

*Full Length Research Paper*

# Fungi from submerged plant debris in aquatic habitats in Iraq

Abdullah H. Al-Saadoon and Mustafa N. Al-Dossary\*

Department of Biology, College of Science, University of Basrah, Iraq.

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**An annotated checklist and table of the substrate type for the past and updated fungal species recorded from various submerged plant debris in aquatic habitats of Iraq are provided. Sixty seven (67) species of freshwater and marine fungi occurring in different types of plant debris collected from various locations of Iraq were registered. These include: 46 species of ascomycota, 19 species of hyphomycetes and two species of coelomycetes. Of these, 11 species were reported for the first time in Iraq. Brief descriptions of the new records are presented.**

**Key words:** Fungi, aquatic habitat, Iraq.

## INTRODUCTION

The role of fungi associated with plant debris in aquatic habitats is immense and they are responsible for most of the decomposition of organic materials, thus contributing in nutrient regeneration cycles (Rani and Panneerselvam, 2009; Wong et al., 1998). Noteworthy, fungal taxa have been isolated from submerged woody substrata in freshwater habitats (Shearer, 1993; Goh and Hyde, 1996; Hyde and Goh, 1998; Tsui et al., 2003; Fallah and Shearer, 2003; Vijaykrishna et al., 2006; Raja et al., 2011, 2012, 2013; Hu et al., 2012; Vasilyeva et al., 2013; Zhang et al., 2014) and marine habitats (Kohlmeyer and Kohlmeyer, 1979; Kohlmeyer, 1984; Cuomo et al., 1985; Hyde and Jones, 1989; Jones, 2000; Kohlmeyer and Kohlmeyer, 2002; Alias et al., 2010; Khan and Manimohan, 2011; Sakayaroj et al., 2011; Borse et al., 2013). Little attention has been given so far to fungi colonizing submerged substrates in aquatic habitats in Iraq. Our knowledge on the occurrence of such fungi has

been confined to the work of Abdullah (1983). There are a few isolated records by Abdullah and Abdulkadir (1987), Abdulkadir and Muhsin (1991), Abdullah and Al-Saadoon (1994a, b, 1995), Muhsin and Abdulkadir (1995), Guarro et al. (1996, 1997a, b), Al-Saadoon and Abdullah (2001), Muhsin and Khalaf (2002) and Al-Saadoon and Al-Dossary (2010). This work provides a checklist and describes some fungal species from submerged wood substrates in aquatic habitats in Iraq.

## MATERIALS AND METHODS

Submerged plant debris (leaves, small branches, stems and wood of deciduous and herbaceous plants) were collected from several locations in south Iraq, these materials were placed in plastic bags and brought to the laboratory, rinsed with tap water, placed on moist filter papers in glass chambers and incubated at 25°C. Samples were examined periodically for any fungal growth.

\*Corresponding author. E-mail: [mustaffanjm@yahoo.com](mailto:mustaffanjm@yahoo.com).

Cultures of fungi were obtained where possible from single spores; overall emphasis was placed on direct examination of fungi for morphological characterization. For ascomycetes, squash mounts of fungal fruiting bodies were prepared on slides mounted with water and then covered with cover slips for initial examination, water was replaced with lactophenol cotton blue for measurement and photography. India ink in distilled water was used to reveal gelatinous sheaths or appendages on or around ascospores. Permanent slides, dried specimens and/or living cultures were deposited at the Department of Biology, College of Science, University of Basrah.

## RESULTS AND DISCUSSION

### Taxonomy

#### *Ascomycota*

***Aniptodera chesapeakensis* Shearer and Miller, Mycologia 69: 887(1977):** Specimen examined: On submerged dead stem of *Arundo donax* and *Phragmites australis*, Khor Al-Zubair estuary, Basrah, Iraq, March, 1992. On submerged dead stem of *A. donax* and *P. australis* Shatt Al-Arab River near University campus, Basrah September 1995. On unidentified dead twigs submerged in Shatt Al-Arab river near Abu-AlKhasib, Basrah, November 1998. On submerged dead stem of *Typha australis* and leaf bases of date palm (*Phoenix dactylifera* L.) in brackish water, Al-Kahla`a river, Missan, Southern Iraq, March 2009. On submerged dead stem of *P. australis* and unidentified wood, Shatt Al-Arab river near University campus, Basrah, April 2010.

This species was originally described by Shearer and Miller (1977) on Balsa wood submerged in Patuxent River, U.S.A. Subsequent reports of this species have been made by Minoura and Muroi (1978) on Balsa wood submerged in freshwater lake in Japan, from United States on *Juncus roemerianus* and *Spartina alterniflora* by Kohlmeyer and Kohlmeyer (1979), on submerged wood in India Ocean near Sri Lanka by Koch (1982), on drift wood collected from Karala coast, India by Khan and Manimohan (2011) and from west and east coast of India by Borse et al. (2013).

This species has been isolated from submerged dead stem and floating dead leaves of *T. australis* in southern marshes of Iraq (Abdullah and Abdulkadder, 1987) (Table 1 shows the presence of each fungal species).

***A. fusiformis* Shearer, Mycologia 81: 139(1989):** Specimen examined: On dead stem of *P. australis* and unidentified twigs submerged in water near Qurna, Basrah, Iraq, November, 2010. The fungus was originally described from submerged woody materials in freshwater habitats in USA (Shearer, 1989).

The Iraqi collections were reported from brackish habitat on submerged wood and stem of *T. australis* in

Al-Kahla`a river, Missan, southern Iraq (Al-Saadoon and Al-Dossary, 2010).

***A. mauritaniensis* Hyde, Ho and Tsui Mycoscience 40: 172(1999):** Specimen examined: On submerged dead leaf base of date palm, Al-Kahla`a river, Missan, March 2009. On unidentified wood submerged in Shatt Al-Arab River near University campus, Basrah, April 2010.

The type of species was originally described from submerged wood in Black river in Mauritius (Hyde et al., 1999). This species has been described from submerged dead leaf base of date palm tree in Shatt Al-Arab River near University campus, Basrah, Iraq (Al-Saadoon and Abdullah, 2001).

***A. palmicola* Hyde, Ho and Tsui Mycoscience 40: 171(1999):** Specimen examined: On submerged dead stem of *P. australis*, Al-Kahla`a river, Missan, March 2009. On unidentified wood submerged in Shatt Al-Arab River near Abu-Al-Khasib, Basrah, March 2009. On submerged dead leaf base of date palm, Shatt AL-Arab River near University campus, Basrah, April 2010.

This species was originally described from South Africa on submerged rachis of *Raphia australis* in 1999 (Hyde et al., 1999). *A. palmicola* has been isolated from stem of *A. donax* and unidentified wood immersed in water of Shatt Al-Arab river near University campus, Basrah, southern Iraq (Al-Saadoon and Abdullah, 2001).

***Arxiomyces campanulatus* Horie, Udagawa and Cannon. Mycotaxon 25: 231 (1986):** This type of species was found parasitizing *Stachybotrys chartarum* isolated from cultivated soil in Japan (Horie et al., 1986). The Iraqi collection was found parasitizing *Stachybotrys* sp. developed on dead stem of *A. donax* floating in water of Khor Al-Zubair channel, Basrah, southern Iraq (Al-Saadoon and Abdullah, 2001).

***Arxiomyces zubairiensis* Abdullah and Al-Saadoon. Marina Mesopotamica 9:245(1994):** Specimen examined: On submerged dead stem of *P. australis*, Al-Kahla`a river, Omara, March 2009. On submerged dead stem of *A. donax* in Shatt Al-Arab River near Abu-AlKhasib, Basrah, November 2010.

*A. zubairiensis* was originally described in Iraq by Abdullah and Al-Saadoon (1994b) parasitizing *Stachybotrys* sp. on *P. australis* dead stem collected from tidal zone of Khawr Al-Zubair canal, southern Iraq. Recently, it was isolated from sugarcane plant in Iraq. *A. zubairiensis* differs from two other known species in the genus (*Arxiomyces vitis* (Fuckel) P.F. Cannon and Hawksworth and *Arxiomyces campanulatus* Horie, Udagawa and Cannon) by its globose to

**Table 1.** List of fungal species and substrate type from water habitats in Iraq.

Fungal species	Substrate type											
	<i>Arundo donax</i>	<i>Cyperus rotundus</i>	<i>Halocneumum strobilaceum</i>	<i>Phoenix dactylifera</i>	<i>Phragmites australis</i>	<i>Salicornia europea</i>	<i>Salsola baryosma</i>	<i>Suaeda sp.</i>	<i>Tamarix aphylla</i>	<i>Typha australis</i>	Unidentified wood	U. twigs
<b>Ascomycota</b>												
<i>Aniptodera chesapeakensis</i>	+			+	+					+	+	+
<i>A. fusiformis</i>					+					+		+
<i>A. mauritaniensis</i>				+	+						+	
<i>A. palmicola</i>	+			+	+						+	
<i>Arxiomyces campanulatus</i>	+											
<i>A. zubairiensis</i>	+				+							
<i>Canariomyces notabilis</i>						+						
<i>Chaetomium globosum</i>	+				+							
<i>Coniochaeta saccardoii</i>				+								
<i>Corollospora maritima</i>				+								
<i>C. pseudopulchella</i>				+								
<i>Decorospora gaudefroyi</i>								+				
<i>Didymosphaeria futilis</i>									+			
<i>Jahnula bipileata</i>				+							+	
<i>Kirschsteiniothelia maritima</i> *	+			+	+							
<i>Leptosphaeria agnita</i> *					+							
<i>Lignicola laevis</i> *	+				+							
<i>Lulworthia grandispora</i>											+	
<i>L. medusa</i>											+	
<i>Marinosphaera mangrovei</i> *											+	
<i>Monosporascus eutypoides</i>			+									
<i>Mycosphaerella pneumatophorae</i>											+	
<i>Nais aquatica</i> *											+	
<i>N. inornata</i>	+			+							+	
<i>Natantispora retorquens</i>	+									+		
<i>Ophiobolus australiensis</i>				+								
<i>Phaeosphaeria albopunctata</i>										+		
<i>P. orae-maris</i>										+		
<i>P. typharum</i>										+		
<i>Pleospora herbarum</i>										+		
<i>Podospora dolichopodalis</i>					+							
<i>P. inquinata</i>											+	
<i>Preussia aquilirostrata</i>				+								
<i>P. dispersa</i>										+		
<i>Pseudoallescheria desertorum</i>											+	
<i>Pseudohalonectria phialidica</i> *	+				+							
<i>Pseudolignincola siamensis</i> *					+							

Table 2. Contd.

