ACTA MYCOLOGICA
VOL. XXV (1): 131-139
1989

Cellulose inhabiting fungi in the Nile Mud receiving city refuses in upper Egypt

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El-Sharouny H. M. M., A. M. Moubasher, R. A. Badran: *Cellulose inhabiting fungi in the Nile Mud receiving City refuses in upper Egypt*. Acta Mycol. 25(1): 00-000, 1989.

Fifty-five species, which belonged to thirty-six genera, were collected from the four types of cellulose. There was no specific fungal flora isolated from any of the four baits, namely wheat straw, cotton fibers, filter paper and cellophane but some fungi grew noticeably better on some cellulose types than on others. The gross total count of fungi was the highest on cellophane followed descendingly by filter paper, cotton fibers and wheat straw.

INTRODUCTION

Cellulose is by for the most prominent organic compound in nature and its decomposition by soil and water microorganisms has received a considerable attention because of its significance in the biological cycle of carbon (Griffiths, Jones 1963; Park, McKee, 1978; Park 1980; Moustafa, Sharkas 1982).

In a previous work (El-Sharouny et al., unpubl.), the density, frequency and seasonal fluctuations of cellulose decomposing fungi in the Nile water and mud have been analysed by the dilution-plate method. The investigations were designed in order to get some information on the cellulytic fungi associated with the mud of the River Nile which received city refuses. For the study the baiting technique was applied.

MATERIALS AND METHODS

Four types of cellulosic materials were used namely, wheat straw, cotton fibers, filter paper and cellophane.

Mud samples were collected from the Nile shore, 1 kilometer north of Qena, affected by the refuses of the city. Samples were collected bimonthly during January-December 1986 and transferred as soon as possible to the laboratory in a sterile plastic bags.

For the recovery of cellulose-decomposing fungi from mud samples, an equivalent of 50 gm dry mud sample was introduced into 15 cm petri-dish, then baited on their surface with the different cellulose materials and incubated at 25°C for 2-3 weeks. Thereafter, each colonized materials was plated on cellulose-free media (Eggins, Pugh 1962). The developed colonies were examined, indentified, counted and purified by the single hyphae culture method on the same medium.

RESULTS AND DISCUSSION

Fifty-five species which belong to thirty-six genera were collected from the four types of cellulose. The results (Table 1) reveal that the gross total count of all fungi was the highest in case of cellophane strips followed in a descending manner by filter paper, cotton fibers and wheat straw. The monthly total counts irregularly fluctuated but the best counts were estimated in March, April, June and September on wheat straw, in January, February, October and December on cotton fibers, in April, May, July and October on filter paper and in March, May, July and December on cellophane (Fig. 1).

Aspergillus regularly occurred in all months of the experiment and on all baits accounting for 12.6-15.5% of total fungi. Its monthly counts irregularly fluctuated and the highest numbers were recorded in May and June on wheat straw, in June, July and September on cotton fibers, in May and June on filter paper and in May and August on cellophane strips (Fig. 1). Eight species were collected from the genus on the four types of cellulose of which *A. niger*, *A. fumigatus* and *A. flavus* were the most common, and occurred in 8-10, 4-10 and 5-12 months comprising 4.4-4.9%, 1.6-5.4% and 3.4-6.4% of total fungi, respectively. These species were also common in the Egyptian desert and cultivated soils, seeds and grains and on root and leaf surface of some Egyptian higher plants as reported by Moubasher and his collaborators. Raper and Fennell (1965) observed that all members of *Aspergillus* appeared to be capable of hydrolysing the cellulose compounds.

Penicillium emerged in 11-12 months constituting 10-17.7% of total fungi. The genus was absent in June only on filter paper. Its monthly counts were irregular, but the best were recorded in May, August and November, December on cellophane strips (Fig. 1). Four species were collected of which *P. funiculosum* and *P. corylophilum* were the most common (6-11, 9-12 months and 2.9-5.17% and 3.14-5.8%, respectively) on the four types of cellulose. *P. corylophilum* was isolated from cotton fibers and textiles as reported by Mcginnis et al. (1975). Also, Pugh et al. (1963) and Pugh (1964) listed *Penicillium* spp. as microbial genus capable of utilizing cellulose.

El-Nagdy (1981) using cellulose medium, observed that *P. corylophilum* was the most precalent species in the Nile water.

Scolecobasidium variabile was recorded in 9-12 months constituting 2.5-9.3% of the total fungal population on the four baits. Its monthly counts irregularly fluctuated and the best were determined in February, May and September on wheat straw, (Fig. 1). This species was isolated from soils and decaying leaves in Japan, (Ichinoe, 1967 and Matsushima, 1975).

