INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
© VISHWASHANTI MULTIPURPOSE SOCIETY (Global Peace Multipurpose Society) R. No. MH-659/13(N)
www.ijrbat.in

DISTRIBUTION OF TERRESTRIAL ORCHIDS IN SOUTH WESTERN PARTS OF MAHARASHTRA

Anjali Patil, Sunita Patil and Madhuri Kambale
Department of Botany, Rajaram College, Kolhapur 416 004, Maharashtra, India
Corresponding author: patilsunita790@gmail.com

ABSTRACT:
Orchids have a wide range of distribution. They are found to occur in all parts of the world except, perhaps in the Antarctica and are most numerous in the humid tropics and subtropics (Chen *et. al.* 2009).The south Western part of Maharashtra is a part of Western Ghats which has high level of Biological Diversity and is recognized as one of the hotspot of the world along with Sri Lanka (Myers *et.al* 2000). Family Orchidaceae is characterized by a novel form of mycorrhizal interaction. The germination of orchid seeds in nature is very low due to their requirement of a specific mycorrhizal association for germination**.** In the present paper as many as 33 number of terrestrial orchids belonging to the genera *Habenaria*, *Nervelia*, *Malaxis*, *Peristylus*, *Pectilis*, *Geodorum*, *Zeuxine*, *Cheirostylus* and *Eulophia* are recorded from the study area for studying their distribution and mycorrhizal association with these genera..

Keywords : Terrestrial Orchids, *Habenaria, Eulophia,Geodorum, Nervelia, Peristylus, Pecteilis, Malaxis* Orchid Mycorrhiza

INTRODUCTION:

Orchidaceae represents a peak in the evolution of monocots and is one of the most successful families of flowering plants, as is clear from the wide distribution and its innumerable number of species spread all over the world. According to the various assessments between 25000-35000 species in 600-800 genera are recorded under this family (Arditti,1979).The innumerable number of dust like non-endospermous seed and their peculiar mode of germination which requires association with the mycorrhizal fungi are peculiarities which characterize the orchid family. The Orchidaceae is characterized by a novel form of mycorrhizal interaction. Identification of orchid mycorrhizal fungi is a critical first step in exploring the biology of this symbiosis. The nutritional role of Orchid Mycorrhiza in the development of seedlings and in the entire life cycle of chlorophyll-deficient species is well established (Burgeff, 1909; Rasmussen, 1995). The indication of dependence on fungi is that most adult terrestrial orchids have few and unbranched roots that are thick, owing to a highly developed cortex. Mycorrhiza is beneficial symbiont for orchids, they are associated with higher plants by a symbiotic association, and benefit plants in uptake of phosphorus nutrients, production of growth hormones, increase of proteins, lipids and sugar levels, helps in heavy metal binding, salinity tolerance, disease resistance. The majority of the world's orchids are photosynthetic; a small number of species are myco-heterotrophic throughout their lifetime, and recent research indicates a third mode (myxotrophy) whereby green orchids supplement their photosynthetically fixed carbon with carbon derived from their mycorrhizal fungus. It is also essential to determine and perpetuate the range of fungi an adult orchid associates with under different environmental conditions. Thus, there is still more to be learnt about the causes of fungal specificity in the Orchidaceae and its impact on the conservation status of individual orchid species, germinate seeds, leading to more efficient culture of orchid species. The Western Ghat bio-geographic zone, the second richest and diverse

spot as far as orchids are concerned. In the present study we have collected 33 species of Orchids from the study area and successfully conserved them in botanical garden of Rajaram College, Kolhapur.

