SOIL FUNGI OF SOUTH IRAQ

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The south region of Iraq has varied ecosystems : salt marshes, cultivated lands and desert. Most of the soil types of this region of Iraq are saline alluvial (typical of deserts) with some areas having sandy soils (Guest, 1966). The climate is typically arid with hot dry summer and cool rainy winter.

Only a few preliminary investigations have been made on soil fungi of Iraq by Al-Dnoory *et al.* (1959). But these pioneering studies are on the soil mycoflora of Iraq, concentrated on area around Baghdad and central Iraq. Other studies were made by Ismail and Abdullah (1977) who isolated 37 species : 3 belonging to the Phycomycetes, 32 to the fungi Imperfecti, and 2 to the Mycelia Sterilia from soil samples collected from four localities around Basarh.

The paucity of available information on the soil fungi of the south region of Iraq calls for an extensive study of soil fungi of this region. The aim of the present investigation is to study mesophilic sugar fungal populations, their density and distribution in the south region of Iraq. This study represents the first part of a series of investigations to be undertaken by the this authors.

MATERIALS AND METHODS

Following to the method described by Johnson *et al.* (1959), ten soil samples are collected, from different localities in south region of Iraq in November 1977 and April 1978. These localities includes areas under cultivation (*Phoenix dactylifera, Cucumis sativum, Tamarix articulata* and *Lycopersicum solani*). Al-Haur, salt marshes and deserts. Soil samples (2.5 kg. each) are taken from ten spots in each locality and thoroughly mixed to form a composite sample. At each spot the samples are collected at about 5 cms from the roots of dominant plants from the surface level of a depth of about 15 cms.

The Soil samples are analyzed chemically for the estimation of total soluble salts, organic matter, and pH value. Estimation of soil fungi is carried out using the dilution plate method of Johnson *et al.* (1959), with some modifications as follows : (1) Menzeis's (1957) dipper is used instead of pipettes, (2) Modified Czapek's medium, in which glucose (10 gm per L) is replaced by sucrose to isolate sugar fungi. In all cases rose-bengal is added, as bacteriostatic agent to the medium at concentration of 1/15000 (Smith and Dawson, 1944).

Six plates are used for each soil sample. Incubation is conducted at 25°C for the isolation of mesophilic sugar fungi. The colonies of slow growing fungi which are about to be over grown as well as mycelial fragments of some colonies are transferred to fresh Czapek's + 0.05 yeast extract, soil extract or potato dextrose ager.

The cultures are kept in the culture collection of fungi at the College of Education, University of Basrah.

RESULTS

The results given in Table 1 show that south Iraqi soils are generally poor in organic matter contents. It reaches 2.8 percent in cultivated soil and drops to 0.2 percent in non-cultivated sandy soil. The total soluble salts vary greatly from a low value in desert plateau of Sannam hill 0.2 percent to a high value in the salt depression of Al-Hweir 52.9 percent. The pH value of the soil samples reveals no appreciable differences, all soil samples are alkaline and their ranges from 7.3 to 9.1.

In general, saline silty and sandy non-cultivated soils are found poor in their fungal content, while the samples collected from Al-Chebaiesh under *Phoenix dactylifera* trees possessed the highest count (Total count = 68300.0 colonies per gm dry soil). The number of propagules varies greatly from one ecosystem to another. All the soil samples do not show any regular correlation between the fungal content, or the range of fungal genera and the soil pH value.

The results represent in Table 2 show that the highest number of *Aspergilus, Penicillium* species, *Dematiaceous* and Hyaline Hyphomycetes genera are isolated from soil samples No. 7 : (6 *A.* spp. out of 12), (2 *P.* spp out of 6), (3 Dematiaceous Hyphomycetes genera out of 9) and (3 Hyaline Hyphomycetes genera out of 7) and No. 5 (5 *A.* spp. out of 12), (2 *P.* spp. out of 6), (4 Dematious Hyphomycetes genera out of 9) and (1 Hyaline Hyphomycetes genera out

of 7). These samples are silty soil which are relatively rich in organic matter and low in salinity. The least number of genera and species is recorded in soil sample No. 3 where only one species of *Penicilium* is present. Most of the soil samples show regular correlation between the count of *Aspergillus* and range of its species only.

