Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2017, 9(2):165-169

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Studies on the Diversity and Incidence of Soil Fungal Communities in Different Cultivated Lands

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ABSTRACT

Soil mycoflora play an important role as major decomposers in the soil ecosystem. They also provide mankind with very useful pharmaceutical products, such as antibiotics and other valuable substances, including organic acids, enzymes, pigments and secondary metabolites used in the food industry and fermentation. In addition, many soil fungi are biological control agents for plant pathogens and insect pests and some of them are very harmful causing food spoilage and diseases to plants, animals and humans with significant economic losses and produce mycotoxins in certain products. In the recent study, soil samples of two different fields viz, Paddy field and Garden land were studied to record the incidence of fungal composition and their diversity. Aspergillus terreus was found as the dominant one in paddy field soil but Penicillium citrinum was the dominant one in garden soil. The results obtained clearly indicated that Aspergillus terreus, Aspergillus niger, Aspergillus flavus and Penicillium digitatum, Trichoderma were of high occurrence in both the land soils and some other fungi like Fusarium, Chaetomium sp., Curvularia and Paecillomyces spp were negligible. Among the isolates Aspergillus and white sterile mycelia were dominant in all agricultural fields due to high sporulation capacity and the Penicillium spp were producing fungal and bacterial antibiotics and the Aspergillus spp producing different kinds of toxins such as aflatoxin and ochratoxin etc. These toxins may prevent the growth of other fungal species. The frequency of mycoflora in agricultural fields were found to be regulated by many factors like temperature, humidity, vegetation, organic and inorganic materials, soil type and texture. The fungi were mostly observed in months of June to September due to suitable temperature and humidity.

Keywords: Diversity; Soil fungal communities; Cultivated lands; Garden soil

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INTRODUCTION

Soil is considered as the highly complex systems with many components playing diverse functions particularly due to the activity of soil microbes [1]. Soil microflora plays a pivotal role in evaluation of soil conditions and in stimulating plant growth [2]. Microorganisms are beneficial in increasing the soil fertility and plant growth as they are involved in several biochemical transformation and mineralization activities in soils. Cultivation methods and crop management practices found to have greater influence on the activity of soil microflora [3]. Continuous use of chemical fertilizers over a long period may cause imbalance in soil microflora and thereby indirectly affect biological properties of soil leading to soil degradation [4]. Soil ecosystem functioning is moreover governed by the fungi which are fundamental for the soil itself [5]. Especially in forest and agricultural soils, they play a key role in many essential processes such as organic matter decomposition and elemental release by mineralization [6]. Fungi are an important component of the soil micro biota [7]. Micro fungi play a major role in nutrient cycling by regulating soil biological activity [8]. The quantities of organic and inorganic materials present in the soil have a direct effect on the fungal population of the soil. In addition to chemical fertilizers and wide range of pesticides

shows adverse effect on mycoflora which are much useful to maintain soil fertility and eco-balance in the soil atmosphere. The members and kinds of microorganisms present in soil depend on many environmental factors such as the amount and type of nutrients, moisture, degree of aeration, pH and temperature etc. The present study is an attempt to isolate, enumerate and identify different fungal species from the soil samples collected from cultivated lands in and around of Villianur, Puducherry.

MATERIALS AND METHODS

During the present study period, isolation, enumeration and identification of soil fungi were done from different soil samples of varied localities and cultivated fields in and around Villianur, Pondicherry district.

Collection of soil samples

The soil samples were collected from one cultivated field viz., Paddy and one from garden soil situated at various locations in Villianur, Pondicherry district. The soil samples were collected during January 2016 to March 2016 at different intervals from the fields (up to 15cm depth) into small sterilized polythene bags and brought to the Microbiology laboratory, Department of Botany, K. M. Centre for Post Graduate Studies (Autonomous), Pondicherry-605008 with utmost care, stored at 4^{o} C in the refrigerator for further studies. The collection of soil samples is given in Plate I, which shows the physical appearance of the soil samples.

Plate I: Soil samples collected from different fields of Villianur, Puducherry district.

Isolation of fungi from the soil samples

The soil microfungi were isolated and enumerated by two methods, namely Soil Dilution [9] and soil plate method [10] on different media such as Potato Dextrose Agar and Sabouraud Dextrose Agar.

Identification of the soil fungi

Fungal morphology were studied macroscopically by observing colony features (Colour and Texture) and microscopically by staining with lacto phenol cotton blue and observed under compound microscope for the conidia, conidiophores and arrangement of spores. The fungi were identified with the help of available literature and monographs present in the laboratory and with the expertise of the research scholars [11-16].