MATERIAL & METHODS:

Field visits were organized to various localities in the study area for the collection and study of distribution of terrestrial orchids and associated mycorrhiza. Field visits mostly were restricted to the rainy season from June to September (up to October). During the field visits, habitat, phenology, morphology, reproduction/ flowering and fruiting of orchids were observed. Photographs were taken with Nikon Digital camera. Very few specimens were carefully collected for laboratory work. Inflorescences (1-2) were collected for identification purpose only. Tubers were up rooted; only one root per plant (in case of few roots) and two or three roots (in case of profuse rooting) were cut with sharp cutter and stored in labeled containers for further laboratory studies. The uprooted plants were replanted in the same place. A few entire specimens were collected in zip lock poly-bags for ex-situ conservation. In case of a few orchids e.g. *Geodorum, Eulophia* and *Nervelia* flowering and fruiting is in the month of May. Hence, field visits were organized in the month of flowering and fruiting in case of these species only.

RESULTS & DISCUSSION:

In present study 33 no. of Orchids belonging to 10 Genera are collected from the South Western part of Maharashtra and successfully conserved in the Botanical Garden of the Rajaram College Kolhapur for further study. The plants were potted and kept in shade or semi-shade as per their natural requirement. One or two entire plant specimens collected from various localities depending upon their population were planted. For the purpose plastic tubs were used as they are broad and light in weight, hence easy to handle from time to time. Drainage holes were bored at the base for proper drainage of excess water to prevent damage / rotting of tubers. They were filled up to three-fourth its capacity with a mixture of soil and coco peat. This allowed aeration and more prolific rooting. Tubers were planted immediately after collections in such well labeled containers. Watering was done whenever necessary with watering cans. Sometimes in case of plants such as Habenaria diphylla, H. roxburghii, etc. stones/ small rock pieces were added to give the natural habitat. All the orchids are growing luxuriantly in the botanical garden for the last three years. In the month of June when rainy season begins watering also starts. Germination of orchid tubers in the containers begins. Generally it has been observed that Habenaria grandifloriformis, H. longicorniculata, H. foliosa, H. foetida, H. ovalifolia, Malaxis, Eulophia, Geodorum, and some Peristylis species germinate early and their flowering period is also early. Whereas, H. commelinifolia, Nervelia, H. suavolense, Pectilis gigantea etc. germinate and flower late in the season. Many fungi particularly Basidiomycetous fungi have been growing in association with the orchids in the pots for the last three years. All the successfully conserved orchids have been photographed. After the month of October they start to dry. Some pollinators have been seen visiting the orchids otherwise there may be self pollination also. After drying capsules have been collected and stored. Structure of seeds in all the orchid species has been studied. All the containers are maintained without disturbing until the next rainy season. Some of the species of Eulophia, Liparis, Geodorum, and Nervelia flower during the summer months i.e during April and May.

ACKNOWLEDGEMENT:

The present work has been completed under Major Research Project, sanctioned by UGC, New Delhi.

REFERENCES:

Agerer, R. (1995) Anatomical characteristics of identified ectomycorrhizas: an attempt towards a natural classification. In: Varma A, Hock B (eds) Mycorrhiza: structure, function, molecular biology and biotechnology. Springer, Berlin, pp 685–734

Ashford, A.E., Allaway, W.G. (1982) A sheathing mycorrhiza in Pisonia grandis R. Br. (Nyctaginaceae) with development of transfer cells rather than a hartig net. *New Phytol* 90:511–519.

Alexander, C., Alexander, I.J., Hadley, G. (1984) Phosphate uptake by *Goodyera repens* in relation to mycorrhizal infection. *New Phytol* 97:401-411.

Bidartondo, M.I., Burghardt, B., Gebauer, G., Bruns, T.D., Read, D.J. (2004). Changing partners in the dark: isotopic and molecular evidence of ectomycorrhizal liaisons between forest orchids and trees. *Proc Royal Soc Lond B* 271:1799-1806.

Bidartondo, M.I. (2005) The evolution of myco-heterotrophy. *New Phytol.*167:335-352.

Bonnardeaux, Y., Brundrett, M., Batty, A., Dixon, K., Koch, J., Sivasithamparam,K. (2007). Diversity of mycorrhizal fungi in terrestrial orchids: compatability webs, brief encounters, lastingrelationships and alien invasions. *Mycol Res* 111:51-61.

