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Mycorrhizal association in selected epiphytic orchids from Western Ghats of Goa

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Abstract

Present investigation was carried out to report the mycorrhizal association in the roots of five epiphytic orchids species *Viz., Bulbophyllum sterile* (Lam.) Suresh, *Dendrobium barbatulum* Lindl., *Dendrobium ovatum* (L.) Kranzl, *Porpax filiformis* (Wight) Schuit., Y.P.Ng & H.A.Pedersen and *Smithsonia straminea* from western Ghats, Goa. The studied species exhibited the presence of mycorrhizal colonization. An important observation in the present investigation is the occurrence of infection not only in the cells of cortical region and in the layers of the cortex adjoining the endodermis but also in the passage cells of the exodermis and in the velamen region. Some of the endodermal cells were also seen with hyphal entry in the stellar region.

Keywords: Epiphytic orchid, Peloton, Western Ghats, Goa

Introduction:

Mycorrhizal association were known since 1880's (Frank, 1885). It constitutes one of nature's most ubiquitous, widespread, persistent and interesting examples of parasitism. All the orchid seeds growing in wild requires association of the fungus for the purpose of germination. It was in 1903 Noel Bernard, a French Physiologist who first discovered that a fungus was necessary for the germination of orchid seeds. Of the seven types of mycorrhizae *viz.,* VAM, ecto, ericoid, orchid, arbutoid, monotropoid and ectendo mycorrhiza (Peterson, and Fraquhar, 1994), extensive work has been carried out on ectomycorrhizae and vesicular arbuscular mycorrhizae (VAM) whereas the other five types are poorly studied. The orchid mycorrhizae have been paid less attention because of their great variability in life.

The importance of mycorrhizal infection for the germination of orchid seeds and for successful seedling development has been well documented in the past (Peterson and Currrah, 1990; Richardson *et al*., 1992). The fungal entry through root hair in ground orchid *Spathoglottis plicata*, has been reported by Senthilkumar and Krishnamurthy, (1998) and by Weber and Webster (2001). Earlier studies have reported the occurrence of mycorrhizal association in epiphytic orchid (Senthilkumar *et al*, 2000; Radhika KP, Rodrigues BF. 2007; Bukhari and Herlekar, 2015, Bukhari, 2020) The present investigation is an attempt to reveal the presence of endophytic fungi in selected epiphytic orchids from Western Ghats, Goa.

Materials and methods:

Five epiphytic orchids species *viz., Bulbophyllum sterile* (Lam.) Suresh; *Dendrobium barbatulum*

Lindl.; *Dendrobium ovatum* (L.) Kranzl; *Porpax filiformis* (Wight) Schuit., Y.P.Ng&H.A.Pedersen and *Smithsonia straminea* C.J. Saldanha were selected from different localities of Goa for studying mycorrhizal association. The free hanging rots were were collected from newly formed aerial keikiis of both the dendrobium species and from bulbs in case of *Bulbophyllum sterile*. In *Smithsonia straminea* the roots collected were found attached to the bark of the host plant, while in *Porpax filiformis* the thin, delicate, whitish roots arising from the green, reticulated discoid pseudobulb were collected. In *Porpax filiformis* the roots were found attached to the surface of the bark. The collected roots were transported to the laboratory for further processing in polyethylene bags. Roots were rinsed with water and preserved in 70% alcohol for microscopic observations. Thin free hand sections were taken just above the root tip and stained with 0.05% tryphan blue (Phillips and Hayman 1970). Selected sections were observed for mycorrhizal colonization (hyphae, and pelotons). The photographs in the field were taken using digital camera. Photomicrographs of the transverse sections were taken using camera attached to an Olympus microscope.

Results and discussion

Cross sections of the roots of all the selected epiphytic species exhibited presence of mycorrhizal association. Peloton were observed in the entire cortical region (Fig. II. c-e & Fig III). About 40% to 80% of the cortical cells in the cross section showed presence of pelotons. Apart from peloton in the cortical cells, hyphae were also observed randomly in the velamen region. Peloton were also reported in the stelar region penetrating through endodermal cells via the passage cells (Fig II a-h & Fig III a-f). The fungal colonization was also noticed in few passage cells of the exodermis in the present investigation. Results on the ooccurrence and distribution of rare epiphytic orchids from Western Ghats, Goa are depicted in Table I & Fig. I a-e.

