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ARBUSCULAR MYCORRHIZA FUNGAL ASSOCIATION AND ITS IMPORTANCE IN SOME EDGE PLANTS

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ABSTRACT

A survey of arbuscular mycorrhizal (AM) fungi on 15 edge plants was undertaken, and percent of mycorrhizal colonization and spore number per 50g soil was determined. Varied percent of root colonization with varied spore number was recorded. Altogether 21 AM spores were isolated. The results revealed that Genus *Glomus* was most predominant among the recovered spore genera. The incidence of stunted plant growth, lower stem diameter, lower length of leaves, chlorosis and thin leaves with lower content of total chlorophyll pigment was demonstrated in those edge plants, which were without or less root colonization. However, edge plants, with higher AM colonization, showed improved plant growth, increased stem diameter, larger leaves without chlorosis and significantly increased total chlorophyll content in the leaves. This indicates the importance of AM fungal association in edge plants.

INTRODUCTION

Majority of vascular flora is associated with mycorrhizal fungi, the most dominated mycorrhiza is arbuscular mycorrhizal fungi (AMF) (Brundrett 1991). This fungi constitute one of the important components of soil microbiota, directly involved in improving plant growth under the reduced fertilizer input. The presence of AM fungi has been reported from different habitats and on a wide range of plants. Occurrence of AM fungi and its association in different host plants, grown in various types of soils, is well documented (Jagpal & Mukherjee 2003). Importance of the AM fungi has received considerable attention in the recent years owing to their beneficial response in improving crop productivity (Brundrett & Kendrick 1990). Reports of AM fungal association in edge plants are very meagre. Therefore, the present study was undertaken to assess AMF association of edge plants of Dharwad in Karnataka.

MATERIALS AND METHODS

Root and rhizospheric soil samples were collected from 15 edge plants growing in five different regions of Dharwad *viz*., Karnatak University Botanical Garden, K.C. Park, Azad Park, Taiwak factory and Karnatak College campus of Dharwad. Plants were screened during the month of June 2006. The geographical location is lying between (17' 17' to 15° N latitude and 74°48' to 76' E longitude). For each species, five plants were sampled. Plant roots were dug out, washed free of soil, and stored in formalin aceto-alcohol (FAA) prior to staining. The rhizospheric soil samples of individual plants within a species were mixed and one part was used for VAM fungal spore enumeration and other for the soil characteristics.

Roots were stained with 0.05% tryphan blue in lactophenol according to Phillips & Haymann (1970). Percentage of root length colonization was estimated by magnified intersection method (Mcgoniel et al. 1990). VA fungal spores were recovered by wet-sieving and decanting method (Gedermann & Nicolson 1963). VAM fungal spores were mounted in polyvinyl alcohol lactophenol

and identified using the manual of Schenck & Perez (1990). Eleven soil variables were measured and nutrients were estimated according to Jackson (1973). Percent of organic matter was determined according to Piper (1950). Electric conductivity was measured using bridge meter and pH in 1:1 (W/W) soil to water ratio.

RESULTS AND DISCUSSION

Most of the studied plants harboured arbuscular mycorrhiza fungal colonization. Table 1 shows physico-chemical characteristic of the soil samples collected from different rhizospheres of edge plants in different localities of Dharwad. The percent colonization was varied and range from 47.3% to 98.5 %. Table 2 gives the list of edge plants showing percent root colonization and spore number per 50g soil. It was quite interestingly recorded that Bignoniaceae, Casurianaceae, Combretaceae and Acathaceae show moderate colonization, whereas families Euphorbiaceae and Agavaceae lower colonization. The highest percent colonization was recorded in Compositae (98.5%). Similarly spore number was varied and did not correlate with percent colonization.

Altogether 20 AM fungal spores were isolated from the study as shown in Table 3. Among fungal spores *Glomus* species were most predominated over *Acaulospora* and *Gigaspora*. *Sclerocystis* is considered to be the least and enterophospora being completely absent among the recovered spores. Table 4 shows the improved stem diameter, leaf length and total chlorophyll content in heavily colonized edge plants than that of lower colonized edge plants. This brings direct advantages of mycorrhizal plants having ability to overcome nutrition, especially phosphorus, water stress and stomatal regulation (Janos 1980, Manoharachary 2006). The interconnecting network of external hyphae acts as an additional catchment and as absorbing surface in the soil beyond the depletion zone that would be otherwise inaccessible. Arbuscular mycorrhizal fungi is not only efficient in utilization of available nutrients from soil but also involve in transfer of nutrients from components of soil minerals and inorganic residues to solution and in nutrient cycling in an ecosystem among edge plants (Harley & Smith 1983, Lakshman 1996).