Forty one species belonging to twenty genera are identified during the course of this investigation, Table 3. The genus *Aspergillus* is occupied the first place in count (Mean total count = 4188.1 colonies per gm dry soil) and second frequency of isolation (7 times out of 10). It is represented by 12 species and thus possessed the widest spectrum among all recovered genera. Two of these species namely ; *A. niger* and *A. sydowii* are of moderate (5 times and Mean total count = 1353.5 colonies per gm dry soil) and low occurence (2 times and Mean total count = 1721.7 colonies per gm dry soil) respectively and are by far the most dominant species. *A. candidus, A. terreus, A. versicolor,* and *A. ochraceus* are of low occurrence from 176.7 to 375.0 colonies per gm dry soil). The remaining five species are of rare occurrence. The second place in count go to *Penicillium* (Mean total count = 2548.7 colonies per gm dry soil), but it takes the first place in occurrence (isolated from all samples). Six species are identified of which *P. notatum* (recorded 8 times) and *P. vinaceum* (recorded 4 times) are most frequent. *P. roqueforti* is isolated in high count (Mean total count = 1050.0 colonies per gm dry soil), but in one sample only. The other species are less frequent. The third place in count and frequency of occurrence go to *Stachybotrys* which is represented by one species namely ; *St. atra* (Mean toal count = 993.3 colonies per gm dry soil and recorded 3 times). The fourth and fifth places in

count are recorded for *Humicola* (2 species namely ; *H. fuscoatra* (Mean total count = 883.3 colonies per gm dry soil and isolated 4 times) and *Fusarium* (Mean total count = 583.3 colonies per gm dry soil and isolated 4 times) respectively. Both *Cladosporium* (*C. herbarum*) and *Ulocladium* (2 species namely ; *U. botrytis*, and *U.* sp.) are of moderate occurrence (isoloted 4 times) and respectively constituted 307.7 and 62.5 colonies per gm dry soil. The other genera or species show very low count and occurrence. The results in Table 3 also show that there is considerable variety in the genera or species of fungi in any sample tested.

The results in Table 4 show that the cultivated soils are rich in fungal populations (Mean total count = 16525.0 colonies per gm dry soil) as compared with non-cultivated soils (Mean total count 3241.3 colonies per gm dry soil). It is also seen that the fungal populations are constituted mainly by the genera of *Aspergillus*, and *Penicillium*. *Penicillium* is more abundant in non-cultivated soil (Mean total count = 3063.5 colonies per gm dry soil and percentage = 42.2). Most of the other fungal genera are more found in cultivated soil than in non-cultivated soil.

DISCUSSION

The soil fungi of south Iraq are studied in ten soil samples collected from different localities representing ecosystems. The data reveal that most of cultivated and fertile soils have a greater populations of soil fungi as well as a wider spectrum of fungal genera or species than non-cultivated soils. Such conclusion was also reached by Al-Doory *et al.* (1959) and Ismail & Apdullah (1977).

About forty one mesophilous species belonging to eighteen genera are isolated. These fungi come under : (1) Phycomycetes (18) Ascomycetes, (15) Dematiaceous Hyphomycetes and (7) Hyaline Hyphomycetes. No selective dstribution of different soil fungi are recorded in the various ecosystems and soil types. This result is in conformity with those obtained by Ranzoni (1968), Moubasher & Moustafa (1970), Moustafa & Musallam (1975) and El-Dohlob & Abu-Ellil (1978).

The soils of south Iraq (arid region) are predominated by *Aspergillus* especially by *A. nigar* and *A. sydowii* than by any fungal genera and species identified. Moubasher & El-Dohlob (1970) showed that *Aspergillus* was more abundant in Egyptian soil in summer months. Also Moustafa & Musallam (1975), and Ismail & Abdullah (1977) observed the aboundance of *Aspergillus* in Kuwaiti and Iraqi soils respectively.

