INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES

Volume-3, Issue-3, July-Sept-2013 ISSN 2231-4490

Coden : IJPAES www.ijpaes.com

Received: 24th May-2013 Revised: 01st June-2013 Accepted: 04th June-2013

Research Article

DIVERSITY OF AM FUNGI AT PAH CONTAMINATED AREA OF WESTERN RAJASTHAN

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ABSTRACT: A field survey of various districts of Western Rajasthan was under taken to evaluate the occurrence of Arbuscular Mycorrhizal Fungal (AMF) association with them. Pollution has become a worldwide environmental issue it has created many health problems which may destroy the living life on the planet. Many of the regions have been extremely affected with the pollutants from the industries and automobiles. These can be remediated with the help of plants as well and plants are helped with the Mycorrhizae. These Mycorrhizae help the plant to accumulate pollutants within them or lock in the soil so that it can't move to another place or their form is changed to another so that it cannot make harm to other plants. Plants are having association with the mycorrhizae in a compatible manner. Mycorrhizae increase the root absorption zone by increasing the rooting of the plant. This help the plant to absorb more and more pollutants from the soil to store in the plant itself remediating the soil free from pollutants.
Keywords: Mycorrhizae, Pollutants, Remediation.

INTRODUCTION

Worldwide, contamination of soil is a severe problem. The negative effects of pollutants on the environment and on human health are diverse and depend on the nature of the pollution. Pollution results destruction in the environmental status having many floes in it, it will cause harm to soil and its environment and cause harm to the habitat to that particular area. Now a day the problem of pollution has been increased due to CFC'S released in the atmosphere. This CFC'S has depleted the ozone layer in the atmosphere, and by this ozone depletion the atmosphere is affected very much, harmful rays can easily penetrate the earth atmosphere and in result of this the temperature of the earth has been increased so much. This caused harm to many living things like insects, animals, human being and plants. The harm caused to plants is more dangerous because it is the producer of the ecosystem it producers food and rest all of the living things relay on it weather direct or indirect. Likewise the ability of the plant to withstand in the adverse conditions is carried out with the help of mycorrhizae. Mycorrhizae are the symbiotic association with the plants which help the plant to increase its rhizospheric area of the plant roots so that to absorb more nutrients as well as some plants have ability to absorb pollutants in them. Mycorrhiza helps the plant to accumulate pollutant in them with this rooting modification. Mycorrhiza are symbiotic associations that form between the roots of most plant species and fungi. These symbioses are characterized by bi-directional movement of nutrients where carbon flows to the fungus and inorganic nutrients move to the plant, thereby providing a critical linkage between the plant root and soil. In infertile soils, nutrients taken up by the mycorrhizal fungi can lead to improved plant growth and production. As a result, mycorrhizal plants are often more competitive and better able to tolerate environmental stresses than are nonmycorrhizal plants. Mycorrhizal associations vary widely in form and function. Ectomycorrhizal fungi are mostly basidiomycetes that grow between root cortical cells of many plant species, forming a Hartig net. Arbuscular mycorrhizal fungi belong to the order Glomales and form highly branched structures called arbuscules, within root cortical cells of many herbaceous and woody plant species.

Plant responses to colonization by mycorrhizal fungi can range from dramatic growth promotion to growth depression. Factors affecting this response include the mycorrhizal dependency of the host crop, the nutrient status of the soil, and the inoculum potential of the mycorrhizal fungi. Management practices such as tillage, crop rotation, and fallowing may adversely affect populations of mycorrhizal fungi in the field. Where native inoculum potential is low or ineffective, inoculation strategies may be helpful.

MATERIALS AND METHODS

SITE DESCRIPTION

The Indian Desert comprises about 70% part of the Western Rajasthan, incorporating various district processing arid and semi-arid regions. Out of which some areas were taken into consideration like Jodhpur, Jaisalmer and Bikaner. An intensive field survey of these sites was under taken in order to find out occurrence of AMF association with them. Important climatological characteristics of districts are surveyed.

SOIL SAMPLING

Soil samples were collected from polluted sites at the depth of 10-15µm to obtain mycorrhizal spores.

SPORE ISOLATION

Spore from the soil was extracted by the wet-sieving and decanting method technique of [10]. Total spore number of Mycorrhizal fungi in the soil sample was estimated by the method given by [1] and spore densities were expressed as the no of spore per 100 g of soil. The identification of spore was based on spore size, color, wall layer and hyphal attachment using the identification manual of [6] and the description provided by the international collection of vesicular and AMF.