The occurrence of mycorrhizal colonization in the roots of epiphytic orchids in the present study is in agreement with Senthilkumar *et al.,* (2000), who have reported the mycorrhizal association in the epiphytic orchid *Acamphe praemorsa*. The results on the occurrence of loose hyphal network in the cortical region are in agreement with Bukhari and Herlekar, (2015) who have made similar observations in their studies on epiphytic orchids from Western Ghats. However, in some parasitic species *Rhizoctonia*, chlamydospores and sclerotia have been reported occasionally in the epidermal cells of the host (Sneh *et al.,* 1991).

Tightly interwoven coils called the pelotons are considered to be the most distinctive character of an orchid mycorrhiza (Currah and Zeimer, 1992) and reflects the establishment of a successful, stable symbiosis (Zettler, 1997). The occurrence of mycorrhizal association in the epiphytic orchid has led to the general assumption that they play an important role in the epiphytic orchid as well (Senthilkumar *et al.,* 2000). An important observation in the present investigation is the occurrence of the infection in the layers of the cortex adjoining the endodermis. Some of the endodermal cells were also seen with hyphal entry in the stellar region. In the present study digestion was randomly observed in the cortex and not in some definite cells, designated as digested layers' Which have been recognized in some species in the inner cortex (Hadley 1982; Williamson and Hadley, 1970). Pelotons, formed within the cells in the form of coiled structures greatly increases the interfacial surface area between orchid and fungi. However, since infection is a continuous process in this epiphytic orchid and since all cells of the cortex are not colonized at the same time, in a mature root there was a mix-up of younger and older colonization (Senthilkumar and Krishnamurthy, 1999).

Mycorrhizal fungi are well known for the translocation of sugars and phosphates to the orchid (Richardson *et al.,* 1992). This type of fungal symbiotic association has already been reported in terrestrial orchid (Senthilkumar *et al*., 2000). In the cross section the pelotons appears as loosely arranged fungal mycelial network which appears as spherical and hexagonal balls in the parenchymatous cells of the cortical region. One of the important feature of the orchid mycorrhizae is the lysis of the pelotons (Peterson and Currah, 1990) These cells where lyses of the peloton take place, were digested 'digestion cells (Burgeff, 1959).

Orchid requires an external source of nutrient for seed germination and development. Since the seeds are microscopic with small amount of underdeveloped embryo the presence of endophytic fungi is very much essential under natural condition and since the epiphytic orchids do not have the advantage of a regular supply of water absorbed from the soil, they live under more or less xerophytic conditions and develop a peculiar habit of depending upon mycorrhizal fungus in their roots, for their supply of nourishments.

Table 1
Occurrence and distribution of epiphytic orchids from Western Ghats, Goa

Sl. No.	Name of the orchid	Host	Locality
1	*Bulbophyllum sterile* (Lam.) Suresh	*Anacardium occidentale, Areca catechu*	Rivona, Colomb, Dabal (Dharbandora), Netravali
2	*Dendrobium barbatulum* Lindl.	*Artocapus heterophyllus*	Gaondongrem-Canacona, Cotigao, Rivona
9	*Dendrobium ovatum* (L.) Kranzl.	*Carea arborea, Mangifera indica, Artocarpus heterophyllus*	Netravali, Rivona, Quepem
4	*Porpax filiformis* (Wight) Schuit.,Y.P.Ng&H.A.Pedersen	*Areca catechu, Mangifera indica*	Gaondongrem-Canacona, Cotigao, Dabal (Dharbandora)
5	*Smithsonia straminea* C.J. Saldanha	*Termenalia* sp.	Dabal (Dharbandora)

