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A study of Rhizosphere fungal populations of two plants from two populations in Ulhasnagar

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ABSTRACT

Rhizosphere is a very specific region around the roots where maximum activities of microorganisms take place among themselves and with the plant roots. Smt. C. H. M. College is having 16 acres of lush green area wherein a number cultivated and wild plants grow luxuriously almost throughout the year. Just outside the college, flows the Waldhuni River which is completely polluted. Though the wild populations of plants are same in both, CHM campus and the banks of Waldhuni River, the soil to which they are exposed is completely different. The present project is an attempt to study the differences fungal populations in the rhizosphere of two plants - *Polygonumglabrum* and *Scopariadulcis*. It was observed that in the polluted soils, the number of fungal populations was more.

Keywords: Rhizosphere soil, *Polygonumglabrum, Scopariadulcis, Aspergillus, Penicillium*.

INTRODUCTION

The rhizosphere is a small area of soil around the root. In 1904, Hiltner, the soil bacteriologist and the professor of Agronomy at Technical College of Munich, Germany, for the first time demonstrated that the microbes in the rhizosphere play an important role in the nutrition and growth of the plant. The rhizosphere region is very small covering only a few millimeters. Only in sandy soils itcan be extended up to 1 centimeter. Lynch and Whipps, (1990) and Pinton *et al*., (2001), elaborately studied the peculiarities of this region. According to them, the region is rich in root exudates and hence in soil organic matter. It harbors dense populations of variety of microorganisms. Clark (1949), suggested that actual root surface has still higher concentrations of root exudates and hence it attracts more number of microorganisms. He considered the root surface as the rhizoplane region. It is practically difficult to isolate the two regions and the microorganisms thereof.

Because of this, nowadays a term root soil interface is commonly used for the area that may cover both the regions.

The nature of root exudates varies with the plant species, age of the plant, the vegetative and the reproductive stage of the plant and the region of the root. These exudations are of varied nature from sugars, amino acids, organic acids to secretary and excretory products of the plant. They may include secondary metabolites of the plant. All this not just increases the organic matter in the soil but also decides the type of microorganisms that can grow in the rhizosphere of that plant. The presence of microorganisms also increases the root exudations. (Barber and Martin, 1976). The root exudes these substances from specific regions such as germinating seeds, sloughed off cells, root hairs, root apices, etc. The complex geometry of root soil interface is modified by root hairs and mycorrhizae. This increases the volume of rhizosphere and the heterogeneity of soil porosity. (Hinsinger, *et al*., 2004).

The rhizosphere populations comprise of microflora (bacteria, actinomycetes, fungi, algae and viruses), microfauna (protozoa), mesofauna (nematodes) and macrofauna (insects, mites, termites, millipedes, slugs, snails, earthworms, etc). The different associations, interactions of these organisms with each other and with the plant make a complex food web in this region. There associations include symbiotism, parasitism, nitrogen fixing, phosphate solubilization, etc. (Curl and Truelove, 1986). It is practically impossible to study all these organisms at any one time. Hence the present work includes the study of only fungal populations from such soils.

Smt. C. H. M. College is situated on 16 acres of lush green campus in Ulhasnagar, a suburb near Mumbai on Central Railway. It encompasses 6 colleges, 4 gardens, a playground in the backyards and a foreground. The entire area is covered by more than 200 cultivated and wild plants. Waldhuni River originates in Kakole Lake, Ambernath, flows through Ulhasnagar, Viththalwadi and meets Ulhas River at Mohane Village near Kalyan. Since the river is highly polluted due to release of industrial and domestic sewage, it is often regarded as Waldhuninalla (environmental Status Report, Kalyan). The banks of the river thus become the storage spaces for the pollutants brought by the river water as they gradually settle in the same area. The growth of the plants and the nature of exudates in this region is altered because of these conditions. The fungal populations surviving in these conditions are peculiar and hence this project has been undertaken.

MATERIAL AND METHODS

The plants selected were *Polygonumglabrum* and *Scopariadulcis*.

Polygonumglabrum
Family: Polygonaceae
It is herb with few branches. The stem is reddish below and possesses a reddish ring at the node. The leaves are lanceolate, acuminate, glabrous and with sheathing leaf bases. Flowers are pink in long racemes.

Scopariadulcis
Family: Scrophulariaceae.
It is a small, erect, much branched herb. The leaves are small, opposite or in whorls of three, acute, elliptic and serrate. Flowers are axillary, in whorls of 2-3.

Collection of material-plant and soil-

1. The plants of the selected species were collected from the campus of Smt. C. H. M. College, Ulhasnagar and from the banks of Waldhuni River opposite to College.
2. In the laboratory, the plants were gently shaken to remove the loose soil around the roots. The soil that remained adhered to the root surface was collected with sterile scalpel in sterile petriplates as the soil of root-soil interface (rhizosphere) as suggested by Oritsejafor and Adenjii, 1990).
3. All the soil samples were analyzed for soil pH, texture, moisture, organic matter content and for fungal populations.