Fungi derive carbon and energy source from the host plants, which it synthesizes. During the vegetative growth period, before seed or fruit setting, higher plants are not carbon or energy limited. Thus, AMF colonization results mostly in a profit for the plant exchange of nutrients.

Advantages conferred on examined plants by arbuscular mycorrhiza fungal colonization were enormous, when the soil phosphorus concentration is at low. Fries & Allen (1998) predicted that AM fungi might be responsible for closed nutrient cycles with minimal loss by decomposing litter directly and transportation of the nutrients, thus, released to the hosts in tropical regions. As evident from the present study, pH of the soil does not seem to influence the spore types and consequently the arbuscular mycorrhiza fungal species. A good to reasonably high correlation existed between the number of spores and percent colonization due to macro and micro elements present in the soil. This may be attributed to the factors nullifying the influence of one or other on mycorrhizal spore population and colonization.

Table 1: Physico-chemical characteristics of the soil collected from rhizosphere of edge plants in Dharwad.

Characteristics	Garden soil
pH	6.7
Soil moisture (%)	28.04
Organic matter (%)	0.82
E.C. mmho/cm	0.97
N (mg/kg soil)	1.42
P (mg/kg soil)	0.27
K (mg/kg soil)	2.42
Zn (mg/kg soil)	2.03
Cu (mg/kg soil)	1.06
Mg (mg/kg soil)	1.43
Pb (mg/kg soil)	0.95

Table 2: List of edge plants associated with AM fungi in Dharwad showing percent root colonization and total spore number per 50 g soil.

S.No	Name of the plant	Family	Percent colonization	Spores/50 g soil
1	*Adhatoda vasica* Nees.	Acanthaceae	66.3	102
2	*Agave americana* Linn.	Agavaceae	78.0	98
3	*Clerodendron inerme* Gaertn.	Verbenaceae	92.2	74
4	*Casurina equisetifolia* Forst.	Casurinaceae	46.2	107
5	*Duranta plumieri* Jacq.	Verbenaceae	61.5	105
6	*Euphorbia nivulia* B.Ham.	Euphorbiaceae	66.7	78
7	*Euphorbia tirucalli* L.	Euphorbiaceae	75.0	93
8	*Guizotia abyssynica* Cass.	Compositae	98.5	63
9	*Jatropha carcus* L.	Euphorbiaceae	83.8	75
10	*Jatropha grandulifera* Roxb.	Euphorbiaceae	66.3	79
11	*Lantana camara* Linn.	Verbenaceae	80.0	110
12	*Tagetes erecta* L.	Compositae	85.7	121
13	*Quesqualis indica* Linn.	Combretaceae	51.4	75
14	*Tecoma stans* Juss.	Bignoniaceae	47.3	105
15	*Thanbergia alata* Boj.	Acanthaceae	53.9	83

Table 3: Occurrence of AM fungal spores in rhizosperic soil of edge plants in five localities of Dharwad.

Sl No.	AM fungal species	K.U.Botanical Garden	K.C.Park	Azad park	Taiwak factory	K.C. Campus
1.	*Acaulospora laevis*	+	-	+	+	-
2.	*Acaulospora tuberculata*	+	+	+	-	+
3.	*Acaulospora lacunose*	-	+	-	+	+
4.	*Gigaspora gigantea*	+	-	+	-	+
5.	*Gigaspora candida*	+	+	+	+	-
6.	*Gigaspora decipiens*	-	-	-	+	+
7.	*Glomus aggregatum*	-	+	-	+	+
8.	*Glomus constrictum*	+	+	-	-	+
9.	*Glomus fasciculatum*	+	+	+	-	+
10.	*Glomus macrocarpum*	+	+	+	+	+
11.	*Glomus geosporum*	+	-	+	+	-
12.	*Glomus leptotichum*	-	+	+	-	-
13.	*Glomus intraradices*	-	+	-	+	+
14.	*Glomus epigaeum*	-	+	+	-	-
15.	*Glomus hoi*	+	+	-	+	+
16.	*Glomus lacteum*	+	-	+	-	+
17.	*Sclerocystis rubiformis*	+	-	+	+	-
18.	*Scutellospora aurigloba*	-	+	-	+	-
19.	*Scutellospora callospora*	-	+	+	-	-
20.	*Scutellospora nigra*	-	-	+	-	+
21.	*Scutellospora reticulata*	+	+	-	+	-

Mean value of 14 samples; + = Present; - = Absent

The present study suggests the need for evaluation of effects of different AM isolates on different edge plants belonging to different plant families. An important next step in this direction could be determined by the functional difference among the different members of individual edge plants. Such studies may help in elucidating the contribution of AM fungal association in the seedling establishment stage, particularly in nutrient poor sites.