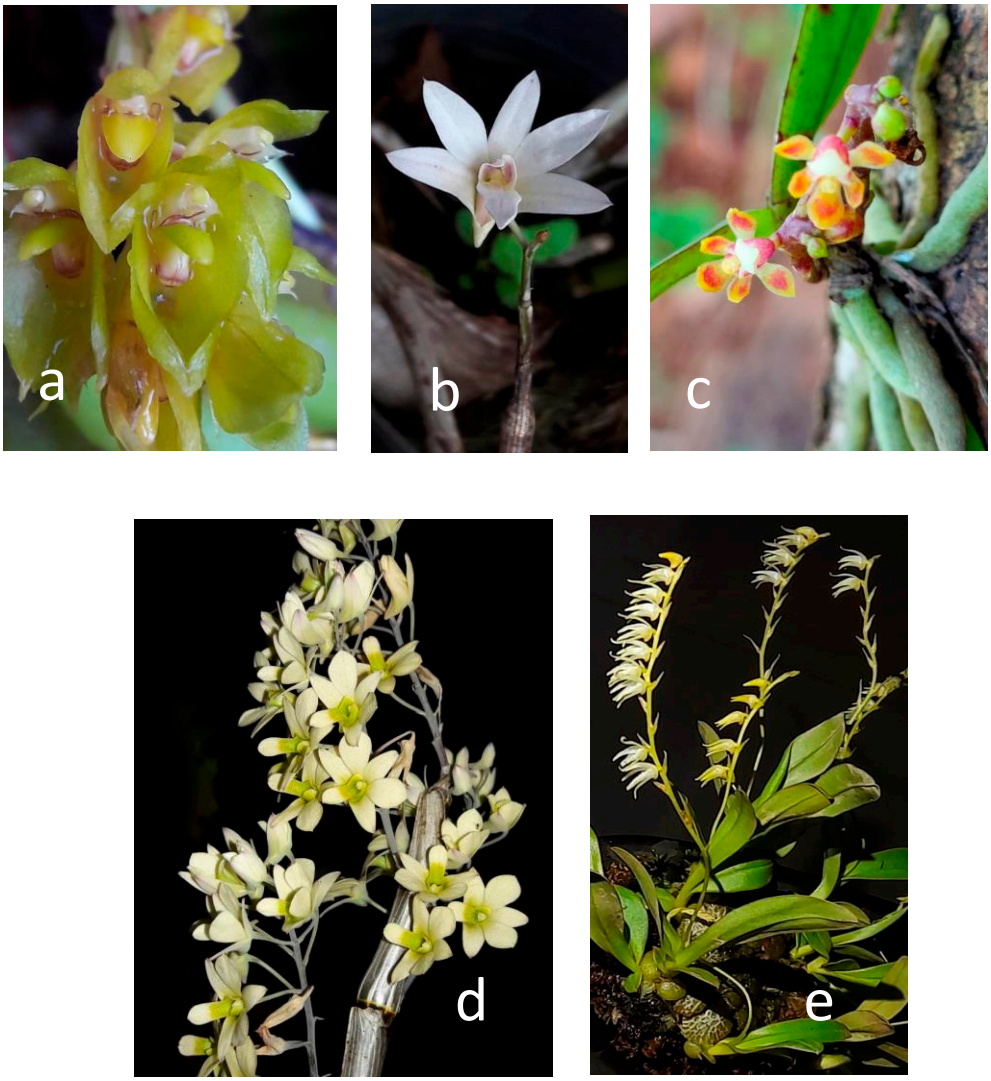

Fig.1: Habit,: Epiphytic orchids from Western Ghats, Goa
A) Bulbophyllum sterile; B) Dendrobium barbatulum; C) Smithsonia straminea; D) Dendrobium ovatum; E) Porpax filiformis