<i>Pyrenophora typhaecola</i>									+
<i>Savoryella lignicola</i>				+					
<i>Sphaerulina orae-maris</i>									+
<i>Syspastospora tetraspora</i>	+								
<i>Verruculina enalia</i>	+			+					+
<i>Zopfiella cephalothecoidea</i>	+								+
<i>Z. karachiensis</i>				+					+
<i>Z. latipes</i>	+	+	+	+	+				+
<i>Z. submerse</i>	+			+					
<b>Hyphomycetes</b>									
<i>Alternaria alternata</i>	+			+					
<i>Aureobasidium pullulans</i>				+				+	
<i>Bactrodesium linderi</i>								+	
<i>Beltrania rhombic</i>								+	
<i>Cirrenalia macrocephala</i>	+		+	+				+	
<i>Clavatospora bulbosa</i>			+						+
<i>Cumulospora marina</i>	+	+		+					
<i>Cylindrocladium camelliae</i>	+			+					
<i>Dendryphiella arenaria</i> *				+					+
<i>Exserohilum rostratum</i>	+	+		+					
<i>Halenospora varia</i>	+			+					+
<i>Halosigmoidea parvula</i> *									+
<i>Moromyces varius</i> *									+
<i>Monodictys pelagica</i>		+	+		+				
<i>Periconia prolifera</i>				+					+
<i>Stachybotrys atra</i>	+		+	+					+
<i>Trichocladium alopallonellum</i> *			+						
<i>Virgariella atra</i>									+
<i>Zygosporium masoni</i>									+
<b>Coelomycetes</b>									
<i>Camarosporium roumeguerii</i>		+				+	+		
<i>Coniothyrium obiones</i>								+	

\*: New record.

subglobose ascospores, whereas the former two species are characterized by ovoid to ellipsoidal ascospores.

**Canariomyces notabilis v. Arx. Persoonia 12: 185(1984):** This type of species was originally isolated from palm litter from Gran Canaria (Arx et

al., 1988). This species has been collected from Khor Al-Zubair channel, Basrah, southern Iraq, on stem of *Salicornia europea* submerged in saline

water (Al-Saadoon and Abdullah, 2001). This collection represents the first report for the species from marine habitat.

**Chaetomium globosum Kunze, Mykol. Hefte 1:16(1817) (For the synonyms see von Arx et al., 1986):** Specimen examined: On submerged dead stem of *P. australis*, in Shatt Al-Arab river near Abu-AlKhasib, Basrah, November 1998. On submerged dead stem of *A. donax*, in Shatt Al-Arab river near University campus, Basrah, April. 2010.

*C. globosum* is a variable species, especially in the pigmentation of the colonies and the colour of the ascomatal hairs reflected light (von. Arx et al., 1986). This species is associated with decomposing plant debris and has been reported from both terrestrial and aquatic habitats. It was isolated from submerged dead stems of *Carex oligosperma* in freshwater habitat, USA (Fallah and Shearer, 2001). The fungus has been reported from different habitats in Iraq.

**Coniochaeta saccardoi (Marchal) Cain, Univ. Toronto stud. Biol. Ser. 38:65(1934):** Five species of *Coniochaeta* viz. *Coniochaeta leucoplaca*, *Coniochaeta lignaria*, *Coniochaeta kellermania*, *Coniochaeta velutina* and *Coniochaeta renispora* were isolated from freshwater habitats (Shearer, 1993; Crane and Shearer, 1995), however, *C. saccardoi* has been reported on dung, soil and decaying plant materials (Checa et al., 1988). This species has been isolated from dead date palm leaf submerged in Euphrates River, Nassirya city, Iraq (Al-Saadoon and Abdullah, 2001). This finding represents the first report of the species from freshwater habitats.

**Corollospora maritima Werderman. Notizbl. Bot. Gart. u. Museum zu Berlin 8:284(1922):** *Arenariomyces cinctus* Höhnk, Veröff. Int. Meeresforsch. Bremerhaven 3:28(1954); *Peritrichospora integra* Linder, Farlowia 1:414(1944).

Kohlmeyer (1984) considers this fungus as tropical one. Zainal and Jones (1984) reported this fungus on drift wood in coastal waters of Kuwait. It was the most frequently reported in southern Thailand (Sakayaroj et al., 2011). The species has been encountered from west and east coast of India (Borse et al., 2013)

The species was found on leaves of *Phoenix dactylifera* submerged in Shatt Al-Arab River near University campus, Basrah, Iraq (Abdulkadir and Muhsin, 1991).

**Corollospora pseudopulchella Nakagiri and Tokura, Trans. Mycol. Soc. Jpn. 28:428(1987):** Ascospore of *C. pseudopulchella* is similar to that of *Corollospora pulchella*

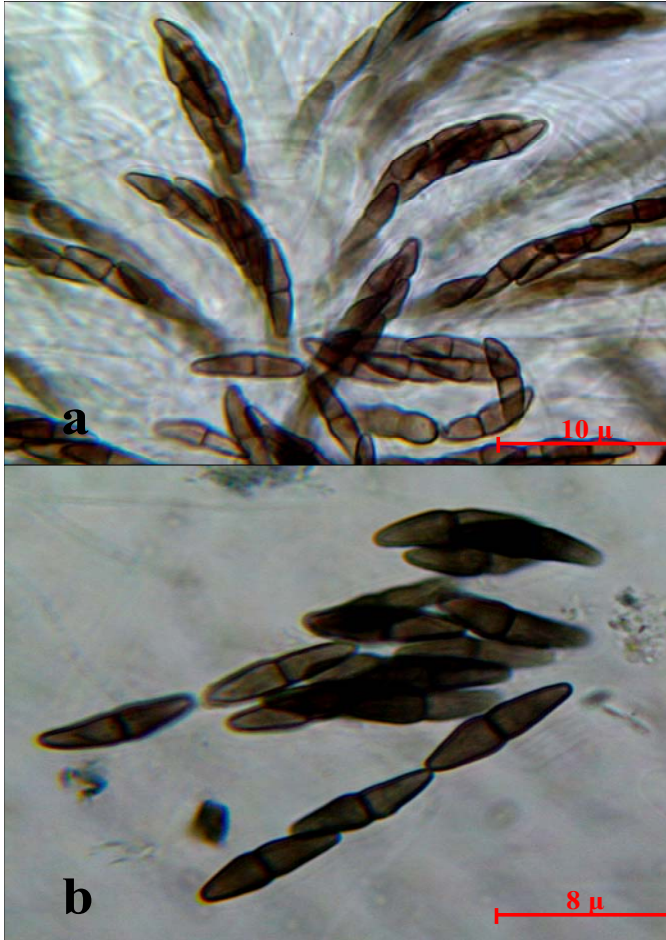
in size and septation, however, in the former species, the ascospore is attenuated toward both ends and sometimes seems to have terminal appendages, but *Corollospora pulchella* has ascospores with rounded ends. Most recently this species has been recorded from Kerala and Tamil Nadu state, India (Borse et al., 2013). It was recovered from submerged wood and leaf bases of date palm (*Phoenix dactylifera* L.) in brackish water of Al-Kahla'a river, Missan, southern Iraq (Al-Saadoon and Al-Dossary, 2010). This species is a typical marine taxon and to our knowledge, there is no report from the literature on this species from brackish water, thus it was for the first time to be recorded from brackish water in Al-Kahla'a river located faraway 200 km from the Arabian Gulf and this is typical marine taxon which has been reported from sea-foam in Japan (Nakagiri and Tokura, 1987).

**Decorospora gaudefroyi (Pat.) Inderb., Kohlm. And Volkm-Kohlm., Mycologia 94: 657(2002):** *Pleospora gaudefroyi* Pat. Tabulae Analticae Fungorum, Paris 2:40 (1886).

The genus differs from *Pleospora* at the molecular and morphological level, especially the well developed gelatinous sheath drawn into 2-4 subconical extensions (Yusoff et al., 1994). It has been reported on *Salicornia* spp. (Kohlmeyer and Kohlmeyer, 1979). This fungus was found on dead stems of *Suaeda* sp. submerged in coastal waters of Umm Qasr, north of Arabian gulf, Iraq and reported under the synonyms of *Pleospora gaudefroyi* (Abdulkadir and Muhsin, 1991).

**Didymosphaeria futilis (Berk and Br.) Rehm, Hedwigia 18: 167(1879):** In this monograph, Aptroot (1995) regarded *D. futilis* as one of the seven accepted species in the genus *Didymosphaeria*. This fungus is cosmopolitan and it has been found in and on stems of various plants, also on dead leaves, wood and even linoleum (Aptroot, 1995). This species was isolated from decaying leaves of *T. australis* collected from Um-Al-Shwech, southern marshes of Iraq (Abdullah and Abdulkadir, 1987).

**Jahnula bipileata Raja and Shearer, Mycologia 98:321(2006):** *J. bipileata* is morphologically closest to *J. aquatica*, however, the former species differs clearly from *J. aquatica* as it has ascomata with a long cylindrical neck and irregularly striated rough-walled ascospores with a hyaline cap at both apices, features not observed in *J. aquatica* (Raja and Shearer, 2006). This species was recently recovered from USA on submerged decorticated wood in freshwater (Raja and Shearer, 2006). It was reported on submerged leaf bases of date palm in Hamadan tributary, Abu-Alkhasib and submerged



**Figure 1.** *Kirschsteiniothelia maritima* a: asci and ascospores; b: ascospores.

wood in Al-Kahla`a river, Omara, southern Iraq (Al-Saadoon and Al-Dossari, 2010). This finding represents the first report of the species from brackish habitat and dead leaf of date palm is perhaps a new substrate.

***Kirschsteiniothelia maritima* (Linder) D. Hawksw., Bot. J. Linn. Soc. 91:183 (1985) (Figure 1):** *Amphisphaeria maritima* Linder, Farlowia 1:411(1944). *Microthelia maritima* (Linder) Kohlm., Nova Hedw. 2:322(1960). *Microthelia Linderi* Kohlm. Trans. Mycol. Soc. 57: 483(1971).

Ascomata on natural substrate semiglobose, superficial, ostiolate, short papillate, carbonaceous, black and gregarious, 57-128 µm high and 104-268 µm diameter. Asci clavate to elongate-ellipsoidal, pedunculate, thick walled, lacking an apical apparatus, 38-52 × 8-13 µm. Ascospores brown, 1-septate, constricted at the septum, 15-20 × 6-8 µm.

Specimen examined: On dead stem of *A. donax*, *P. australis* and leaf bases of *Phoenix dactylifera* submerged in Euphrates river, near Qurna, Basrah, Iraq,

November 2010.

The genus *Kirschsteiniothelia* was established by Hawksworth (1985) using *Kirschsteiniothelia aethiops* (Berk. and Curtis) D. Hawksworth as the type species. *Kirschsteiniothelia maritima* (Linder) D. Hawksworth, has been collected from an aquatic habitat (Hawksworth, 1985). The fungus was found on drift wood, bark and coniferous wood (Jones et al., 2009). It was isolated from only one sample for the first time in Kerala state, India (Khan and Manimohan, 2011), most recently it was recorded from Kerala and Pradesh states, India (Borse et al., 2013). Three new plant substrates were investigated for this fungus in this study, and probably the first time to be recorded from brackish water.