Statistical analysis

The number of colonies per plate in 1gram of soil was calculated.
The percent contribution of each isolate was calculated by using the following formula:

$$\% \text{ contribution} = \frac{\text{Total no. of CFU of an individual species}}{\text{Total no. of CFU of all species}} \times 100$$

RESULTS AND DISCUSSION

During the present study period, altogether 85 fungal colony forming units (CFUs) were isolated from the soil samples of the paddy land and garden soil. In fungal composition, a total of 19 species under 11 genera were recorded from both the soils of the crop field. Paddy field soil contributed the maximum (52%) fungal population and it was followed by garden soil (48%) (Figure 1). Fungal diversity of any soil depends on a large number of

factors of the soil such as pH, organic content and the relative humidity prevailing in the soil environment [18]. They [18] also elaborated in their work that the physicochemical parameters like, soil pH and their textures are also determine the fungal population in agricultural fields of Villianur. The soil mycoflora study made by Gaddeyya et al [19] was in agreement with our report that they also isolated 173 fungal colonies under15 fungal species from the crop fields in Salur, Andhra Pradesh. The maximum fungal species were belonged to Deuteromycotina followed by Zygomycotina and a few were under ascomycotina, but no fungi were recorded from basidiomycotina group. Among the fungal isolates, aspergilli were the dominant followed by sterile mycelia. In concentration and composition, paddy field soil was found to be the good contributor of fungi per gram soil than garden soil. It may be attributed that the chemical fertilizers used in the latter (garden) which prevented the growth of fungi in the field or acted as killer of fungi in the soil. *Aspergillus* was isolated with six species like, *Aspergillus awamori, A. candidus, A. nidulans, A. niger, A. oryzae* and *A. terreus. Penicillium citrinum* and *P. fellutanum* were recorded from garden but no penicilli were recorded from paddy field soil at all. White sterile mycelia were recorded in more numbers from both the soils. Other Dematiaceous fungi were isolated sporadically from the soil samples. *Curvularia* was isolated from paddy field soil and *Trichoderma* was isolated from garden soil samples.

Table 1: Percentage occurrence of fungal isolates from different soil samples

Sl. No.	Fungi	Paddy soil	Garden soil
1	*Aspergillus flavus*	-	4.7
2	*A. niger*	4.6	7.1
3	*A. parasiticus*	2.3	-
4	*A. penicilloides*	2.3	-
5	*A. terreus*	25.5	-
6	*A. ustus*	-	11.9
7	*Aspergillus sp.*	2.3	-
8	*Chaetomium sp.*	-	16.6
9	*Curvularia intermedia*	4.6	-
10	*C. lunata*	4.6	-
11	*C. lunata var. aeria*	6.9	-
12	*Gray sterile mycelia*	25.5	-
13	*Paecillomyces carneus*	9.3	-
14	*P. variotii*	9.3	-
15	*Penicillium citrinum*	-	35.7
16	*Penicillium fellutanum*	-	6.9
17	*Trichoderma sp.*	-	11.9
18	White sterile mycelia	-	4.7
19	Yellow sterile mycelia	-	11.9

Aspergillus terreus was found as the dominant (25.5%) one in paddy field soil but *Penicillium citrinum* was the dominant (35.7%) one in garden soil (Table 1), which also showed the percentage contribution of fungal isolates from different soil samples of the cultivated and horticultural lands. The soil mycoflora in the fields viz, Paddy and garden soil were observed. The most common among them viz., *Aspergillus flavus* (4.7%) *Aspergillus niger* (4.6%), *Aspergillus parasiticus* (2.3%), *Aspergillus terreus* (25.5%), *Aspergillus ustus* (11.9%), *Penicillium fellutanum* (6.9%), *Penicillium chrysogenum* (6.9%), *Penicillium* (3.4%), *Trichoderma* sp. (11.9%), *Fusarium oxysporum* (5.2%), *Chaetomium* sp. (16.9%), *C. lunata* var. *aeria* (2.9%), Gray sterile mycelia (25.5%) and Yellow sterile mycelia (11.9%) were isolated and characterized. Relative occurrence of soil fungi isolated from the two fields is given in Figure 2, which showed the different pattern of their distribution in the soil.

