

FUNGI INHABITING SURFACE SEDIMENTS OF SHATT AL-ARAB RIVER AND ITS CREEKS AT BASRAH, IRAQ

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The mycobiota of surface sediments from Shatt Al-Arab river and its creeks at Basrah city was surveyed by three isolation methods. One hundred and forty one species assigned to 70 genera were isolated from 40 sediment samples. Some species were found abundant with high frequency while others were frequently recorded. The most frequent species were in order: *Aspergillus niger*, *Aspergillus terreus*, *Fusarium redolens*, *Trichoderma viride*, *Aspergillus fumigatus*, *Fusarium solani*, *Aspergillus flavus*, *Absidia corymbifera*, *Fusarium oxysporum*, *Penicillium notatum*, *Aspergillus candidus* and *Stachybotrys atra*. Several novel species which have been appeared in the literature from the same region were also detected from sediment of Shatt Al-Arab. The majority of the detected species are well known as a soil inhabiting fungi. Our findings are compared with a similar survey on the fungal flora in sediments in several parts of the world.

Key words: surface sediment, fungi Shatt Al-Arab, Iraq

Introduction

Contributions dealing with the knowledge of the mycobiota inhabiting aquatic sediments in different parts of the world have been carried out by many workers (Sparrow,1937; Ueda, 1980; Bourt and Johnson,1962;Tubaki et al. 1975; El-Wahid et al.,1982; Ulfig et al.,1997, 1998 and Ito and Nakagiri,1997). In Iraq, however, previous contributions on fungi inhabiting surface sediments of Shatt Al-Arab were directed to taxonomic studies describing several novel and interesting species (Abdullah and Abbas,1994a, 1994b; Abdullah et al.2000; Cannon et al.1995; Sivanesan et al.,1993). Studies on the occurrence of thermophilic and thermotolerant in sediment of Shatt Al-Arab River (Abdullah and Abbas, 1994c) and on the incidence of some dermatophytes and other keratinophilic fungi in surface sediments of Shatt Al-Arab (Abdullah and Hassan,1995) were also conducted.

The present investigation was directed to contribute for a better understanding to the knowledge of the microfungal species composition in such habitat.

Materials and Methods

The method used for collection of the aquatic sediment samples was the same as described by Borut and Johnson (1962). Forty sediment samples were taken from randomly selected sites in the Shatt Al-Arab River and its creeks (fig.1). The mud samples were taken with Ekman dredge. The dredge was surface sterilized by swabbing it with 95% alcohol several times. To minimize contamination only the central portion of the sediment caught up by the dredge was taken with the aid of a sterile trowel and transferred aseptically into sterile screw cap glass containers. Sediment samples were

stored in refrigerator at 5 C. The samples were processed within 1 to 2 days. The direct plate (Warcup,1950), the dilution plate (Johnson et al.,1959) and the heat and alcohol treatment method (Warcup,1951) were used for isolation of fungi. A dilution of 10 was chosen for the estimation of the fungal total count. Two types of growth media were used for isolation of fungi, viz; potato carrot agar (20g peeled potato, 20g carrot, 20g agar, 1L distilled water) and Malt extract agar (Mackneur, Canada). To each medium 50mg/L chloramphenicol (SDI, Iraq) was added to inhibit bacterial growth. Plates for all methods and media (six replicate each) were incubated at 25 and 45 C in the dark.

The total soluble salts, the organic matter content and the PH value of the sediment samples were determined according to Piper (1947), Jackson (1958) and Swingle (1969) respectively.

Results and Discussion

Table 1 summerzes the soluble salt percentage, the organic content percentage, PH values, number of species detected and the total fungal colony count for each sediment sample. The total soluble salt content was low for the majority of sediment samples and it ranged from 0.10 / to 1.37%. The organic matter content of the 40 samples tested varied from low value (0.087%) in sample no.1 to relatively high value (6.536%) in sample no.37. The lowest values of PH ranged from 5.42-5.71, the highest were between 7.06-7.31, but the most common values ranged from 6.23-6.97. No regular correlation can, however, be detected between the number of the detected species in the 40 sediment samples and the above abiotic factors.

