

The First Report on a Moss-Fungus Association from Egypt

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ABSTRACT. An association between the discomycete fungus *Byssonectria tetraspora* (Berk.) Rogerson and Korf and the moss *Bryum argenteum* Hedw. is reported, described and illustrated. This is the first report of such an association from Egypt. Associations between mosses and fungi are briefly discussed.

Any work, however preliminary, on the association between different organisms owes much to earlier works on the subject, particularly those of Schwendener (1860), De Bary (1879) and Schimper (1883). Schwendener (1860) was able to give an accurate account of the internal dual structure of several lichens. De Bary (1879) was the first to propose the term "Symbiosis" to describe the intimate relationship between different species. His collective term included parasitic, mutualistic and all other states of interrelationships. Concepts pertaining to the separate origin and development of the parts (mitochondria, plastids...) of eukaryotic cells and their association to form the whole have been dealt with in detail by Margulis (1981) who mentioned that this particular story of the eukaryotic cell evolution had been dubbed the " Serial Endosymbiotic Theory" by Taylor (1974) and that perhaps the earliest scientific idea that cell organells came from hereditary symbiotic associations was that published in 1883 by Schimper. Literature on symbiosis is, at present, enormous and the foregoing hint would suffice for the present paper which pertains to a moss-fungus association.

Mosses form associations with several organisms belonging to all kingdoms (Monera, Protocista, Fungi, Plantae and Animalia). Examples of such associations have been described by El-Saadawi and Abou-El- Kheir (1973), Richardson (1981) and Abou-El-Kheir *et al.* (1986).

Fungi, on the other hand, form associations with an enormous number of organisms, again covering all kingdoms including their own. Lichens, endomycorrhizae and ectomycorrhizae are among the most familiar examples of such associations.

The focus here is on fungal-moss association. In this connection Dennis (1968) listed over 25 species of fungi that grow in association with mosses, of which he named 15 genera. More recently, Ellis and Ellis (1988) listed some 70 species of fungi that grow on or with bryophytes. Among these, they identified about 40 species, belonging to 35 genera.

In this communication an association between a fungus and a moss is reported for the first time from Egypt.

Materials

Moss samples, which included the tiny orange apothecia of the fungus, were collected repeatedly between January and April during two successive years, 1997 and 1998. The moss was compared with authentic specimens kept at CAIA. (Herbarium of the Botany Department, Faculty of Science, Ain Shams University) and identified as *Bryum argenteum* Hedw. The fungus is most probably a new variety of the discomycete species *Byssonectria tetraspora* (Berk.) Rogerson and Korf. (cf Dennis, 1968; Ellis and Ellis, 1988).

Description

A) Locality

Between “Mansh’yet El-Sadr” and “Kobri El-Kobba”, part of the course of the Cairo Under-Ground Metro runs over-ground. The rail lines in this section are bounded on both sides by low-lying cement-covered walls. Fresh water leaking from nearby pipes flows over parts of these walls (Fig.1).



Fig. 1 Fresh water leaking from nearby pipes

B) Moss

Carpets of *Bryum argenteum* (Fig. 2) grow on these wet niches, especially on partly shaded places of the north-facing wall. At one site the fern *Adiantum capillus veneris* L. and a few herbs accompany the moss vegetation. Filamentous algae are also observed in many of the sites (Fig.2). *Bryum argenteum* occurs in different parts of the country, including Cairo (Imam and Ghabbour, 1972), Giza (El-Saadawi and Abou El-Kheir, 1973), Alexandria and the western Mediterranean coast (Shabbara, 1990) and southern Sinai (Abou Salama, 1991). The shoots are rhizomatous. Aerial branches are up to 4 mm long. Stems possess a small central strand which is absent at the apex. Leaves are imbricate, strongly concave, up to 4.5 mm long, with an entire plain unbordered margin; apiculate to obtuse or subacute apex and slender ending-below-apex costa. The latter mostly ends at the middle of the lamina or is even restricted to its base. Apical parts of stems detach easily.



Fig. 2. Carpets of *Bryum argenteum*

C) Fungus:

The tiny orange-coloured apothecia of the discomycete fungus grow either in groups (Figs. 2 and 3) or scattered among the green shoots of the moss gametophyte. The whitish hyphae of the fungal mycelium intimately surround the rhizoids of the moss shoots.



Fig. 3 The tiny orange-coloured apothecia of the discomycete fungus

The apothecia are almost sessile, 1-1.5 mm in diameter with a flat to convex surface and an undulate pale yellow margin. The asci are operculate, (100) 144-153 (170) μm long and 15-20 μm wide (Fig. 4). When soaked in water, the asci expand and increase greatly in length (Fig. 5) and finally break down into fragments. Spores 4 (rarely 5) in each ascus (Figs 4 and 5), are ellipsoid to fusiform, smooth, $\pm$ hyaline and 25 (30) $\times$ 12-14 μm in size. Paraphyses clavate, $\pm$ straight, mostly aseptate, about 150 μm long and 4-5 μm wide below and up to 10 μm wide at apex, with orange contents (Fig. 6). Asci also have orange contents, especially when young (Fig. 7). Spores usually include one very large (up to 10 μm in diameter), 0-2 large and numerous small to very small guttules (Figs 4 and 5). This is the first record of the fungus *Byssonectria tetraspora* from Egypt.