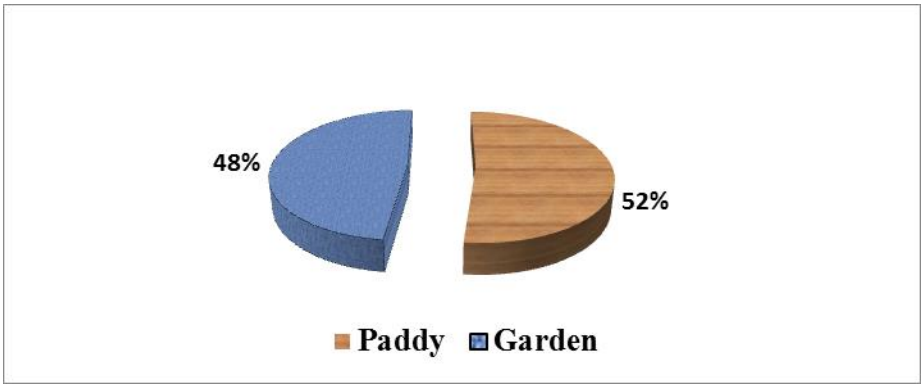

Figure 1: Distribution of soil fungi between garden soil and paddy field soil

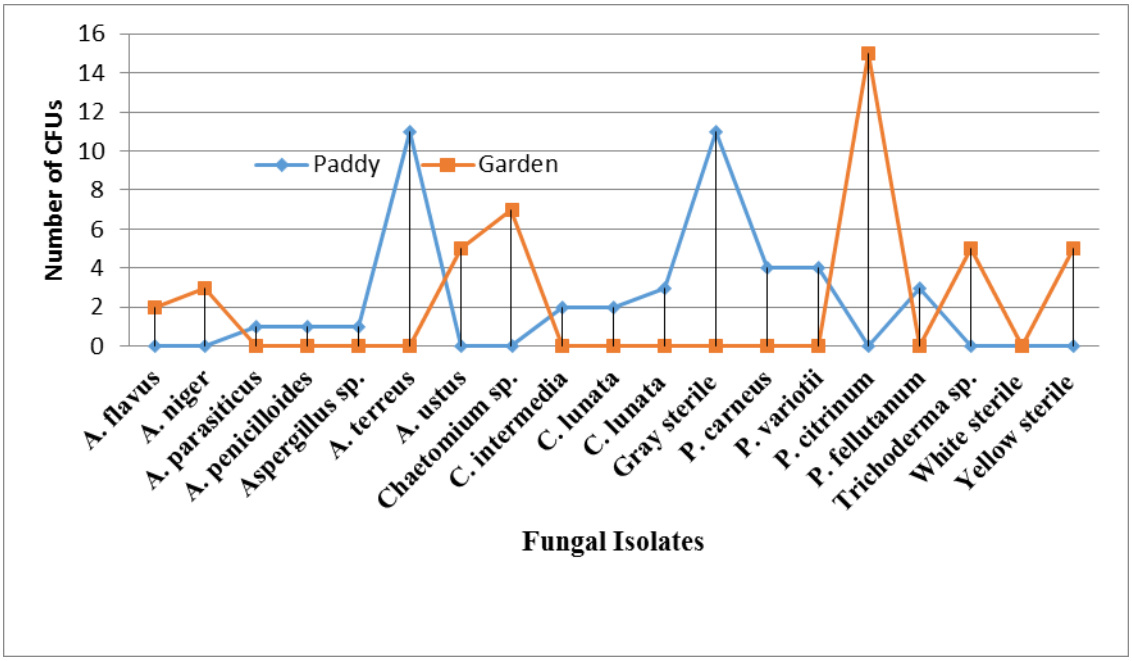

Figure 2: Relative occurrence of soil fungi isolated from two different fields

Diversity was found to be higher in the paddy cultivated land as compared to the garden soils where the mycorrhizal association might have helped in the fungal profilation or the prevailing moisture in the former might have helped in sporulation of more fungi. The incidence of fungal communities and their variation with percentage frequency are given in Table 1.

The Soil pH, organic content and water are the main factors affecting the fungal population and diversity [18]. The organic carbon, nitrogen, phosphorus, potassium are important for the growth of soil fungi. In the absence of any of these growth parameters, the growth and sporulation of moulds as well as other microbes are not possible in the soil [1,2]. It has been reported that the density of fungal population occurred during the monsoon (rainy) season when the soil moisture was significantly high [9]. Gaddeyya et al [18] has reported that environmental factors such as pH, moisture, temperature, organic carbon, organic nitrogen play an important role in the distribution of mycoflora. The mycoflora analysis of different soils of all the places should be done to analyze their abundance and distribution.

CONCLUSION

During the present investigation of soil mycoflora, paddy field soil was found to harbor more number of fungi in comparison to garden soil. The wet ness of the former attracted more number of fungi than the former, where the perfect blend of environmental factors supported more number of fungi to sporulate in paddy field soil. In future,

more work pertaining to soil mycoflora study of different crop fields would be promoted to analyze the factors who are generally involved in promoting fungal population in the crop field soils.

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