Fungal total count of the 40 sediment samples was ranging between 750-7500 colonies /g of oven dry sediment (Table 1). These finding indicate a poor distribution of the fungal propagules in sediment samples and the reason may be attributed to the semianaerobic condition of the sediment. Data for the total fungal count in the present study is much lower than those (34917-52305 colonies/g dry soil) obtained by Abdullah and Zora (1993) for the soil of the surrounding date palm plantations. However, data for the total fungal count (450-2300 colonies/g dry mud) given by Ito and Nakagiri (1997) for 30 mud samples in Okinawa, Japan and data obtained by Abdullah et al.,(2000) for 16 sediment samples from the Shatt Al-Arab estuary and North-West Arabian Gulf (467-1417) showed close values.

One hundred and forty one species representing 72 genera were isolated from 40 sediment samples collected from Shatt Al-Arab River and its creeks at Basrah. Their frequency of their occurrence is presented in Table 2. The fungi isolated have been divided into four groups according to their percentage of occurrence: H= high frequency (more than 50%), M= moderate frequency (25-50%), L=low frequency (12-24%), VL= very low frequency(less than 12%).

Twelve species were isolated with high frequency (listed in order): *Aspergillus niger*, *Aspergillus terreus*, *Fusarium rodelens*, *Trichoderma viride*, *Aspergillus fumigatus*, *Fusarium solani*, *Aspergillus flavus*, *Absidia corymbifera*, *Fusarium oxysporum*, *Penicillium notatum*, *Aspergillus candidus* and *Stachybotrys atra*. The moderate frequency group was represented by 20 species. The remaining 95 species were representing the very low frequency group (Table 2). Moustafa and Sharkas (1982) reported that *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus nidulans*, *Aspergillus flavus*, and *Stachybotrys atra* were the dominant species in tidal mudflats of Kuwait. Ito

and Nakagiri (1997) recorded *Phoma* spp, *Acremonium* spp., *Penicillium purpurogenum*, *Aspergillus terreus*, and *Talaromyces flavus* to be the most frequent species in mangrove mud in Okinawa, Japan, while Ito et al.,(2001) found that *Penicillium* spp., *Trichoderma harzianum*, *Aspergillus aculeatus*, *Aspergillus niger*, and *Eupenicillium javanicum* as the most frequent fungi in mangrove soil in Thailand.

Aspergillus was represented by seventeen species and thus possessed the widest spectrum among all recorded genera. Among the Aspergilli, *A.niger*, *A.terreus*, *A.fumigatus* and *A. flavus* were the major species in their frequency of occurrence. The above species were reported by Moustafa and Sharkas (1982) as the most frequent species isolated from mudflat in Kuwait. In a subsequent study on the same habitat carried out by El-Wahid et al.,(1983), the species have showed good growth under limited oxygen supply. Therefore, the above authors suggested that these species may live in active form in the mud and they expect that these species may contribute to the microbial activity in mud. Al-Dossary et al.,(2001) showed the capability of *Aspergillus terreus* strain isolated from Shatt Al-Arab River sediment to degrade a mixture of five polycyclic aromatic hydrocarbons in laboratory experiment. The above Aspergilli species were also found common by Borut and Johnson(1962) in sediment of coastal North Carolina, U.S.A. and in mangrove mud in Okinawa, Japan (Ito and Nakagiri,1997).

Of the 9 penicillia found in this survey (Table 2), *Penicillium notatum* was the only species among the high frequency group, while *Penicillium daleae* and *Penicillium nigricans* were among the moderate frequency group. The later two species were detected from estuarine sediments North Carolina (Borut and Johnson, 1962).

Four species of the genus *Fusarium* were identified. Among these *Fusarium rodelens*, *F. solani* and *F. oxysporum* were among the high frequency group and showed 87.5%, 80% and 67.5% frequency of occurrence respectively (table 2). The latter two species have also been shown as the most frequent species isolated from soil at date palm plantations in Iraq (Abdullah and Zora,1993).