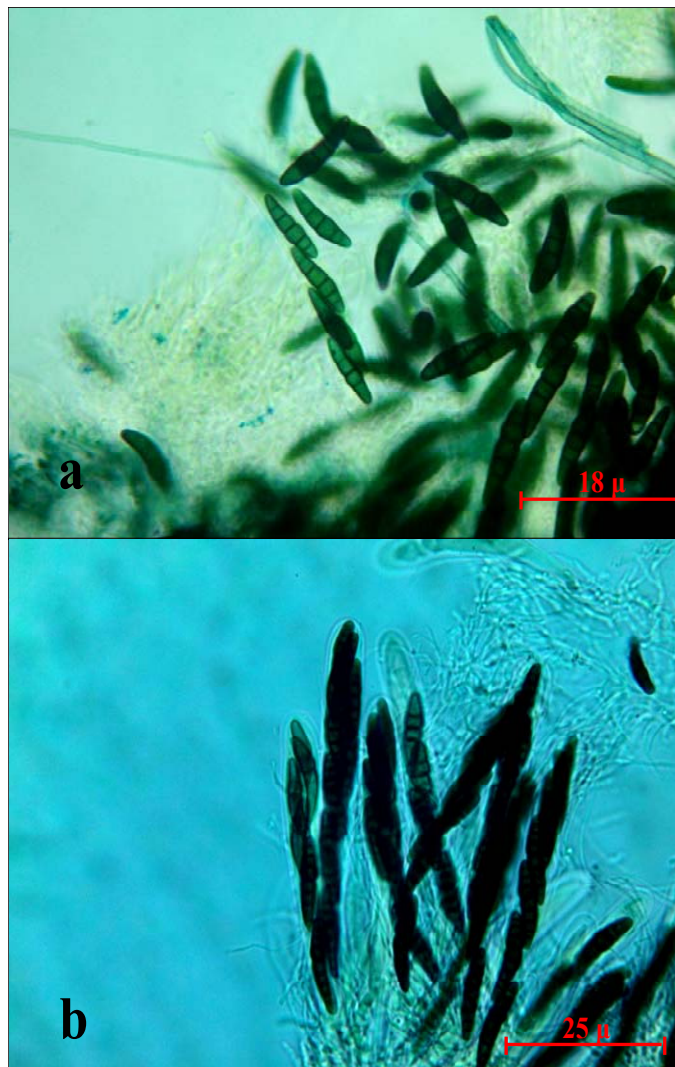
***Leptosphaeria agnita* (Desm.) Ces and de Not., Schema Sfer. Ital. 236(1863) (Figure 2):** *Sphaeria agnita* Desm., Anns Sci nat. (Bot. ser. 3) 313(1851). Ascomata on natural substrate, papillate, subglobose, ostiolate, immersed and later becoming almost superficial, 275-340 µm diameter.

Asci cylindrical to clavate, shortly stalked, bitunicate, 8-spored, 100-130 × 10-12 µm, separated by filamentous pseudoparaphyses. Ascospores cylindrical, 5-6 septate, the 3rd cell from the apex is wider than the rest, straight or slightly curved, golden brown, 30-37 × 5-6 µm. Specimen examined: On dead culms of *Phragmites australis* submerged in Shatt Al-Arab river near Al-Karma tributary, Basrah, February 2010.

More than 1.600 taxa have been described in *Leptosphaeria* Ces. and de Not. (Crane and Shearer, 1991). *Leptosphaeria* sensu stricto, as accepted by Barr (1987), Eriksson (1967), Hedjaroude (1969), Holm (1957), Shoemaker (1984) and von Arx and Muller (1975), includes species with scleropectenchymatous ascomata that occur on dicotyledonous plants. The fungus was collected on *Eupatorium cannabinum*, *Scutellaria galericulata* and *Senecio jacobaea* (Lucas and Webster, 1967). This is the first record of *L. agnita* from Iraq.

***Lignincola laevis* Höhnk, veroeff, Inst. Meereforsch. Bremerhaven 3: 216 (1955) (Figure 3):** Ascomata on natural substrate subglobose or ellipsoidal, superficial or immersed, ostiolate, papillate, light brown to black with long neck 120-320 µm high. Asci 8-spored, clavate to subfusiform, short pedunculate without apical apparatus, thin walled, unitunicate, persistent, whole asci and ascospores released through the ostiole into the water later central part of ascus swelling in water, then break up, 46-55 × 9.5-17 µm.

Ascospores 20-26 × 6-9 µm, biseriolate, ellipsoidal, one-septate, hyaline, slightly constricted at the septum, without appendages. Specimen examined: On submerged dead culms of *A. donax* collected in shore line, near Umm Qasr, Basrah, March 2009. On submerged



**Figure 2.** *Leptosphaeria agnita* a: ascospores; b: asci and ascospores.

dead culms of *P. australis* in Khor Al-Zubeir channel, Basrah, February 2009. On submerged dead culms of *P. australis* collected in Qarma tributary, Shatt Al-Arab river Basrah, April 2010.

The genus *Lignincola* has only one unifying character, the hyaline, 1-septate ascospores, lacking appendages (Jones et al., 2009). *Lignincola laevis* (type species) is characterized by hyaline or dark ascospores, semi-persistent fusiform asci, which swell in the middle when mounted in water, and small, thin walled ascospores without appendages (Höhnk, 1955).

This fungus was isolated from mangrove plants in Malaysia (Elias et al., 2010). It was recorded on driftwood collected from Kerala, India from southern Thailand (Sakayaroj et al., 2011) and from west and east coasts of India (Borse et al., 2013), the Iraqi collections are in agreement with the description given for the species by Hohnk (1955) and Pang et al. (2003). The collections were

found in brackish and saline water, Basrah, southern Iraq.

***Lulworthia grandispora* Meyers, Mycologia 49: 513(1957):** Many *Lulworthia* species were originally described by Barghoorn and Linder (1944) as *Halophiobolus*, but transferred to earlier taxon *Lulworthia* (Sutherland, 1916) by Cribb and Cribb (1955). The genus has been shown to be polyphyletic based on 18S and 28S sequences analysis and two new genera erected to accommodate species that do not group within the genus *Lulworthia* sensu stricto (Campbell et al., 2005).

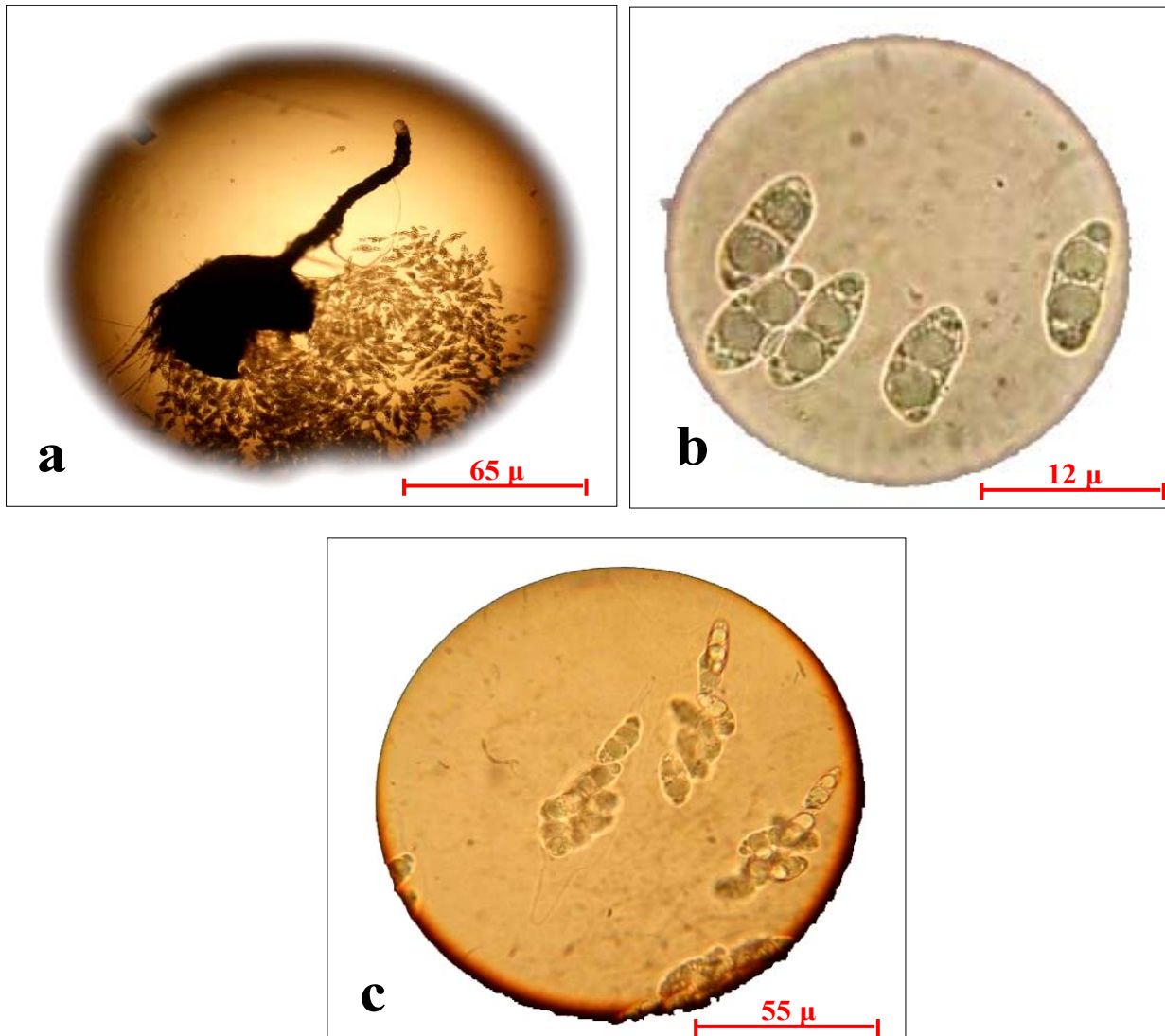
Anamorphs of different *Lulworthia* spp. include: *Anguillospora marina* (*Lindra obtusa*), *Cirrenalia pygmaea*, *Cirrenalia tropicalis*, *Cumulospora varia* and *Orbimyces spectabilis* (Jones et al., 2008). It has been stated that this lignicolous species appeared to be restricted to tropical and subtropical waters (Johnson and Sparrow, 1961; Kohlmeyer and Kohlmeyer, 1979). The fungus has been isolated from twigs in eastern Thailand (Dethoup and Manoch, 2009), from mangrove plants in Malaysia (Alias et al., 2010), from southern Thailand (Sakayaroj et al., 2011) and from west and east coasts of India (Borse et al., 2013), this species was isolated from wood submerged in Qarma tributary, Basrah, southern Iraq (Muhsin and Khalaf, 2002).

***L. medusa* (Ellis and Everh.) Cribb and J.W. Cribb, Pap. Dept. Bot. Univ. Qd. 3:80(1955):** *Halophiobolus medusa* (Ellis and Everh.) Linder, Farlowia 1:419(1944); *Linocarpon medusa* (Ellis and Everh.) Petr., Sydowia 6:388(1952); *Ophiobolus medusae* Ellis and Everh., Journal of Mycology 1: 150(1885).

This fungus is closely related to other members of the genus however, the only differentiated character can be made based on the ascospore measurements. The species generally found on culms of *Spartina* species (Jones et al., 2009). This species has been isolated from submerged wood in brackish water, Abu-Alkhasib, Basrah, southern Iraq (Muhsin and Khalaf, 2002).

***Marinosphaera mangrovei* K.D. Hyde, Can. J. Bot. 67: 3080(1989) (Figure 4):** Ascospores on natural substrate ellipsoidal, globose, subglobose, elongate, immersed, ostiole, papillate, membranous, light to dark brown, solitary or gregarious, 840-1120  $\mu\text{m}$  high, paraphyses wide, simple, septate.