Dematiaceous Hyphomycetes is higher in count, frequency, and spectrum range of genera and species in south Iraqi soil than those of Hyaline Hyphomycetes. The prevalence of dark-coloured Deutromycetes was reported in French Sahara (Nicot, 1960), Sonoran desert, U. S. A. (Razoni, 1968) and of the arid and extreme-arid climatic belts of salt marshes, Egypt (Zahran *et al.*, 1977).

Fusarium is the most abundant genus of Hyaline Hyphomycetes in the south arid region of Iraq. Tolba (1952) and Tolba & Moubasher (1957) recorded a high prevalence of *Fusarium* among the fungi recorded from damping-off of cotton and lettuce during the summer months. Also Moubasher & El-Dohlob (1970) showed striking predominance of *Fusarium* over all the soil fungi

during June-July 1967 (the hottest months during their experimental period). *Fusarium* was frequent in Wadi El-Natrun (arid region) (El-Dohlob *et al.*, 1978).

Species of *Penicillium*, mainly represented by *P. notatum* and *P. roqueforti*, are mre abundant in non-cultivated soils.

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SUMMARY

Twenty genera and forty one species of fungi are isolated from soil samples from different ecosystems of soutn Iraq. Twelve species of *Aspergillus*, 6 of *Penicillium*, 12 of Dematiaceous, 6 of Hyaline Hyphomycetes, one genus of Phycomycetes and one genus of mycelia Sterilia namely ; *Rhizoctonia* are identified. Most of the fertile and cultivated soils show a greater population as well as a wider spectrum of genera and species than the non-cultivated soils. Most of the fungal genera and species do not show regular correlation between the count and frequency of occurrence. No selective distribution of different soil fungi are met within the various ecosystems and soil types.

Aspergillus is the most abundant genus in the soils of south Iraq and predominating in cultivated soils, but *Penicillium* is most frequently met within non-cultivated soils. Dematiaceous are more abundant than Hyaline Hyphomycetes.

الملخص العربي

فطريات التربة في جنوب العراق

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لقد تم عزل احدى وأربعين نوعا تنتمي الى عشرون جنسا من نظم بيئية مختلفة من جنوب العراق ولقد عرف أثنى عشر نوعا تنتمي الى جنس الاسبرجلس ، وستة أنواع تنتمي الى جنس البنيسيليوم ، وخمسة عشر نوعا تنتمي للفطريات السود الناقصة وسبعة أنواع تنتمي للفطريات الشفافة اللون الناقصة وجنس واحد ينتمي للفزول الفطرية العقيمة وهو رايزوكتونيا وقد أتضح من خلال هذا البحث أن الاراضي المزروعة والخصبة تحتوي على عدد أكثر ومتنوع من الاجناس والانواع من الاراضي غير المزروعة ولا توجد علاقة واضحة بين الاعداد ومدى التكرار .

ولا توجد فطريات مميزة لاي نظام بيئي ، أو نوع تربة ، ووجد أن جنس الاسبرجلس هو السائد في تربة جنوب العراق ، وأنه يسود في الاراضي المزروعة بينما البنيسيليوم يسود في الاراضي غير المزروعة . وأن الفطريات السود الناقصة تسود على الفطريات الشفافة اللون الناقصة .

