PROJECT COMPLETION REPORT (PCR)

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TITLE:- DIVERSITY AND EVALUATION OF VA-MYCORRHIZA FROM AKOLA REGION

INTRODUCTION

Soil, an underground terrestrial ecosystem shows the greatest diversity of organisms. Especially rhizospheric region is the most dynamic environment that harbors Arbuscular Mycorrhizae the most dominant fungal associations. The roots of almost all higher plants are known to form mutualistic symbiosis with fungi. German botanist Albert Bernhard Frank in 1885 introduced the Greek word Mycorrhiza .These are termed *MYCORRHIZAS.* (fungus root from the Mykes -Mushoom or fungus and rhiza -root). Harley and Smith (1983) preferred using the term symbiosis for describing this interdependent mutualistic relationship where the host plant receives mineral nutrients, while the fungus obtains photosynthesis derived carbon compound carbohydrate from the plant.

Allen (1991) defined a mycorrhiza as " A mutualistic symbiosis between plant and fungus localized in a root like structure in which energy moves primarily from plant to fungus and inorganic resources move from fungus to plant ". More than 90% of all plant families studied, agricultural and natural environments form mycorrhizal associations and they can be essential for plant nutrition. Mycorrhizas are found in a wide range of habitats, including deserts, lowland tropical rainforests, high latitudes and altitudes, and aquatic ecosystems. There are few exceptions to the rule that mycorrhizas are found in all plant species that are economically important to human.

Although, they were discovered in 1855, mycorrhizae are millions of year older as fossil mycorrhizae have been found in the carbonaceous deposits. The Glomales are currently classified in the zygomycetes. Recent information from sequence of their 185 ribosomal genes indicate that they form an ancient group branching before the Ascomycetes and the Basidiomycetes (Rosendah and Dodd, 1995).

Mycorrhizal associations are widespread amongst plant families and appear to have evolved and spread with the early land plants. Tremendous advances in research on mycorrhizal physiology and ecology over the past 40 years have led to a greater understanding of the multiple roles of AMF in the ecosystem. This knowledge is applicable to human endeavors of ecosystem management, ecosystem restoration and agriculture.

In natural ecosystems AMF are typically found as mixed communities with multiple species colonizing any given plant root. Since the functionality of the symbiosis is highly variable and dependent upon the identity of the AMF and host species involved (Johnson et al., 1997; Klironomos, 2003), the composition of AMF species colonizing a given plant has important implications for its fitness. Taken to the level of the plant community, AMF species composition may be a salient determinant of plant community composition (e.g. van der Heijden et al., 1998). Thus, alteration of AMF community composition could have important implications for ecosystem function (Rillig, 2004).

The study of Arbuscular mycorrhizal (Am) fungi has fundamental and practical importance. First because in most environments “root biology” is actually “Mycorrhizal biology” and second because of the practical importance of AM in fields as diverse as sustainable agriculture, horticulture reforestation and ecosystem management.(Bethlenfalvay and Schuepp, 1944; Barea and Jeffries, 1995)

The diagnostic features of arbuscular mycorrhiza (AM) are the highly branched arbuscules and vesicles of various shape and sizes that develop in the root cortical cells. The fungus initially grows between cortical cells but soon penetrates the host cell wall and grow within the cell lumen. Neither the fungal cell wall nor the host cell membrane is branched (Bonfante and Perotto, 1995). As the fungus grows, the host cell membrane invaginates and envelops the fungus, creating a new compartment, where materials of high molecular complexity are deposited. This apoplastic space prevents a direct contact between the plant and the fungus cytoplasm and allows efficient transfer of nutrients between the symbionts.

It shows Arbuscules- These are dichotomously branched, bush like haustoria formed in cortical cells. They are later digested by the host cell. Vesicles- These are spherical or oval, thin walled structures formed terminally or intercalary from intercellular or intracellular hyphae. These contain fat granules and serve as storage organs. Other structures produced by VAM fungus are auxillary cells, extrametrical hyphae and spores (Jakobsen et al., 1992).

