Botany

OCCURRENCE AND DISTRIBUTION OF ZOOSPORIC FUNGI AND AQUATIC HYPHOMYCETES IN UPPER EGYPT

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SUMMARY: Eighty species which belong to 34 fungal genera yielding 2992 colonies were recovered from surface water (zoosporic fungi) and submerged decaying leaves (aquatic hyphomycetes) samples (160 samples each) during this investigation. Of these fungi, 45 species related to 8 genera of zoosporic fungi (862 colonies) and 35 species related to 26 genera of aquatic hyphomycetes (2130 colonies). Three species of zoosporic fungi (Achlya rodriguazina, Isoachlya toruloides and Saprolegnia luxurians) in addition to fourteen species of aquatic hyphomycetes are new records for Egypt. The richest samples of aquatic fungi (both zoosporic and hyphomycetes) were those collected from water areas with low or moderate temperature and comparatively high total organic matter and dissolved oxygen. Achlya (13 species) and Saprolegnia (12 species) were the commonest zoosporic fungal genera whereas Triscelophorus (2 species), Anguillospora (2 species) and Alatospora (one species) were the most prevalent genera of aquatic Hyphomycetes. The samples collected from Assiut governorate were the richest in zoosporic fungi (23 species and 7 genera) whereas those collected from Aswan governorate were the poorest (6 species and 3 genera). The samples collected from Qena governorate were the richest in aquatic Hyphomycetes (21 species and 16 genera) whereas those collected from El-Giza governorate were the poorest (8 species and 8 genera).

Key Words: Zoosporic fungi, aquatic hyphomycetes.

INTRODUCTION

Man's concern with environmental aspects may also account for the increased interest in aquatic organisms. Pollution of streams, rivers and local shores is common. Therefore, the role of microfungi in these situations is important. The occurrence and distribution of zoosporic fungi in relation to water characteristics as well as to the various geographical regions of the world have been intensively studied (9,18,39,40,42,50,53,60). Nilsson (46) and Singh and Musa (52), mentioned that aquatic hyphomyctes have a world-wide distribution and have been repeatedly observed on decaying leaf litter in temperate and tropical streams. A major role of these fungi in decomposition of leaf materials in water has been suggested by various investigations. Many of the fungi which are referred to as aquatic hyphomycetes have a terrestrial potential and apparently, a limited terrestrial occurrence (31). Numerous investigations have dealt with the occurrence and ecological distribution of the so-called aquatic hyphomycetes (Fungi Imperfect) which regularly occur on submerged decaying leaves of dicotyledonous trees and shrubs (2,4,7,11,19,23-25,30,33-35,46,52).

In Egypt, while numerous investigations have been conducted dealing with the seasonal occurrence and distribution of zoosporic fungi in various water habitats (13,14,16,17,38), knowledge of the water borne hyphomycetes is very scanty.

Thus, the present work aimed to investigate the occurrence and distribution of mainly aquatic hyphomycetes as well as zoosporic fungi in Upper Egypt (8 governorates).

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MATERIALS AND METHODS

160 water samples were collected from various water areas (river Nile, irrigation canals, pools and closed ponds) in eight governorates namely: Aswan, Qena, Sohag, Assiut, El-Minia, Beni-Suef, El-Fayoum and El-Giza (20 samples from each) during the period from July, 1989 to December, 1990. These water samples were collected in sterile conical flasks (1 liter each) containing sterilized halves of hemp and sesame seeds and barley and maize grains as baits. In addition, submerged decaying leaf samples of common plants (*Eucalyptus rostrata, Phoneix dactylifera, Phragmites australis, Musa nana, Salix subserrata, Ricinus communis, Eichhornia crassipes, Cyperus alopecuroides, Imperata cylindrica, Dalbergia sissoo, and Pyrus malus*) were collected from these water sites. Leaves were best gathered individually and placed at once in clean plastic bags and returned to the laboratory (33,34). The water temperature and the pH value were recorded at the site and the total soluble salts as well as the contents of organic matter and dissolved oxygen were determined.

For the recovery of zoosporic fungi, the baiting technique (37) was used. The seeded plates were incubated at 22°C for 4 to 6 weeks during which the zoosporic fungi which colonized the seeds were examined weekly. For the determination of fungal density (counts), the fungal species appearing on one plate was counted as one colony.

For the estimation of aquatic hyphomycetes, the leaves were washed under tap water to remove any surface mud or other debris, then they were cut into equal segments (about 1 cm^2 each) and put in shallow dishes (10 plates for each sample and 5 leaf segments for each plate) with sterilized distilled water. These plates were incubated at 20°C and examined after a few days for hyphomycetes. Growth of aquatic hyphomycetes can usually be seen especially on the cutting edges of leaf margins and on exposed veins in areas where decay is occurring. When growth of a particular species has been located, a small portion of the leaf bearing growth can be cut out and used to make a water mount that can be studied under high power (30).

