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Mycoflora Population and Species Dynamics in selected Vegetable Crop Nurseries

Pavani M, Patibanda A K, Srinivas T and Ramachandra Rao G
Department of Plant Pathology, Agricultural College, Bapatla 522 101, Andhra Pradesh

ABSTRACT

Eighty fungal isolates belonging to twenty five genera were obtained on potato dextrose agar from rhizosphere and bulk soils of egg plant, cauliflower and tomato nurseries. From rhizosphere soil of egg plant, cauliflower and tomato nurseries and bulk soil assessed, egg plant and cauliflower rhizosphere gave better support to soil mycoflora with higher Rhizosphere and Soil ratio (R:S). Tomato rhizosphere was found to offer lesser support to the soil mycoflora with lower R:S ratio. Thirty four isolates belonging to fourteen genera, twenty isolates belonging to eight genera and twenty six isolates belonging to ten genera were obtained from egg plant, cauliflower and tomato nursery systems respectively. Among these, *A. niger, A. flavus*, *Fusarium*, *Macrophomina* and *Phoma* were all appeared by 10th day in all the three test crops rhizosphere indicating their better rhizosphere colonizing ability as primary colonizers. Native *Trichoderma* sp. could be isolated in the rhizosphere of only egg plant system 20 days after sowing and hence regarded as a secondary colonizer which required stimulus from rhizosphere. *Trichoderma* population was found nil in the rhizosphere soils of tomato and cauliflower indicating that these crops could not stimulate growth of native *Trichoderma* species.

Key words : Bulk soil, Population dynamics, Rhizosphere soil.

Rhizosphere is the zone/region of soil immediately surrounding the plant roots together with root surfaces and is subjected to the influence of plant roots. The rhizosphere region is a highly favorable habitat for the proliferation, activity and metabolism of numerous microorganisms. Ratio between the mycoflora population in rhizosphere and that in bulk soil (Rhizosphere effect or R:S ratio) represents the ability of the plant roots supporting various mycoflora. The R:S ratio of fungal population is believed to be narrow in most of the plants, usually not exceeding 10 (Pandey and Palni, 2007). Higher R:S value indicates greater support to the mycoflora. However, some species may be favoured more compared to other in the rhizosphere depending upon type and age of the crop and also on soil type. The zoospore forming lower fungi such as *Phytophthora, Pythium, Aphanomyces* are strongly attracted to the roots in response to particular chemical compounds excreted by the roots and cause diseases under favourable conditions. Belanger and Avis (2002) stated that in natural systems, the microbial communities (saprophytes, endophytes, epiphytes, pathogens and beneficial microorganisms) tend to live in relative harmony where all populations generally balance each other out in their quest for food and space. In the present investigation, mycoflora population was monitored from the rhizosphere soil and compared with bulk soil.

MATERIAL AND METHODS

Egg plant (cv. Bapatla Local), cauliflower (cv S-22) and tomato (cv Arka Vikas) nurseries were grown on raised beds in sandy loam soils of Agricultural College, Bapatla during 2011-12. Seedlings were pulled carefully from the soil at 10, 15, 20, 25 and 30 days after sowing and gently tapped to remove pebbles and soil attached to the root system. Afterwards, soil closely adhered to the root system was considered as rhizosphere soil and collected by vigorously shaking the roots. Such rhizosphere soil collected from individual plants was then bulked, thoroughly mixed and used for monitoring fungal population using serial dilution method on PDA. One ml of soil suspension was spread on ten PDA plates @ 0.1ml per plate. Such spread plates were incubated at 28$\pm$1^{0}C. Samples were analysed crop wise and period wise. Soil samples were also collected from bulk soil (where

Table 1. Rhizosphere Effect Of Test Crop Nurseries.

Days After Sowing	Egg Plant			Cauliflower			Tomato		
	R	S	RE	R	S	RE	R	S	RE
10th	42.0	7.0	6.0	42.0	13.0	3.2	14.0	4.0	3.5
15th	38.0	12.0	3.2	72.0	14.0	5.1	45.0	8.0	5.6
20th	25.0	12.0	2.1	36.0	13.0	2.8	20.0	7.0	2.9
25th	45.0	12.0	3.8	33.0	9.0	3.7	11.0	11.0	1.0
30th	64.0	20.0	3.2	77.0	29.0	2.7	32.0	29.0	1.1
Mean	42.8	12.6	3.4	52	15.6	3.3	24.4	11.8	2.1

Figures are total soil mycoflora expressed as X x 10^3 cfu/g soil
R- Rhizosphere soil S- Bulk soil RE- Rhizosphere effect

no crop was taken up) 15cm away from seedlings but within 50cm of nursery area whenever rhizosphere isolations were made. Total fungal colony forming units (cfu) were counted from all the ten plates and presented in the Tables 1 to 4. Fungal identification was done following Domsch *et al* (1980) and Watanabe (2001).