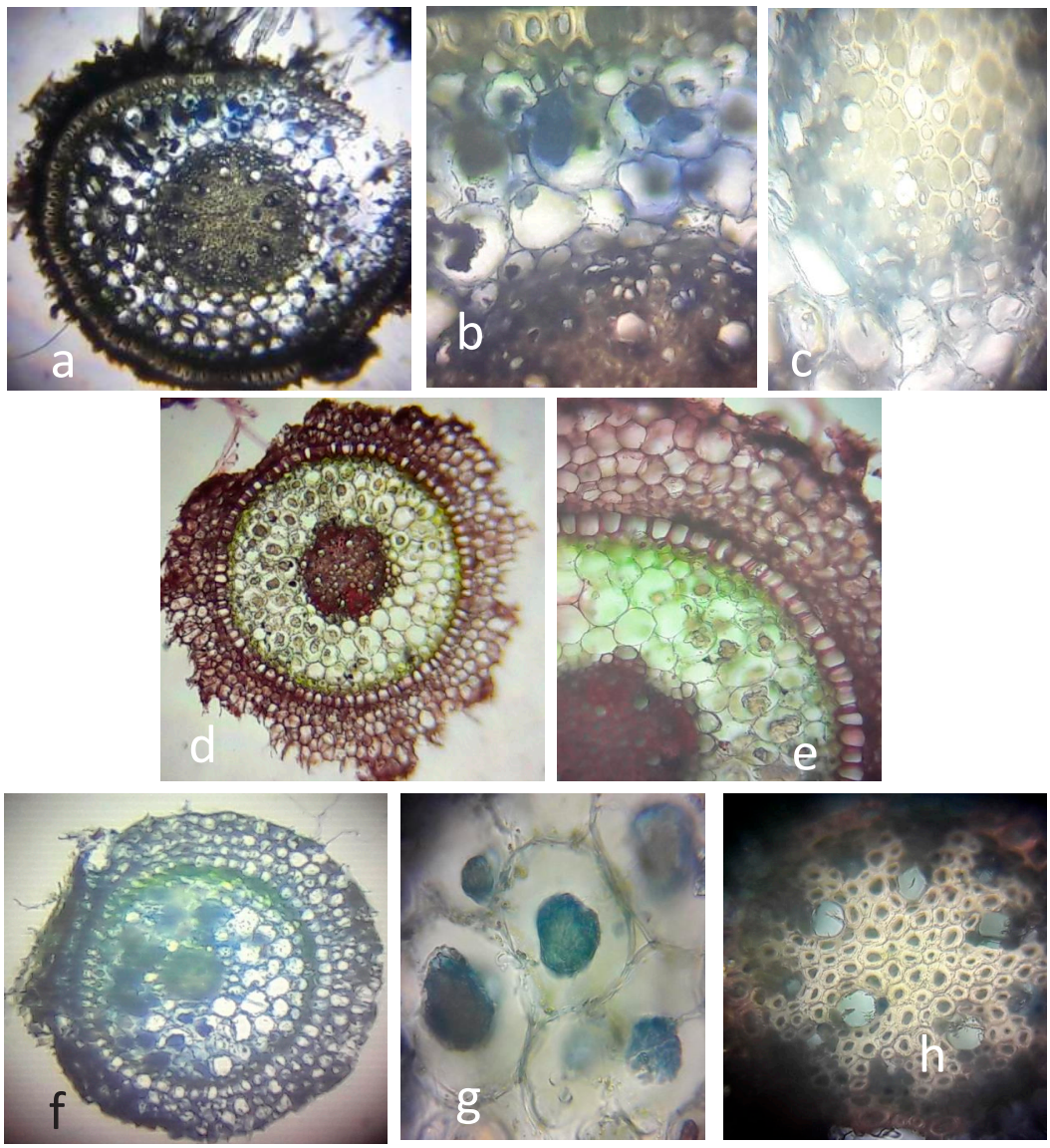

Fig. II: Mycorrhizal association in epiphytic orchids of Western Ghats, Goa
(a-c) *Bulbophyllum sterile*; d-e) *Dendrobium barbatulum*; (f-h) *Dendrobium ovatum* Peloton formation in cortical region (a, b, d,, e, f); Hyphal penetration in velamen region (a, d, f); Hypahl penetration in stellar region through endodermis (c, h)