To isolate a species in pure culture, a piece of leaf bearing abundant conidiophores was placed in few drops of sterilized water in a covered watch glass. In the course of half a day a conidial suspension will probably have developed in the water (this can be checked under low power). Single spores were isolated and streaked on 1% malt extract agar and incubated at 20°C (30). The pure cultures were maintained on slopes of 2% malt extract agar and stored at 5-10°C and sub-cultured every 1-2 months.

RESULTS AND DISCUSSION

The water temperature in sites ranged between 14 (Qena) and 20 (Aswan), pH value between 6.4 (Sohag) and 8.4 (El-Giza), the total soluble salts between 83 (El-Fayoum) and 550 mg/L (Qena), the contents of organic matter between 10.5 (El-Fayoum) and 67.5 (Assiut) mg/L and the dissolved oxygen fluctuated between 3.11 (Aswan) and 11.2 (Beni-Suif) mg/L as shown in Table 1.

a. Zoosporic fungi

Using baiting technique, 45 species related to 8 genera of zoosporic fungi contributing 862 colonies (Table 2) were isolated from 160 water samples collected from various water areas in Upper Egypt (20 samples from each governorate of Aswan, Qena, Sohag, Assiut, El-Minia, Beni-Suef, El-Fayoum and El-Giza). The richest samples in zoosporic fungi were those which were of low or moderate temperature (16-21°C) and those having relatively high contents of organic matter and dissolved oxygen. These results are similar to those obtained by many authors (6,8,17,36,41,44,47,55). On the contrary, Alabi (1) and Rattan *et al.* (50) mentioned that no clear relationship could be established between the occurrence of zoosporic fungi and the fluctuations in the amount of dissolved oxygen.

The total soluble salts (83-550 mg/L) did not represent an important factor (at least in this investigation) affecting the populations of zoosporic fungi. However, vari-

Table 1: Some characteristics of water samples collected from the governorates of Upper Egypt.

	Temperature °C		pH		Total soluble salts (mg/L)		Organic matter content (mg/L)		Oxygen dissolved (mg/L)	
Governorates	lower	higher	lower	higher	lower	higher	lower	higher	lower	higher
Aswan	14.5	20.0	6.8	8.3	180	477	22.0	64.0	3.1	6.8
Qena	14.0	18.0	6.5	8.2	235	550	31.6	65.0	4.1	7.6
Sohag	14.0	17.5	6.4	8.0	219	410	11.2	28.1	4.5	9.8
Assiut	15.0	18.5	6.5	8.2	106	310	17.5	67.5	5.1	9.1
El-Minia	14.5	18.0	6.6	8.2	234	467	14.0	28.5	5.9	10.5
Beni-Suef	15.0	19.5	6.8	8.3	111	265	12.8	30.1	5.6	11.2
El-Fayoum	15.0	19.0	6.8	8.0	83	193	10.5	22.0	5.5	9.5
El-Giza	15.5	19.0	6.7	8.4	162	380	11.7	26.5	4.8	7.8

able results were obtained by many authors (17,20,21,56,57), showing that the zoosporic fungi, specially saprolegniales, were of rare occurrence or completely missed in brachish and saline water.

Table 2: Total counts (TC), per 10 plates and the number of cases of isolations (NCI) of zoosporic fungi recovered from twenty water samples collected from each Governorate of Upper Egypt (8 Governorates) using baiting technique at 22°C.