RESULTS AND DISCUSSION

Variation occurred in the total population of soil mycoflora when isolations were made from bulk soil depending upon time of isolation. Fungal cfu varied from 4 to 29 x 10^3 cfu/g in bulk soil (Table 1). In general soil mycoflora population increased from 10th day to 30th day. This indicated that soil is dynamic and the mycoflora population keeps changing. Hence, whenever rhizosphere soil was collected simultaneous isolations were also made from bulk soil near the respective crop nursery and R:S ratios were calculated.

Soil fungal population and species dynamics in egg plant nursery

Total fungal colony forming units (cfu) in bulk soil varied from 7-20 x 10^3 cfu/g soil with maximum obtained on 30th day and least on 10th day when egg plant nursery was taken up. In egg plant rhizosphere, total fungal flora varied between 25-64 x 10^3 cfu/g rhizosphere soil with maximum obtained on 30th day and least on 20th day (Table 2). The fungal population in rhizosphere soil is higher than that in bulk soil on any day of observation. Buyer *et al*. (2002) reported that culturable bacteria and fungi had larger population densities in the rhizosphere than in bulk soil.

No specific trend was observed in the population of rhizosphere mycoflora with increase in the age of the seedlings. The egg plant rhizosphere effect, calculated based on rhizosphere mycoflora population and bulk soil mycoflora population, varied between a minimum of 2.1 (20th day) to a maximum of 6.0 (10th day) (Table 1). On an average, 42.8 x 10^4 cfu/g soil was obtained from brinjal rhizosphere which is higher than 12.6 x 10^3 cfu/g in bulk soil with an R:S ratio of 3.4.

Thirty four isolates belonging to fourteen genera, *viz., Aspergillus, Botryodiplodia*, *Chaetomium*, *Coniothyrium*, *Curvularia*, *Fusarium*, *Humicola*, *Macrophomina*, *Metarrhizium, Mortierella, Phoma*, *Rhizoctonia, Sordaria and Trichoderma* were obtained from egg plant rhizosphere (Table 1). Of these, *Aspergillus niger, Chaetomium*, *Fusarium*, *Humicola*, *Macrophomina*, *Mortierella, Phoma*, *Rhizoctonia* and *Sordaria* appeared in both rhizosphere and bulk soils. Genera that appeared only in rhizosphere soil but not in bulk soil include two species of *Aspergillus, i.e., A. terreus* and *A. flavus*, *Botryodiplodia, Coniothyrium, Curvularia, Metarrhizium* and *Trichoderma*. Further, only 12 isolates belonging to nine genera namely *A. niger*, *A. flavus*, *Botryodiplodia*, *Coniothyrium*, *Curvularia, Fusarium, Macrophomina, Phoma* and *Rhizoctonia* were found associated with 10 day old egg plant rhizosphere indicating their early colonizing abilities of rhizosphere. Fungi capable of capturing the primary resource are called "Ruderal species" (Cooke and Rayner, 1984) or r-stratagists (Campbell, 1989). Fungi that failed to capture

Table 2. Mycoflora population and species dynamics of egg plant nursery soil .