Trichoderma sp. emerged in 8-11 months on the four baits contributing 3.5-7.01% of the total populations. Its monthly counts irregularly fluctuated and the best was determined in October on wheat straw, in August on cotton fibers, in September on filter paper and in July on cellophane, (Fig. 1). *T. viride* is known to be a cellulose decomposer (Pugh et al. 1963, Flannigan 1970). Moustafa and Sharkas (1982), working on fungi associated with cellulose decomposition in the tidal mud-flats of Kuwait, reported that *T. Koningii* was a good cellulose-decomposer.

Chrysosporium pruinosum was encountered in 7-10 months constituting 1.2-5.6% of the total fungi on the four cellulose materials. The best estimates were obtained in August and September on wheat straw. The species is known to attack cellophane vigorously (Carmichael, 1962).

Scytalidium state of *Henderssanula toruloidea* emerged in 8-11 months accounting for 2.6-7.5% of the total fungi on the four bats of cellulose. The highest counts appeared in April, June and November on wheat straw and in October on cellophane strips.

Gliomastix murorum var. *polychroma* occurred in 3-10 months comprising of 0.22-5.08% of the total fungi. The best count was recorded in June and August on wheat straw.

Exophiala sp. appeared on 4-8 months constituting 0.77-2.9% of the total fungi on the four cellulose materials. Its monthly counts were irregular and the highest were recorded in May and August on wheat straw, in March and August on cotton fibers, in February on filter paper and in August on cellophane.

Coemansia sp. was recorded in 1-9 months comprising 0.06-2.7% of total fungi on the four baits. Its frequency and total count were the lowest (1 month and 0.06% of total populations) on cellophane, the highest (9 months and 2.77% of total fungi) on filter paper strips. Abdel-Mallek (1984) isolated this organism on cellulose agar from Egyptian soil.

Botryotrichum piluliferum emerged in 6-10 months accounting for 1.8-2.7% of total fungi on the four cellulosic materials. Its highest frequency (10 months) was determined on cellophane. This species was reported to be cellulytic by Tribe (1960, 1966). Macauley and Thrower (1966) reported that most of the species of *Moniliales* were able to utilize both soluble and insoluble cellulose.

Table 1

Total count /per segment/ and number /out of 12/ of fungi isolated by baiting mud samples with 4 types of cellulose

Genera et species \ Cellulose baits	Wheat		Straw		Cotton		Fibers		Filter		Paper		Cellophane	
	TC		NCI		TC		NCI		TC		NCI		TC	NCI
Aspergillus	19.3		12		19.8		12		33.8		12		28.4	12
A. niger Van Tieghem	5.4		10		6.2		8		7.0		8		7.9	9
A. fumigatus Fres.	6.1		9		2.3		4		2.5		10		4.2	8
A. flavus Link.:Fr.	3.9		5		8.1		9		9.2		10		7.9	12
A. terreus Thom	1.9		4		1.0		5		3.6		8		2.0	8
A. flavus var. columnaris Raper et Fenn.	1.6		4		1.3		4		9.1		10		4.7	10
A. ochraceus Wilhelm	0.3		2		-		-		0.4		2		0.2	2
A. candidus Link : Fr.	0.1		1		0.7		3		1.1		3		0.7	5
A. nidulans /Eidam/ Winter	-		-		0.2		1		0.9		2		-	-
Penicillium	11.4		12		15.0		12		15.9		11		31.9	12
P. funiculosum Thom	5.3		9		5.3		9		4.5		6		9.3	11
P. corylophilum Dierchx	4.7		9		7.3		11		4.9		9		10.5	12
P. chrysogenum Thom	1.1		3		2.4		9		3.1		6		6.5	11
P. verruculosum Peyr.	0.3		2		-		-		3.4		6		5.6	11
Scolecobasidium variable Barron et Busch	10.6		11		6.0		9		3.9		10		9.7	12
Trichoderma sp.	8.0		11		5.7		9		5.4		8		6.3	9
Chrysosporium pruinosum /Gilman et Abbott/	6.4		10		3.9		10		3.0		7		2.1	7
Scytalidium state of Hendersonula toruloidea Nattras	8.6		8		4.0		9		4.1		11		7.7	11
Gilomastix murorum var.polychroma /Van Beyma/ Dickinson	5.8		8		2.4		5		3.4		10		0.4	3
Exophiala sp.	3.3		8		2.5		5		1.2		4		1.4	5
Coemansia sp.	3.1		8		1.7		6		2.8		9		0.1	1
Verticillium lateritium /Berk./	2.7		8		0.7		3		2.3		7		1.1	4
Botryotrichum piluliferum Sacc et Marchal	3.1		7		2.7		6		2.8		8		4.3	10
Pseudourotium zonatum Van Beyma	2.4		7		0.3		2		1.4		5		0.3	3
Stachybotrys chartarum /Ehreb.: Link/ Hughes	2.7		6		2.3		4		2.8		9		3.9	8
Fusarium	3.5		5		14.8		11		12.7		11		28.8	12
F. solani /Martn/ Sacc.	1.6		4		10.4		9		4.3		8		12.9	11
F. moniliforme Sheldon	1.6		4		2.5		5		3.4		7		13.4	12
F. equiseti /Corda/ Sacc.	0.3		2		1.9		3		5.0		8		2.5	6