Governorates	Aswan		Qena		Sohag		Assiut		El-Minia		Beni-Suef		Fayoum		Giza		Total	
Genera and species	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI
Achlya	16	7	35	11	72	20	48	11	76	13	42	11	28	10	33	9	350	92
A. americana Humphrey	0	0	0	0	0	0	14	3	14	3	15	5	0	0	12	4	55	15
A. apiculata deBary	7	3	0	0	0	0	1	1	5	2	0	0	0	0	0	0	13	6
A. abortiva Coker and Braxton	0	0	3	2	0	0	3	1	0	0	0	0	0	0	0	0	6	3
A. caroliniana Coker	0	0	0	0	0	0	0	0	2	1	0	0	0	0	12	3	14	4
A. colorata Pringsheim	0	0	0	0	2	1	0	0	0	0	10	2	18	7	0	0	30	10
A. conspicua Coker	9	5	0	0	0	0	12	3	0	0	0	0	0	0	0	0	21	8
A. dubia Coker	0	0	14	5	0	0	16	4	13	4	12	5	0	0	0	0	55	18
A. flagellata Coker	0	0	0	0	0	0	2	1	3	1	0	0	0	0	0	0	5	2
A. imperfecta Minden	0	0	0	0	0	0	0	0	0	0	0	0	10	4	0	0	10	4
A. klebsiana Pieters	0	0	0	0	15	5	0	0	6	2	0	0	0	0	0	0	21	7
A. prolifera C. G. Nees	0	0	0	0	2	1	0	0	0	0	5	2	0	0	0	0	7	3
A. racemosa Hildebrand	0	0	18	7	53	15	0	0	33	10	0	0	0	0	0	0	104	32
A. rodriguazina F. T. Wolf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	3	9	3
Aphanomyces laevis de Bary	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	1
Allomyces	0	0	3	3	1	1	3	2	0	0	0	0	0	0	2	1	9	7
A. Arbuscula Butler	0	0	0	0	1	1	1	1	0	0	0	0	0	0	2	1	4	3
A. macrogynus (Emerson) Emerson and Wilson	0	0	3	3	0	0	2	1	0	0	0	0	0	0	0	0	5	4
Dictyuchus	9	4	4	2	14	5	36	12	17	7	6	3	9	5	15	6	110	44
D. monosporus Leitgeb	0	0	0	0	4	1	2	1	0	0	0	0	0	0	0	0	6	2
D. polysporus Lendstedt	0	0	0	0	0	0	1	1	2	2	0	0	0	0	0	0	3	3
D. Sterile Coker	9	4	4	2	10	4	33	10	15	5	6	3	9	0	15	6	86	39
Isoachlya	0	0	0	0	9	3	12	4	6	2	0	0	0	0	4	1	31	10
I. monilifera (de Bary) Kauffmann	0	0	0	0	3	2	3	2	0	0	0	0	0	0	0	0	6	4
I. toruloides Kauffman and Coker	0	0	0	0	0	0	0	0	2	1	0	0	0	0	4	1	6	2
I. unispora Coker	0	0	0	0	6	2	9	2	4	1	0	0	0	0	0	0	19	5
Phytophthora	0	0	0	0	4	1	0	0	2	1	0	0	0	0	0	0	6	2
P. cinchonae Sawada	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	2	1
P. omnivora de Bary	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	4	1
Pythium	0	0	3	2	4	3	6	3	31	11	7	2	3	1	6	3	60	25
P. acanthicum Drechsler	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	1	5	2
P. butleri Subram	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
P. marisipium Drechsler	0	0	0	0	0	0	0	0	14	5	0	0	0	0	0	0	14	5
P. indicum Meers	0	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0	3	2
P. ostracodes Drechsler	0	0	0	0	3	2	0	0	4	2	0	0	0	0	0	0	7	4
P. salpingophorum Drechsler	0	0	0	0	0	0	0	0	13	4	0	0	0	0	4	2	17	8
P. torulosum Coker and Patterson	0	0	3	2	0	0	3	1	0	0	0	0	0	0	0	0	6	3
P. ultimum Trow	0	0	0	0	0	0	0	0	0	0	5	1	0	0	0	0	5	1
P. oedochilum Drechsler	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	2	1
Saprolegnia	24	9	34	10	49	14	71	14	28	7	25	7	20	7	43	10	294	78
S. aniospora de Barry	0	0	0	0	0	0	9	3	0	0	0	0	0	0	14	5	23	8
S. diclina Humphrey	7	3	0	0	12	4	12	4	0	0	0	0	0	0	0	0	31	11
S. eccentrica (Coker) Seymour	0	0	0	0	0	0	0	0	7	3	0	0	0	0	12	4	19	7
S. ferax (Gruith) Thuret	0	0	0	0	15	5	0	0	0	0	13	4	17	7	0	0	45	16
S. furcata Maurizio	0	0	7	2	0	0	0	0	0	0	0	0	3	1	0	0	10	3
S. hypogyna de Barry	0	0	0	0	15	5	14	4	18	4	0	0	0	0	0	0	47	13
S. megasperma Coker	10	4	13	4	0	0	0	0	0	0	7	2	0	0	0	0	30	10
S. monoica Prigsheim	7	5	0	0	0	0	13	4	0	0	0	0	0	0	0	0	20	9
S. parasitica Cocer	0	0	10	5	7	2	0	0	0	0	5	2	0	0	0	0	22	9
S. terrestris Cookson and Seymour	0	0	4	2	0	0	14	3	0	0	0	0	0	0	0	0	18	5
S. turfosa Minden	0	0	0	0	0	0	9	4	0	0	0	0	0	0	17	4	26	8
S. luxurians (Bhargava et Srivastava) Seymour	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	3	1
Total counts (colonies)	49		79		153		178		160		80		60		103		862	
Total number of species	6		10		16		23		19		9		6		11		45	
Total number of genera	3		5		7		7		6		4		4		6		8	

The pH values of water samples were of neutral or in alkaline side (6.4-8.4) exhibiting a narrow range and did not play any regular pattern in various samples. Thus the pH values did not play a major factor governing the fungal occurrence and distribution in this investigation. Similar observations were reported by many authors (3,10,14,17,49). On the contrary, some investigations concluded that pH values have an important role affecting the diversity and population of zoosporic fungi (8,41,51,54).