S. No.	Isolate	Designated as	Population in Rhizosphere soil (X x 10^3 cfu / g soil)					Population in bulk soil (X x 10^3 cfu / g soil)				
			10^{th} day	15^{th} day	20^{th} day	25^{th} day	30^{th} day	10^{th} day	15^{th} day	20^{th} day	25^{th} day	30^{th} day
1	*Aspergillus terreus*	At_1	0	0	1	0	0	-	-	-	-	-
2	*Aspergillus flavus*	Af_1	3	1	2	0	0	-	-	-	-	-
3	*Aspergillus niger*	An_1	3	3	1	2	4	0	2	0	0	1
4	*Botryodiplodia* sp	*Botryodiplodia*	2	1	0	0	0	-	-	-	-	-
5	*Chaetomium* sp	Ch_1	0	1	0	0	0	-	-	-	-	-
6	*Chaetomium* sp	Ch_2	0	0	1	2	4	0	0	1	1	2
7	*Coniothyrium* sp	*Coniothyrium*	2	1	0	1	1	-	-	-	-	-
8	*Curvularia* sp	Cu_1	0	2	0	0	1	-	-	-	-	-
9	*Curvularia* sp	Cu_2	0	0	0	1	1	-	-	-	-	-
10	*Curvularia* sp	Cu_3	2	0	0	0	0	-	-	-	-	-
11	*Fusarium* sp	F_1	4	2	1	0	0	2	1	0	0	0
12	*Fusarium* sp	F_2	2	1	0	0	0	0	1	0	0	0
13	*Fusarium* sp	F_3	0	2	1	3	2	0	0	0	2	0
14	*Fusarium* sp	F_4	0	0	1	2	1	-	-	-	-	-
15	*Fusarium* sp	F_5	0	0	0	7	11	0	0	0	2	3
16	*Humicola* sp	Hu_1	0	0	1	0	0	-	-	-	-	-
17	*Humicola* sp	Hu_2	0	0	0	0	3	0	0	0	0	2
18	*Macrophomina* sp	M_1	3	2	1	0	1	1	0	0	0	0
19	*Macrophomina* sp	M_2	0	3	8	5	2	0	1	6	1	0
20	*Macrophomina* sp	M_3	0	0	0	10	19	0	0	0	3	5
21	*Metarrhizium* sp	*Metarrhizium*	0	0	0	0	1	-	-	-	-	-
22	*Mortierella* sp	*Mortierella*	0	2	0	0	0	0	1	0	0	0
23	*Phoma* sp	P_1	3	2	0	0	0	0	2	1	0	0
24	*Phoma* sp	P_2	0	2	0	0	0	-	-	-	-	-
25	*Phoma* sp	P_3	0	2	2	5	10	0	1	1	2	6
26	*Phoma* sp	P_4	0	2	1	0	0	0	1	1	0	0
27	*Phoma* sp	P_5	0	0	0	6	0	0	0	0	1	0
28	*Phoma* sp	P_6	0	0	0	0	3	0	0	0	0	1
29	*Rhizoctonia* sp	R_1	2	1	0	0	0	-	-	-	-	-
30	*Rhizoctonia* sp	R_2	4	2	1	0	0	1	0	0	0	0
31	*Rhizoctonia* sp	R_3	12	4	1	1	0	3	2	1	0	0
32	*Rhizoctonia* sp	R_4	0	2	0	0	0	-	-	-	-	-
33	*Sordaria* sp	S_1	0	0	1	0	0	0	0	1	0	0
34	*Trichoderma* sp	*Trichoderma*	0	0	1	0	0	-	-	-	-	-
		Total	42	38	25	45	64	7	12	12	12	20

Table 3. Mycoflora population and species dynamics of cauliflower nursery soil.

S. No.	Isolate	Designated as	Population in Rhizosphere soil (X x 10^3 cfu / g soil)					Population in bulk soil (X x 10^3 cfu / g soil)				
			10^{th} day	15^{th} day	20^{th} day	25^{th} day	30^{th} day	10^{th} day	15^{th} day	20^{th} day	25^{th} day	30^{th} day
1	*Aspergillus fumigatus*	Afu_1	0	8	6	0	5	0	3	1	0	0
2	*Aspergillus terreus*	At_2	0	0	0	17	18	0	0	0	0	2
3	*Aspergillus flavus*	Af_2	0	0	1	0	1	-	-	-	-	-
4	*Aspergillus niger*	An_2	2	1	1	0	2	0	0	0	0	1
5	*Cladosporium* sp	*Cladosporium*	0	0	2	0	0	-	-	-	-	-
6	*Fusarium* sp	F_6	3	1	5	0	3	1	0	1	0	0
7	*Fusarium* sp	F_7	0	7	1	0	3	0	1	1	2	0
8	*Fusarium* sp	F_8	0	25	1	1	5	0	4	0	0	3
9	*Macrophomina* sp	M_4	7	0	0	0	0	3	0	0	0	2
10	*Macrophomina* sp	M_5	0	3	2	0	1	0	1	0	0	0
11	*Macrophomina* sp	M_6	0	0	2	1	4	0	0	2	4	3
12	*Macrophomina* sp	M_7	0	0	0	0	8	-	-	-	-	-
13	*Naranus* sp	*Naranus*	18	4	1	0	1	3	1	0	0	0
14	*Penicillium* sp	Pen_1	2	0	0	0	1	1	0	0	0	0
15	*Penicillium* sp	Pen_2	0	6	0	0	2	0	2	0	0	0
16	*Penicillium* sp	Pen_3	0	0	2	2	2	0	0	1	0	0
17	*Penicillium* sp	Pen_4	0	0	0	0	2	0	0	0	0	6
18	*Phoma* sp	P_7	2	1	1	0	2	-	-	-	-	-
19	*Phoma* sp	P_8	0	0	0	0	2	-	-	-	-	-
20	*Verticillium* sp	*Verticillium*	8	16	11	12	15	5	2	7	3	12
		Total	42	72	36	33	77	13	14	13	9	29