Cylindrocladium parvum P.J. Anderson	2.1	4	0.5	2	1.8	9	0.1.	1
Chaetomium	1.6	4	3.4	7	3.1	7	4.3	9
C. globosum Kunze: Fr.	1.1	3	1.1	5	0.9	5	1.8	8
C. olivaceum Cooke et Ellis	0.5	2	2.3	4	2.2	7	2.5	6
Eupenicillium euglaucum /Van Beyma/ Stolk et Samson	1.6	4	1.1	3	-	-	-	-
Talaromyces stipitatus /Thom/ C.R. Benj.	1.5	4	0.7	4	1.8	9	1.2	5
Cladosporium	1.5	4	3.5	7	3.5	8	3.8	11
C. herbarum /Pers./ Link : Fr.	1.0	4	1.0	3	1.1	5	1.4	6
C. cladosporioides /Fes./ De Vries.	0.5	2	2.5	6	2.4	8	2.4	9
Gliocladium	1.1	4	2.4	6	4.0	11	6.6	4
G. virens Miller, Gidden et Foster	0.6	3	1.4	5	2.9	10	0.1	1
G. rossum Bainier	0.5	1	1.0	3	1.1	4	0.5	4
Alternaria alternata /Nees/ Keissler	0.6	4	1.9	6	3.7	10	2.6	7
Paecilomyces variotii Bainier	1.1	3	2.2	7	6.1	10	4	8
Drechslera halodes /Drechsler/ Subram et Jain	1.1	3	1.1	5	2.8	7	2.5	8
Humicola grisea Traaen	0.9	3	4.2	8	2.2	6	3.7	8
Beauvreria bassiana /Bals./ Vuill.	0.8	3	3.9	8	3	8	-	-
Acremonium	0.7	3	1.3	3	3.5	6	4	9
A. strictum W. Gams	0.5	2	1.3	3	2.7	6	2.8	9
A. implicatum /Gilman et Abb./ Gams	0.2	2	-	-	0.8	4	1.2	3
Sepedonium chrysospermum/Bull./ Fries	0.8	3	5.4	8	2.9	8	3.1	9
Pestalotia pezizoides de Not	0.9	2	1.5	5	2.2	6	2.9	6
Scopulariopsis brevicaulis /Sacc./ Hughes	0.5	2	0.9	4	3.0	9	2.3	7
Papulospora irregularis Hotson	0.4	2	2.1	5	3.4	8	3.2	7
Curvularia tuberculota Jain	0.4	2	3.3	7	4.3	5	3.8	11
Mucor	0.3	2	0.9	4	2.4	8	4.3	8
M. circinelloides Van Tieghem	0.2	2	0.4	3	1.3	5	1.2	6
M. racemosus Fres.	0.1	1	0.5	2	1.1	6	3.1	8
Tetracladium marchalianum de Wild.	-	-	-	-	0.9	6	-	-
Pythium	0.3	1	1.4	5	1.7	5	0.2	1
P. rostratum Bulter	0.2	1	0.8	5	1.0	5	0.2	1
P. ultimum Trow	0.1	1	0.4	1	0.3	2	-	-
P. oligandrum Drechsler	-	-	0.2	1	0.4	1	-	-
Periconia saraswatipurensis Bilgrami	-	-	-	-	-	-	2.5	7
Gross total count	112.9		123.1		147.7		179.6	