Achlya (13 species), *Saprolegnia* (12 species) and *Dictyuchus* (3 species) were the commonest genera and were represented in 57.5%, 48.75%, 27.5% of total samples constituting 40.60%, 34.11%, and 12.76% of total zoosporic fungi respectively. On the other side,

Table 3: Total counts (TC, per 50 leaf segments in each sample) and the number of cases of isolations (NCI, per 20 samples in each Governorate) of aquatic Hyphomycetes recovered from submerged decaying leaves collected from the Governorates of Upper Egypt.

Governorates	Aswan		Qena		Sohag		Assiut		El-Minia		Beni-Suef		Fayoum		El-Giza		Total	
Genera and species	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI	TC	NCI
Alatospora	21	9	57	16	107	17	16	5	1	1	47	16	6	4	4	1	259	69
A. acuminata Ingold	21	9	57	16	107	17	16	5	1	1	47	16	6	4	4	1	259	69
Anguillospora	9	3	40	7	88	10	68	9	63	11	71	12	79	17	33	8	451	77
A. crassa Ingold	0	0	0	0	15	3	23	6	7	2	0	0	0	0	0	0	45	11
A. longissima (de Wild.) Ingold	9	3	40	7	73	9	45	9	56	11	71	12	79	17	33	8	406	76
Camposporium	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	1
C. pellucidum (Grove) Hughes	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	1
Clavatospora Tentacula (umphlett) Nilsson	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	0	6	2
Culicidospora aquatica Petersen	0	0	0	0	0	0	4	1	0	0	0	0	13	3	1	1	18	5
Dactylella submersa (Ingold) Nilsson	4	2	5	2	52	10	9	4	7	2	3	2	3	2	0	0	83	24
Dendrospora junciola Iqbal	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
Exophialo jeanselmei (Langeron) Mc Ginnis	6	2	4	2	2	1	0	0	2	1	1	1	0	0	0	0	15	7
Flabellospora and Padhye	0	0	8	3	11	4	10	2	12	4	2	1	10	4	0	0	53	18
F. crassa Alasoadura	0	0	2	1	10	3	10	2	12	4	0	0	5	2	0	0	39	12
F. tetracladia Nawawi	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1
Flabellospora sp.	0	0	6	2	0	0	0	0	0	0	2	1	5	2	0	0	13	5
Flagellospora	0	0	57	7	21	7	6	2	2	1	15	3	26	6	1	1	128	27
F. curvula Ingold	0	0	13	3	1	1	0	0	0	0	0	0	0	0	0	0	14	4
F. penicillioides Ingold	0	0	44	7	20	7	6	2	2	1	15	3	26	6	1	1	114	27
Heliscus submersus Hudson	0	0	3	1	5	2	0	0	0	0	1	1	1	1	0	0	10	5
Isthmotricladia laeensis Matsushima	0	0	0	0	0	0	10	3	0	0	0	0	0	0	0	0	10	3
Lateriramulosa uni-inflata Matsushima	0	0	0	0	0	0	12	2	5	1	13	3	19	5	1	1	50	12
Lemonniera	0	0	4	2	0	0	1	1	0	0	1	1	0	0	0	0	6	4
L. aquatica de Wild.	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1
L. terrestris Tubaki	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
L. filiformis Petersen	0	0	3	1	0	0	0	0	0	0	1	1	0	0	0	0	4	2
Lunulospora curvula Ingold	0	0	0	0	0	0	0	0	5	2	0	0	4	3	0	0	9	5
Mycocentrospora acerina (Harfig) Deighton	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	2	1
Pyramidospora	9	3	2	1	5	2	2	1	13	3	17	6	51	9	36	9	135	34
P. casuarinae Nilsson	5	2	2	1	4	2	0	0	12	2	17	6	51	9	36	9	127	31
P. constricta Singh	4	1	0	0	1	1	2	1	1	1	0	0	0	0	0	0	8	4
Polycladium equiseti Ingold	0	0	2	2	0	0	2	1	6	3	3	1	0	0	0	0	13	7
Speiropsis species	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	4	1
Tetracladium marchalianum de Wild.	13	4	38	8	31	2	1	0	0	0	0	0	0	0	3	2	87	23
Torula herbarum Pers.	1	1	0	0	0	0	0	0	0	0	0	0	2	2	0	0	3	3
Tricladium	0	0	2	2	0	0	0	0	0	0	4	1	4	1	0	0	10	4
T. caudatum Kuzuha	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
T. patulum Mavanova and Marvan	0	0	1	1	0	0	0	0	0	0	4	1	4	1	0	0	9	3
Tripospermum myrti (Lind) Hughes	0	0	2	1	0	0	1	1	0	0	0	0	0	0	0	0	3	2
Triscelophorus	14	2	65	7	68	16	36	4	127	13	170	13	182	19	96	10	758	84
T. monosporus Ingold	13	2	58	7	54	15	28	4	89	13	122	13	181	19	96	10	641	83
Triscelophorus sp.	1	1	7	3	14	8	8	2	38	7	48	6	1	1	0	0	117	28
Trisulcoporium acerinum Hudson and Sutton	0	0	2	1	0	0	0	0	4	1	0	0	0	0	0	0	6	2
Varicosporium giganteum Crane	0	0	2	1	0	0	6	3	0	0	0	0	0	0	0	0	8	4
Total counts (colonies)	77		293		390		189		247		354		404		175		2130	
Total number of species	10		21		15		20		15		15		16		8		35	
Total number of genera	8		16		10		18		12		14		14		8		26	