Brundrett, M.C., Scade, A., Batty, A.L., Dixon, K.W., Sivasithamparam, K. (2003). Development of *in situ* and *ex situ* seed baiting techniques to detect mycorrhizal fungi from terrestrial orchid habitats. *Mycol Res* 107:1210-1220.

Cameron, D.D., Leake, J.R., Read, D.J. (2006) Mutualistic mycorrhiza in orchids: evidence from plant-fungus carbon and nitrogen transfers in the green-leaved terrestrial orchid *Goodyera repens*. New Phytol 171:405-416.

Cameron, D.D., Johnson, I., Leake, J.R., Read, D.J. (2006). Mycorrhizal acquisition of inorganic phosphorus by the green-leaved terrestrial orchid *Goodyera repens*. *Ann Bot* 99:831-834.

Dickson, S. (2004) The Arum-Paris continuum of mycorrhizal symbioses. *New Phytol* 163:187–200.

Dickson, S., Schweiger, P., Smith, F.A., Söderström, B., Smith, S. (2003). Paired arbuscules in the Arum-type arbuscular mycorrhizal symbiosis with Linum usitatissimum. *Can J Bot* 81:457–463.

Duddridge, J.A., Read, D.J. (1982). An ultrastructural analysis of the development of mycorrhizas in Monotropa hypopitys L. *New Phytol* 92:203–214.

Ellis, M.B. 1971 & 1976. More Dematiaceous Hypomycetes. 42,65,148 pp.

Gebauer, G., Meyer, M. (2003). 15N and 13C natural abundance of autotrophic and mycoheterotrophic orchids provides insight into nitrogen and carbon gain from fungal association. *New Phytol* 160:209-223.

Girlanda, M., Selosse, M.A., Cafasso, D., Brilli, F., Delfine, S., Fabbian, R., Ghignone, S., Pinelli, P., Segreto, R., Loreto, F., Cozzolino, S., Perotto, S. (2006) Inefficient photosynthesis in the Mediterranean orchid *Limodorum abortivum* is mirrored by specific association the ectomycorrhizal Russulaceae. *Mol Ecol* 15:491-504.

Gams. 2000. The Mycota. 323pp.

Hadley, G. (1982). Orchid Mycorrhiza. In: Arditti J, ed. Orchid biology: reviews and perspectives, II. Ithaca, NY, USA: Cornell University Press, 83–118.

Julou, T., Burghardt, B., Gebauer, G., Berveiller, D., Damesin, C., Selosse, M.A. (2005). Mixotrophy in orchids: insights from a comparative study of green individuals and non photosynthetic individuals of *Cephalanthera damasonium*. *New Phytol* 166:639-653.

Leake, J.R. (1994). The biology of myco-heterotrophic ('saprophytic') plants. *New Phytol* 127:171-216.

Leake, J.R. (2005). Plants parasitic on fungi: unearthing the fungi in myco-heterotrophs and debunking the "saprophytic" plant myth. *Mycologist* 19:113-122

Masuhara, G., Katsuya, K. (1994) *In situ* and *in vitro* specificity between *Rhizoctonia* spp. And *Spiranthes sinensis* (Persoon) Ames. var. amoena (M. Biebertsien) Hara (Orchidaceae). *New Phytol* 127:711-718.

McCormick, M.K., Whigham, D.F., O'Neill, J. (2004). Mycorrhizal diversity in photosynthetic terrestrial orchids. *New Phytol* 163:425-438.

McCormick, M.K., Whigham, D.F., Sloan, D., O'Malley, K., Hodkinson, B. (2006) Orchid-fungus fidelity: A marriage meant to last? *Ecology* 87:903-911.

McKendrick, S.L., Leake, J.R., Read, D.J. (2000) Symbiotic germination and development of myco-heterotrophic plants in nature: transfer of carbon from ectomycorrhizal *Salix repens* and *Betula pendula* to the orchid *Corallorhiza trifida* through shared hyphal connections. *New Phytol* 145:539-548.

Naga M. S., Kandilkere, R. S. 2012. Non mycorhizal fungal endophytes in two orchids of Kaiga forest (Western Ghat), *India Journal of Forestry Research* 23(3) : 453-460.

