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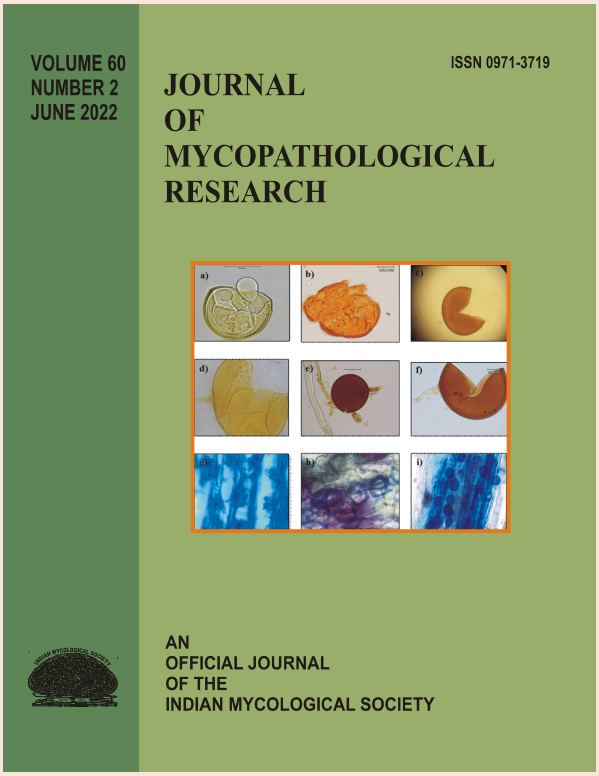

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Diversity of rhizosphere mycobiota of some oil yielding crops in Davanagere region of Karnataka, India

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The present investigation was carried out with the rhizosphere mycobiota of selected oil yielding crops like Groundnut, Mustard and Sunflower in Davanagere region. The rhizosphere soil samples were randomly collected from oil yielding crop fields of Davanagere region. Physico-chemical parameters were analysed using standard procedures. Rhizosphere mycobiota (fungi) was isolated on different culture media, viz., Potato Dextrose Agar and Martins Rose Bengal Agar media supplemented with 1% Streptomycin, from the collected soil samples using dilution plate technique. A total of 165 colonies were isolated, about 38 species belonging to 14 genera. Maximum number of fungal colonies belonging to Ascomycetes and few to Zygomycetes. The rhizophere mycobiota including *Alternaria* sp, *Aspergillus* (8 spp.), *Cladosporium cladosporoides, Colletotrichm* spp, *Curvularia* (4 spp.), *Fusarium* (7 spp.), *Mucor flavus, Penicillium* (3 spp.), *Rhizopus* (3 spp.), *Chaetomium* (2 spp.), *Macrophomina phaseolina, Talaromyces stipitatus, Trichoderma* (3 spp.) and *Trichothecium roseum* were identified. Physicochemical analysis revealed that soil is rich in mycoflora due to acidic p^H, rich organic matter and optimum moisture content. Among the isolates the *Aspergillus* species was dominant of selected oil yielding crop fields of Davanagere region due to their sporulation ability. The percentage occurrence of the mycobiota was statistically evaluated.

Key words: *Aspergillus*, Davanagere, mycobiota, oil yielding crops, rhizosphere

INTRODUCTION

Rhizosphere is the narrow zone of soil surrounding the root where microbe population are stimulated by root activities. (Chandrasekhar *et al.* 2014). The rhizophere 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 interest (Deshmukh *et al,* 2013). The rhizosphere is a micro ecological zone in direct proximity of plant roots. It is functionally defined as the particulate matter and microorganism that cling to roots after being gently shaken in water. The theoretical extent of the rhizosphere is dependent on the zone of influence of the plant roots and associated microorganisms. The rhizosphere is a metabolically busier, faster moving, more competitive environment than the surrounding soil.

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Fungus also protects plants by supplying a protective health to supply both water and phosphorus to the plant roots during droughts. In plants, exudates can be a healing and defensive response to repel insect attack, or it can be an offensive habit to repel other incompatible or competitive plants (Turukmane *et al.* 2018). Fungi are present in the soil depend on many environmental factors such as the amount and type of nutrients, moisture, aeration, p^H and temperature etc.

Davangere region is an agricultural and food treasury of Karnataka state located in central part of Northern Karnataka. It is the heart of Karnataka. The region is primarily agrarian in character and more than 75% of population depending directly or indirectly on agriculture for their livelihood. The district occupies the total geographical area 5913.4 sq.km. In this district consist of different types of soil like, Black & Red soil, Red Sandy soil mixed with clay soil and patches of black soil and Black Cotton soil. This region comprises different type of soil which is suitable for growing the major oil

yielding crops like ground nut, mustard and sunflower that are adapted the same climatic conditions. These crops are grown in short duration, photosensitivity, wide adaptability and drought tolerance. It consists of hot humid monsoon type of climate, the annual rainfall is 637mm and the temperatures ranges from 43^{0}C, depending upon the climatic season. The major oil yielding crops are Ground nut, Sunflower, Mustard, Sesame, Niger and Castor.