Thirty two species of ascomycetes have been recovered during this survey (table 2). However, non of the ascomycete species detected in this study showed a high frequency of occurrence. The ascomycete species assigned to 19 genera viz: *Aschotricha*, *Byssochlamys*, *Chaetomium*, *Coonemeria*, *Corynascus*, *Dichotomyces*, *Emericella*, *Emericelliopsis*, *Eupenicillium*, *Eurotium*, *Gymnoascus*, *Lophotrichus*, *Microascus*, *Monoascus*, *Neocosmospora*, *Percisiospora*, *Pseudallescheria*, *Sphaerodes* and *Thermoascus*.

Chaetomium showed the highest spectrum among ascomycetes (9 species), followed by *Emericella* (3 species) then *Byssochlamys*, *Microascus* and *Monoascus* (2 species each). The rest genera were represented by one species each. *Chaetomium bostrychodes* and *C. globosum* displayed low frequency of occurrence, while the rest of *Chaetomium* species assigned to the very low group of occurrence. It is worthy to mention that *Chaetomium subcurvisporum* has been recently described by Abdullah and Al-Bader (1989) as a new thermotolerant species from Nineva forest soil, North Iraq was also detected during this survey. The re-isolation of the above species from a different habitat in the present study suggested that the fungus might has a wide range of distribution in this country.

Microascus cinereus and *M. trigonosporus* were representing the very low frequency of occurrence group. The two species were also detected in very low frequency of

occurrence from salt marshes of Kuwait (Moustafa,1975). *Micoascus cinereus* was also reported from mangrove mud in Japan and Thailand (Ito and Nakagiri,1997; Ito et al.,2001). *Emericella* were represented by three species viz: *Emericella echinulata*, *E. nidulans* and *E.purpurea*. *Emericella nidulans* showed low frequency of occurrence(22.5%). The latter species was also isolated in low frequency from mangrove mud in Japan (Ito and Nakagiri, 1997).The remaining two *Emericella* species were isolated in very low frequency of occurrence.*Dichotomyces cejpii* and *Emericellopsis stalkia* were assigned to the very low frequency of occurrence group.The former species has been also isolated from river sediments in Nagasaki, Japan (Ueda,1989). *Emericellopsis stalkiae* was originally described from mud collected near the margin of a saline lake in Wyoming, U.S.A by Davidson and Christensen (1971).Most of the species of *Emericellopsis* were isolated from saline aquatic sediments (Borut and Johnson,1962), from mangrove mud (stolk, 1955), from salt lake sediment (Tubaki et al.1975) and from saline soil in salt marshes of Kuwait (Moustafa, 1975). The sequences of the ITS region from terrestrial and aquatic *Emericellopsis* species were analyzed (Zuccaro et al.2004). The group consisted of four clades, one of which contained only species originating from aquatic sources. *Emericellopsis stalkiae* and other species with olivaceous small ascospores bearing long pointed extensions on their wings fell into the marine clade. These characters suggest adaptation for flotation and substrate surface attachment (zuccaro et al.2004).

Two novel *Monoascus* species namely *Monoascus pallens* and *M. sanguineus* described from sediment of Shatt Al-Arab river and its creeks recently by Cannon et al.,(1995) have been reisolated during this survey. The majority of *Monascus* species have been considered to be typical of osmophilic habitats (Pitt and Hocking, 1985), frequently being isolated from foodstuffs or other substrates with low water activity. The isolation of these two distinct species of *Monascus* from surface sediment samples from water is therefore, a little surprising. Habitat adaptation is demonstrated by their complete lack of or very restricted growth on G25N, a specialized culture medium with low water activity(Pitt,1980).

Three species of *Acremonium* were encountered viz: *Acremonium alabamensis*, *A. butyri* and *A. sordidulum*. Tubaki et al.,(1975) isolated *A. butyri* from sediment of lake Sengari in Japan. *Acremonium alabaamensis* and *A. sordidulum* , so far have not been isolated from aquatic sediment. The former species is a thermophilic since it does not grow at 25 C, but grows well at temperature between 37 C and 50 C.