SOIL TESTING

Soil samples were analyzed for pH and electrical conductivity. The organic carbon was estimated by the method of [12]. Gravimetrical estimation by hydrometer for soil texture was analyzed by the method given by [11]. By surveying the above three sites it has been found that these plants have been found abundantly in these places because soil's physiochemical properties allow plants to grow and survive there. Here the soil pH ranges from 5.52-8.60, and the organic carbon content is between 0.12% and 0.45%. By observing and examining the soil collected from the different places, these five genera of spores have been identified these are:-

1. Glomus
2. Acaulospora
3. Gigaspora
4. Scutellospora

Acaulospora & *Glomus* were the most abundant in all four soil samples. So here we can conclude that the various species of AMF varies with the different plant. The no. of spores isolated from the collected soil samples ranges from 80-150 spores per 100 g of soil, and there is found variation in the no. of spore population from the different sites.

ROOT COLONIZATION

In order to determine the root colonization percentage the roots are treated by the method given by [9], for rapid assay of Mycorrhizal association, while by the method given by [8] the infection percentage can be determined. By applying above method the colonization of the root sample varies between 40% to 60%. The stained roots show the presence of globose to subglobose or ellipsoid bodies vesicles or spores, dichotomously branched structure arbuscules & hyphae in all the sites.

TRAP CULTURE

Pot cultures are called trap cultures have been shown to useful tool for the inducing sporulation of AMF from field soils in semi arid ecosystem in order to facilitate the detection of AMF species that are present in the rhizosphere & roots. To establish this trap culture the field soil was autoclaved and planted with surface sterilized seeds (by 0.1% of $HgCl_2$ solution for 2 min. And then washed with distilled water) of *Cenchrus ciliaris.*

MASS PRODUCTION

The spores isolated from the soil samples are then collected and the spore of similar types having same genera is collected separately. These are then allowed to grow with the plant in the trap culture. These spores are either saw directly with the help of syringe or making synthetic seeds of these spores. After a plant attains successive height the soil of these pots again collected for the isolation of spores from the soil. These spores are now called as pure culture because the spore are alike and of same genera. In this way the pure cultures of different five spores can be obtained.

SOIL PARAMETERS

Soil samples were analyzed for pH and electrical conductivity on 1: 2.5, soil: water suspension. Organic carbon was es1timated by the method of [12] using 1 N potassium dichromate and back titrated with 0.5 N ferrous ammonium sulphate solution. Available phosphorus in soil was determined by extraction with 0.5 M sodium bicarbonate for 30 min [7]. Soil texture was estimated gravimetrically by hydrometer method [11].

RESULT AND DISCUSSION

An extensive field investigation was carried out to evaluate spatial distribution and colonization of AMF species present in the rhizosphere and to study effect of edaphic factors on AMF population in the rhizosphere. (Table no.1).

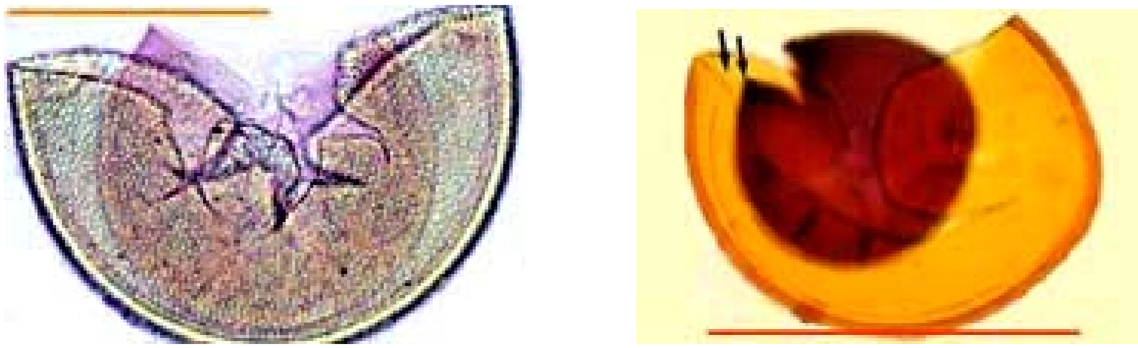

Fig.1: Spores of Acaulospora

Fig. 2: Spores of Scutellospora

Fig 3: Spores of Glomus **Fig. 4: Spores of Gigasspora**

Table 1: Relationship between AMF spore population and different Edaphic factors

Edaphic factors	AMF spore population
pH	0.87**
EC	0.55
OC	0.69*
Olsen P	-0.84**
Temp (max)	0.15
Temp (min)	-023
RH	0.09

*p<0.05; **p<0.01; n = 12

The reveals correlation analysis between AMF spore population and different edaphoclimatic factors. It is evident from the results that AMF spore populations were affected by soil pH, organic carbon and Olsen P content. A significant positive correlation with pH ($r = 0.87$, $p<0.01$) and organic carbon ($r = 0.69$, $p<0.05$) was recorded during present investigation.