Asci clavate, short pedunculate, persistent, unitunicate, thin-walled, J-subapical plate and pore, 8-spored, 100-140 x 10-12  $\mu\text{m}$ . Ascospores broad ellipsoidal to fusiform, initially 0-septate but becoming distinctly 3-septate, hyaline to yellow color, smooth-walled and lacking a sheath or appendages, 29-33 x 7-8  $\mu\text{m}$ . Specimen examined: On unidentified wood submerged in Shatt Al-Arab river near Qarma tributary, Basrah, April 2010. The



**Figure 3.** *Lignicola laevis*. a: ascoma and asci; b: ascospores; c: asci.

species is easily identified by its wide, regularly septate paraphyses (Jones et al., 2009). This is a common species, often found on an early colonizer of mangrove wood (Alias, 1996).

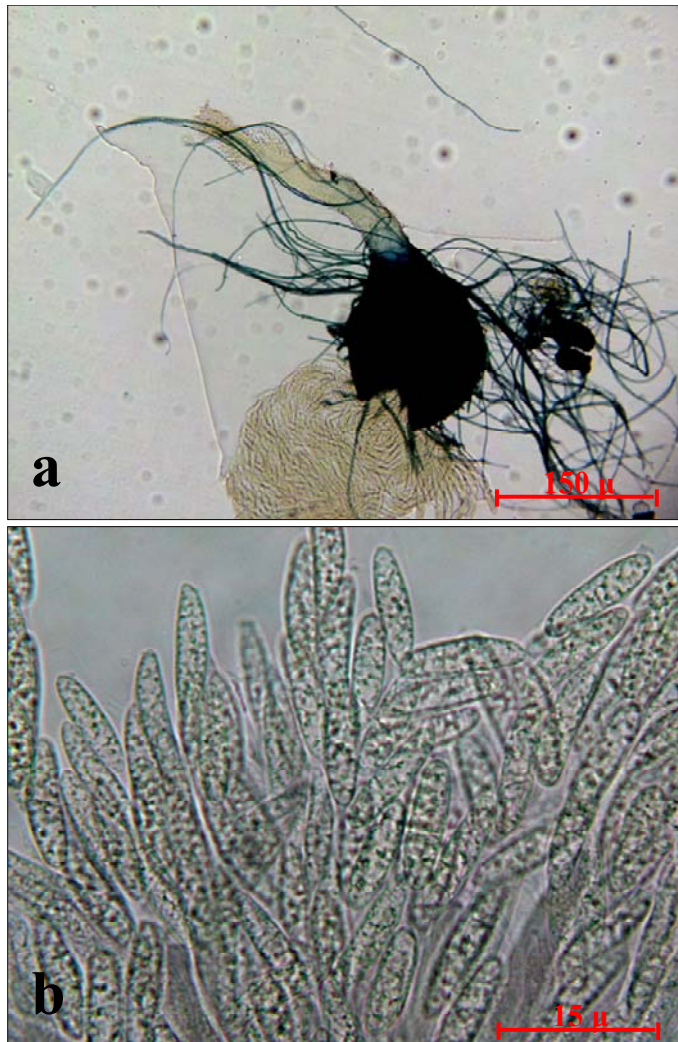
It was isolated from twigs collected from beach of Rayong province eastern Thailand (Dethoup and Manoch, 2009), from southern Thailand (Sakayaroj et al., 2011), on driftwood collected from Kerala state, India (Khan and Manimohan, 2011) and from west coasts of India (Borse et al., 2013). This is the first record and new substrate for the fungus from Iraq.

***Monosporascus eutypoides* (Petraek) vonArx, Kavaka 3:34(1975):** *Rechingeriella eutypoides* Petraek, Sydowia 8:170(1954); *Bitrimonospora indica* Sivanesan, Talde and Tilak, Trans. Br. Mycol. Soc. 63:595(1974).

The fungus was originally described by Sivanesan et al. (1974) as *Bitrimonospora indica* found on *Achyranthes aspera* from India. von Arx (1975) considered *B. indica* and *Rechingeriella eutypoides* are cospecific. The latter species was described by Petraek and Ahmed (1954) from decaying roots of unidentified plant in Pakistan. von Arx (1975) transferred *R. eutypoides* Petraek to the genus *Monosporascus*. This fungus was found on stem bases of *Halocneumum strobilaceum* collected from shoreline of Khor Al-Zubair canal, Basrah, southern Iraq (Abdullah and Al-Saadoon, 1995).

***Mycosphaerella pneumatophorae* Kohlmeyer, Ber. Dtsch. Bot. Ges. 79:32 (1966):** A well characterized genus, primarily of circa 500 terrestrial species causing leaf spot disease of a wide range of hosts. Marine taxa





**Figure 4.** *Marinospaera mangrovei*; a. ascoma and asci; b. asci and ascospores.

are generally on the salt marsh plants *Armeria*, *Limonium*, *Salicornia* and *Suaeda*. *M. pneumatophorae* occur on the bark of pneumatophores of *Avicennia* species, with recent records from Asian mangroves (Jones et al., 2009), and from Tamil Nadu state, India (Borse et al., 2013).

This species was reported from submerged wood in saline water of Khor Al-Zubair canal, Basrah, southern Iraq (Muhsin and Khalaf, 2002). The taxonomic relegation of species within the genus is based on the substrate type, however, Muhsin and Khalaf (2002) had filed this isolated fungus under this taxon.

***Nais aquatica* K.D. Hyde, Aust. Syst. Bot. 5: 117(1992):** Ascomata on natural substrate globose to ampulliform, partly immersed or superficial, black membranous, ostiolate, papillate, periphysate, 120-390 µm

high. Asci, 8-spored, 80-82.4 x 45-46.6 µm thin walled, lacking an apical pore or thickening, deliquescent.

Ascospores 31.9-34.2 x 15.6-16.3 µm, hyaline, broadly ellipsoidal, bicelled, not constricted at the septum, relatively thin-walled, with oil droplets forming inner wall ornamentations at the septum. Specimen examined: On unidentified wood submerged in Shatt Al-Arab River near Qarma tributary, Basrah February, 2010.

A genus characterized by hyaline bicelled ascospores with a characteristic arrangement of the internal wall ornamentation along the septum where small oil globules aggregate and lacking appendages. *N. aquatica* is similar to *Nais inornata*, but the former differs in that ascospores develop appendages on release from the ascomata (Hyde, 1992). This is the first record of *N. aquatica* from Iraq.

***N. inornata* Kohlm. Nova Hedw. 4:409(1962):** Specimen examined: On submerged dead stem of *P. australis*, Qarma tributary, Shatt Al-Arab River, Basrah, April 2011.

The data from DNA sequence analysis is by Pang et al. (2003) have shown that *N. inornata* is closely related to *Aniptodera*. *N. inornata* is a marine taxon (Dethoup and Manoch, 2009), however, it has been reported from brackish lake in Italy (Grasso and Laferla, 1985). This species has been isolated from submerged wood in brackish water southern Iraq (Muhsin and Khalaf, 2002). Recently, it has been isolated from brackish water, but on submerged leaf bases of date palm in Omara city, this fungus seems to extend its distribution to Missan province, North-East Basrah (Al-Saadoon and Al-Dossary, 2010).

***Natantispora retorquens* (Shearer and Crane) J. Campb., J.L. Anerson and Shearer, Mycologia 95: 543(2003):** *Halosarpheia retorquens* Shearer and J.L. Crane, Bot. Mar. 23: 608(1980). Specimen examined: On submerged dead stem of *P. australis*, Qarma tributary, Shatt Al-Arab River, Basrah, April 2011.

Campbell et al. (2003) segregated this species from *Halosarpheia* based on sequence data, although distinguishing morphological features at the generic level are not established. From combined 18S and 28S sequences *Natantispora* species are distantly placed from *Halosarpheia* (Abdel-Wahab et al., 2001).

This species was originally described only from freshwater habitats (Shearer and Crane, 1980), although it has been reported frequently from brackish and marine habitats (Kohlmeyer and Volkmann-Kohlmeyer, 1991). It is among the very few species of Halosphaeriales that occur in both freshwater and marine habitats (Campbell et al., 2003). This fungus has been isolated from submerged dead stem of *Typha australis*, Abu Al-Khasib, Basrah, Southern Iraq (Al-Saadoon and Al-Dossary, 2010).

***Ophiobolus australiensis* Johnson et Sparrow. Fungin in oceans and estuaries. Weinheim, p. 419(1961):** This species was reported on dead leaves of *Phoenix dactylifera* submerged in Umm Qasr saline waters, Basrah, southern Iraq (Abdulkadir and Mahsin, 1991).

***Phaeosphaeria albopunctata* Shoemaker and Babcock, Can. J. Bot. 67:1566 (1988):** *Leptosphaeria albopunctata* (Westendorp) Sacc., Syll, Fung. 2: 72(1883).

This species has also recently been transferred from *Leptosphaeria* to the genus *Phaeosphaeria* (Khashnobish and Shearer, 1996). It has a world wide distribution and reported as a saprophyte on a variety of salt marsh plants such as *Juncus maritimus*, *Spartina alterniflora*, *Spartina townsendii* and *Phragmites communis* (Kohlmeyer and Kohlmeyer, 1979). Kumar (1973) reported on the species on the driftwood submerged in sea water near Madras, India. This fungus is found on *T. australis* in southern marshes of Iraq (Abdullah and Abdulkadir, 1987).

***Phaeosphaeria orae-maris* (Linder) Khashn and Shearer, Mycol. Res. 100: 1351(1996):** *Leptosphaeria oraemaris* Linder, Farlowia 1: 413(1944).

The delimitation between *Phaeosphaeria* and *Leptosphaeria* has been obscure, however, based on morphological data and ITS2 and partial 28S rRNA sequences, Khashnobish and Shearer (1996) supported the monophyly of *Phaeosphaeria* and suggested that the genus is delimited by the relatively thin peridium composed of thin-walled pseudoparenchyma with 2-4 cell layers. This species has recently been transferred from *Leptosphaeria* to the genus *Phaeosphaeria* (Khashnobish and Shearer, 1996). It has been recorded from west and east coasts of India (Borse et al., 2013). This species was isolated on dead leaves of *T. australis* submerged in water, southern marshes of Iraq (Abdullah and Abdulkadir, 1987). This collection seem to be the first record from a warm region.

***Phaeosphaeria typharum* (Desm.) L. Hdm., Symb. Bot. Ups. 14: 126(1957) (For the synonyms see Jones et al., 2009):** This species has been reported from marshes and marine habitats in Europe and North America (Apinis and Chester, 1964; Gessner and Goos, 1973b). It has also been reported from freshwater habitats on different species of *Typha* plants in Europe by Muller (1950); Munk (1957) and Pugh and Mulder (1971). Kohlmeyer and Kohlmeyer (1979) considered this species as facultative marine fungus. Abdullah and Abdulkadir (1987) reported the species on decomposing leaves of *T. australis* submerged in water, southern marshes of Iraq.