Gilmaniella multiporosa was originally described from soil marsh ecosystem in North Sinai, Egypt (Moustafa and Ezz-Eldin,1989). Our finding represents the second report for the species outside the type locality.

Thermophilic and thermotolerant species were represented by fourteen species viz: *Acremonium alabamensis*, *Acrophialophora levis*, *Chaetomium subcurvisporum*, *Coonemeria aegyptica*, *geosmithia argillaceum*, *Malbranchea cinnamomea*, *Myceliophthora thermophila*, *Myriococcum thermophilum*, *Paecilomyces variotii*, *Corynascus sepeidonium*, *scytalidium thermophilum*, *Thermoascus aurantiacus*, *Thermomyces lanuginosus* and *Thermophymatospora fibuligera*.. The majority of the reported species were previously reported by Abdullah and Al-Bader (1990) and Abdullah and Zora (1993) from soil at surrounding date palm plantations.

Several opportunistic pathogenic fungi for human and animals were detected during this survey. Species belonging to *Scopulariopsis*, *Scytalidium*, *Pseudallescheria* and *Phialophora* were the most interesting. *Scedosporium* anamorph of *Pseudallescheria* is emerging as a pathogen in immunocompromised patients while *Scopulariopsis brevicaulis* is frequently involved in onychomycosis (de Hoog and Guarro, 1995) *Phialophora cyclaminis* is so far isolated from soil, wood, dung and aquarium water (Domsch et al.,1980).Several members of the genus *Phialophora* are known as human pathogens (de Hoog, 1983).*Scytalidium lignicola* is considered among dematiaceous fungi of medical importance. Dickinson et al.,(1983) reported the first case of subcutaneous phaeohyphomycoses caused by *S. lignicola* in human involving the ankle.Recently, Costa et al.(1988) reported a case of tinea pedis with interdigital lesions of the feet caused by *Scytalidium* anamorph state of *Hendersonula toruloides*. In a previous study on surface sediments of Shatt Al-Arab River and its creeks,Abdullah and Hassan(1995) isolated several opportunistic pathogens and dermatophytes including *Microsporum fulvum*, *M. gypseum* and *Trichophyton verrucosum* by using hair baiting method of Vanbreuseghem (1952).*Exserohilum curvisporum* and *Trichurus dendrocephalus*, two hyphomycetes were recently described as new species from soil at date palm plantations in Basrah (Sivanesan et al.,1993, Udagawa et al.,1985) were also detected from Shatt Al-Arab River sediment.

Basidiomycetes were not detected on plates incubated at 25 C. However, an anamorphic form (*Thermophymatospora fibuligera*) a basidiomycetous hyphomycete has been found on plates incubated at 45 C. This taxon was originally described from soil at date palm plantations in Basrah by Udagawa et al.,(1986). Recently the same fungus has been isolated from Nagura River and Maria River in Japan (Ito and Nakagiri, 1979). During their cultural studies on four North American species in the *Ganoderma lucidum* complex, Adaskavege and Gilberston (1989) reported the formation of chlamydospores in the culture of *G. colossum* similar in morphology to the conidia of our isolate. Moreover, culture of *G. colossum* has an optimum temperature of 35-40 C and growth range of 25-48 C.

The majority of the remaining species were detected in very low frequency of occurrence and they are well known as soil inhabiting fungi (Domsch et al.,1980).The majority of them were previously isolated from the surrounding date palm plantations by Abdullah and Zora (1993), and therefore, may be originated from the surrounding terrestrial habitat by being washed into the river and its creeks by rain or wind. The mere isolation of a fungus from a certain habitat does not mean that such a fungus has certain activity in the habitat.