Oil seed crops generally are one of the most important crops in the world. The oil seeds are energy rich crops, grown generally under the energy-starved conditions. These are mainly cultivated in arid and rain-fed conditions in which low soil fertility poses serious challenges to the realization of optimum yield. Generally, oil seeds show good response to both major nutrients and micronutrients. The major oil seed crops include Soya been, Coconut, Oil palm, Groundnut, Sunflower, Mustard and Sesame etc. Majority of the oil seed consists of proteins and high contents of essential amino acid which are beneficial to human health.

The investigation is undertaken because Davangere region comprises different agro climatic zone and it is the most agreeable and healthy climatic condition for growing the crops. Half of this district population depends on farming and agriculture. Fungi are present in the soil of different oil yielding crops during different climatic condition, and seasonal variation. Till date, no attempt has been made so far to screen the soil mycobiota in this area. Keeping view of the aforesaid, the present study was aimed to isolate, enumerate the rhozospheric soil samples collected from the selected Major oil yielding crops in Davanagere district, Karnataka.

MATERIALS AND METHODS

Study area

Davanagere region is an agricultural and food treasury of Karnataka state located in central part of Northern Karnataka. Total area of district is 54, 98,397 sq.km. It lies in 13^0 45$'$ 00$''$ N and 14^0 50$'$ 00$''$ N latitude and 75^0 30$'$ 00$''$ E and 76^0 30$'$ 00$''$ E longitudes.

Field survey

Field survey was undertaken during work period of selected oil yielding crops like Groundnut, Mustard and Sunflower from all the of Davangere region to isolate and enumerate the fungal diversity from the soil samples. Randomized sampling method is used for survey and collection of rhizospheric soil samples (Ianjewar, 2019).

Collection of soil sample

The rhizosphere soils collected randomly from a depth of 15 cm near the rhizosphere region of plants, with the help of a sterilized metal spatula into a small sterilized Zipper polythene bags and brought to laboratory stored at 4^{0}C for the mycological examination. For the analysis of soil nutrients, one kg of soil was separately collected in polythene bags. Each sample bag was labelled appropriately by indicating the site of collection and date (Gnanasekaran *et al*. 2015).

Physicochemical analysis of soil samples

Soil samples were analyzed for the following physicochemical parameters: soil type, soil texture, moisture content, pH, electrical conductivity, organic carbon, micro and macronutrient analysis (Wodaje Addis *et al.* 2014).

Isolation of soil mycobiota

Dilution plate technique described by (Warcup, 1955) used for the isolation of fungi from various rhizosphere soil samples. 10 grams of soil samples were suspended in 90 ml of distilled water. The flasks were shaken thoroughly in order to get uniform distribution of the soil particles. The soil suspensions were diluted in 10 fold increment from 10^{-2} to 10^{-4}. For plating, 0.1 ml of each dilution was spread on Potato Dextrose Agar (PDA) and Martin's Rose Bengal Agar supplemented with 1% streptomycin to inhibit bacterial growth. The inoculated plates were incubated in an inverted position for 3-7 days at room temperature 28$\pm$ 2º c. There replicate plates were prepared for each sample. Slides of isolated fungi were prepared in lacto phenol cotton blue method and were examined under stereo-binocular microscope and compound microscope. Isolates were identified on the basis of colony morphology, cultural, colony character and spore structure by using relevant literature (Gilman, 2001, Nagamani *et al.* 2006)

Data Analysis

Population density expressed in terms of Colony Forming Unit (CFU) per gram of soil with dilution factors (Rakesh and Raju 2013). The percentage contribution of each isolate calculated by using the formula,

$$\% \text{ Contribution} = \frac{\text{Total No. of CFU of an individual Species}}{\text{Total No. of CFU of all Species}} \times 100$$

CFU= Colony forming unit

RESULTS AND DISCUSSION

During the investigation period three rhizosphere soil samples were collected from of selected oil yielding crop fields in Davanagere region, Karnataka. The physicochemical parameters of rhizosphere soil such as soil type, soil texture, colour, p^H, electrical conductivity, moisture content, macro nutrients (nitrogen, organic carbon, phosphorus, potassium sulphur) and micro nutrients (copper, magnesium, zinc and iron) were carried out in detail which are represented in Tables 1 and 2.