Aphanomyces (*A. laevis*) was of rare occurrence and was recovered from one sample only, constituting 0.23% of total zoosporic fungi. Klick and Tiffany (40) reported similar resulted in Northwest Iowa (U.S.A.) and observed that *Achlya* and *Saprolegnia* had the greatest species diversity. In the present study, *Pythium* (9 species), *Isoachlya* (3 species), *Allomyces* (2 species) and *Phytophthora* (2 species) were represented in 15.63%, 6.25%, 4.38% and 1.25% of total samples constituting 6.96%, 3.60%, 1.03%, and 0.70% of total counts respectively. Dictyuchus sterile (9.98% of total counts), *Achlya* racemosa (12.06% of total counts), A. dubia (6.30% of total counts) and *Saprolegnia* ferax (5.22% of total counts) were the most prevalent species emerging from 24.38%, 20.00%, 11.25% and 10.00% of total samples respectively. On the other side, seven species (Table 2) were of rare occurrence (0.63% of total samples each).

These results are in accordance with those obtained by many authors (14,17,40), who reported that the zoosporic fungal population in freshwater habitats is mainly composed of *Achlya*, *Saprolegnia*, *Dictyuchus* and *Pythium*.

The broadest spectrum of species (23 species; 20.65% of total zoosporic fungi) were isolated from the water samples collected from Assiut governorate whereas the narrowest spectrum (6 species; 5.68% of total fungi) were from Aswan governorate.

Achlya was the most dominant genus in samples collected from Sohag (100% of samples), Qena (55%), El-Minia (65%), Beni-Suef (55%) and El-Fayoum (50%).

Saprolegnia was the most common genus in samples collected from Aswan (45%), Assiut (70.0%) and El-Giza (50.0%).

Dictyuchus showed its maximum frequencies in samples collected from Assiut (60% of samples).

These zoosporic fungal species (Table 1) were previously isolated in our laboratory from water and submerged mud samples (14-17,37).

However, three species of zoosporic fungi namely; *Achlya* rodriguazina, *Isoachlya* toruloides and *Saprolegnia* luxurians had been not previously recovered in Egypt (new records).

Aquatic hyphomycetes

Thirty five species which belong to 26 genera related to 2130 colonies were isolated during this investigation (Table 3).

The decaying leaf samples which were collected from the water sites with low or moderate temperature were also, as in case of zoosporic fungi, the richest in aquatic hyphomycetes. Ingold (30) reported that the highest development of these fungi in the last three or four months of the year. Iqbal and Webster (34) and Michaelides and Kendrick (43) observed that the concentration of conidia was high throughout the year except in the period May-July. Moreover, Willoughby and Archer (59) reported that the Hyphomycete conidia were more abundant during the wet period than the dry. Also, Iqbal and Webster (35) recorded the highest sporulation of the most aquatic hyphomycetes during autumn and winter whereas no conidial production during summer months.

Also, it was found that the decaying leaves collected from water areas having comparatively high contents of dissolved oxygen were the richest in aquatic Hyphomycetes. Thus the dissolved oxygen may play an important role in population of these fungi. This is confirmed by many authors (26-29,33,58) who pointed out that a well aerated stream contained a dense accumulation of spores.