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Table 1. Some chemical, physical characteristics of sediment samples , total fungal counts and number of fungal species in each sample

Sample No.	PH	total soluble salts %	organic matter %	total fungal count	No.of species
1	6.56	0.61	0.087	1700	25
2	6.91	0.78	1.21	1867	23
3	6.82	0.76	1.013	1634	21
4	6.73	0.73	1.033	1755	22
5	6.74	1.22	1.044	2900	26
6	7.10	0.72	1.848	2167	22
7	7.06	0.66	1.748	1711	24
8	6.97	0.74	2.762	1913	17
9	6.91	1.30	3.741	1544	19
10	6.81	0.94	3.567	1344	22
11	7.13	0.78	2.967	1788	21
12	6.71	0.86	3.567	1250	23
13	6.62	0.68	4.114	1175	26
14	6.90	0.65	0.523	2725	23
15	6.65	0.66	1.884	550	25
16	6.59	0.77	1.046	1725	23
17	6.54	0.92	3.978	1375	19
18	6.85	0.70	0.314	1875	27
19	6.53	0.84	0.523	3125	25
20	6.72	0.73	1.779	950	21
21	7.3	1.37	1.204	3033	24
22	7.0	0.69	0.301	3267	10
23	7.10	0.82	1.204	2833	17
24	7.23	0.71	1.204	3033	14
25	7.31	0.72	1.512	2126	18
26	5.42	0.64	0.602	4576	25
27	6.81	0.80	1.505	3788	24
28	7.12	0.48	2.108	4712	27
29	6.89	0.32	2.412	5156	25
30	6.41	1.35	2.316	4198	25
31	6.92	0.42	0.536	5597	16
32	6.71	0.71	1.876	5673	23
33	6.73	0.90	5.092	3912	20
34	6.58	1.21	0.268	750	22
35	6.23	0.10	0.402	2250	18
36	6.61	0.35	0.613	950	18
37	6.82	0.94	6.536	3250	23
38	6.35	0.37	1.876	1300	23
39	5.71	0.36	0.712	7500	15
40	6.82	0.28	1.072	2216	18

Table 2. List of fungal species, their percentage of occurrence, frequency class and sample number

Fungal species	%frequency	Frequency class	Sample No.
<i>Aspergillus niger</i> Tiegh	100	H	1-40
<i>A. terreus</i> Thom	92.5	H	1-11,13-26,29-40
<i>Fusarium rodelens</i> Wollenw	87.8	H	1-20,22-5,27,29-30,32-40
<i>Trichoderma viride</i> Pers.	87.5	H	1-7,9-10,12-24,26,34,36-38, 40
<i>Aspergillus fumigatus</i> Fresen.	85.0	H	1-20,23-24,26-28,30-35, 37-38,40
<i>Fusarium solani</i> (Mart.)Sacc.(aggregate)	80	H	2-7,9-10,12-13 15,16,18-26, 28-32,34-38, 40
<i>Aspergillus flavus</i> Link	72.5	H	1-22,25,28-31,35,38
<i>Absidia corymbifera</i> (Cohn)Sacc.&Trotter	67.6	H	2-10,12,14-16,17,19-23, 26, 28-30,34 -38
<i>Fusarium oxysporum</i> Schlecht	67.5	H	2-3,5-11,13-24-30,37-39
<i>Penicillium notatum</i> Westl.	55	H	2-8,12-13,18-19,21,23,25-26,30-34,36-37
<i>Aspergillus candidus</i> Link	50	H	1-8,10,14-17,19, 21,29,33-35,38
<i>Stachybotrys atra</i> Corda	50	H	1-3,5-8,10-11,13,18-19, 21,23,26,28-29,33,36,40
<i>Oidiodendron griseum</i> Robak	47.5	M	1-2,4,14-26,28-29,33
<i>Alternaria alternate</i> (Fr.) Keissler	42.5	M	1-5,8,11,13,24,25-30,37-38
<i>Paecilomyces variotii</i> Bain	42.5	M	10,12-20,26-29,31-33,
<i>Cladosporium cladosporoides</i> (Fresen.) G.H.de vries	40	M	1-13,12,14-15,18, 20,25, 27-28,30,32,34,39
<i>Byssochlamys nivea</i> Westling	37.5	M	1,12-20,24,26,29, 32-33
<i>Trichurus spirales</i> Hasselber	37.5	M	3-4,6-9,11,14,18,23,27-29, 37-38
<i>Cunninghamella echinulata</i> (Thaxt)Thaxt	32.5	M	6,14,18,19,26,28-30,33-34 37-39
<i>Rhizopus stolonifer</i> (Ehrenb)Lind	32.5	M	9,13,14,16,17,21, 23,25, 27,31,34,36,37
<i>Exserohilum rostratum</i> (Drechsler) Leonard&Suggs)	30	M	1,3-6,12,14-15,21, 25, 30,35
<i>Mucor circinelloides</i> Van Tieghem	30	M	9,14-15,24,26, 28-31,33-35
<i>Sepedonium niveum</i> Masse&Salmon	30	M	1,3,11,16-18,26- 27,30, 33,37
<i>Penicillium daleae</i> Zaleski	27.5	M	4,6,10,15,18,21, 23,26, 30, 33,36
<i>Penicillium nigricans</i> Ehrenberg	25	M	2,5,12,19,21,25 30,32, 34, 37