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Table 1

Details of fungal collection in the soil samples tested

Soil No.	Total count	No. of genera	Locality	Ecosystem and Plant cover	Soil type	pH	Total soluble salts	Organic Compound content
1	4466.7	6	Abu Al-Khasib	*Phoenix dactylifera*	Silty	8.1	0.6	2.8
2	2816.7	7	Al-Athal	*Lacopersicum solani*	Sandy loam	8.1	1.1	1.1
3	2200.0	1	Al-Athal	*Tamarix articulata*	Sandy loam	8.8	4.0	1.2
4	93.3	6	Abu Al-Khasib	Salt marshe	Silty	8.4	20.0	1.2
5	17666.7	7	Ash-Shafi	*Cucumis sativum*	Silty	8.0	2.3	1.2
6	3200.0	3	Ad-Deir	*Phoenix dactylifera*	Silty	8.5	9.3	0.7
7	68800.0	8	Al-Chebaiesh	*Phoenix dactylifera*	Silty	7.7	0.6	2.4
8	112.0	5	Al-Hweir	Salt marshe	Silty	9.1	52.9	0.8
9	12666.7	3	Sannam hill	Non-cultivated	Sandy loam	7.3	3.9	0.7
10	93.3	8	Plateau of Sannam hill	Non-cultivated	Sandy	8.3	0.2	0.2

Soil numbers 2, 3, 9 & 10 collected in November 1977 and the rest in April, 1978.

Table 2

Details on *Aspergillus*, *Penicillium*, Dematiaceous & Hyalin Hyphomycetes in the fungal collection.

Soil No.	*Aspergillus*		*Penicillium*		Dematiaceous Hyphomycetes		Hyaline Hyphomycetes	
	Count	No. spp.	Count	No. spp.	Count	No. genera	Count	No. genera
1	533.3	2	200.0	2	1333.3	3	933.3	1
2	1166.7	5	133.3	1	1216.7	3	233.3	1
3	-	-	2100.0	1	-	-	-	-
4	-	-	76.7	1	16.7	5	-	-
5	6333.3	5	2000.0	2	5000.0	4	4333.3	1
6	600.0	1	2400.0	1	200.0	1	-	-
7	33200.0	6	6400.0	2	19600.0	3	6000.0	3
8	34.0	2	4.0	2	6.0	2	68.0	1
9	-	-	12166.7	2	333.3	1	166.7	1
10	13.3	2	6.7	2	40.0	4	6.7	2

Table 3

List of fungi identified with mean total count and occurrence

Sample No. → / Fungal organisms ↓	1	2	3	4	5	6	7	8	9	10	Mean total count	No. of Isolates	Occurrence.
Aspergillus	+	+	–	–	+	+	+	+	–	+	4188.0	7	H
A.niger Tiegh	+	–	–	–	+	+	+	+	–	–	1353.0	5	M
A.candidus Link ex Fr.	+	+	–	–	+	–	–	–	–	–	176.0	3	L
A.sydowii (Bian & Sart) Thom Church	–	+	–	–	–	–	+	–	–	–	1721.0	2	L
A.terreus Thom	–	+	–	–	+	–	+	–	–	–	375.0	3	L
A.ochraceus Wilhelm	–	–	–	–	+	–	+	–	–	–	233.0	2	L
A.versicolor (Vuill) Tirab.	–	–	–	–	+	–	+	–	–	–	193.0	2	L
A.clavatus group	–	–	–	–	–	–	+	–	–	–	40.0	1	R
A.wentii Wehmer	–	–	–	–	–	–	–	+	–	–	3.0	1	R
A.cremeous group	–	–	–	–	–	–	–	–	–	+	1.0	1	R
A.fumigatus Fres	–	+	–	–	–	–	–	–	–	–	1.7	1	R
A.carneus (Tiegh.) Blochw.	–	+	–	–	–	–	–	–	–	–	88.0	1	R
Penicillium	+	+	+	+	+	+	+	+	+	+	2548.0	10	H
P.notatum Westl.	+	–	+	–	+	+	+	+	+	+	850.0	8	H
P.vinacium Gilm & Abbott	+	+	–	–	+	–	+	–	–	–	639.0	4	M
P.roqueforti Thom	–	–	–	–	–	–	–	–	+	–	1050.0	1	R
P.oxalicum Currie & Thom	–	–	–	+	–	–	–	–	–	–	8.0	1	R

Table 3 (contd..)