Moreover, the richest samples in aquatic Hyphomycetes were those containing relatively high contents of organic matter. It was observed that no clear relationship between either the pH value or the contents of total soluble salts of collected samples and the population of aquatic Hyphomycetes. Unfortunately, there is no available literature concerning the relationships of the organic matter contents, total soluble salts and pH value of water habitats and aquatic conidial fungi population.

Triscelophorus (2 species), *Anguillospora* (2 species) and *Alatospora* (one species) were the most common genera and were represented in 52.5%, 48.13%, 43.13% of total samples contributing 35.59%, 21.17% and 12.16% of total counts of aquatic hyphomycetes, respectively. *Camposporium (C. pellucidum), Mycocentrospora (M. acerina), Dendrospora (D. junicola)* and *Speiropsis (Speiropsis species)* were of rare occurrence and each was represented in 0.63% of total samples constituting 0.09, 0.09, 0.05 and 0.19% of total counts of aquatic hyphomycetes, respectively.

Triscelophorus monosporus, Anguillospora longissima and *Alatospora acuminate* were the most prevalent species and were isolated from 51.88%, 47.50%, 43.13% of total samples constituting 30.09%, 19.06% and 12.16% of total counts, respectively. Ingold (31) reported that *Triscelophorus monosporus* and Clavari opsis aquatica have a worldwide range. Padgett (48) concluded that freshwater Hyphomycetes *Triscelophorus monosporus, Lunulospora curvula* and *Campylospora chaetocladia* play a significant role in processing submerged leaf litter in tropical stream.

Hudson and Ingold (22) isolated 16 species of aquatic hyphomycetes from 15 streams in Jamaica. Of these species *Lunulospora curvula, Flagellospora curvula, Tetracladium marchalianum* and *Triscelophorus monosporus* were the most common species.

The remaining species (Table 3) were of rare, low or moderate occurrence (0.63-19.38% of total samples). These species were previously isolated from submerged decaying leaves (2,4,12,23,24). *Flagellospora curvula* was of low occurrence (16.88% of total samples). This is not in accordance with Ingold (30) and Müller-Haeckel and Marvanova (45) who reported that *Flagellospora curvula* was one of the most common of all aquatic Hyphomycetes and was found all over the world. The samples collected from Qena and Assiut contributed the broadest spectrum of species (21 and 20 species related to 16 and 18 genera, respectively) constituting 13.76% and 8.87% of total counts of hyphomycetes respectively. The narrowest spectrum of species was recorded in the samples collected from El-Giza (8 species related to 8 genera; 8.22% of total aquatic hyphomycetes) and Aswan (10 species; 8 genera; 3.62%). The highest populations of aquatic hyphomycetes were recorded in samples collected from El-Fayoum (18.97%), Sohag (18.31%) and Beni-Suef (16.62% of total fungi). These samples were not listed with those contributed the broadest spectrum of species (Qena and Assiut).

Alatospora acuminata was of high occurrence in samples collected from Sohag (85%), Qena, Assiut and Beni-Suef (80.0% of total samples in each). *Anguillospora longissima* recorded its maximum frequency in samples collected from El-Fayoum emerging in 85.0% of total samples. *Dactylella submersa* showed highest frequency in samples collected from Sohag representing in 50.0% of samples. *Pyramidopsora casuarinas* recorded its highest occurrence in samples collected from El-Fayoum and El-Giza and was represented in 45.0% of samples in each one. *Triscelophorus monosporus* contributed its maximum frequency in samples collected from El-Fayoum and Sohag emerging from 95.0% and 75.0% of samples, respectively. Ingold (30) reported that the natural habitat of aquatic Hyphomycetes appears to be the sumberged decaying leaves of dicotyledonous trees and shrubs. These fungi can be found throughout the year, but for anyone starting their study the autumn months are to be recommended.

Fourteen species of aquatic hyphomycetes are new records to Egypt. These are, *Anguillospora crassa, Camposporium pellucidum, Culicidopsora aquatica, Dendrospora juncicola, Exophiala jeanselmei, Flabellospora species, Lateriramulosa uni-inflata, Lemonniera filiformis, Polycladium equiseti, Speiropsis species, Tricladium patulum, Tripospermum myrti, Trisulcosporium acerinum* and *Varicosporium giganteum.*

REFERENCES

1. Alabi RO : Seasonl periodicity of Saprolegniaceae at Ibadan, Nigeria. Trans Br Mycol Soc 56:337-341, 1971.

2. Alasoadura SO : Some aquatic hyphomycetes from Nigeria. Trans Br Mycol Soc 51:535-540, 1968.

3. Al-Saadi HA, Rattan SS, Muhsin TM, Haameed HA : Possible relation between phytoplankton numbers and Saprolegnioid fungi in Shatt Al-Arab near Basrah, Iraq. Hydrobiologia 63:57-62, 1979.