An experienced worker can readily recognize the coarse fungal hyphae with their distinctive angular morphology. These hyphae are restricted to the cortical region of the roots and never penetrate the stele. All the fungal special form arbuscules – small tree like, hyphal filled, invaginations of the cortical cells which provide intimate contact between the plasmalemma of the two symbiotic partners and are presumably the point of material exchange between host and fungus.

They persist in active form for a very short period 1 to 15 days. With the exception of species of *Gigaspora* and *scutulospora*, the fungi form vesicles within the roots. These are lipid filled, terminal swelling of hyphae with a storage / perennating function.

Objective of the present work entitled:

DIVERSITY AND EVALUATION OF VA-MYCORRHIZA FROM AKOLA REGION

The VA Mycorrhizae are the most ancient and widespread in association involving plants. Detail field studies are necessary to understand the abundance and type of indigenous arbuscular mycorrhizal fungi present in the rhizosphere. Specially, the rhizosphere soil features are very essential to study, because it plays key role in mycorrhizal distribution. From the published data of VA Mycorrhizal survey it has been virtually noted that only sporadic information of VAM ecology and distribution is available and there is a need for complete study of biodiversity of VAM fungi in Purna river sub-basin region. For Akola district no record of such studies is available. Therefore this is an attempt to know the VAM fungal dynamics, their qualitative and quantitative distribution in saline soils. The objective is to evaluate VAM fungi and to identify them from the selected representative area of Akola district.

RESULTS AND DISCUSSION

Vesicular-Arbuscular Mycorrhizal Fungi are found in many types of soils around the world and known to form symbiotic associations with wide variety of plant species. The interest in this association largely came from the observations that these fungi increase uptake of mineral nutrients in host plants, besides they accord protection from environmental stresses, reduce susceptibility of the plant to certain pathogens, alter water relations and photosynthetic capacity of plant and increase reproduction. The Purna river valley soils have severe limitations for their sustainable use due to the development of adverse physical conditions especially poor internal drainage and therefore, the farmers are not in a position to maintain sustainable crop production under rainfed situation. On this account, Purna valley soils attracted the attention for detailed studies of VAMF and utilization of these for the welfare of mankind. Keeping this view in mind the present study was made and the following results were obtained.

Mycorrhizal Association

All the five different wild herbaceous plant species studied i.e. *Alysicarpus tetragonolobus* Edgew., *Crotalaria notonii* Wt. and Arn., *Indigofera cordifolia* Heyne ex Roth., *Achyranthes aspera* L. and *Lagascea mollis* Cav. exhibited AM fungal association. The feeder roots were found to be colonized by AMF hyphae and vesicles the arbuscules were not recorded from root cortical cells. The physico-chemical properties of soil samples indicated that the soil was slightly alkaline (pH 7.2 to 7.8;Ec 0.19 to 0.29) Available N- 265 to 320 Kg/ha; Available P-18.72 to 24.35Kg/ha ; Available K-278 to 305Kg/ha and Organic C- 0.42 to 0.68%.The spore population in the rhizosphere soil samples ranged between 27 to 41 in 10g of soil(Table-I).

Twenty one composite soil samples were wet-sieved for extracting spores. Every individual isolated spore was identified taxonomically. In all twenty nine species of vesicular arbuscular mycorrhizal fungi were identified. The identified species belong to the genera of *Acaulospora* (four species); *Glomus* (Twenty species);*Gigaspora* (one species);*Scutellospora* (Three species) and

Sclerocystis (one species)(Table-II). The occurrence frequency of the five genera was 12.21%, 80.99%,1.8%,3.61% and 1.35% respectively.