TC - Total count; NCI - Fungi numbers; * - New records to the Egyptian Mycoflora

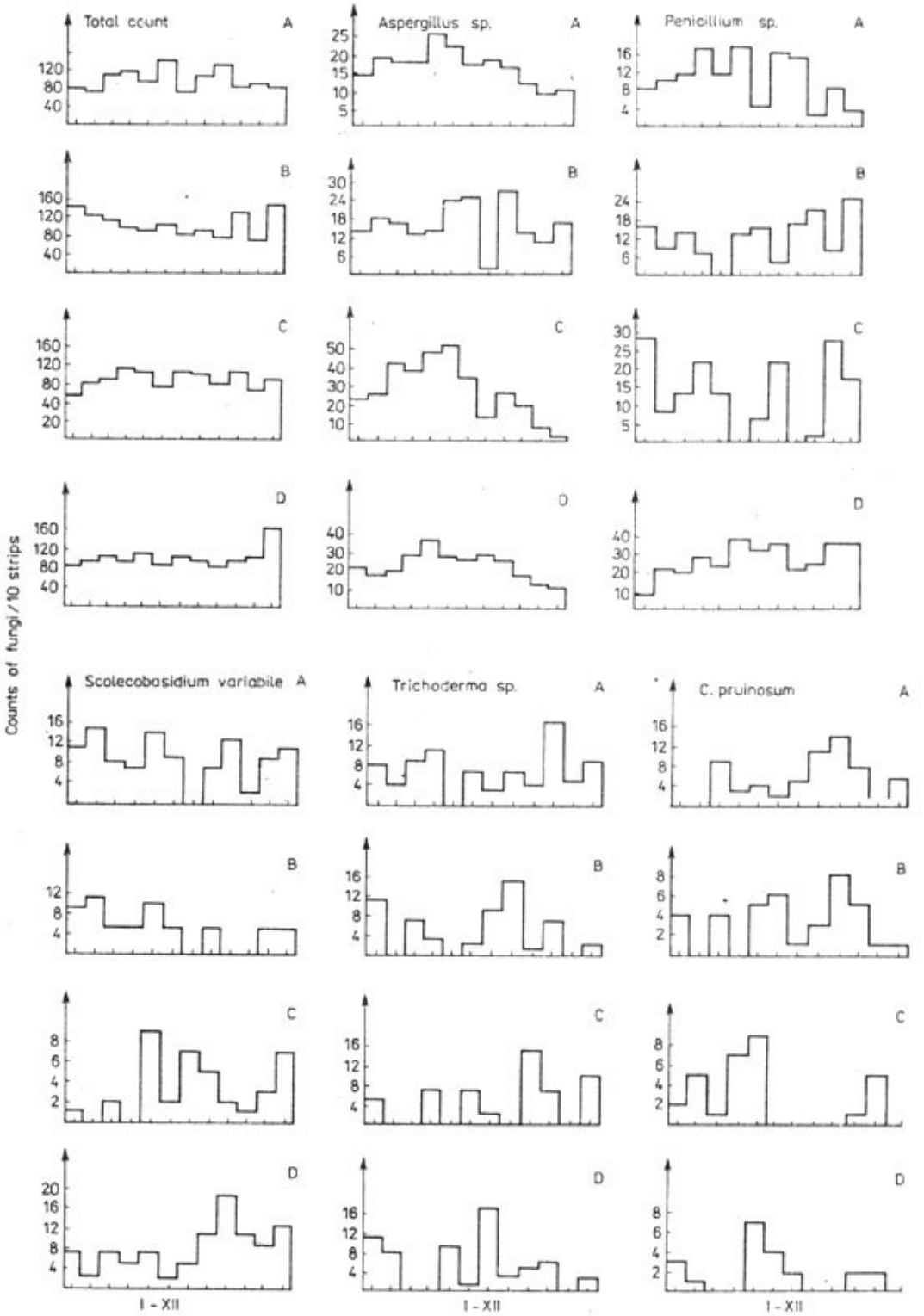
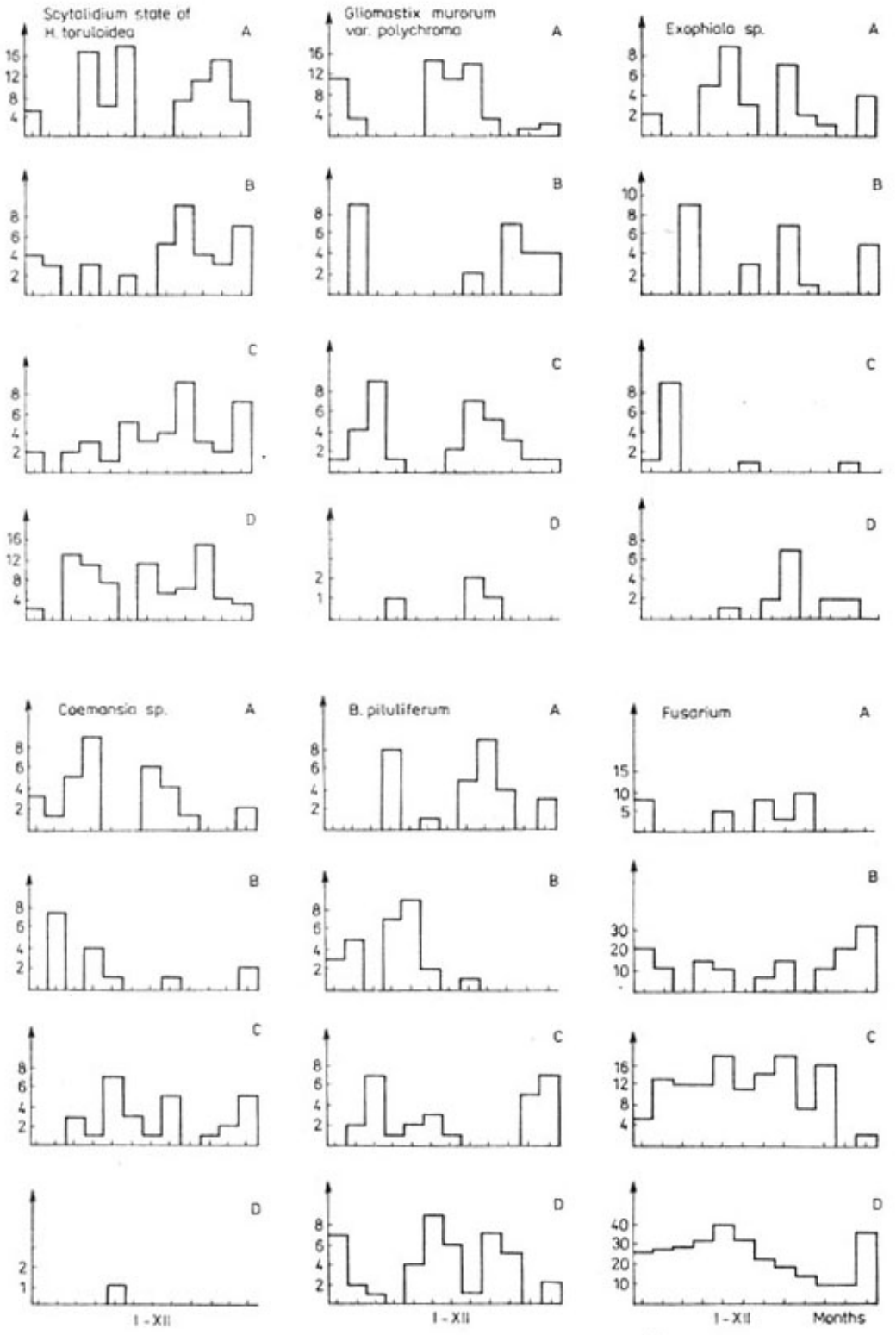