Table 4: Edge plants showing the improved stem diameter, leaf length and total chlorophyll content with AM fungal association.

S.No	Name of the plant	Family	Stem Diameter (cm)	Leaf Length (cm)	Chlorophyll content/plant (mg)
1	*Adhatoda vasica* Nees.	Acanthaceae	1.7	10.4	0.42
2	*Agave americana* Linn.	Agavaceae	2.8	25.8	0.51
3	*Clerodendron inerme* Gaertn.	Verbenaceae	0.8	3.5	0.60
4	*Casuarina equisetifolia* Forst.	Casurinaceae	16.3	8.7	0.29
5	*Duranta plumieri* Jacq.	Verbenaceae	0.7	2.3	0.38
6	*Euphorbia nivulia* B.Ham.	Euphorbiaceae	1.3	10.5	0.46
7	*Euphorbia tirucalli* L.	Euphorbiaceae	1.6	3.6	0.51
8	*Guizotia abyssynica* Cass.	Compositae	0.3	5.3	0.63
9	*Jatropha carcus* L.	Euphorbiaceae	3.3	21.8	0.71
10	*Jatropha grandulifera* Roxb.	Euphorbiaceae	2.4	18.5	0.42
11	*Lantana camara* Linn.	Verbenaceae	2.1	3.8	0.37
12	*Tagetes erecta* L.	Compositae	0.3	6.6	0.44
13	*Quesqualis indica* Linn.	Combretaceae	0.6	9.5	0.52
14	*Tecoma stans* Juss.	Bignoniaceae	2.9	2.7	0.58
15	*Thanbergia alata* Boj.	Acanthaceae	0.3	2.0	0.43

REFERENCES

Brundrett, M. 1991. Mycorrhizas in natural ecosystem. In: Advances in Ecological Research, Edited by M. Begon, A.H. Fitter and A. Macfadyan, Academic Press, London, pp. 171-313.

Brundrett, M. and Kendrick, B. 1990. The roots and mycorrhizae of herbaceous wood land plants. New Phytol., 114: 467- 479.

Fries, C.F and Allen, M.F. 1998. Tracking the facts of exotic and local VA mycorrhizal fungi. Agric. Ecosy. Environ., 34: 87-96.

Gerdemann, J.W. and Nicolson, T.H. 1963. Spores of mycorrhizal endogone species extracted from soil by wet sieving and decanting. Trans. Brit. Mycol. Soc., 46: 235-244.

Harley, J.L. and Smith, S.E. 1983. Mycorrhizal Symbiosis. Academic Press, London. 496 pp.

Jackson, M.L. 1973. Soil Chemical Analysis Prentice-Hall, India, pp. 537-580.

Jagpal, R. and Mukerjee, K.G. 2003. Distribution of VA mycorrhizal association in old Delhi ridge. 115: 135-143.

Janos, D.P. 1980. Mycorrhizae influence tropical succession. Biotropica, 12: 56-64.

Lakshman, H.C. 1996. Possible way of nutrient distribution by weeds colonized with VA mycorrhiza. World Weeds, 11: 72-74.

Manoharachary, M. 2006. Biodiversity of arbuscular mycorrhizal (AM) fungi. Techniques in Mycorrhizae, 18: 9-29.

McGoniel, T.P., Miller, M.H., Evans D.G., Fairchild, G.L. and Swan, J.A. 1990. A new method which gives an objective measure of colonization of roots by vesicular arbuscular mycorrhizal fungi. New Phytol., 115: 495-501.

Phillips, J.M. and Haymann, D.S. 1970. Improved procedure for clearing roots and staining parasitic VAM fungi for rapid assessment of infection. Trans. Brit. Micol. Soc., 55: 158-161.

Piper, C.S. 1950. Soil and Plant Analysis. Interscience Publications, New York, 91 pp.

Schenck, N.C. and Perez, Y. 1990. Manual for identification of VA mycorrhizal fungi. Gainsville, USA, Synergistic Publications, 286 pp.