Native AM fungi in five dominant herbaceous plant species showed rich diversity in the present study. The field soil samples showed spores of more than one AM fungus. AMF are not thought to be host specific (Mosse,1973). It is possible that the same root may become infected by more than one AM fungus. (Abbott and Robson,1982). The most dominant AMF species *Glomus fasciculatum* and *Glomus aggregatum* indicated their high survival and adaptation. There are many factors like edaphic, host dependence, sporulation ability, dormancy and distribution patterns of AMF spores which could affect spore density in the soils, have been reported previously (Koske, 1987; Bever et al. and Zhao, 1999)

Table I

Physico-chemical analysis of soil samples

Sr.No.	Site	pH	Ec	Org. C%	Avl. N Kg/ha	Avl. P Kg/ha	Avl. K Kg/ha	Spore count/10g
1	S_1	7.8	0.19	0.68	320	18.72	305	41
2	S_2	7.2	0.29	0.56	298	18.72	285	27
3	S_3	7.6	0.24	0.42	265	24.35	278	38

Table II-

Identified arbuscular mycorrhizal fungi and their occurrence frequencies

No.	**Arbuscular Mycorrhizal Fungi**	**Occurrence times**	**Occurrence frequency (%)**
	Acaulospora	**27**	**12.21**
1	*A. Bireticulata* Rothwell &Trappe	13	5.88

2	*A .foveata* Trappe & Janos	08	3.61
3	*A.laevis* Gerdmann & Trappe	04	1.8
4	*A.rehmii* Sieverding & Toro	02	0.9
	Glomus	**179**	**80.99**
1	*G.aggregatum* Schenck & Smith	37	16.74
2	*G.albidum* Walker & Rhodes	08	3.61
3	*G. ambisporum* Smith & Schenck	10	4.51
4	*G. clarum* Nicolson & Schenck	04	1.8
5	*G. constrictum* Trappe	04	1.8
6	*G. dimorphicum* Boyetchko & Tewari	13	5.88
7	*G .deserticola* Trappe,Bloss & Menge	05	2.26
8	*G. etunicatum* Becker & Gerdemann	05	2.26
9	*G. fasciculatum* (Thaxter) Gerdmann & Trappe emend. Walker & Koske	29	13.12
10	*G .fistulosum* Skou & Jakobsen	04	1.8
11	*G. geosporum* (Nicolson & Gerdmann) Walke	03	1.35
12	*G .heterosporum* Smith & Schenck	20	9.04
13	*G. intraradix* Schenck & Smith	03	1.35
14	*G .leptotichum* Schenck & Smith	04	1.8
15	*G. maculosum* Miller & Walker	10	4.52
16	*G. mosseae* Nicolson & Gerdmann Gerdmann& Trappe	05	2.26
17	*G. multicaule* Gerdmann & Bakshi	02	0.9
18	*G. pulvinatum* (P.Hennings) Trappe & Gerdmann	04	1.8
19	*G. pustulatum* Koske, Friese,Walker & Dalpe	06	2.71

20	*G.reticulatum* Bhattacharjee & Mukerji	03	1.35
	Gigaspora	04	1.8
1	*G.albida* Schenck & Smith	04	1.8
	Scutellospora	08	3.61
1	*S .calospora* Nicolson & Gerdmann Walker & Sanders	02	0.9
2	*S. heterogama* Nicolson & Gerdmann Walker & Sanders	02	0.9
3	*S. reticulata* Koske,Miller & Walker Walker & Sanders	04	1.8
	Sclerocystis	**03**	**1.35**
1	*S.taiwanensis* Wu & Chen	03	1.35
Total : VAMF = 29 species		221	100

CONCLUSION

It is concluded from the results of this study that relatively higher AM fungal spores were observed in rhizosphere soil with varied species. Stabilization of disturbed ecosystems like Purna river basin is dependent upon successful establishment of the most effective plant community. As mycorrhizal plants serve this purpose, there is a great potential for saline soil reclamation programme. Successful selection and maintenance of these essential mycorrhizal fungi are needed to be focused in future research.

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ACKNOWLEDGMENTS

We acknowledge the University Grants Commission (WRO) for the financial assistance for carrying out the work.