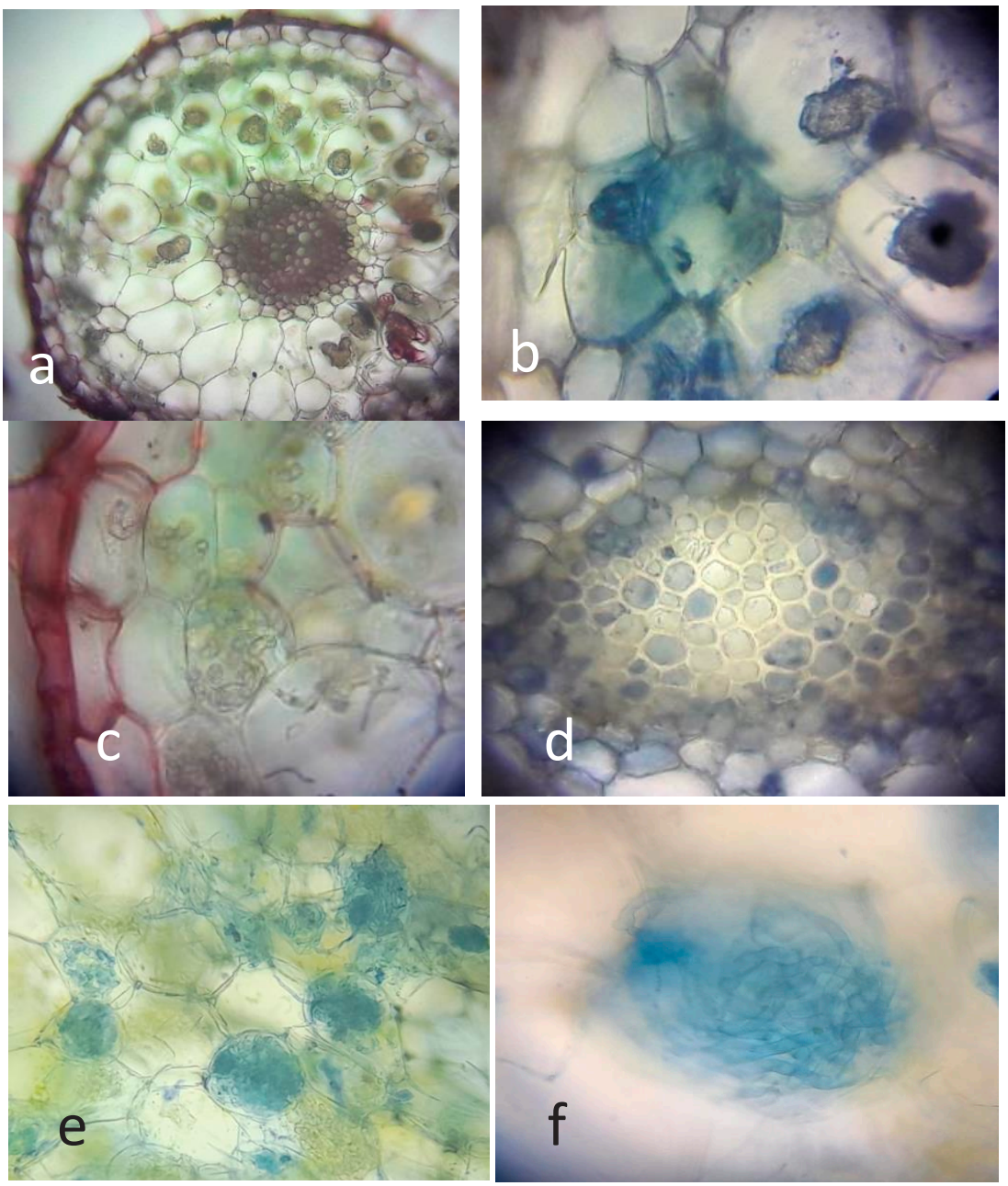

Fig. III: Mycorrhizal association in epiphytic orchids of Western Ghats, Goa
(a-d) *Porpax filiformis*; (e-f) *Smithsonia straminea*
Peloton formation in cortical region (a, b, c,, e, and f);
Hyphal penetration in stellar region through endodermis (d)

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