Robertson, D.C., Robertson, J.A. (1982). Ultrastructure of Pterospora andromedea Nuttal and Sarcodes sanguinea Torrey mycorrhizas. *New Phytol* 92:539–551.

Robertson, D.C., Robertson, J.A. (1985). Ultrastructural aspects of Pyrola mycorrhizae. *Can J Bot* 63:1089–109Rasmussen, H.N. (2002). Recent developments in the study of orchid mycorrhiza. *Plant Soil* 244:149-163.

Smithm S.E., Read, D.J. (2008). Mycorrhizal symbiosis, 3rd edn. Academic, San Diego.

Selosse, M.A., Weiß, M., Jany, J.L., Tillier, A. (2002a) Communities and populations of sebacinoid basidiomycetes associated with the achlorophyllous orchid *Neottia nidus-avis* (L.) 53. L.C.M. Rich. and neighbouring tree ectomycorrhizae. *Mol Ecol* 11:1831-1844.

Selosse, M.A., Richard, F., He, X., Simard, S.W. (2006) Mycorrhizal networks: des liaiso dangereuses? *Trends in Ecol Evol* 21:621-628.

Shefferson, R.P., Weiß, M., Kull, T., Taylor, D.L. (2005). High specificity generally characterisesmycorrhizal association in rare lady's slipper orchids, genus *Cypripedium*. *Mol Ecol* 14:613-626.

Smith, S.E., Read, D.J. (1997) Mycorrhizal symbiosis. Academic Press, Cambridge.

Taylor, D.L., Bruns,T.D. (1997) Independent, specialized invasions of ectomycorrhizal mutualism by two nonphotosynthetic orchids. *Proc Natl Acad Sci* USA 94:4510-4515.

Taylor, D.L., Bruns, T.D., Szaro, T.M., Hodges, S.A. (2003). Divergence in mycorrhizal specialization within *Hexalectris spicata* (Orchidaceae), a nonphotosynthetic desert orchid. *Am J Bot* 90:1168-1179.

Xiaoya, M., Kang, J., Nontachaiyapoom, S., Wen, T. and Hyde, K.D. 2015. Non-Mycorrhizal endophytic fungi from Orchids. *Current Science* 109 (1): 72-87.

PLATE NO. I
ORCHID SPECIES COLLECTED DURING THE PROJECT WORK

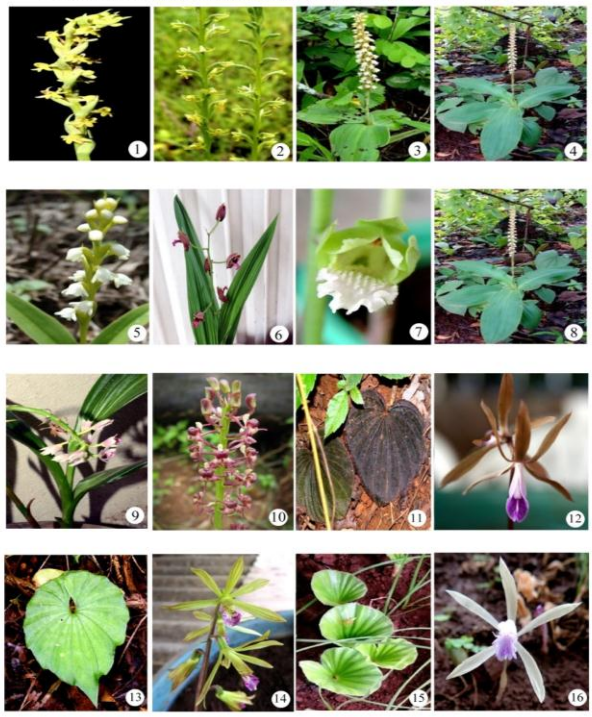
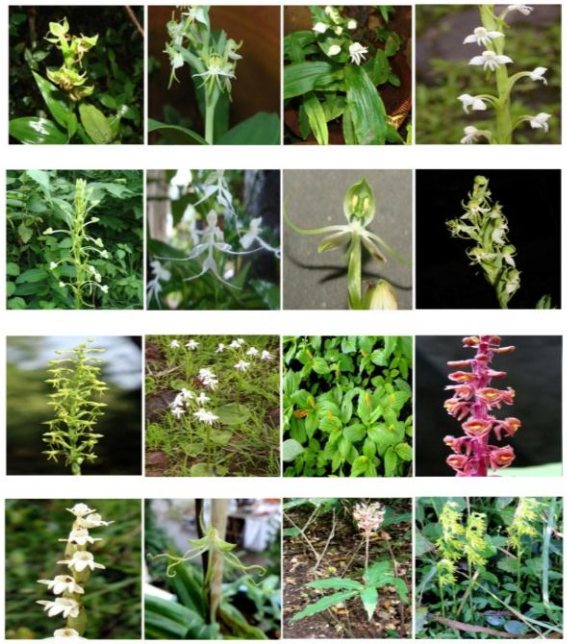