Fig. 1. Monthly counts of fungi isolated by baiting mud, at the laboratory on Eggins et Pugh's agar at 25°C during January-December 1984

A – wheat straw, *B* – cotton fibers, *C* – filter paper, *D* – cellophane strips


Scytalidium state of H. toruloidea
Gliomastix murorum var. polychroma
Exophiala sp.
Coemansia sp.
B. pilulifera
Fusarium
A
B
C
D
I - XII
Months

Fusarium emerged in 5-12 months constituting 3.07-16.02% of total fungi on the four cellulosic materials. Three species were collected from which, *F. solani* and *F. moniliforme* were common (4-11, 4-12 months and 1.4-8.12%, 1.4-7.5% of total population, respectively). The best count of the genus was determined in December on cotton fibers and in May-June and December on cellophane strips (Fig. 1). These species were reported as cellulose decomposers (Walsh and Stewart, 1969, 1971 and Malik and Eggins, 1970).

The remaining genera and species were less frequent (Table 1).

It is to be mentioned that there was no basic difference in the composition of fungal floras of the types of cellulosic materials recovered during all the experiment but some fungi noticeably promoted selected cellulose types. It seems that the buildup of fungal population at the site of study may clarify the role played by fungi in the biodegradation of cellulosic wastes in the freshwater environments.

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