Rhizosphere fungi were isolated from Jan 2020 to Dec 2020. The soil mycobiota in different oil yielding crops like Groundnut, Mustard and Sunflower were observed. About thirty eight species belongs to sixteen genera were identified by using relevant literature. Out of these 9 genera and 27sp belongs to Asomycetes, two genera and three species belongs to Zygomycetes, three genera and seven sps belongs to Ascomycota. Among thirty eight species 8 were of *Aspergillus,* 7 of *Fusarium,* 04 of *Curvularia,* 3 of *Penicillium*, 3 of *Trichoderma,* 2 of *Chaetomium and Rhizopus* sp, were recorded. The other genera represented by *Alternaria, Colletotrichum, Macrophomina, Talaromyces, Trichothecium, Nigrospora* have been listed in Table 3. During the course of study Deutero-mycotina reported as dominant group. This observations have also been observed by several workers in their different agricultural crop fields from many parts of the world (Sharma and Raju 2013; Niharika *et al.,* 2013; Beatrice and Santhi 2016; Patil and Barabde, 2016). During our investi-

Table 1: Type, colour and texture of soil samples

			Soil Texture		
Crop Name	Soil Type	Soil Colour	Sand %	Clay%	Silt%
Ground Nut	Sandy clay loam	Blackish Brown	86	10	4
Mustard	Loamy sand	Light Brown	84	14	2
Sunflower	Sandy loam	Red	80	6	14

Table 2: Physico-chemical analysis of soil sample

Crop Name	Moisture Content (%)	P^H	EC (dS/m)	OC (%)	N (kg/hac)	P (kg/hac)	K (kg/hac)	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)
Ground Nut	6.08	7.31	0.370	0.24	361.20	77.90	161.28	2.16	0.84	3.12	25.06
Mustard	5.97	7.06	0.479	0.27	154.80	103.57	194.88	1.80	1.54	13.60	22.72
Sunflower	7.64	6.85	0.385	0.29	206.40	126.59	133.06	3.90	0.68	20.46	36.38

Table 3: Occurrence of rhizosphere mycobiota in oil yielding crops at Davanagere Region

Region	No. of total colonies	Average No. Individual Colonies															
		Alternaria (1 sps.)	*Aspergillus* (8 sps.)	*Chaetomium* (2 sps.)	*Cladosporium*	*Co llelotrichum* sps.	*Curvularia* (4 sps.)	*Fusarium* (7sps.)	*Macrophomina* sps	*Mucor* sps	*Nigrospora* sps	*Penicillium* (3 sp)	*Pestalostiopsis* sps	*Rhizopus* sps	Talaromyces sps	*Trichoderma* (3 sps)	*Trichothecium* sps
Groundnut	62	2	16	2	1	2	4	9	2	1	-	10	2	5	1	5	1
Mustard	45	1	13	1	1	1	2	6	-	2	1	7	1	3	1	4	1
Sunflower	58	-	18	2	2	1	3	8	-	2	2	8	-	3	2	7	-
Total	165	3	47	5	4	4	9	23	2	5	4	25	3	11	4	16	2

Table 4: Percentage contribution of fungal species of some oil yielding crops in Davanagere Region

Fungal Species Obtained	Groundnut		Mustard		Sunflower	
	TNC	% of Contribution	TNC	% of Contribution	TNC	% of Contribution
Alternaria alternata	2	3.2	1	2.2	-	-
Aspergillus flavus	3	4.8	3	6.6	2	3.4
Aspergillus fumigatus	3	4.8	2	4.4	3	5.2
Aspergillus nidulans	1	1.7	2	4.4	2	3.4
Aspergillus niger	4	6.5	3	6.6	2	3.4
Aspergillus ochraceus	1	1.7	2	4.4	2	3.4
Aspergillus sydowii	1	1.7	1	2.2	1	1.7
Aspergillus terrus	2	3.2	-	-	2	3.4
Aspergillus quadrilineatus	1	1.7	-	-	2	3.4
Chaetomium globosum	1	1.7	1	2.2	1	1.7
Chaetomium elatum	1	1.7	-	-	1	1.7
Cladosporium cladosporoides	1	1.7	1	2.2	2	3.4
Colletotrichum sps.	2	3.2	1	2.2	1	1.7
Curvularia lunata	2	3.2	1	2.2	1	1.7
Curvularia akiinensis	1	1.7	-	-	1	1.7
Curvularia chlamydospora	-	-	1	2.2	1	1.7
Curvularia fallax	1	1.7	-	-	-	-
Fusarium equisitae	1	1.7	-	-	2	3.4
Fusarium incarminatum	2	3.2	-		1	1.7
Fusarium proliferatum	1	1.7	1	2.2	-	-
Fusarium oxysporum	3	4.9	2	4.4	2	3.4
Fusarium solani	2	3.2	2	4.4	1	1.7
Fusarium verticilloides	-	-	1	2.2	1	1.7
Fusarium proliferatum	-	-	-	-	1	1.7
Macrophomina phaseolina	2	3.2	-	-	-	-
Mucor flavus	1	1.7	2	4.4	2	3.4
Nigrospora oryzae	-	-	1	2.2	2	3.4
Pestalotiopsis microspora	2	3.2	1	2.2	-	-
Penicillium chrysogenum	4	6.5	3	6.6	3	5.2
Penicillium citrinum	3	4.8	2	4.4	2	3.4
Penicillium cummune	3	4.8	2	4.4	3	5.2
Rhizopus stolonifer	3	4.8	2	4.4	1	1.7
Rhizopus nigricans	2	3.2	1	2.2	2	3.4
Talaromyces stipitatus	1	1.7	1	2.2	2	3.4
Trichoderma atroviridae	1	1.7	-	-	2	3.4
Trichoderma harzianum	2	3.2	2	4.4	3	5.2
Trichoderma viridae	2	3.2	2	4.4	2	3.4
Trichothecium roseum	1	1.7	1	2.2	-	-