primary resource are called k-strategist (Campbell, 1989).

It may be further mentioned here that the population of native *Trichoderma* was found not only very less (1 x 10^3 cfu/g soil) but also appeared only after 20 days of sowing indicating its inability to compete with other primary colonizers and to colonize the rhizosphere early. Hence native *Trichoderma* appeared to be a k-strategist. It is also noteworthy here that native *Trichoderma* could not be isolated from bulk soil. Anasuya (2009) reported that sandy loam soils of Bapatla, Andhra Pradesh had negligible population of *Trichoderma*. Though the soils are acidic and contain high fungal cfu (1.3-2.5 x 10^5 cfu/g soil). She further reported that *Trichoderma* spp could be obtained using direct soil plate method rather than soil dilution method. Warcup (1950) opined that direct soil plating leads to isolation of dormant conidia. Thus, appearance of *Trichoderma* only in rhizosphere soil is indicative of stimulation from egg plant rhizosphere. Among the egg plant rhizosphere mycoflora, maximum cfu was with *Rhizoctonia* (12 x 10^3 cfu/g soil) on 10^{th} day and *Macrophomina* on 30^{th} day (19×10^3 cfu/g soil). Both these fungi are known to be plant pathogenic. The present study indicated strong rhizosphere colonizing abilities of these two tongi.

Soil fungal population and species dynamics in cauliflower nursery

When fungal flora from cauliflower rhizosphere were

Table 4. Mycoflora population and species dynamics of tomato nursery soil.

S. No.	Isolates	Designated as	Population in Rhizosphere soil (X x 10^3 cfu / g soil)					Population in bulk soil (X x 10^3 cfu / g soil)				
			10th day	15th day	20th day	25th day	30th day	10th day	15th day	20th day	25th day	30th day
1	*Aspergillus flavus*	Af_3	0	1	1	1	1	0	0	0	3	1
2	*Aspergillus fumigatus*	Afu_2	1	1	0	0	0	-	-	-	-	-
3	*Aspergillus niger*	An_3	2	22	0	2	2	1	6	0	1	1
4	*Aspergillus terreus*	At_3	0	4	2	0	1	0	1	0	0	1
5	*Fusarium* sp	F_9	1	1	0	0	0	-	-	-	-	-
6	*Fusarium* sp	F_{10}	0	1	1	0	2	0	0	1	0	2
7	*Fusarium* sp	F_{11}	0	2	0	0	0	-	-	-	-	-
8	*Fusarium* sp	F_{12}	0	1	0	1	0	0	0	0	2	0
9	*Fusarium* sp	F_{13}	0	0	1	0	0	-	-	-	-	-
10	*Fusarium* sp	F_{14}	0	0	0	1	0	-	-	-	-	-
11	*Fusarium* sp	F_{15}	0	0	0	0	4	0	0	0	0	4
12	*Helminthosporium* sp	H_1	0	2	0	1	1	0	0	0	1	1
13	*Helminthosporium* sp	H_2	0	0	1	0	0	-	-	-	-	-
14	*Macrophimina* sp	M_8	1	1	0	0	0	-	-	-	-	-
15	*Macrophimina* sp	M_9	0	0	2	0	0	0	0	1	0	0
16	*Macrophimina* sp	M_{10}	0	0	1	1	0	-	-	-	-	-
17	*Macrophimina* sp	M_{11}	0	0	0	0	4	0	0	0	0	3
18	*Macrophimina* sp	M_{12}	0	0	0	0	2	0	0	0	0	2
19	*Papulaspora* sp	*Papulaspora*	0	1	2	0	0	0	0	1	0	0
20	*Phoma* sp	P_9	3	4	7	3	4	1	1	4	5	2
21	*Phoma* sp	P_{10}	0	0	0	0	6	0	0	0	0	5
22	*Rhizoctonia* sp	R_5	4	2	0	0	3	1	0	0	0	4
23	*Rhizopus* sp	*Rhizopus*	0	0	0	0	1	0	0	0	0	2
24	*Sordaria* sp	S_2	2	1	1	0	0	1	0	0	0	1
25	*Sordaria* sp	S_3	0	1	1	0	1	0	0	0	1	1
26	*Sphaeropsis* sp	*Sphaeropsis*	0	0	0	1	0	0	0	0	1	0
		Total	14	45	20	11	32	4	8	7	11	29