4. Barlocher F, Rosset J : Aquatic hyphomycetes spora of two Black Forest and two Swiss Jura streams. Trans Brit Mycol Soc 76:479-483, 1981.

5. Barlocher F : On the ecology of Ingoldian fungi. Bioscience 32:581-586, 1982.

6. Cook WB, Bartsch AF : Aquatic fungi in water with high waste loads. Sewage Indust Wastes 31:1316-1322, 1959.

7. Chamier AC, Dixon PA : Pectinases in leaf degradation by aquatic hyphomycetes, the enzymes and leaf maceration. J Gen Microbiol 128:2469-2483, 1982.

8. Dayal R, Tandon RN : Ecological studies of some aquatic phycomycetes. II- Fungi in relation to chemical factors of the water. Hydrobiologia 22:324-330, 1963.

9. Dayal R, Thakur J : The occurrence and distribution of aquatic fungi in certain ponds of Varanasi. Hydrobiologia 27:548-558, 1966.

10. Dick MW, Newby HV : The occurrence and distribution of Saprolegniaceae in certain soils of southeast England. I- Occurrence. J Ecol 49:403-419, 1961.

11. Dubka IA : Translated title: Ukrainian aquatic hyphomycetes. Kiev, Acad Sci Ukrain RSKMG Holodhy Bot Inst, 1974.

12. Dyko BJ : A preliminary study of aquatic hyphomycetes on leaves in forest and stream leaf litter. J of Tennessee Acad Sci 51:6-8, 1976.

13. El-Hissy FT : Freshwater fungi in Egypt. J Bot 17:187-189, 1974.

14. El-Hissy FT, Moubasher AH, Nagdy MA : Seasonal fluctuations of freshwater fungi in river Nile (Egypt). Z allg Mikrobiol 22:521-527, 1982.

15. El-Hissy FT, El-Nagdy MA : Aquatic phycomycetes on the mud of the River Nile, Assiut, Egypt. Sydowia 36:118-124, 1983.

16. El-Hissy FT, Abd-Elaah GA : Aquatic phycomycetes from Egyptian soils. Sydowia 41:150-159, 1989.

17. El-Hissy FT, Khallil AM : Studies on aquatic fungi in Delta *region (Egypt). Zentralbl Microbiol 144:421-432, 1989.*

18. Fox NC, Wolf FT : Aquatic phycomycetes of Randor lake, Nashville. Tennesse Acad Sci 52:100-104, 1977.

19. Gónczól J : Ecological observations on the aquatic hyphomycetes of Hungary. I- Acta Botanica Academiae Scientiaram Hungaricae 21:243-264, 1975.

20. Höhnk W : Saprolegniales und Monoblepharidales aus der Umgebung Bremens, mit besonderer Berúcksichtigung der Saprolegniaceae. Abhandl Naturwiss Bremen 29:207-237, 1935.

21. Höhnk W : Ein Beitrag zur Kenntnis der Phycomyceten des Brackwassers. Kieler Meeresforsch 3:337-361, 1939.

22. Hudson HJ, Ingold CT : Aquatic hyphomycetes from Jamaica. Trans Br Mycol Soc 48:469-478, 1960.

23. Ingold CT : Aquatic hyphomycetes of decaying alder leaves. Trans Br Mycol Soc 25:339-417, 1942.

24. Ingold CT : Further observations on aquatic hyphomycetes. Trans Br Mycol Soc 26:104-115, 1943.

25. Ingold CT : Some new aquatic hyphomycetes. Trans Br Mycol Soc 28:35-43, 1944.

26. Ingold CT : Actinospora megalospora n. sp., an aquatic hyphomycete. Trans Br Mycol Soc 35:66-70, 1952.

27. Ingold GT : Another aquatic spore-type with clamp connections. Trans Br Mycol Soc 44:27-30, 1961.

28. Ingold GT : The tetraradiate aquatic fungal spore. Mycologica 58:43-46, 1966.

29. Ingold GT : Spores from foam. Bulletin of the British. Mycological Society 1:60-63, 1967.

30. Ingold GT : An illustrated guide to aquatic and water-borne hyphomycetes (Fungi Impefecti) with notes on their biology. Freshwater Biological Association. Scientific Publication No. 30. Trans Br Mycol Soc 65:522-527,1975.