TNC- Total no. of individual colonies

gation period we have recorded *Aspergillus* sp, *Fusarium* sp, *Curvularia* sp, *Penicillium* sp., *Trichoderma* sp. followed by *Cladosporium*, *Mucor, Rhizopus*, *Pestalotia, Talaromyces, Trichothecium*. In the earlier reports also indicate that *Aspergillus* were dominant in agricultural crop field soils (Chandrashekar *et al.,* 2014) and same was reported by Niharika *et al.,* (2013) in Groundnut, Sunflower and different crop fields of Andhra Pradesh. Colony forming unit is a good estimate

of fungal population in different ecosystem such as soil and is one of the most common methods employed by researchers. Total number of colonies, the percentage contribution of fungi have been presented in Table 4. The percent contribution of the individual species to the total fungal population showed variation. Diversity of fungal species varies greatly within crops to crops and regions to region. The maximum per cent contribution showing by Groundnut crop fields as compared to the Mustard and Sunflower. In Groundnut rhizosphere region the *A. niger, P.chrysogenum* 6.5% and *A. flavus, A. fumigatus* 4.8% is dominant. In Mustard rhizosphere region *A. niger, P.chrysogenum* and *A. flavus* 6.6% were dominant. *A. fumigatus, P. chrysogenum* and *T. harzianum* are dominant in the Sunflower crop fields. Turukmane *et.al.* (2018) isolated the most common fungi *Aspergillus niger, Aspergillus flavus, Aspergillus nidulens, Penicillium frequentans, Penicillium chrysogenum, Trichoderma viridae, Fusarium oxysporum* and *Fusarium solani,* from *Canna indica* rhizosphere soil.

According to Chandrashekar *et al.,* (2014), the toxins produced by the *Aspergillus* species and antibiotics produced by *Penicillium* species may be preventing the growth of other fungal species. Shiny Niharika *et.al.* (2013) soil mycoflora *Aspergillus flavus* (16.1), *Aspergillus terreus* (16.1) and *Penicillium frequentans* (12.9) were dominant in the soil of Groundnut field. The colonies of *Aspergillus* species were predominant in all rhizosphere samples of groundnut fields. The result obtained in this research indicated that *Aspergillus fumigatus* and *Aspergillus niger* has the higher percentages and high number of occurrences. The highest number of fungal species isolated from the rhizosphere is not surprising, due to the production of substrate by growing root in the form of root exudates containing amino, sugar, organic acid, nucleotide and other substrate (Shinkafi and Gobir, 2018). Physicochemical analysis showed that p^H of the soil is acidic and is rich with both macro and micro nutrients which is favourable for the growth of fungi. Fungal diversity of any soil depends on a large number of factors of the soil (Marschner *et al.,* 2003). The direct relationship is observed between the soil texture and moisture content. Silt and Clay soil holds the highest moisture content that' there is increased population of fungi is observed. The fungal flora acts as universal agent of decay, from which new life continually arises and is nourished, the fungi makes a unique contribution to the maintenance of soil fertility.

CONCLUSION

In the present study the rhzosphere soil sample of some oil yielding crops in Davangere region was studied for detecting the fungal diversity. The fungal population was observed mostly in the monsoon season as the soil moisture was high. Among the isolates *Aspergillus* and *Penicillium* species were dominant in all the crop fields due to high sporulation. The toxins produced by the *Aspergillus* species and antibiotics produced by *Penicillium* species may be preventing the growth of other fungal species. This study is an effort to understand the rhizosphere mycobiota diversity in the oil yielding crops of Davanagere region as soil mycobiota not only plays an important role in decomposition and contribute to biogeochemical cycling but also are responsible for the prevalence of diseases in the crop fields.

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