List of fungi identified with mean total count and occurrence

Sample No. → / Fungal organisms ↓	1	2	3	4	5	6	7	8	9	10	Mean total count	No. of isolates	Occurrence
Stachybotrys atra Corda	–	–	–	+	+	–	+	–	–	–	993.0	3	L
Humicola	+	+	–	–	–	+	+	–	–	–	883.0	4	M
H.grisea Traaen	+	+	–	–	–	+	–	–	–	–	123.0	3	L
H.fuscoatra Traaen	–	–	–	–	–	–	+	–	–	–	760.0	1	R
Cladosporium herbarum (Pres.) Link-ex S.F.Gray	–	–	–	+	+	–	+	+	–	–	407.7	5	M
Ulocladium	+	–	–	+	–	–	–	–	+	+	62.5	4	M
U.botrytis Preuss	–	–	–	+	–	–	–	–	+	+	35.8	3	L
U.sp.	+	–	–	–	–	–	–	–	–	–	26.7	1	R
Alternaria	–	–	–	+	+	–	–	–	–	+	367.2	3	L
A.alternate (Fr.) Keiss	–	–	–	+	+	–	–	–	–	–	366.8	2	L
Scytalidium	+	–	–	+	+	–	–	–	–	+	41.2	4	M
S.lignicola Presante	+	–	–	+	+	–	–	–	–	–	40.2	3	L
Papulospora sp.	–	+	–	–	–	–	–	–	–	–	113.3	1	R
Pleospora herbarum (Pres.ex Fr.) Rabenh	–	+	–	–	–	–	–	–	–	–	5.0	1	R
Fusarium spp.	+	–	–	–	+	–	+	–	+	–	583.3	4	M
Cephalosporium roseoriseum Saksena	–	–	–	–	–	–	+	–	–	–	440.0	1	R
Verticillium punicéum Cook & Ellis	–	–	–	–	–	–	+	–	–	–	120.0	1	R
Trichosporella sp.	–	–	–	–	–	–	–	+	–	–	6.8	1	R
Mucor sp.	–	+	–	–	–	–	–	–	–	–	6.7	1	R
Rhizoctonia sp.	–	+	–	–	–	–	–	–	–	–	23.3	1	R

Table 4

Dominant general found in cultivated and non-cultivated soils

Ecosystem → / Fungal genera ↓	Cultivated		Non-cultivated	
	Mean total count	Percentage	Mean total count	Percentage
Penicillium	2205.6	13.3	3063.5	94.5
Aspergillus	6972.2	42.2	11.8	0.3
Ulocladium	44.4	0.3	89.6	2.7
Cladosporium	511.1	3.0	2.7	0.1
Alternaria	611.1	3.7	2.0	0.1
Humicola	1472.2	8.9	-	-
Stachybotrys	1655.6	10.0	0.4	0.01
Scytalidium	66.7	0.4	2.9	0.1
Trimmatostroma	-	-	0.5	0.1
Pleospora	8.3	0.05	-	-
Papulospora	188.9	1.1	-	-
Fusarium	944.4	5.7	41.7	1.3
Cephalosporium	733.3	4.4	-	-
Verticillium	200.0	1.2	-	-
Botryotrichum	-	-	0.8	0.03
Beniowskia	-	-	0.8	0.03
Trichosporiella	-	-	17.0	0.5
Rhizoctonia	38.9	0.2	-	-
Mucor	11.1	0.1	-	-
Mean total count	16525.0		3241.3	

Aspergillus versicolor group, *Pencillium frequants* series, *P. aurantiacandidum*, *Alternaria* spp 1 & 2, *Scytalidium thermophyllium*, *S.* sp, *Beniowskia* sp., *Botryotrichum piluferum*, and *Trimmatostroma betulinum* are found in less than one in mean total count.

Occurrence : H = High ; More than 5 cases out of 10, M = Moderate ; 5 — 4 cases out of 10, L = low ; 3 — 2 cases out of 10 and R = rare ; less than 2.

Table 4. Dominant genera found in cultivated and in non-cultivated soils.