<i>Phoma leveillei</i> Boerema & Bollen	25	M	1,4-5,17,24-25,27-28,39-40
<i>Emericella nidulans</i> (Eidam) Vuill	22.5	L	3,16,20,25,27, 29,35,37-38
<i>Penicillium stoleniferum</i> Thom	22.5	L	5,10,15,23,26, 28,31, 36, 40
<i>Rhizomucor miehei</i> (Cooney & Emerson)Schipper	22.5	L	1,8,14,18,26,29,33,38,40
<i>Aspergillus awamorii</i> Nakazawa	20	L	3,5-6,8-11,16
<i>Ulocladium atrum</i> Preuss	20	L	2,10-11,21,28-29,39-40
<i>Penicillium brevicompactum</i> Dierckx	20	L	2,5,8,13,18,21,31,37
<i>Humicola grisea</i> Traaen	17.5	L	15-16,20,27-29,30,32
<i>Rhizopus arrhizus</i> Fischer	17.5	L	15,26,29,32-33,35,38
<i>Coonemeria aegyptica</i> (Ueda&udagawa) Mouch.	17.5	L	4,12,14,17-18, 20,33
<i>Mucor racemosus</i> Fres.	17.5	L	16,22,27,31,33,35,39
<i>Actinomucor elegans</i> (Eidam) Benj.&Hass	15	L	21,25,35,37-38
<i>Penicillium roqueforti</i> Thom	15	L	2,9,13,26-27, 39
<i>Fusarium chlamydosporum</i> Wellen&Reink.	15	L	4,11,16,19,28,35
<i>Chaetomium bostrychodes</i> Zopf	12.5	L	6-8,16,13
<i>Dichotomyces cejpai</i> (Milko) Scott	12.5	L	12-14,19-20
<i>Monoascus pallens</i> P.F. Cannon, Abdullah, B.A. Abbas	12.5	L	2,12-13,17,19
<i>Monodictys pelagica</i> (Johnson) Jones	12.5	L	20,25-26,30,33
<i>Scopulariopsis brevicaulis</i> (Sacc.) Bainer	12.5	L	14,17,21,23,32
<i>Gliocladium roseum</i> Bain	12.5	L	4,9,17,26,38
<i>Rhizopus oryza</i> Went & Frisen	12.5	L	3,5,9-10,13
<i>Bipolaris ellisii</i> (Danquah) Alcorn	10.0	VL	32-34,36
<i>Chaetomium atrbrunneum</i> Ames	10.0	VL	10,16,28,38
<i>Chaetomium indicum</i> Corda	10.0	VL	5,15,24,30
<i>Curvularia lunata</i> (wakker) Boedjin	10.0	VL	5,7,15,30

