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STUDIES ON MYCOFLORA ASSOCIATED WITH HERBARIUM SHEETS

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In the present investigation an attempt was made towards association of fungal colonies with herbarium sheets. Deterioration of herbarium sheets by fungal colonies was noticed. Twenty six fungal species were isolated from the herbarium sheets and identified. Genus *Aspergillus* was reported as a dominated fungus.

Key words: Deterioration, Herbarium sheet, Mycoflora.

Herbaria represent fundamental documentation of the diversity of plants. The process of documentation through herbarium involves drying and preservation of plant specimens on paper sheets of a standard dimension bearing information. Paper sheets are composed of cellulose. These sheets are badly damaged due to biodeterioration. Biodeterioration is any undesirable changes in the properties of materials caused by the vital activities of an organism. There are number of abiotic and biotic factors which have deteriorating effects on materials. Of these, biological factors such as fungi may cause devastating damage (Mishra and Mishra 2009). Fungal growth produce brown, black, yellow or even colourless stains or spots on paper known as foxing. Once these stain penetrate the paper layers they cannot be easily washed or extremely difficult to remove (Nigam and Pathak 1991). A review of literature revealed that comparatively little attention has been made on study of mycoflora associated with herbarium sheet. Therefore, an attempt has been made for studying the fungal flora associated with herbarium sheet and their deteriorating effects.

Twenty to twenty five year old herbarium sheets were collected from wooden cupboard of Herbarium Sections, Department of Botany, JNV University Jodhpur in month of March to June, 2010. The collected herbarium sheets were examined by nacked eye to observe the associated mycoflora on the basis of symptoms such as discoloration, disfigurement, foxing, glaze, odour, stain, stiffness or brittleness, strength and texture, etc. Associated mycoflora were isolated from the herbarium sheets by three methods, viz. direct observations, standard blotter method and agar plate methods. In direct observation method, the samples were observed directly by naked eye and by placing them under the dissecting and compound microscope. Any spore or mycelium, which was found over the surface of sample, was aseptically mounted in lactophenol and observed for characterization. Hyaline fungal mycelium was stained with cotton blue before mounted in lactophenol. In Standard Blotter method, three replicate of 0.5cm^2 cm samples (deteriorated part of herbarium sheet) were aseptically placed equidistance in pre sterilized petri plate containing moistened blotter. The plates were incubated at 25±2^{o}C and fungi appearing over the surface of paper samples were isolated. In agar plate method, pre-sterilized petri-plates

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Table 1 : Fungal flora associated with deteriorated herbarium sheets

S. No.	Fungal flora	Methods		
		Direct observation	Standard blotter method	Agar plate method
1.	*Alternaria alternata*	+	+	+
2.	*A. solani*	+	+	+
3.	*Aspergillus flavus*	+	+	+
4.	*A. fumigatus*	-	+	+
5.	*A. niger*	-	+	+
6.	*A. ochraceous*	-	-	+
7.	*A. tamari*	+	+	+
8.	*A. terreus*	+	+	+
9.	*Chaetomium flavum*	-	+	+
10.	*C. globosum*	-	+	+
11.	*C. indicum*	-	-	-
12.	*Cladosporium herbarum*	-	-	+
13.	*Curvularia lunata*	-	+	+
14.	*Drechslera tetramera*	-	+	+
15.	*Fusarium moniiformis*	-	-	+
16.	*F. oxysporum*	-	+	+
17.	*Memnoniella echinata*	+	+	+
18.	*Mucor globosum*	-	+	+
19.	*M. racemosus*	+	+	+
20.	*Penicillium citrinum*	+	+	+
21.	*Rhizopus nigricans*	-	-	+
22.	*R. stolonifer*	-	-	+
23.	*Stachybotrys atra*	-	-	+
24.	*Trichoderma sp.*	-	-	+
25.	*Sterile mycelium 1*			+
26.	*Sterile mycelium 2*			+
	Total	**9**	**18**	**25**

were poured by Potato dextrose agar media supplement with rose bangal and streptomycin aseptically. Three replicate of small pieces of 0.5 cm^2 of samples of herbarium sheet were placed uniformly on Petri plates. They were incubated at 25±2°C for 72h and fungi appearing over the surface of samples were isolated. All isolated fungal colonies were identified by the using of fungal identification keys given by Gilman (1945), Barnett (1960), Barron (1972), Ellis (1971) and Barnett and Hunter (1998). Observations were made for presence or absence of mycoflora associated with herbarium sheet for tabulation of data.

A total 26 species including 2 non spore forming fungi were isolated from samples of herbarium sheet. The 24 spore forming fungi belongs to Zygomycetes (2 genera with 4 species), Ascomycetes (1genera with 3 species) and Deuteromycetes (10 genera with 17 species). Out of 24 species, six species of *Aspergillus* followed by three species of *Chaetomium*, two species of each of *Alternaria, Fusarium, Mucor and Rhizopus* while single species of *Cladosporium, Curvularia, Drechslera, Memnoliella, Penicillium, Stachybotrys* and *Trichoderma* were reported (Table 1). Out of 24 species, 9 species namely *A. alternata, A. flavus, A. fumigatus, A. niger, C. flavum, C. globosum, M. racemosus, R. nigricans* and *R. stolonifer* were isolated from all three methods, while *A. solani, A. ochraceous, A. tamari, C. herbarum, F. moniliformis, F. oxysporum, M. globosum, P. citrinum* were isolated by standard blotter and agar plate methods. *A. terreus, C. lunata, D. tetramera, M. echinata, S. atra, Trichoderma* sp. and two sterile mycelia were isolated by agar plate method. *C. indicum* was isolated only by standard blotter method. All the isolates showed profuse growth on the surface of herbarium sheet, indicating sufficient nutrient to support these form. It was also noticed that there was qualitative prevalence of fungal components associated with herbarium sheets. The original colour of the herbarium sheet was changed from cream or white colour to black, green, yellow and bluish green in patches and the surface became non-glazy and rough. The texture and strength were also decreased and the herbarium sheets were found

to be very brittle.

The results conclusively indicate that fungal spores remain suspended in the air, which settled on herbarium sheets and digest the materials resulting in the foxing, rendering the rapid loss of strength and texture.

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