monitored and isolated, it indicated that total fungal flora varied between 33-77 x 10^3 cfu/g soil with maximum obtained on 30th day and least on 25th day (Table 3). Though the fungal population associated with cauliflower rhizosphere was slightly higher than that in egg plant, average R:S ratio is almost similar, *i. e*., 3.3. Thus cauliflower and egg plant rhizosphere were found to support fungal flora equally well. Variation in soil mycoflora population is dependent on soil type and crop. Anasuya (2009) reported that acidic soils contain higher fungal cfu compared to alkaline soils with lower cfu. Pandey and Palni (2007) reported that coniferous species of the subtropical and temperate locations, *viz*., Cedrus, Pinus and Taxus supported relatively higher microbial population in the rhizosphere in comparison to other species.

Simultaneous isolations from bulk soil surrounding cauliflower nursery indicated a population of 9-29×10^3 cfu/g soil which is almost similar to the bulk soil population obtained from egg plant. The rhizosphere effect of cauliflower varied from 2.7-5.1 with maximum on 15th day followed by 25th day (3.7) and least on 30th day and 20th day (Table 1).

Twenty isolates belonging to eight genera, *viz., Aspergillus, Cladosporium*, *Fusarium*, *Macrophomina*, *Naranus, Penicillium, Phoma* and *Vertcillium* were obtained from cauliflower rhizosphere (Table 2). Of these, except *A. flavus* and *Cladosporium,* one species each of *Penicillium, Phoma* and *Macrophomina* which appeared only in rhizosphere, all other isolates appeared in both rhizosphere and bulk soils. Of the 20 isolates belonging to eight genera obtained from cauliflower rhizosphere, only seven genera namely *A. niger, Fusarium, Macrophomina, Naranus, Penicillium, Phoma* and *Verticillium* were found in 10 day old rhizosphere and hence these may be regarded as primary colonizers. Native *Trichoderma* isolate(s) could not be obtained from cauliflower rhizosphere throughout the period of observations indicating its inability to compete with other primary colonizers and to colonize the cauliflower rhizosphere. Among the cauliflower rhizosphere mycoflora maximum cfu was obtained by *Fusarium* sp (25×10^3 cfu/g soil) on 15th day followed by *Naranus* on 10th day (18×10^3 cfu/g soil) and *A. terreus* on 30th day (18×10^3 cfu/g soil). Six of the eight genera, *viz*., *Aspergillus, Cladosporium, Fusarium, Macrophomina, Phoma* and *Verticellium* obtained from cauliflower system are known plant pathogens.

Soil fungal population and species dynamics in tomato nursery

When fungal flora from tomato rhizosphere were monitored and isolated, it indicated that total fungal flora varied between 11-45×10^3 cfu/g soil with maximum obtained on 15th day and least on 25th day (Table 4). The fungal population associated with tomato rhizosphere was lower than that in egg plant or cauliflower. Thus, tomato rhizosphere was found to support fungal flora lesser than that of cauliflower or egg plant. Pandey and Palni (2007) reported that *Abies pindrow* (a conifer), *Betula utilis*, and *Rhododendron campanulatum*, species of the subalpine region were found to exert a distinct negative rhizosphere effect. The negative rhizosphere effect coincided with lowering of the soil pH in the rhizosphere region. However such negative rhizopshere effect was not observed with any of the three crops studied. Differences existed only in the quantum of rhizosphere effect as evidenced from variation in total fungal mycoflora obtained from individual cropping system.

Simultaneous isolations from bulk soil surrounding tomato nursery indicated a population of 4-29x10^3cfu/g soil which is almost similar to the bulk soil population obtained from egg plant and cauliflower. The rhizosphere effect of tomato varied from 1.0-5.6 with maximum on 15th day followed by 10th day (3.5) and least on 25th day and 30th day (Table 1).