<i>Geotrichum candidum</i> Link	10.0	VL	5.10.15,32
<i>Graphium putredinis</i> (Corda) Hughes	10	VL	11-12,18,40
<i>Malbranchea cinnamomea</i> (Libert) Oorschot & de Hoog	10.0	VL	14,26,28,40
<i>Phoma glomerata</i> (Corda) Wollenw&Hochapfel	10.0	VL	27,29,32,34
<i>Pseudallescheria</i> sp.	10.0	VL	9,10,12,20
<i>Talaromyces stipitatus</i> Benjamin	10.0	VL	2.12,34,36
<i>Thermomyces lanuginosus</i> P. Tsikinsky	10.0	VL	28,32,36,40
<i>Ulocladium chlamydosporum</i> Mouch.	10.0	VL	7,12,32,39
<i>Aspergillus clavatus</i> Desm.	7.5	VL	10,13,30
<i>Aspergillus nidulans</i> (Eidam) Wint	7.5	VL	4,6,7
<i>Aspergillus wentii</i> Wehmer	7.5	VL	3,36,37
<i>Aureobasidium pullulans</i> (De Bary) Arnaud	7.5	VL	4,10,11
<i>Chaetomium murorum</i> Corda	7.5	VL	6,16,27
<i>Corynascus sepedonium</i> (C.Emmons)V.Ar	7.5	VL	34,37,40
<i>Bipolaris australiensis</i> (M.B.Ellis) Tsuda&Ueyama	7.7	VL	10,31,38
<i>Emericella purpurea</i> Samson & Mouch.	7.5	VL	7,11,36
<i>Gymnascus</i> sp.	7.5	VL	6,11,37
<i>Microascus trigonosporus</i> Emmons &Dodge	7.5	VL	12,29,39
<i>Myrothecium roridium</i> Tode	7.5	VL	26,28,38
<i>Stachybotrys</i> sp.	7.5	VL	1,5,7
<i>Syncephalastrum racemosum</i> Cohn	7.5	VL	6,21,24
<i>Alternaria chlamydospora</i> Mouch.	5.0	VL	2,11
<i>Alternaria tenuissima</i> (Kunz) Wiltshire	5.0	VL	15,31
<i>Aspergillus ochraceus</i> K.Wilh	5.0	VL	1-2
<i>Aspergillus oryzae</i> (Ahlburg) Cohn	5.0	VL	2,20
<i>Cephaliophora irregularis</i> Thaxter	5.0	VL	6,21
<i>Chaetomium globosum</i> Kunz	5.0	VL	14,27

<i>Chuppia sarcinifera</i> Deighton	5.0	VL	25,27
<i>Cunninghamella elegans</i> Lanche	5.0	VL	37,38
<i>Bipolaris hawaiiensis</i> (M.B.Ellis)Uchida&Aragaki	5.0	VL	5,11
<i>Emericellopsis stolkiaie</i> Hodge & Pery	5.0	VL	4,12
<i>Monascus sanguineus</i> P.F.Cannon,Abdullah&B.A.A bbas	5.0	VL	18,29
<i>Mucor hiemalis</i> Wehmer	5.0	VL	7,37
<i>Myriococcum thermophilum</i> (Fergus)Van der Aa	5.0	VL	18,27
<i>Paecilomyces inflatus</i> (Burnside) Carmichael	5.0	VL	12-13
<i>Pseudeurotium multisporum</i> (Saito& Minoura)Stolk	5.0	VL	15,19
<i>Ulocladium chartarum</i> (Preuss) E.G.Simmons	5.0	VL	3,26
<i>Acremonium alabamense</i> Morgan-Jones	2.5	VL	27
<i>Acremonium butyric</i> (Van Beyma)W.Gams	2.5	VL	4
<i>Acremonium sordidulum</i> W.Gams&Hawksw.	2.5	VL	34
<i>Acrophialophora levis</i> Samson& Tariq	2.5	VL	38
<i>Alternaria phragmospora</i> Van Enden	2.5	VL	12
<i>Alternaria raphani</i> Groves& Skolko	2.5	VL	1
<i>Aspergillus flavipis</i> (Bain&Sart.)Thom&Church	2.5	VL	7
<i>Aspergillus parasiticus</i> Spear	2.5	VL	4
<i>Aspergillus</i> sp.	2.5	VL	1
<i>Aspergillus sydowia</i> (Bain&Sart) Thom&Church	2.5	VL	13
<i>Aspergillus ustus</i> (Bain) Thom & Church	2.5	VL	18
<i>Aspergillus</i> <i>versicolor</i> (Vuill.)Tirab	2.5	VL	7
<i>Byssochlamys fulva</i> Oliver & Smith	2.5	VL	37
<i>Chaetomium elatum</i> Kunz	2.5	VL	19
<i>Chaetomium reflexum</i> Stolko	2.5	VL	20

