Research Article

International Journal of Bioassays
ISSN: 2278-778X
www.ijbio.com

STUDIES ON THE MYCOFLORA IN THE RHIZOSPHERE OF SUGARCANE (*SACCHARUM OFFICINARUM* L.).

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Received for publication: December 19, 2012; **Revised**: January 12, 2013; **Accepted**: February 21, 2013

Abstract: The rhizosphere mycoflora of two varieties of sugarcane (*Saccharum officinarum* L.) was studied qualitatively and quantitatively from sugarcane plantation in Baramati tehsil. Two sugarcane varieties viz. CO 86032 and CO 0265 were investigated. With age activities of fungi increased. When near maturity the number of colonies declined. Isolated fungi from both rhizosphere and non rhizosphere soil were dominated by *Aspergillus, Alternaria, and Rhizopus*. Fungi including *Fusarium* spp., and dark sterile mycelia were present in higher frequencies on root surfaces than in the surrounding soils. Although the results were slightly varying the number and the type of fungal colonies in both the varieties were nearly same.

Keywords: Fungi, Mycoflora, Rhizosphere, *Saccharum officinarum*, Soil fungi, Sugarcane.

INTRODUCTION

The rhizosphere is a hot spot of microbial interactions as exudates released by plant roots are a main food source for microorganisms and a driving force of their population density and activities. The term 'rhizosphere', since its inception the fungal development in that zone has fostered great interest (1,2). The rhizosphere harbors many organisms that have a neutral effect on the plant, but also attracts organisms that exert deleterious or beneficial effects on the plant (1,3,4). The root surfaces of higher plants are occupied by an epiphytic flora of the fungi, certain species of which are characteristic for that habitat. The substrate is provided chiefly by the excretion of organic substances in low concentrations from the roots. Plant age as well as plant type are influential in exudates release and impact on microflora in rhizosphere zone (5,6,7). Such excretions are also largely responsible for a zone of increased microbial numbers around the root, which is known as the rhizosphere. Such increases in fungal counts reached maximum at crop maturity and soon falls off.

MATERIALS AND METHODS

The study area, Baramati, tehsil of Pune District in Maharashtra state of India is hot semi-arid region (8). It is southern eastern part of district lies between 18° 3'N latitude and 74° 13'-74° 40'E longitude having total geographic area of 1,38,247 hector, receiving 530.2 mm of average rainfall. Maximum and minimum temperatures are 43°C and 19°C respectively with mean daily temperature above 22°C (9). Samples of soils from the rhizosphere of sugarcane (*Saccharum officinarum* L.) varieties CO 86032, CO 0265 were collected by shaking up-rooted plants (between 45-315 days old) in sterile paper bags. Non rhizosphere soil from same sampling site and variety was also sampled every time. Soil moisture and pH were recorded immediately after sampling. The serial dilution plate method was adopted (10, 11). Aureomycin plus Streptomycin (5µg/ml) were used to resist the bacterial growth. Simultaneously pH and moisture content were recorded (12,13,14).

R/S ratio was obtained as =

$$\frac{\text{No. Of colonies from rhizosphere / g of soil (R)}}{\text{No. Of colonies from non rhizosphere/ g of soil (S)}}$$

RESULTS AND DISCUSSION

Sugarcane plants of both the varieties, promoted fungal development in the vicinity of the root zone as compared to the soil away from rhizosphere effect (Fig.1). During the early stages of the cane growth (45 days), the number of the fungal isolates dropped compared to the original population. One would be inclined to say that due to the first influence of ecological factors in such microhabitats some fungi may be unable to orient directly with the new changes (6,15). It reveals the adaptive changes that are taking place in the zone. Also plants may compete for the

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available nutrients before their exudates reach the soil.

Till the 180 days plant age number of fungal colonies increased, reaching its maximum when plants were 180 days old. Fungal activity then dropped consistently with senescence. Similar results were shown with different crop plants. These changes in favor of the rhizosphere flora were correlated with. Metabolic secretions or excretions periodically released into the soil are in line with increasing age and development. Such changes happening in the rhizosphere zone by the developing roots and their sloughed off cells are influencing rhizosphere flora positively (5). The pH and soil moisture content were found to be relatively lower in CO 0265 growing soil than in soils with CO 86032 (Table 1). The pH dropped in the rhizosphere soil in both varieties, indicating acidic secretions by the cane plant roots.

Table.1: Soil pH, moisture content (MC) and R/S ratio in relation to plant age.

Plant Age (Days)	CO 86032-Soil			CO 0265-Soil		
	pH	MC	R/S Ratio	pH	MC	R/S Ratio
Pre sowing	7.8	11.8	1.00	7.6	11.3	1.00
45	7.6	12.1	1.06	7.4	11.7	1.05
90	7.2	13.1	1.12	6.7	9.9	1.22
135	7.1	19.7	1.94	6.5	18.7	1.29
180	7.2	16.8	2.19	6.8	15.9	2.13
225	7.8	17.9	1.61	7.0	16.1	1.88
270	8.1	15.9	1.12	7.6	16.0	0.94
315	8.2	18.5	0.94	8.1	17.1	0.83