Table 2: Physicochemical characteristics of different district soils of Desert Region

District	pH	EC (dSm-1)	OC (%)	Olsen P (mgkg-1)	Texture
Bikaner	5.36	0.24 ± 0.01	0.38 ± 0.01	4.9 ± 0.01	Sandy loam
Jaisalmer	8.42	0.25 ± 0.04	0.38 ± 0.01	4.6 ± 0.01	Sandy
Jodhpur	5.35	0.28 ± 0.03	0.38 ± 0.01	4.2 ± 0.04	Loamy sand

± Standard error of mean

Physicochemical characteristics of site soils for Desert Region (Table no. 2). Distribution of AMF species associated with plants found in polluted Region (Table no. 3). Soil texture varies from sandy gravel to clay loam. The soil had a pH ranged from 5.35 to 8.42, organic carbon 0.38 ± 0.01 and Olsen P level 4.2-7.7 mg kg^{-1} .In general , soil are alkaline in reaction ,low in organic matter content and available P status. In table the pH of the Bikaner and Jodhpur is slightly acidic because of presence of heavy metals and other pollutants from the industrial waste. The pH, EC (dSm-1), OC (%), Olsen P (mgkg-1), Texture of Bikaner is the mean or average value which is calculated from different sites of Bikaner. Like wise same is calculated for Jodhpur and Jaisalmer.

Table 3: Distribution of AMF species associated with Plant found in Polluted Region

AMF species	Bikaner	Jaisalmer	Jodhpur
Glomus aggregatum Schenck & Smith	+++	+	++
Glomus constrictum Trappe	+	_	+
Glomus desertocola Trappe Bloss & Menge	++	+	+++
Glomus mosseae Gerd. & Trappe	+	++	++
Acaulospora leavis Gerdmann & Trappe	+	+	+
Acaulospora morrawae Spain & Schenck	_	+	_
Acaulospora sporocarpia Berch	+	_	+
Gigaspora margarita Becker & Hall	_	_	+
Gigaspora gigantean Nicol & Gerd	+	_	++
Gigaspora rosea Nicol & Schenck	++	+	+++
Scutellospora calospora Walker & sanders	+++	++	++
Scutellospora nigra Walker & senders	_	+	_

- = Absent, + = Low (< 20%), ++ = Moderate (20-50%), +++ = High (>50%),

Twelve species of AMF were identified in the rhizosphere soils collected from field and successive pot cultures scattered over four genera viz. *Glomus, Acaulospora* , *Gigaspora and Scutellospora. Table* no 3- *Glomus (4* species) were most dominant and made up for more than 50% of the total isolates followed by *Acaulospora (*3 species), *Gigaspora* (3 species) and *Scutellospora* (2 species). It is evident that the occurrence of various species of AMF varied considerably with different tree species.

It is reported that genus Glomus to be the most common AMF genus distributed globally and it is also known to dominate in the tropical areas [2] as well as temperate region [5] of the World. Its dominance under various climatic conditions ranging from tropical [2] to high arctic region [5] has been reported earlier. Wide occurrence of genus *Glomus* in the present study as well as reports of several workers suggested that genus *Glomus* has a very wide ecological amplitude, that is responsible for its adaptability and survival in different habitats and vegetational composition. *Glomus* is to be the most abundant of all AMF genera under arid environment, which may be due to its resistance to high soil temperature. Our. *Glomus* is considered to be the most common arbuscular mycorrhizal genus in this region.

CONCLUSION

The *Glomus sp.* is found abundantly in the regions of Jodhpur, Jaisalmer and Bikaner. The study shows that the *Glomus sp*. have much more compatibility with the plants which are grown in the areas of polluted site, it help the plant to survive there and control the pollution by accumulating, absorbing, or degrading the pollutants within plant parts or near its vicinity. Furthermore studies can be done on the Mycorrhizal association with the plant at the polluted site in order to reduce the PAH contamination from the soil and study the physiological, chemical and molecular modification or changes in plant as well as in Mycorrhizae also. This will help the future aspects of the environmental pollution to control and reduce it.

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