Soil analysis

1. The pH of the soil samples was determined with the help of pH meter. (Labindia, PICO).

2. The texture of soil was determined by mechanical analysis method as described by Rai (1998).
3. The organic matter content of soil was determined by rapid titration method (Walkley and Black, 1934).
4. The fungal populations were isolated on Potato dextrose agar (Difco Manual, 1969), Malt extract agar (Difco Manual, 1969), Aspergine Mannitol agar (Thornton, 1922) and Czapeck' Dox agar, (Difco manual, 1969) by serial dilution method (Prammer and Schmidt, 1966).
5. The pure cultures were maintained on respective media at room temperature.
6. The fungi were identified at ARI, Pune.

RESULTS & DISCUSSION

pH:

The pH of the soil samples from the college campus showed slightly higher pH values than those of river banks. It may be due to the diverse types of pollutants having different pH values getting mixed together. The overall range of pH was from 4.0 to 8.5 i. e. from acidic, neutral to basic. Since, *Aspergillus* and *Penicillium* grow well at all these pH values, they grow well in all these soils.

The soil texture of rhizosphere soil of *Polygonumglabrum* from the college campus was clayey with some amount of gravel. That from the

Table 1. pH of the soil samples

Name of the plant	Sample	pH for the sample from the river banks	pH for the sample from the college campus
	I	6.5	5.0
	II	7.0	7.5
	III	7.0	7.5
	I	6.5	4.0
	II	7.0	7.0
	III	7.0	8.5

Table 2: organic matter content

Name of the plant	Sample	Soil sample from the CHM campus	Soil sample from the river banks
Polygonumglabrum	I	1.69	3.25
	II	0.73	1.06
	III	1.57	4.73
Scopariadulcis	I	0.43	0.84
	II	0.32	0.88
	III	0.76	0.82

Table 3: fungal flora isolated on selected media

Name of the plant	Soil samples from river banks				Soil samples from the college campus			
	PDA	AMA	CDA	MA	PDA	AMA	CDA	MA
Polygonumglabrum	*A. candidus*	*A. niger*	*A. ornatus*	*P. decumbens*	*Absidia glauca*	*Fusarium roseum*	*A. glaucus*	*F. solani*
	A. ochraceous	*A. fumigatus*	*A. terreus*	*A. niger*	*P. decumbens*	*Curvularia lunata*	*A. ochraceous*	*P. chrysogenum*
	A. niger	*A. versicolor*	*P. decumbens*		*A. candidus*	*Curvularia pallescens*	*Mucor species*	*Curvularia lunata*
			A. niger		*A. niger*	*Sporotrichum chlorinum*	*Trichoderma viride*	*Sporotrichum chlorinum*
					Nonsporulating mycelium	*A. niger*	*P. chrysogenum*	*A. niger*
Scopariadulcis	*P. steckii*	*A. niger*	*A. niger*	*A. repens*	*A. clavatus*	*A. flavus*	*A. versicolor*	*A. repens*
	A. nidulans	*A. flavus*	*A. flavus*	*P. chrysogenum*	*P. chrysogenum*	*P. frequentans*	*P. chrysogenum*	*Curvularia pallescens*
	A. oryzae	*Rhizopus nigricans*		*A. fumigatus*	*Curvularia lunata*	*P. chrysogenum*	*P. steckii*	*A. clavatus*
	A. niger			*A. niger*	*Sporotrichum chlorinum*	*F. roseum*	*Mucor species*	*A. niger*
					Trichoderma virde	*A. niger*	*A. niger*	

AMA-Aspergine mannitol agar, PDA-Potato Dextrose Agar, MA-Malt extract agar
CZA-Czapeck' Dox agar *A. –Aspergillus* *P. Penicillium* *F.-Fusarium*

river banks was sandy clay. The rhizosphere soil of *Scopariadulcis* from college campus was sandy with lot of gravel. Soil samples from the college campus light coloured with less of decomposing matter. The soil from the river banks was blackish, with lot of decomposing matter and foul smell. The soils from the college campus were dry and favoured the growth of Aspergilli. The soil pH values of both the plants for the two locations are given in the table no. 1.

Organic matter

The soil organic matter from the rhizosphere soil samples ofboth the plants was higher in the soils from the river banks and was slightly less in the soil samples of college campus. The soil organic matter represents the decaying organic matter. The more the organic matter, the more is the growth of saprophytic fungi such as Aspergilli and Penicilli. The Rhizosphere mycoflora of the soil. The organic matter content of the soil samples are given in table no. 2.

The dominant genus in all the rhizosphereic soil samples was *Aspergillus*. The species diversity was found to be maximum for the same genus. *Aspergillus niger* was the dominant species. The number of species isolated was higher in the soil samples collected from the river banks. It may be because of higher amount of organic matter present in the soil.

CONCLUSION

The rhizosphere soils are rich sources of fungal populations. The rhizosphere soils from the river banks (though polluted) are rich in soil organic matter and harbor a vast diversity of fungi.

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