The rhizosphere effect (R/S ratio) is also presented in Table.1. R/S ratio demonstrated that microbial activity increased with the plant age, and then a confirming decline in the ratio marked the drop of activity with maturation. The ratio was used to determine the microbial activity in the root zone compared to that of the surrounding soil away from plant roots. A list of fungal species prevailing in the sampling area is shown in the Table 2. Isolated fungi from both rhizosphere and non-rhizosphere soils were identified by using standard literature (16,17). It was observed that mycoflora of these soils is dominated by the genus *Asperillus, Alternaria* and *Rhizopus*. It is well known that soils of the tropics are rich in *Aspergillus* spp., while *penicillia* are the dominant fungi in soils of the temperate regions (4,14). Fungi including *Fusarium* spp., *Curvularia* spp. and dark sterile mycelia were present in the higher frequencies on the root surfaces than in the surrounding soils. *A. fumigatus, A. flavus. A. nidulans* and the hyaline sterile mycelia occurred in higher frequency in non-rhizosphere soils. On the other hand, *A. niger, A. tamari, Trichoderma viridae* and the dark sterile mycelia were encouraged by the plant root exudates. Although *Rhizopus* spp. was isolated in lower quantities from the non rhizosphere samples, yet their frequency of occurrence decreased with plant growth (Table.2). This effect was attributed to the response of the Mucorales to different plant root secretions (15).

CONCLUSION

Fungal associations with the root surfaces are also shown in Table 2. However due to competition only specialised root inhabitants overwhelmed other fungal species in that area (2,11,13). The dark sterile mycelia were considered as typical root inhabitants. Figure-2 shows the number of fungal species in the rhizosphere, non rhizosphere and on rhizoplanes (root surfaces). The largest number of fungi was isolated from the rhizosphere. It was shown that the activity and growth of most soil inhabiting fungi are enhanced by plant root exudates. The least number of fungal isolates were found on root surfaces (root surfaces) (Fig. 2). It was suggested that fungal species have a limited and specific space on the surface of roots for their development and only specialised root inhabitants can gain advantage on that area (7,18).

Table.2: List of fungal species isolated from soils of rhizosphere, non rhizosphere and root surfaces of sugarcane and their abundance.

Fungal isolate	Rhizo-sphere soil	Non Rhizo-sphere soil	Rhizopl-ane
Alternari solani Sorauer	+ + +	+	-
Aspergillus clavatus Desmaziers	+ +	+	-
Aspergillus flavus Link	+ + +	+ + + +	-
Aspergillus fumigates Fres.	+ + +	+ + +	-
Aspergillus nidulans Winter	-	-	+
Aspergillus niger Van Tieghman	+ + +	+ +	-
Aspergillus tamari Kita	+	+	+
Aspergillus spp.	+	+	-
Chaetomium spp.	-	-	+
Cladosporium herbarum Link.	+ +	+	++
Cladosporium cladosporoides G.A. Vries	+ +	+	++
Culvularia geniculta Poedjin	+	-	+
Emerciella spp.	+	+ +	-
Fusarium solani Appel & Wollenweber	+	-	+
Fusarium spp.	-	-	++
Helminthosporium spp.	+	-	+
Mucor spp.	+	+	-
Penicillium nigricans Thom	+	+	-
Penicillium spp.	+	+	-
Rhizoctonia solani Kuhn.	+	-	+
Rhizopus nigricans Ehrenberg	+	-	-
Rhizopus nodosus Namyslowski	+ +	+	+
Rhizopus spp.	+ +	+	+
Sterile dark mycellia	+	-	++
Sterile hyaline mycellia	+	+ +	-
Trichoderma viridae Gray	+ +	+	++

(Indicators: - Not detected, + Rare Presence, ++ Frequent, +++ Abundant, ++++ Highly Abundant)

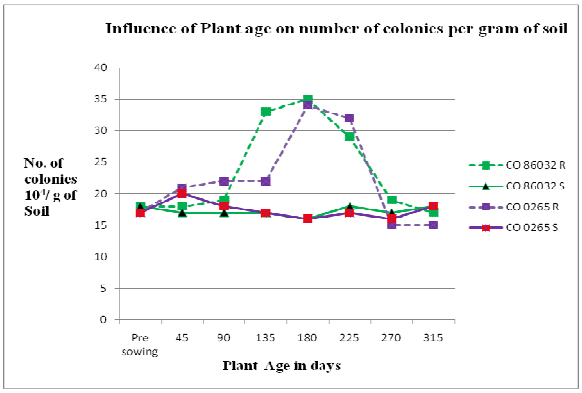

Fig.1: Influence of Plant Age on No. of Colonies per Gram of soil.

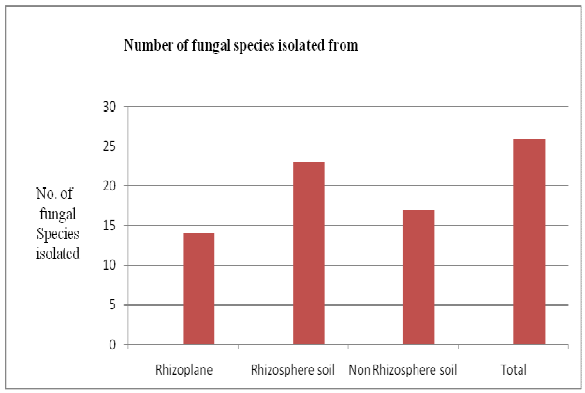

Fig.2: Fungal Isolates

Present investigations are in line with preparing Regional Biological Directory (RBD). Plant or host specific soil mycoflora and its documentation is worthwhile in designing and developing strategies for better yield and quality produce.

ACKNOWLEDGEMENT

Authors express their sincere gratitude towards the authorities of BCUD, University Of Pune, Agricultural Development Trust and Principal, Shardabai Pawar Mahila Mahavidyalaya, Shardanagar, Baramati for their constant support and providing facilities during the work.

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Source of support: Nil
Conflict of interest: None Declared