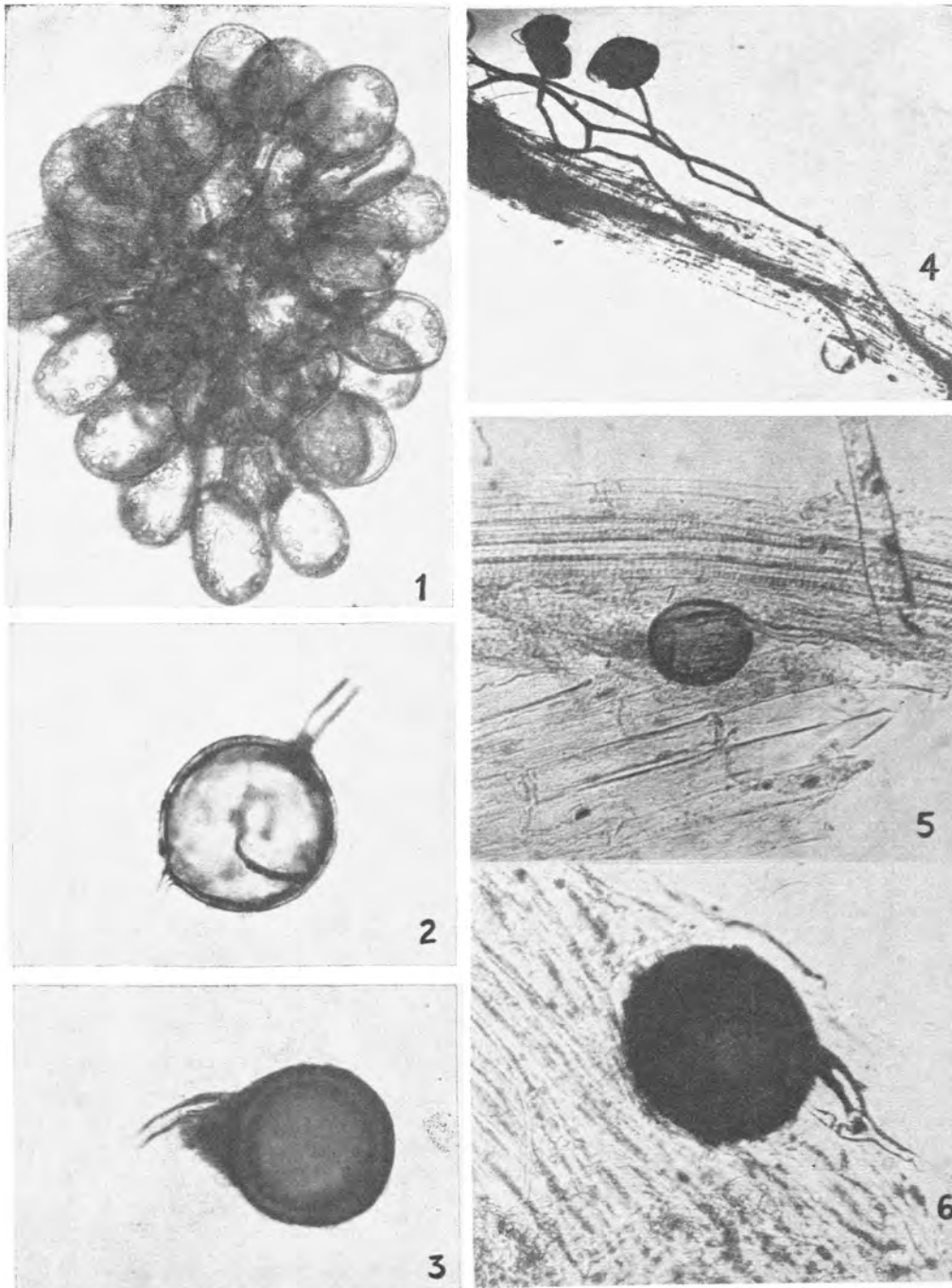


Figure 1 1, Sporocarp of *Sclerocystis* ($\times 400$), 2 & 3 Chlamydospores of *Glomus* sp. with hyphal attachment; 4-6, Vesicular arbuscular mycorrhizal association in *Botrichium virginarium*, *Lygodium flexnosum* and *Paraneima cyatheoides* respectively ($\times 100$)