Fig: 1*Peristylus aristatus* 2.*Peristylus densus* 3.*Peristylus goodyeroides* 4.*Peristylus plantagineus* 5. *Peristylus lawii* 6,7,8.*Eulophia spectabilis* 9.*Geodorum densiflorum* 10. *Liparinervosa* 11,12. *Nervelia plicata* 13,14. *Nervelia concolor* 15,16. *Nervelia crociformis*

PLATE NO. II
ORCHID SPECIES COLLECTED DURING THE PROJECT WORK



17. *Habenaria digitata* 18. *Habenaria foetida* 19. *Habenaria gibsonii* 20. *Habenaria brachyphylla* 21. *Habenaria commelinifolia* 22. *Habenaria crinifera* 23. *Habenaria diphylla* 24. *Habenaria foliosa* 25. *Habenaria furcifera* 26. *Habenaria grandifloriformis* 27,28. *Malaxis versicolor* 29. *Habenaria heyneana* 30. *Habenaria multicaudata* 31. *Habenaria stenopetala* 32. *Habenaria marginata*

PLATE NO. III
ORCHID SPECIES COLLECTED DURING THE PROJECT WORK

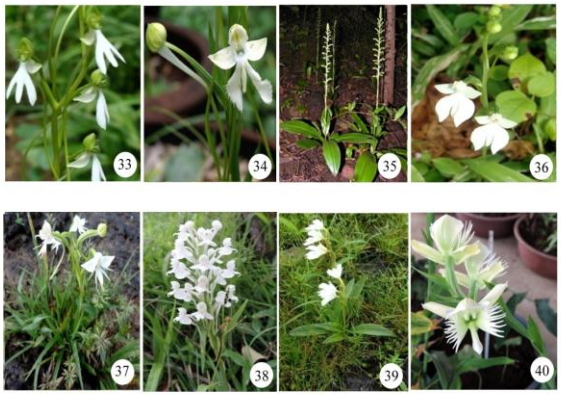


Fig.33 *Habenaria longicorniculata* 34. *Habenaria longicornu* 35. *Habenaria ovalifolia* 36. *Habenaria plantaginea* 37. *Habenaria rariflora* 38. *Habenaria roxburghii* 39. *Habenaria suaveolens* 40. *Pecteilis gigantea*

PLATE NO. IV
ORCHIDS CONSERVED IN BOTANICAL GARDEN IN RAJARAM COLLEGE, KOLHAPUR

Fig.41. *Eulophia spectabilis* 42. *Habenaria brachyphylla* 43. *Habenaria crinifera* 44. *Habenaria diphylla* 45. *Habenaria foetida* 46. *Habenaria grandifloriformis* 47. *Habenaria longicorniculata* 48. *Habenaria marginata* 49. *Habenaria suaveolens*

PLATE NO. V
IDS CONSERVED IN BOTANICAL GARDEN IN RAJARAM COLLEGE, KOLHAPUR

Fig : 50-56 Orchids conserved in college garden