***Pleospora herbarum* (Fr.) Rabenh. Ex Ces. And de Not. Comm. Soc. Critt. Ital. I. 217(1863):** This species has been previously reported on a variety of salt marshes plants from Brition by Apinis and Chester (1964). It has been isolated from dead leaves and stems of *T. australis* submerged in water, southern marshes of Iraq (Abdullah and Abdulkadir, 1987).

***Podospora dolichopodalis* Mirza and Cain, Can J. Bot. 47: 2018(1969):** This fungus has been reported from dung of herbivorous animals in USA and Brazil (Mirza and Cain, 1969; Lundqvist, 1973). This species was found on *P. australis* submerged in Shatt Al-Arab river, near Basrah University, Basrah, Iraq (Al-Saadoon, 2000). *P. australis* was considered a new substrate.

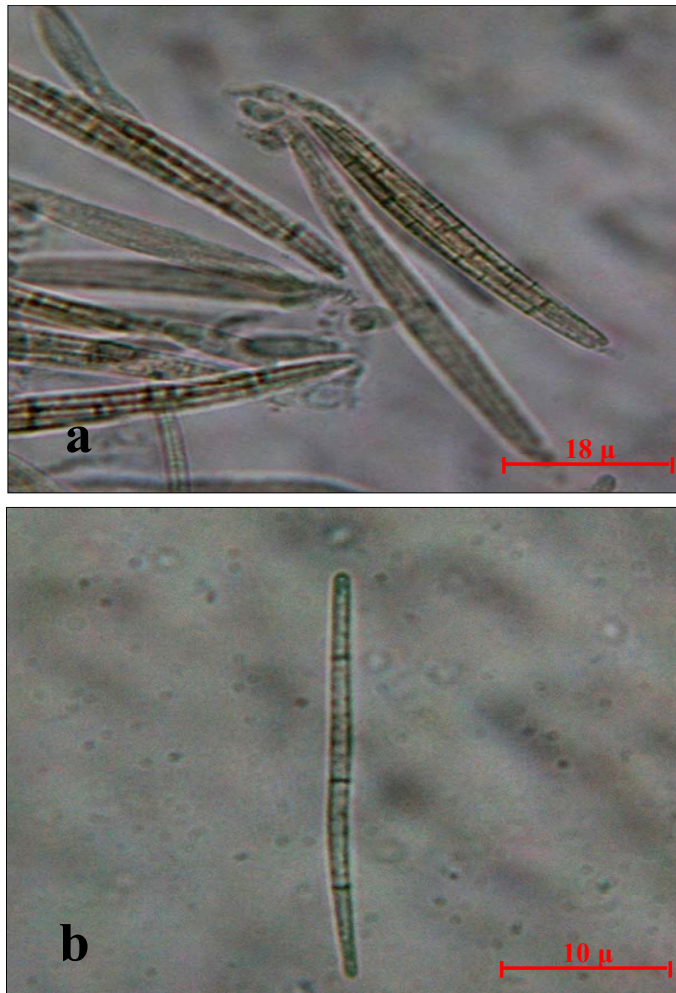
***P. inquinata* Udagawa and Ueda, Mycotaxon 22: 399(1985):** *P. inquinata* is the only species exclusively recorded from marine sediment collected in the Nagasaki Bay, Japan (Udagawa and Ueda, 1985). It was isolated from freshwater habitat on unidentified wood submerged in the Euphrates River near Battha town, DeQar governorate, south of Iraq (Al-Saadoon, 2000). It was the second kind of the species and unidentified substrate collected from freshwater habitat considered as new substrate.

***Preussia aquilirostrata* Guarro, Abdullah, Gene and Al-Saadoon, Mycol. Res. 101: 305(1997):** It was described from leaf bases of date palm tree (*Phoenix dactylifera* L.) submerged in Shatt Al-Arab River, Basrah, Iraq (Guarro et al., 1997).

***P. dispersa* (Clum.) Cain, Can. J. Bot. 39: 1645(1961):** The species was isolated from water and sediment from pool in USA by W.B. Cooke (Cain, 1961). It was isolated from decomposing leaves of *T. australis* plant submerged in water, southern marsh, Iraq (Abdullah and Abdulkadir, 1987).

***Pseudoallescheria desertorum* (Arx and Mustafa) McGinnis, Mycotaxon 14: 98(1982):** It was isolated from submerged wood in freshwater, Garma, Basrah, Iraq (Muhsin and Khalaf, 2002).

***Pseudohalonectria phialidica* Shearer, Can. J. Bot. 67:150(1989) (Figure 5):** Ascomata on natural substrate immersed, partially immersed or superficial, bright yellow, becoming greyish yellow, globose to flattend globose, 132-350 × 256-400 µm. Asci pale yellow, cylindrical, straight or sigmoid, 8-spored in a single fascicle, short stalked, 106-133 x 10.6-11.9 µm. Ascospores hyaline, yellow in mass, 3-4 septate, filiform, slightly curved or

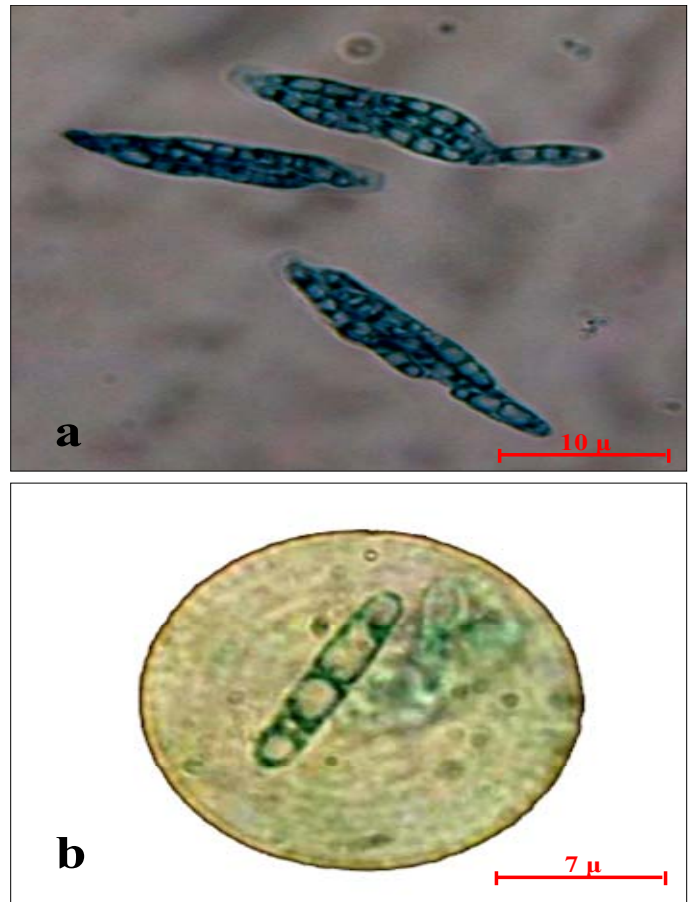


**Figure 5.** *Pseudohalonectria phialidica*; a. asci; b. ascospore.

sigmoid with oil droplets interrupted at regular intervals by non refractile regions  $60-65 \times 3.9-4.6 \mu\text{m}$ . Specimen examined: On submerged dead stems of *Arundo donax* and *P. australis*, Qarma tributary, Shatt AlArab, Basrah Iraq, April 2010.

*Pseudohalonectria* Minoura and Muroi was established in 1978 for *P. lignicola*, an ascomycete found on balsa wood submerged in Japanese lake (Minoura and Muroi, 1978). *P. phialidica* was originally isolated from submerged woody debris in the Salt Fork of the Vermilion river, USA (Shearer, 1989). This fungus has been isolated from freshwater (Shearer, 1989), however, at the present study, it was found on submerged dead culms of *A. donax* and *P. australis* in brackish water and a new substrates were found.

***Pseudolignincola siamensis* Chatmala and E.B.G. Jones, Nova Hedw. 83: 226(2006) (Figure 6):** Anamorph: *Humicola siamensis* Chatmala and E.B.G.



**Figure 6.** *Pseudolignincola siamensis*; a. asci; b. ascospore.

Jones. Ascomata globose, dark brown, deeply immersed in the wood, coriaceous with long neck, solitary, catenophyses,  $700-1150 \mu\text{m}$ .

Asci clavate to slightly cylindrical, long pedicellate, unitunicate, thin-walled, truncate at the apex with a refractive thickening and retraction of the plasmalemma at the apex,  $46.6-56.8 \times 9.8-13.3 \mu\text{m}$ , ascospores cylindrical, 1-4-septate, hyaline, smooth-walled, lacking a sheath or appendages,  $20-21-25 \times 4-5 \mu\text{m}$ . Specimen examined: On dead stem of *P. australis*, submerged in water near Qurna, Basrah, Iraq.

April 2010. *P. siamensis* was isolated from plant substrata in Thailand mangroves. It is characterized by having clavate asci with a truncate, thickened apex, a pore, the ascus plasmalemma is retracted and ascospores are 1-4 septate, hyaline, cylindrical and lacking appendages (Jones et al., 2006). *P. siamensis* has only been cited once for Iraq and a new substrate was found.

***Pyrenophora typhaecola* (Cke.) Mull. Sydowia 5: 256(1951):** This species has a world wide distribution and

has been repeatedly collected on *Typha* (Munk, 1957; Wehmeyer, 1961; Pugh and Mulder, 1971). It was reported on dead stem and leaves of *T. australis* submerged in water southern marshes of Iraq (Abdullah and Abdulkadir, 1987).

***Savoryella lignicola* Jones et Eaton, Trans. Br. Mycol. Soc. 52: 161(1969):** The species is known from freshwater, brackish water and marine water habitats and appears to have a wide distribution and wide salinity tolerance (Eaton and Jones, 1971; Hyde, 1993, 1994; Hyde and Jones, 1988; Kohlmeyer and Kohlmeyer, 1979). *Savoryella lignicola* was observed on the collections from Lakshadweep island and noticed on drift wood from Kerala, India (Khan and Manimohan, 2011), and recorded from west and east coasts of India (Borse et al., 2013). It was reported from fresh water habitat on *P. australis* stem submerged in a stream in Nineva province, north of Iraq (Al-Saadoon and Abdullah, 2001).

***Sphaerulina orae-maris* Linder, Farlowia 1:413(1944):** This species can be separated from the other marine fungus *Sphaerulina albispiculata* Tubaki by its ascospores with a short papillae neck and the number of ascospore septa (Jones et al., 2009). *S. orae-maris* is accepted as an obligate marine fungus (Kohlmeyer and Volkmann-Kohlmeyer, 1991), nevertheless, it was isolated from submerged wood in freshwater, Basrah, Iraq (Muhsin and Khalaf, 2002).

***Sypastospora tetraspora* Abdullah and Al-Saadoon, Marina Mesopotamica 9:83(1994):** The species was isolated from decaying dead stem of *Arundo donax* L. collected from Khor Al-Zubair channel southern Iraq (Abdullah and Al-Saadoon, 1994a).

The genus *Sypastospora* was erected by Cannon and Hawksworth (1982) to accommodate *S. parasitica* (Tul.) P.F. Cannon and D. Hawksworth (1982). The second species of the genus is *S. boninensis* Horie, Udagawa and P.F. Cannon (1986). *S. tropicalis* D. Garcia, Stachigel and Guarro has recently been isolated from tropical soils (Garcia et al., 2002).