Table 1 Incidence of mycorrhiza and mycorrhizal fungi in roots of ferns

Fern species	Vesicle	Arbuscule	Hyphae	Infection %	Endogone	Glomus	Gigaspora	Acaulospora	Sclerocystis	Total endogonaceous spores
<i>Athyrium asperum</i>	+	+	+	92	+	—	+	—	+	131
<i>A. bentamense</i>	+	—	+	86.6	+	—	—	+	—	27
<i>A. drepanopterum</i>	+	—	+	79.1	—	+	—	+	+	23
<i>A. japonicum</i>	+	+	+	80.0	—	+	+	—	+	132
<i>A. latifolium</i>	+	+	+	81.5	+	+	+	—	+	141
<i>Dryopteris elongata</i>	+	—	+	78.1	+	+	+	+	+	134
<i>D. hirtipes</i>	+	+	+	82.3	+	—	—	+	+	58
<i>D. nigra</i>	+	+	+	72.0	+	+	+	—	+	34
<i>D. spersa</i>	+	+	+	80.6	—	+	+	+	+	125
<i>Paranema cyatheoides</i>	+	+	+	75.8	+	+	—	+	+	124
<i>Polystichium acutatum</i>	+	—	+	77.7	+	+	—	—	+	141
<i>P. abericulatum</i>	+	+	+	73.0	+	—	—	—	+	115
<i>P. semifertile</i>	+	+	+	67.8	—	+	—	+	+	62
<i>Blechnum orientale</i>	+	+	+	66.6	+	—	—	—	+	59
<i>Bruinea insignis</i>	+	+	+	70.9	—	—	+	—	+	141
<i>Oleandra wallichii</i>	+	+	+	83.3	+	—	—	—	+	32
<i>Dricanopteris lincaris</i>	+	+	+	65.0	+	+	—	—	+	44
<i>Gleichenia japonica</i>	+	+	+	79.1	—	—	+	—	+	31
<i>Lindsaya cutrota</i>	+	+	+	76.9	—	+	+	—	+	57
<i>Cheilanthes ferinosa</i>	+	+	+	85.7	+	+	—	—	+	83
<i>Botrychium viriginianum</i>	+	—	+	74.2	—	+	+	—	+	161
<i>Osmunda cloyioniana</i>	+	+	+	82.3	+	+	—	—	+	88
<i>Platogyria adnota</i>	+	+	+	74.5	—	—	+	—	+	78

Assessment of Infection

From the composite root sample, infection was measured as suggested by Phillips and Hayman (1970).

Extraction and identification of endogonaceous spores

Rhizosphere soil was wet sieved (Gerdemann & Nicolson 1963). After sieving fractions retained on 250, 170 and 50 μm sieves were collected and analysed for endogonaceous spores. Spores mounted in lactophenol were identified with the keys of Gerdemann and Trappe (1974). The total number of spores per 100 g of wet soil was recorded.

Results (table 1, plate 1)

All the fern species exhibited endomycorrhizal infection. The mycorrhizal infection ranged between 63.3 to 92.0%. The soil type of different sites varied from sandy loam to clay loam and pH ranged from 4.2 - 5.5. More than one type of endogonaceous spores were isolated from the rhizosphere of each fern species. Different morphological stages of Vesicular arbuscular mycorrhiza were observed in roots of fern species. Presence of hyphae and vesicles in the cortical region was common feature in all the species. Some of the fern species lacked the arbuscules. Mainly four different types, viz. *Glomus*, *Acaulospora*, *Gigaspora* and *Sclerocystis* spores were predominant. Maximum number of endophytes was isolated from *Thelypteris multilineata* while lowest from *Athyrium drepanopterum*.

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Discussion

All the fern species growing in different natural communities were infected with vesicular arbuscular mycorrhiza. Cooper (1976) also observed that the members of Filicales group generally possessed endomycorrhizal association in natural community. The intensity of infection varied from one plant species to another. This variation in mycorrhiza may be due to seasonal changes (Mason 1964, Hayman 1970), plant growth (Khan 1974) and land disturbances (Reeves et al 1979). In the present study where the difference in climatic and physicochemical characters of soil was not so remarkable, the cause for the different degree of infection and the variation in population of endogonaceous spores may be attributed primarily to the host influence. The fern species may regulate the mycorrhizal infection either by secretion of certain stimulatory or inhibitory chemical substances. The potentiality of their beneficial effect on establishment and uptake of nutrients may vary from one endophyte to another depending upon the environmental and other conditions (Mosse 1973). The presence of more than one endophyte with the single plant species supports the contention that endophytes are not host specific.

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