Twenty six isolates belonging to ten genera, *viz., Aspergillus, Fusarium*, *Helminthosporium*, *Macrophomina*, *Papulaspora, Phoma, Rhizoctonia, Rhizopus, Sordaria* and *Sphaeropsis* were obtained from tomato rhizosphere (Table 4). All these ten genera appeared in both rhizosphere and bulk soils. Of there tungal genera, only seven genera namely *A. fumigatus*, *A. niger,* one isolate each of *Fusarium, Macrophomina, Phoma, Rhizoctonia* and *Sordaria* were found in 10 day old rhizosphere and hence these may be regarded as primary colonizers. Five out of these seven genera, *i.e*., *A. niger*, *Fusarium, Macrophomina, Phoma*, and

Rhizoctonia are known plant pathogens. Native *Trichoderma* isolate(s) could not be obtained from tomato rhizosphere throughout the period of observations indicating its inability to compete with other primary colonizers and to colonize the tomato rhizosphere. Among the tomato rhizosphere mycoflora maximum cfu was obtained by *A. niger* (22 x 10^3 cfu/g soil) on 15th day.

From the above results it may interpreted that egg plant and cauliflower rhizospheres supported mycoflora better than tomato. Buyer *et al.* (2002) who found, after fatty acid analysis, a strong soil effect but little plant effect on the microbial community indicating that the overall microbial structure was not affected by the rhizosphere. However, the present investigation revealed that the type of mycoflora and their population varied with the type of crop.

During present investigation, only one isolate of *Trichoderma* could be obtained that to only from egg plant rhizosphere on 20th day but not before. This indicated that native *Trichoderma* population is very low and is also not a primary colmizes. Anasuya (2009) while studying the effect of cropping systems on native *Trichoderma* population in Guntur district of Andhra Pradesh reported that in sandy soils where tobacco nurseries are grown though total fungal cfu varied between 1.3 - 2.5 x 10^5 cfu/g soil, the native *Trichoderma* population was negligible and majority of the samples were found to have nil population of *Trichoderma*. Present study confirmed that the nursery soil chosen (sandy loam) contained minimal *Trichoderma* population and could be isolated only from egg plant and not from other two crop systems.

Oyeyiola (2009) reported the rhizosphere soil contained a greater spectrum of fungal species than the non rhizosphere soil. The rhizosphere effect increased progressively with increase in plant age upto 6th week after sowing and then declined. They isolated species of *Pencillium, Aspergillus, Mucor* and *Alternaria.* It is to be noted here that *A. niger, A. flavus*, *Fusarium*, *Macrophomina* and *Phoma* (all are plant pathogenic) were all appeared by 10th day in all the three test crops' rhizosphere indicating their better rhizosphere colonizing ability.

LITERATURE CITED

Anasuya M 2009 Prevalence of *Trichoderma* spp. and fluorescent *Pseudomonas* in different cropping systems. *M.Sc. (Ag.) Thesis*. ANGRAU, Hyderabad, India.

Belanger R R and avis T J 2002 Ecological process and interactions occurring in leaf surface fungi. In: Lindow., S. E., Hecht-Poinar., E. L., Elliot., V.J. (Eds). *Phyllosphere Microbilogy*, APS Press. St. Paul, MN. 193-207.

Buyer J S, Roberts D P and Cohen E R 2002 Soil and plant effects on microbial community structure. *Canadian journal of Microbiology*, 48: 955-964.

Campbell R 1989 Biological Control of Microbial Plant Pathogens. *Cambridge Univ. Press*, 218.

Cooke R C and Rayner A D M 1984 The Ecology of Saprophytic Fungi. Longman, Lodon, U. K.

Domsch K H, Gams W and Anderson T H 1980 Compaendium of Soil Fungi. Institute of Soil Biology. Federal Agricultural Research Centre. *Federal Republic of Germany*, Vol.1, 2: 1-859.

Oyeyiola G P 2009 Rhizosphere Mycoflora of Okro (Hibiscus esculentus). *Research Journal of Soil Biology*, 1: 31-36.

Pandey A and Palni L S 2007 The rhizosphere effect in trees of the Indian central Himalaya with special reference to altitude. *Applied Ecology and Environmental Research,* 5(1): 93-102.

Warcup J H 1950 The soil plate method for isolation of fungi from soil. *Nature*. 116: 117-118.

Watanabe T 2001 Morphology of Cultured fungi and Key to Species. *Pictorial atlas of soil and seed fungi,* p:486.

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