& Groves			
<i>Chaetomium subcurvisporum</i>	2.5	VL	38
Abdullah&Al-Bader			
<i>Chaetomium succineum</i> Ames	2.5	VL	34
<i>Cladosporium herbarum</i>	2.5	VL	13
(Pers.) Link			
<i>Colletotrichum</i> sp.	2.5	VL	38
<i>Culcitalna achraspora</i> Meyers	2.5	VL	6
& Moore			
<i>Culvularia brachyspora</i>	2.5	VL	5
Boedjn			
<i>Curvularia tuberculata</i> Jain	2.5	VL	18
<i>Dendryphion</i> sp.	2.5	VL	26
<i>Drechslera biseptata</i> (Sacc.&	2.5	VL	9
Roum) Richardson&Fraser			
<i>Bipolaris indica</i> Rai,	2.5	VL	31
Wadhawani &Tewari			
<i>Exserohilum curvisporum</i>	2.5	VL	9
Sivanesan, Abdullah & B.A.			
Abbas			
<i>Emericella echinulata</i>	2.5	VL	38
(Fennell& Raper)Horie			
<i>Eupenicillium zonatum</i> Hodge	2.5	VL	18
& Pery			
<i>Eurotium chevalieri</i> Mangin	2.5	VL	18
<i>Geosmithia argillaceum</i>	2.5	VL	23
(Stolk, Evan&Nilsoon)Pitt			
<i>Gilmaniella multiporosa</i>	2.5	VL	28
Moustaffa& Ezz-Eldin			
<i>Graphium penicilioides</i> Corda	2.5	VL	9
<i>Humicola fuscoatra</i> Traaen	2.5	VL	1
<i>Lophotrichus bartlettii</i> (Mas.	2.5	VL	12
& Sal.) Malloch&Cain			
<i>Mammaria echinobotryoides</i>	2.5	VL	17
Ces.			
<i>Myceliophthora thermophila</i>	2.5	VL	25
(Apinis) Van Oorschot			
<i>Neocosmospora vasinfecta</i>	2.5	VL	40
var. <i>africana</i> (Von Arx) P.F.			
Cannon & Haksaw.			
<i>Nigrospora oryzae</i> (Berk,&	2.5	VL	5
Broom) Petch			
<i>Paecilomyces carnus</i>	2.5	VL	3
(Duche& Heim)Brow.&Sm			
<i>Penicillium digitatum</i>	2.5	VL	32
(Pers.)Sacc.			

<i>Penicillium rugulosum</i> Thom	2.5	VL	13
<i>Penicillium sacculum</i> Dale	2.5	VL	21
<i>Persiciospora japonica</i> Horie, Udagawa&P.F.Cannon	2.5	VL	37
<i>Pestalotia palmarum</i> Cook	2.5	VL	1
<i>Phialophora cyclaminis</i> Van Beyma	2.5	VL	36
<i>Rhizopus</i> sp.	2.5	VL	24
<i>Scytalidium lignicola</i> Pesante	2.5	VL	25
<i>Scytalidium</i> <i>thermophilum</i> (Cooney&Emerson) Austwick	2.5	VL	34
<i>Sphaerodes iraqiensis</i> Abdullah& B.A.Abbas	2.5	VL	32
<i>Stachybotrys</i> sp.	2.5	VL	36
<i>Thermoascus aurantiacus</i> Miehe	2.5	VL	28
<i>Thermophymatospora</i> <i>fibuligera</i> Udagawa, Awao & Abdullah	2.5	VL	13
<i>Ulocladium</i> <i>alternariae</i> (Cooke)Simmons	2.5	VL	2
<i>Ulocladium botrytis</i> Preuss	2.5	VL	30