31. Ingold GT : Advances in the study of so-called aquatic hyphomycetes. Amer J Bot 66:218-226, 1979.

32. Ingold GT, Webster J : Some aquatic hyphomycetes from India. Kavaka 1:5-9, 1973.

33. Iqbal SH, Webster J : The trapping of aquatic hyphomycetes spores by air bubbles. Trans Br Mycol Soc 60:37-48, 1973.

34. Iqbal SH, Webster J : Aquatic hyphomycetes spora of the River Exe and its tributaries. Trans Br Mycol Soc 61:331-346, 1973.

35. Iqbal SH, Webster J : Aquatic hyphomycetes spora of some Dartmoor Streams. Trans Br Mycol Soc 69:233-241, 1977.

36. Ismail SL, Rattan SS, Muhsin TM : Aquatic fungi of Iraq. Species of Saprolegnia. Hydrobiologia 65:83-93, 1979.

37. Khallil AM : Studies on aquatic fungi in El-Ibrahimia canal. MSc Thesis, Bot Dept, Faculty of Science Assiut Univ, 1984.

38. Khallil AM : Mycoflora associated with some freshwater plants collected from Delta region (Egypt). J Basic Microbiol 30:663-674, 1990.

39. Khulbe RD : Occurrence of water molds in relation to hydrogen ion concentration in some lakes of Nainital, India. Hydrobiologia 69:3-5, 1980.

40. Klick MA, Tiffany LH : Distribution and seasonal occurrence of aquatic Saprolegniaceae in northwest IOWA. Mycologia 77:373-380, 1985.

41. Lund A : Studies on Danish freshwater phycomycetes and notes on their particularly relative to the hydrogen ion concentration of the water. Mem Acad Roy Sci Denmark Sect Sci 6:1-97, 1934.

42. Lui CH, Volz PA : On the ecology of the Saprolegniaceae. Phytologia 34:209-230, 1976.

43. Michaelides J, Kendrick B : An investigation of factors retarding colonization of conifer needles by amphibious hyphomycetes in streams. Mycologia 70:419-430, 1978.

44. Misra JK : Occurrence, distribution and seasonality of aquatic fungi as affected by chemical factors in six alkaline ponds of India. Hydrobiologia 97:185-191, 1982.

45. Müller-Haeckel A, Marvanova L : Periodicity of aquatic hyphomycetes in the Subarctic. Trans Br Mycol Soc 73:109-116, 1979.

46. Nilsson S : Freshwater Hyphomycetes. Symb Bot Upsal 18:1-130, 1964.

47. Okane K : The seasonal changes of aquatic phycomycetes in the Yokote river system. J JPN Bot 53:245-252, 1978.

48. Padgett DE : Leaf decomposition by fungi in a tropical rainforest stream. Biotropica 8:166-178, 1976.

49. Paul DC, Armando H, Fermin R : Soil and aquatic fungi in wast-stabilization pond system of the state of Mexico Water Air and Soil Pollution 23:249-256, 1984.

50. Rattan SS, Muhsin TM, Ismail ALS : Notes on the occurrence and seasonal perodicity of Saprolegniaceae in Shatt Al-Arab (Iraq). Kavaka 8:41-46, 1980.

51. Roberts RE : A study of the distribution of certain members of the Saprolegniales. Trans Br Mycol Soc 46:213-224, 1963.

52. Singh N, Musa TM : Terrestrial occurrence and the effect of temperature on growth, sporulation and spore germination of some tropical aquatic hyphomycetes. Trans Br Mycol Soc 68:103-105, 1977.

53. Sparrow FK : Ecology of freshwater fungi. In: The Fungi (ed: GC Ainsworth and AS Sussmann), Vol III. Academic Press, London, pp 41-93, 1968.

54. Srivastava GC : Ecological studies on some aquatic fungi. Gorakhpur, India. Hydrobiologia 30:385-404, 1967.

55. Suzuki S : Ecological studies on aquatic fungi in the Matsubars lake group. J Jap Bot 37:60-64, 1962.

56. Te Strake D : Estuarine distribution and saline tolerance of some Saprolegniaceae. Phyton 12:147-152, 1959.

57. Te Strake D : Estuarine distribution of Saprolegniaceae in the Tampa Bay Area. Botanica Marina 23:707-709, 1980.

58. Webster J : Experiments with spores of aquatic hyphomycetes. I- Sedimentation and impaction on smooth surfaces. Ann Botany, London 23:595-611, 1959.

59. Willoughby LG, Archer JF : The fungal spora of a freshwater stream and its colonization pattern on wood. Freshwater Biol 3:219-239, 1973.

60. Zebrowska E : Mycoflora of several containers of the Kampions Forest, Poland Acta Mycol 12:77-89, 1976.

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