*Sypastospora tetraspora* can be distinguished from *Sypastospora parasitica*, *Sypastospora boninensis* and *Sypastospora tropicalis* by its four-spored asci and cylindrical to doliform ascospores, with two large terminal, slightly sunken germ pores.

***Verruculina enalia* (Kohlm.) Kohlm. And Volkm-Kohlm., Mycol. Res. 94:689(1990):** *Didymosphaeria enalia* Kohlm., Ber. Deutsch. Bot. Ges. 79: 28(1966); *Lojkania enalia* (Kohlm.) M.E. Barr, N. Amer. FL. Ser. 2. 13:56(1990). Specimen examined: On stems of *A. donax*

submerged in Qarma tributary, Shatt Al-Arab river, Basrah, Dec. 1994; on dead stems of *P. australis* submerged in Shatt Al-Arab river near Abu-Alkhasib, Basrah, Nov 1999; on unidentified wood submerged in Qarma tributary, Shatt Al-Arab river, Basrah, April 2010.

The species was originally described as a *Didymosphaeria enalia* Kohlm., but accepted by Barr (1990) as *Lojkania enalia* (Kohlm.) M.E. Barr and by Kohlmeyer and Volkmann-Kohlmeyer (1990) as a type of monotypic *V. enalia* (Kohlm.) Kohlm. and Volkm.-Kohlm. Initially referred to the Didymosphaeriaceae, Melanommatales by Kohlmeyer and Volkmann-Kohlmeyer (1990), sequence data place it in the Testudinaceae as the most basal clade of the pleosporales (Schoch et al., 2006). *V. endia* was one of the most common species isolated from twigs collected from beaches in eastern Thailand (Dethoup and Manoch, 2009) and it has been recorded from southern Thailand (Sakayaroj et al., 2011). It was one of the frequently encountered taxon for all states and union territories investigated in India (Borse et al., 2013), this species has been isolated from submerged dead rhizomes of *A. donax*, Shatt Al-Arab river, Basrah (Abdulkadir and Muhsin, 1991). *A. donax*, *P. australis* and unidentified wood were considered as new substrates for this fungus.

***Zopfiella cephalothecoidea* Guarro, Abdullah, Al-Saadoon et Gene, Mycotaxon 59:179(1996):** Specimen examined: On submerged dead stems of *A. donax*, Shatt Al-Arab river near Abu Al-Khasib, Basrah, May 1999; on submerged dead stem of *A. donax*, Shatt Al-Arab, Hamdan tributary, Abu Al-Khasib, April 2000; On unidentified dead twigs submerged in Al-Kahla`a river, Missan, southern Iraq, Nov. 2009.

This fungus has been isolated from unidentified dead twig collected from the Euphrates near Battha town DeQar governorate, southern Iraq (Guarro et al., 1996).

This contributions extend its distribution to the provinces of Basrah and Omara. *A. donax* is considered as a new substrate for this fungus.

***Zopfiella karachiensis* (Ahmed and Asad) Guarro, Trans. Br. Mycol. Soc. 91:589(1988):** *Strattonia karachiensis* Ahmed and Asad, Sydowia 21: 281(1967); *Triangularia karachiensis* (Ahmed and Asad) Udagawa, Trans. Mycol. Soc. Japan 20: 362(1979); *Podosporea faurelii* Mouchacca, Rev. Mycol. 38: 109(1973). Specimen examined: On submerged dead stems of *P. australis*, Shatt Al-Arab River near Abu Al-Khasib, Basrah, February 1994. On submerged dead stems of *P. australis*, Qarma tributary, Basrah, Dec. 1999. On submerged unidentified twigs, Shatt Al-Arab River near Abu Al-Kasib, Basrah, April 2010.

*Z. karachiensis* appears to be reasonably widely distributed (Guarro et al., 1991). There are records of it

from Egypt (Mouchacca, 1973), Japan, Thailand (Udagawa et al., 1979), Kenya, Tanzania and India (Khan and Krug, 1990). The species was originally described by Ahmed and Asad (1967) from sheep dung collected from Pakistan. It was changed to *Zopfiella* because its ascospores are not conical as in *Triangularia* (Guarro and Cano, 1988). It has been isolated from decaying *Typha* stem in water, Al-Hammar marshes, near Basrah, Iraq (Abdullah, 1983).

**Z. latipes (Lundq.) Malloch and Cain, Can. J. Bot. 49: 876(1971):** *Tripterospora latipes* Lundq, Bot. Notiser 122: 592 (1969). Anamorph: *Humicola*- like. Specimen examined : On submerged dead culms of *A. donax* and *P. australis*, Khor Al-Zubair channel, Basrah, Iraq, March 1992. On dead stems of *Halocheilum strobilaceum* and *Salicornia europea* submerged in water, Khor Al-Zubair channel, Basrah, March 1992. On unidentified twigs submerged in Euphrates River, DeQar governorate, June 1994. On *P. australis* submerged in Shatt Al-Arab River, near Basrah University, Basrah, Iraq, Feb. 1995. On submerged leaf bases of date palm, Al-Kahla'a river, Omara, southern Iraq, April 2009. On dead stems of *A. donax* and *Phragmites australis* submerged in Tigris River, near Qurna, Basrah, Nov. 2010. On dead stems of *A. donax* submerged in Shatt Al-Arab River near Qarma, Basrah, April 2011.

This is a fairly common and wide spread species isolated from various herbaceous and woody submerged in both terrestrial and marine ecosystems, as well as from dung (Guarro et al., 1991). It was recorded from Chile, Denmark, India, Japan, South Africa, USA and India (Lundqvist, 1969; Shearer, 1972; Furuya and Udagawa, 1973; Tubaki and Ito, 1973; Borse et al., 2013). It has been isolated on decaying *Typha* plant in water, AL-Hammar marshes, near Basrah, southern Iraq (Abdullah, 1983).

**Z. submersa Guarro, AL-Saadoon, Gene and Abdullah, Mycologia 89:955(1997):** Specimen examined: On submerged dead stems of *P. australis*, Shatt Al-Arab river, near Qarma, Basrah, December 1999. On submerged dead stems of *A. donax*, Shatt Al-Arab river, near Abu-Al-Khasib, Basrah, southern Iraq, April 2009.

*Z. submersa* has been isolated from submerged dead culms of *Phragmites* sp. and *A. donax* in Euphrates River, DeQar, Iraq (Guarro et al., 1997).

## Anamorphic fungi

### Hyphomycetes

**Alternaria alternata (Fr.) Keissler, Beih. Bot. Zbl. 29: 434(1912):** Specimen examined: On submerged dead stems

of *A. donax* and *P. australis*, Shatt Al-Arab river, near Qarma and Abu-Al-khasib, Basrah, June 2009. On submerged dead stems of *P. australis* Shatt Al-Arab River, near Qarma and Qurna, Basrah, April 2011.

This species was reported on *Spartina alterniflora* (Gessner and Goos, 1973a, b; Gessner, 1977, 1978) and *Salicornia* (Reidle and Ershad, 1977). It has been isolated from *P. australis* submerged in water near Basrah University Campus, Basrah (Muhsin and Abdulkadir, 1995).

**Aureobasidium pullulans (DeBary) Arnaud, Ann. Ec. Agric. Montpellier New Ser. 16: 39(1918):** Specimen examined: On unidentified wood submerged in water, Hamdan tributary, Abu-Al-Khasib, Basrah, Dec. 1999. On dead stems of *Suaeda* sp. submerged in water of Khor Al-Zubair channel, Basrah, Jan 2009. On submerged dead stems of *P. australis*, Shatt Al-Arab, near Qarma, Basrah, April 2011.

This species has been recorded from various halophytes (Pugh and Buckley, 1971; Lindsey, 1976). It was isolated from dead stems of *P. australis* submerged in water, Shatt Al-Arab, near Basrah University campus, Basrah (Muhsin and Abdulkadir, 1995).

**Bactrodesmium linderi (Crane and Shearer) M.E. Palm and E.L. Stewart, Mycotaxon 15:319(1982):** *Trichocladium linderi* Crane and Shearer, Mycologia 70: 866(1978). The fungus has been transferred to *Bactrodesmium* based on the presence of compact sporodochia (Palm and Stewart, 1982), and not a feature of *Trichocladium* which has mononematous and scattered conidiophores (Ellis, 1971). The species was originally isolated from balsa wood submerged in estuarine water, USA (Crane and Shearer, 1978). Most recently it has been reported from west and east coasts of India (Borse et al., 2013). It has been reported on dead leaves of *T. australis* submerged in Shatt Al-Arab river, near University campus, Basrah southern Iraq (Abdulkadir and Muhsin, 1991).

**Beltrania rhombica Penzig, Nouvo G. Bot. Ital. 14: 72(1882):** This species was recorded from dead leaves of many tropical plants and isolated from air, seeds and stems in many countries all over the world (Ellis, 1971), from pineapple field soil in Okinawa, Japan (Watanabe, 1971). This fungus has been isolated from submerged dead stem of *T. australis* in Shatt Al-Arab River, near Abu- Al-Khasib, Basrah southern Iraq (Al-Saadoon and Al-Dossary, 2010).

**Cirrenalia macrocephala (Kohlm.) Meyers and R.T. Moore, Am. J. Bot. 47:347(1960):** *Helicoma macrocephala* Kohlm., Ber. Dtsch. Bot. Ges. 71: 99(1958).

Specimen examined: On submerged dead stems of *Aruond donax* in Khor Al-Zubair channel, Basrah, March 1999. On dead stems of *P. australis*, submerged in Shatt Al-Arab river, near Abu- Al-Khasib, Basrah, April 2010. On unidentified wood submerged in Shatt Al-Arab, near Qarma, Basrah, December 2011.

This fungus was reported on drift wood in coastal waters of Kuwait (Zainal and Jones, 1984), on decayed intertidal wood of *Avicennia marina* (Forssk.) Vierh, *Rhizophora mangle* L., *Rhizophora mucronata* Lamk. and driftwood, decayed leaves (Abdel-Wahab et al., 2010). This species has been isolated from dead date palm (*Phoenix dactylifera*) leaves submerged in Shatt Al-Arab River, near University campus, Basrah, Iraq (Abdulkadir and Muhsin, 1991).

***Clavatospora bulbosa* (Anast.) Nakagiri et. Tubaki, Bot. Mar. 28: 489(1985):** *Clavariopsis bulbosa* Anastasiou, Mycologia 53: 11(1962). In culture, the bulbous basal cells may be absent and conidia develops a single row of brown cells (Jones et al., 2009). Kohlmeyer and Kohlmeyer (1979) referred to these as chlamydospores. This species has been reported from freshwater and marine habitats (Kohlmeyer and Kohlmeyer, 1979; Dethoup and Manoch, 2009; Borse et al., 2013) as a state of *Corollospora pulchella* Kohlm. Schmidt and Nair. *C.bulbosa* has been described from wood submerged in freshwater in Basrah, southern Iraq (Muhsin and Khalaf, 2002)/ Most recently Al-Saadoon and Al-Dossary (2010) isolated this species from drift wood and leaf bases of date palm (*Phoenix dactylifera* L.) in brackish water, Al-Kahla`a, Omara, north east Basrah.