Figs. 4 - 7 asci

Discussion

In Egypt work on the association between mosses and other organisms has so far been restricted to one group of organisms namely the algae (see El-Saadawi and Abou-El-Kheir, 1973; El-Saadawi *et al*, Abou-El-Kheir *et al*. 1986, 1988). This is, therefore, the first work in Egypt on the association between a moss and a fungus. The moss is a species of the genus *Bryum*.

Bryum is unusual in that it forms associations with 4 species of fungi (Dennis, 1968; Ellis and Ellis, 1988). Most (about two thirds) of the bryophyte genera that form associations with fungi have only one specific partner. Only *Ceratodon*, *Polytrichum* and *Sphagnum* are reported to form associations with more than 4 species of fungi (6, 8 and 8 species respectively).

The 4 species of fungi reported to grow in association with *Bryum* are *Octospora leucoloma* Hedwig ex S. F. Gray., *O. coccinea* (Crouan) V Brummelen, *Byssonectria raspora* and *Phoma muscicola* A. L. Smith. While the last mentioned species is a deuteromycete fungus, the first three (like the majority of fungi that grow in association with mosses) are discomycetes (see Dennis, 1968; Ellis and Ellis, 1988).

Octospora coccinea grows on sandy soil among three mosses, one of which is *Bryum*, while *Phoma muscicola* grows on capsules of *Bryum* and on two other mosses (Ellis and Ellis, 1988). *Octospora leucoloma* grows on *Bryum argenteum* and other small mosses from Oct. to May (Dennis, 1968), in cushions of *Bryum argenteum* from December to May (Ellis and Ellis, 1988) and on *Bryum bicolor* during winter and spring months on sandy soil in Kuwait (El- Saadawi and Zanaty, 1990). It does not, however, grow on *Funaria hygrometrica* Hedw., strands of which grow in close proximity to those of *Bryum bicolor*. *Byssonectria tetraspora* also grows in cushions of *Bryum argenteum* from January to April as reported here and earlier by Ellis and Ellis (1988).

The association described here between *Bryum argenteum* and *Byssonectria tetraspora* is apparently commensalism since, in many of the studied sites, the growth of the moss was luxurious and its gametophores were robust and healthy whether associated with the fungus or not. This does not, however, exclude mutualism. Even parasitism and other peculiar sorts of relationships (see for example Rabin, 1980; Werner, 1992) cannot be entirely excluded, because at some of the studied sites the fungus seemed most common on yellowish, apparently senescent moss shoots. Detailed studies are therefore needed in order to establish the precise nature of this association. This is also the case in other associations. Grasso and Scheirer (1981), for example, reported the presence of fungi in the hydroids of the moss *Polytrichum commune* Hedw. but did not determine whether this moss-fungus association was pathogenic (host- parasite) or mycorrhizal-like. Fungal-moss associations are not very well understood in general.

The association of *Byssonectria tetraspora* and *Octospora leucoloma* with *Bryum argenteum* and *Bryum bicolor* occurs very often in different parts of the world (for example in Britain, Egypt and Kuwait). This suggests that the relationship must be so close that dispersal of their reproductive units occurs together. And that the relationship is probably the result of co-evolution (cf. Gilbert, 1979; Scott and Taylor, 1983). One of our aims in writing this paper is therefore, to encourage students of botany and microbiology, particularly in this area of the world, to put on record any such associations they encounter and also to investigate carefully the nature of these bryophyte fungal associations.

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أول تسجيل لترباط بين حزاز وفطر من مصر

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المستخلص: تمت الإشارة إلى أن الحزازيات تترباط مع كائنات تنتمي لجميع ممالك الأحياء ، وكذلك تترباط الفطريات مع كائنات من جميع الممالك ، بما في ذلك مملكة الفطريات نفسها. تمت الإشارة بشيء من التفصيل إلى الترباط بين الحزازيات والفطريات وإلى أن هذا البحث يسجل ترباطا بين حزاز *Bryum argenteum* Hedw وفطر *Byssonectria tetraspora* (Berk.) Rogerson & Korf لأول مرة من مصر .

تم وصف الحزاز والفطر والبيئة التي ينموان بها وصفا دقيقا مزودا بصور فوتوغرافية في موقع النمو ومن الميكروسكوب (المجهر) الضوئي .

وضع البحث أن هذا الترباط بين الحزاز والفطر المذكورين يحدث أيضا في جهات أخرى من العالم. وناقش الأسباب المحتملة لتفسير هذا الترباط المتكرر. وذكر أن من بين أهداف هذا البحث بحث دارسي النبات والميكروبيولوجي في هذه المنطقة من العالم ، ليس فقط على تسجيل ما يصادفونه من ترباط بين مثل هذه الكائنات ، ولكن أيضا دراسة كل ترباط بدقة مستفيضة لمعرفة نوع العلاقة بين الكائنين ، والتي لم يزل يحيط بها الكثير من الغموض في معظم الحالات المسجلة في العالم .