***Cumulospora marina* I. Schmidt, Mycotaxon 24: 421(1985):** *Vesicularia marina* I. Schmidt, Natur Naturschutz Mecklenberg 12: 117(1974). *Basramyces marinus* (I. Schmidt) Abdullah, Abdulkadir and Goos, Intern. J. Mycol. and lichenol. 4: 183(1989).

*Cumulospora* is a monotypic genus described by Schmidt (1985) to accommodate a dematiaceous marine hyphomycete, initially referred to as *Vesicularia marina*. The generic name *Vesicularia* was illegitimate and subsequently *Cumulospora* was erected to accommodate this fungus (Schmidt, 1985). The fungus was originally found on decayed wood and rhizomes of *Phragmites communis* in the Baltic sea (Schmidt, 1974). Abdullah et al. (1989) described an identical fungus as *Basramyces marinus* from dead, submerged and floating culms of *P. australis* (Cav.) Trin. ex Steud (Syn. *Phragmites communis*) in southern marshes of Iraq.

*C. marina* is widely distributed from temperate to tropical locations, and is often common on mangrove bark (Chatmala et al., 2004). It has been recorded from west and east coasts of India (Borse et al., 2013).

This fungus was found on dead culms of *Cyperus*

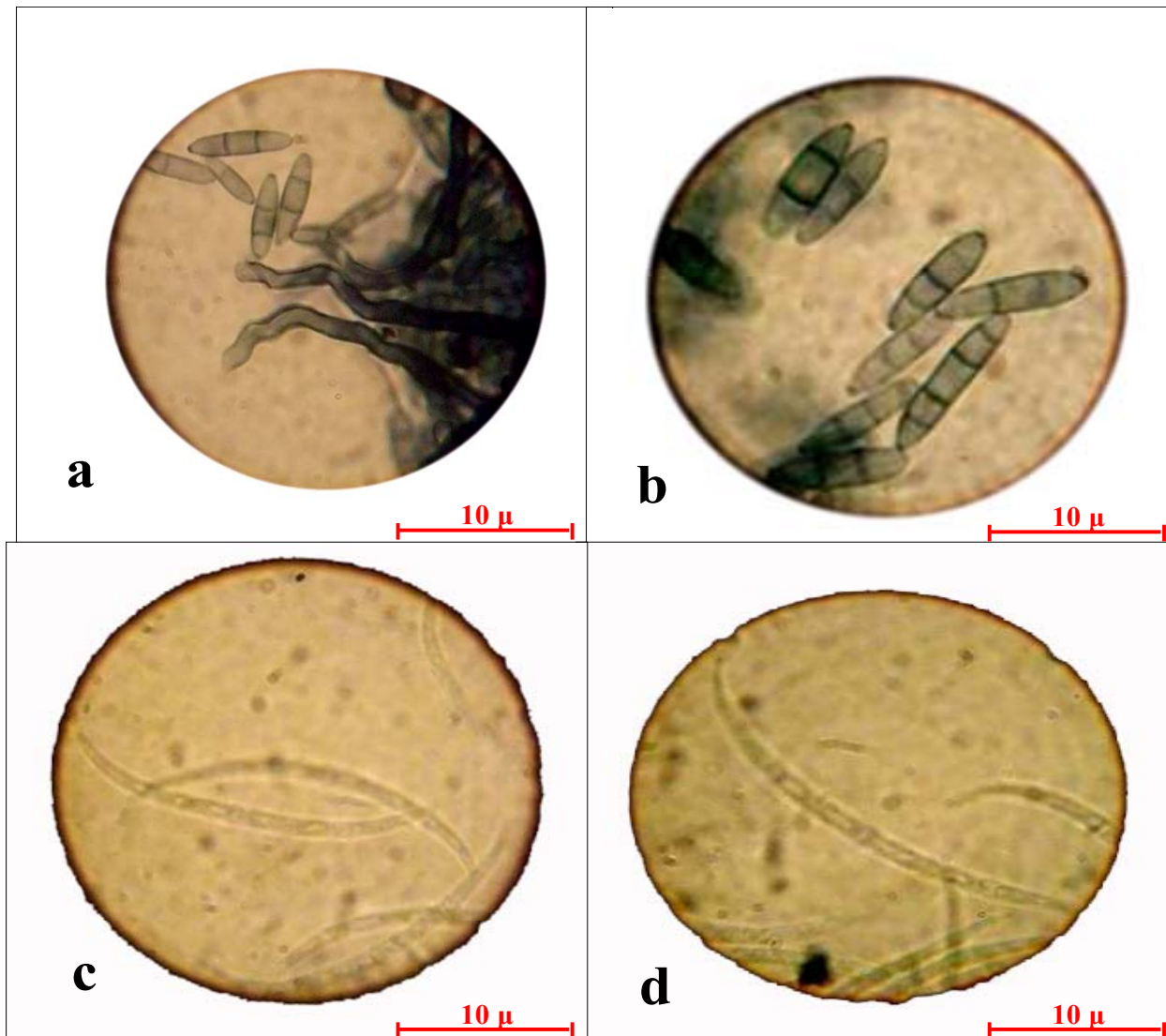
*rotundus* L. and *A. donax* L. submerged in Shatt Al-Arab River, Basrah, southern Iraq and two substrates were considered as new for this fungus (Abdulkadir and Muhsin, 1991).

***Cylindrocladium camelliae* Venkataramani and Ram, Current Science 30: 186(1961):** This species was isolated from root of *Phellodendron amurense* in Japan (Watanabe, 1994). *C. camelliae* was isolated from submerged leaf bases of date palm and stem of *A. donax*, Abu-Al-Khasib, Basrah, southern Iraq, (Al-Saadoon and Al-Dossary, 2010). It was the first report for the species from water habitat.

***Dendryphiella arenaria* Nicot., Rev. Mycol., Paris 23: 93(1958) (Figure 7a and b):** Colonies on PCA growing rapidly, effuse, dark blackish brown, velvety, reverse grey to black; hyphae pale to mid brown, smooth, 2-5 µm thick, septate and branched. Conidiophores macronematous simple or branched, straight or flexuous, pale to mid brown to olive brown, cylindrical 1-3 septate apically swollen up to 90 µm long, conidia straight, ellipsoidal, cylindrical or obpyriform, mostly 1-3 septate, rarely with 4-septa, pale brown to olivaceous, often with dark septa and dark spot at one end 7-20 x 4-6 µm. Specimen examined: On submerged dead stem of *P. australis* and unidentified wood, Shatt Al-Arab, near Qarma, Basrah, southern Iraq, November 2010.

Ellis (1976) referred to the species as *Scolecobasidium*, however, in the marine *Dendryphiella* species conidiogenous cells are enteroblastic and denticles are absent. Ellis (1976) described pegs on the conidiogenous cells but these may be confused with extensions from the conidia as seen in SEM micrographs. *D. arenaria* is frequently reported from saline environments (Kohlmeyer and Kohlmeyer, 1979) and it is known from various salt-marsh halophytes (Gessner and Goos, 1973b; Kohlmeyer and Kohlmeyer, 1979; Muhsin and Booth, 1987). Our collection represents the first report of the species from Iraq.

***Exserohilum rostratum* (Drechsler) Leonard and Suggs., 66: 290(1974):** *Drechsler halodes* (Drechsler) Subram. and Jain, Curr. Sci. 35:354(1966). Specimen examined: On submerged dead stem of *A. donax* and *P. australis*, Shatt Al-Arab river, near Qarma, Basrah, April. 2010. The fungus was reported on the aerial parts of *Spartina alterniflora* (Gessner, 1977) and halophytic plants from an inland salt marsh at Delta, Man, Manitoba, Canada (Muhsin and Booth, 1987). The species has been described as *Drechslera halodes* on dead culms of *Cyperus rotundus* submerged in Shatt Al-Arab River near Al-Khora tributary, Basrah, southern Iraq (Abdulkadir and Muhsin, 1991).



**Figure 7.** *Dendryphiella arenaria*; a. hyphae and conidia; b. conidia and *Halosigmoidea parvula*; c and d. conidia.

***Halenospora varia* (Anastasiou) E.B.G. Jones, Fungal Diversity 35: 154(2009):** *Zalerion varium* Anastasiou, Can. J. Bot. 41: 1136(1963). Specimen examined: On submerged dead stems of *A. donax*, *P. australis* and unidentified wood, Khor Al-Zubair channel, Basrah, March 1994. On dead stems of *A. donax*, submerged in Shatt Al-Arab River, near Abu- Al-Khasib, Basrah, April 2009.

Changed to *Halenospora* because its conidia produce a lateral rather than a terminal spiral as in *Z. maritima*. The individual cells in *H. varia* are narrower than those of *Z. maritima*, and form knot-like structures (Jones et al., 2009). Records in adjacent areas was by RaghuKumar (1973) from Indian Ocean by Koch (1982), from Sri Lanka by Khan and Manimohan (2011), from Lakshadweep Island and Kerala state in India, by Sakayaroj et al. (2011), from Southern Thailand and by Borse et al. (2013) from

west and east coasts of India.

This fungus seems to be cosmopolitan as reported by Kohlmeyer (1984), occurring on intertidal wood, submerged leaves, seedling of *Rhizophora* mangle (Jones et al., 2009). It has been isolated from dead rhizomes of *A. donax* submerged in Shatt Al-Arab River near Nashwa village and Al-Khora tributary, Basrah (Abdulkadir and Muhsin, 1991).

***Halosigmoidea parvula* Zuccaro, J.I. Mitch. and Nakagiri, Bot. Mar. 52: 349-359 (2009) (Figure 7c and d)**

Hyphae branched, septate, hyaline. Conidiophore hyaline, initially short and simple then becoming longer and septate. Conidiogenous cells holoblastic, terminal,

symbodial. Conidia aleuriospores, C to U-shaped, rarely sigmoid, solitary, septate, hyaline, terminal and basal cells of mature conidia, devoid of cytoplasm, 4-5 septate 56.2-68.7 × 2.5-3.2 μm. Specimen examined: On unidentified twigs, submerged in Tigris near Qurna, Basrah, Iraq, November 2010.

Predominantly on decaying seaweeds, especially members of the Fucales (Jones et al., 2009). Mature conidia are generally not constricted at the septa, but before germination each conidial cell becomes rounded and septate into individual cells or several cell clusters, from which hyphae germinate. This is the first reference of *H. parvula* from Iraq.

***Moromyces varius* (Chatmala and Somrith.) Abdel-Wahab, K.L. Pang, Nagahama, Abdel-Aziz and E.B.G. Jones, Mycol. Prog. 9: 555 (2010) (Figure 8a):** *Cumulospora varia* Chatmala and Somrith., Fungal Diver. 17: 3(2004). Specimen examined: On unidentified wood submerged in Shatt Al-Arab river near Qurna, Basrah, Nov. 2010. Colonies on PCA growing rapidly at 25°C, black; reverse black; hyphae septate, branched. superficial or immersed, pale brown. Conidiophores absent. Conidiogenous cells holoblastic, terminal. Conidia 20-80 × 18-48 μm, dark grey to fuscous, solitary, scattered or gregarious, muriform. Conidia initially spiral, but cell division in several planes, leads to a tangled knot of cells.

*C. varia* was transferred to the new genus *Moromyces* by Abdel-Wahab et al. (2010). *M. varius* is different from *Cumulospora marina* by having a muriform, irregularly helicoid conidia, while the latter fungus has rosette-like conidia, globose conidial cells that form pseudo-chains. *C. marina* have conidia that are differentiated into small basal cells which form a filament and larger rounded apical cells, while conidia in *M. varius* form a knot of cells that are more or less similar in shape and size (Abdel-Wahab et al., 2010). It was isolated from decayed driftwood and mangrove seeds in the intertidal zone, Egypt, Japan and Thailand (Chatmala and Somrithipol, 2004; Abdel-Wahab et al., 2010). This is the first record of the species from Iraq.

***Monodictys pelagica* (Johnson) E.B.G. Jones, Trans. Br. Mycol. Soc. 46: 138(1963): *Piricauda pelagica* T.W. Johnson, J. Elisha Mitchell Sci. Soc. 74:42(1958).** *Piricauda arcticocanorum* R.T. Moore, Rhodora 61: 95(1959). Specimen examined: On dead stems of *Salicornia europea* and *Halocnemum strobilaceum* submerged in Khor Al-Zubair channel, Basrah, March 1999. On dead stems leaf bases of date palm submerged in Shatt Al-Arab River, near Abu- Al-Khasib, April 2009 and Qarma, November 2010. A cosmopolitan species occurring on a wide range of substrata, largely with a temperate distribution (Jones et al., 2009). It is known

from submerged wood and drift *Spartina* and salt-marsh halophytes (Jones, 1963; Gessner and Goos, 1973a, b; Davidson, 1974; Muhsin and Booth, 1987). The species has been isolated from the soil and mud of the tidal zone of Khor Al-Zubair canal southern Iraq.

***Periconia prolifica* Anastasiou, Nova Hedw. 6: 260(1963):** Specimen examined: On dead stems of *P. australis* submerged in Shatt Al-Arab river, near Abu- Al-Khasib, Basrah, January 1999; on dead stems of *P. australis* submerged in Shatt Al-Arab river, near Qarma, April 2009, November 2010.

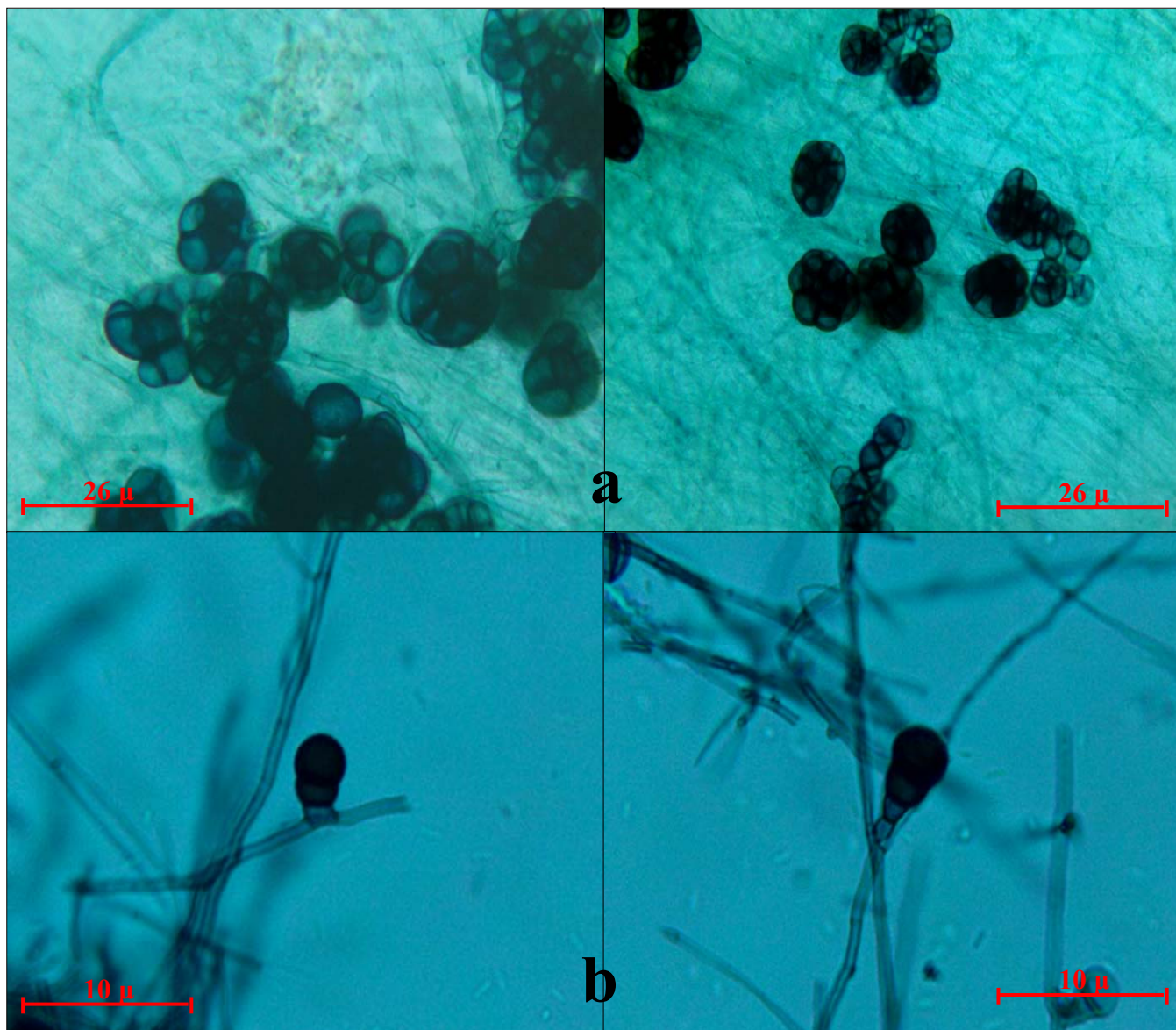
*P. prolifica* is a very common on tropical wood (Vrijmoed et al., 1994) occurring on a wide range of substrata. This species is considered as a marine inhabitant fungus and can be separated from the related species *P. abyssa* Kohlm. by the conidial size (Kohlmeyer and Kohlmeyer, 1979). It represents the anamorph of *Okeanomyces cucullatus* (Kohlm.) K.L. Pang and E.B.G. Jones, however, the later species has been isolated during this survey, also was recently isolated from southern Thailand (Sakayaroj et al., 2011), and from west and east coasts of India (Borse et al., 2013). This species has been isolated from submerged wood in saline water, of Khor Al-Zubair estuary, Basrah, southern Iraq (Muhsin and Khalaf, 2002).

***Stachybotrys atra* Corda, Icon. Fung. (Prague) 1:21 (1837):** Specimen examined: On dead stems of *A. donax*, *P. australis*, unidentified wood and dead leaf bases of *Phoenix dactylifera* submerged in water, Shatt Al-Arab, near Abu- Al-Khasib and Qarma, Basrah, April 2009, November 2010.

*Stachybotrys* has been reported from marine habitats (Meyers and Reynolds, 1959). *S. atra* was reported from submerged twigs of *Tamarix aphylla* in Salton Sea (Anastasiou, 1963). This species was isolated from soil, aquatic sediments, southern Iraq (Muhsin and Al-Helfi, 1981).

***Trichocladium alopallonellum* (Meyers and Moore) Kohlm. and Volkm.-Kohlm., Mycotaxon 53: 392(1995) (Figure 8b):** *Humicola alopallonella* Meyers and Moore, American Journal of Botany 47: 346(1960). Specimen examined: On dead leaf bases of *P. dactylifera* submerged in Shatt Al-Arab near Qarma, November 2010. Hyphae sub-hyaline to light brown, septate and branched. Conidiophores 3-6 × 2.5-5.5 μm, macronematous, simple, smooth, subhyaline to light brown, 0-1 septate, lateral, short, sometimes indistinct, conidiogenous cells usually remaining connected to the conidium. Conidia 9-30 × 7-15 μm, fuscous, obpyriform, ovoid or subglobose, 0-1 septate, apical cell large, 8-14 × 7-12 μm, ovoid, fuscous, basal cell smaller, abconical to cylindrical, light brown, distal cell subglobose, small,





**Figure 8.** *Moromyces varius*; a. conidia and *Trichocladium alopallonellum*; b. hyphae and conidia.

hyaline.

*T. alopallonellum* is a marine species (Meyers and Moore, 1960; Kohlmeyer and Volkmann-Kohlmeyer, 1995; Alias et al., 2010; Borse et al., 2013) with conidia that are mostly 2-septate and pyriform, with fuscous, subglobose distal cell (Goh and Hyde, 1999). *T. alopallonellum* closely resemble *Trichocladium melhae*, however, it differ in having fuscous pyriform conidia that are moderately constricted at the septa and larger. This is the first record of the species from Iraq.

***Virgariella atra* Huges, Can. J. Bot. 31: 653(1953):** This species has been found on rotten wood of *Fagus*,

*Fraxinus* and *Quercus* from Great Britain (Ellis, 1971). From the literature, this species has not been reported from marine environment, thus it was the first time to be recorded from saline water on wood submerged in Khor Al-Zubair estuary, Basrah, southern Iraq (Muhsin and Khalaf, 2002).

***Zygosporium masoni* Hughes, Mycol. Pap. 44:15(1951):** This fungus has been commonly isolated from dead leaves and occasionally other parts of different plants and soil (Ellis, 1971), and from mangroves (Newell, 1976), however, it was found on submerged wood in freshwater in Qrama tributary, Basrah, Southern

Iraq (Muhsin and Khalaf, 2002).

### Coelomycetes

***Camarosporium roumeguerii* Saccardo, *Michelia* 2: 112(1880):** *Camarosporium obiones* Jaap, bot. Ver. Prov. Brandenburg 47: 97(1905). Specimen examined: On dead stems of *Halocneumum strobilaceum* and *Salicornia europea* submerged in Khor Al-Zubair channel, Basrah, January 1994, February 1999.

This species occur on the salt marsh plants *Halimione portulacoides* and various *Salicornia* species (Kohlmeyer and Kohlmeyer, 1979). Only one record for this fungus in the Arabian Gulf was reported by Zainal and Jones (1984) from driftwood in coastal waters of Kuwait. Most recently it has been reported from west and east coasts of India (Borse et al., 2013).

*C. roumeguerii* was found on dead shoots of *Salsola baryosma* Forssic submerged in saline water of Khor Al-Zubair estuary, Basrah, Iraq (Abdulkadir and Muhsin, 1991).

***Coniothyrium obiones* Jaap, *Schr. Naturw. Ver. Schlesing-Holstein* 14: 29(1907):** Occurs on the salt marsh plant *H. portulacoides* (Jones et al., 2009). It has been recorded from Orissa coasts of India (Borse et al., 2013), this species has been isolated on dead twigs of *Tamarix aphylla* (L.) kars. submerged in Al-Khora tributary, Basrah, Iraq (Abdulkadir and Muhsin, 1991).

### Conflict of Interests

The author(s) have not declared any conflict of interests.

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