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Fungi of the genus *Discosia* (*Deuteromycotina*) in the Mediterranean area

Abstract

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Although c. 1500 Mediterranean *Discosia* specimens have been studied, the record is still very incomplete. At present, 19 species (of a world total of 77), and 4 of 6 described sections, are known to occur in 7 Mediterranean countries: 15 in Italy, 11 in France, 5 in Bulgaria, 3 in Spain, and 1 each in Greece, Turkey and Algeria. Four of them have been described but recently. Notes on their distribution, ecology, and substrate preferences are presented.

Introduction

The genus *Discosia* Lib. was described by Libert (1837). According to the modern classification of Sutton (1980), it belongs to the subdivision *Deuteromycotina*, class *Blastodeuteromycetes*, order *Blastales*, suborder *Blastostromatineae*, and includes species with holoblastic conidiogenous cells, forming individual conidia. According to Subramanian & Chandra-Reddy (1974) and Sutton (1980), the genus includes 65 species and infraspecific taxa, but an extensive investigation of the mycotaxonomic literature has shown that no less than 83 names have been published under it. So far, the genus *Discosia* has not been subject to a monographic treatment. The paper of Subramanian & Chandra-Reddy (1974) is a considerable contribution to our knowledge of the genus, but is not unfortunately of a monographic character because of the limited number of specimens studied, which included only nine types or original specimens.

During the years 1980-1993 we have worked at a taxonomic revision of *Discosia*, with the purpose of obtaining the best possible knowledge of the number of taxa and their geographical distribution, arranging them by species delimited in conformity with modern species and speciation concepts in the imperfect fungi, and developing a modern classification of the genus.

Our species concept is based on morphological, biosystematical and physiological criteria. Subdivisions of the genus were defined on the basis of differences in conidogenesis, morphology of the reproductive organs, and the host-plant specificity of para-

sitic species. In this paper, general data on the species inventory, the geographical distribution and the trophic characteristics of the Mediterranean representatives of *Discosia* are presented.

Material and methods

Over 14,000 herbarium specimens from 44 major mycological herbaria were revised during our study, originating from all over the world, of which about 1500 came from the Mediterranean area. Thanks to the valuable assistance of Prof. Dr J. von Arx, former Director of CBS (Baarn, Holland), and to the responsiveness of herbarium curators, we were able to revise the types or original material for almost all species and infraspecific names published so far in this genus.

For the purpose of our study, mixed samples of completely formed, normally developed conidioms were taken from each specimen. Following standard methods, semi-stable lactophenol microscopic preparations with conidioms, conidiogenous cells and conidia were prepared. The morphological peculiarities of the generative organs were studied, and measurements were made, using an Amplival optical microscope. For the detailed study of conidiogenesis, thin cross sections of conidioms were prepared using a freezing microtome.

The variation of the length and width of 100 conidia per specimen was assessed by means of a statistical morphometric analysis. For the comparison of specimens, a linear-graphic representation of the statistical parameters was used: extreme values of the studied features (min-max), arithmetic mean value for each feature (\bar{x}), and standard deviation (S). According to Tibell (1980), the specimens thus compared are discrete with respect to the studied feature when there is no graphic overlap within the range of $\bar{x} \pm S$.

Results and discussion

The morphological characters with the lowest degree of variability, and thus with the highest taxonomic value, are shape and size of the conidiogenous cells and the conidia, number and position of the conidial septa, and exact place of formation of the conidial appendages.

Fresenius (1852) was the first to draw attention to the differences in the position of the conidial septa and the conidial appendages that exist in some species *Discosia*. Later such differences were mentioned by Lobik (1928), Tehon (1933), Morgan-Jones (1964) and others. Subramanian & Chandra-Reddy (1974.) established the constant character of these features and used them taxonomically to classify the ten species they studied into four groups. Yet, as they noted themselves, due to the small number of types or original specimens they had managed to revise, their study remained unfinished and their data tentative.

On the basis of the relative length of the conidial cells and the exact position of the conidial appendages we have grouped the species *Discosia* into 6 sections: *D. sect. Discosia*, with 27 species; *D. sect. Laurina* Vanev, with 24; *D. sect. Clypeata* Vanev, with 4; *D. sect. Libertia* Vanev, with 1; *D. sect. Strobilina* Vanev, with 19; and *D. sect.*

Poikilomera Vanev, with 2 (Vanev 1991). Within the limits of each section, the species were differentiated on the basis of the structure and dimensions of the conidiogenous cells and conidia, as well as of the trophic characterization of the species (saprotrophs, biotrophs).

As a result of our revision, a total of 77 distinct species are recognized in *Discosia*, whereas 18 previously described taxa have been excluded from the genus, 13 remain uncertain due to the lack of herbarium material, and 18 specific and infraspecific names are considered as synonyms.

Discosia species were found to occur in the subarctic, temperate and tropical regions of the world. The largest number of species is found in the temperate zone, and the lowest in the subarctic. A considerable number of species occur in the subtropics and tropics

Table 1. Species of *Discosia* known from the Mediterranean area

| Species | substrate or host | country |
|------------------------|---|--------------------------------------|
| <i>D. artocreas</i> | <i>Acer</i> sp., <i>Betula pendula</i> , <i>Eriobotrya japonica</i> , <i>Fagus sylvatica</i> , <i>Quercus pedunculata</i> | Bulgaria, France, Italy |
| <i>D. faginea</i> | <i>Castanea</i> sp., <i>Crataegus monogyna</i> , <i>Platanus</i> <i>orientalis</i> , <i>Quercus pedunculata</i> | Bulgaria, France, Italy, Spain |
| <i>D. ludwigii</i> | <i>Platanus hybrida</i> , <i>Quercus</i> sp. | Italy, Spain |
| <i>D. minuta</i> | <i>Saxifraga cuneifolia</i> | Bulgaria, Italy |
| <i>D. potentillae</i> | <i>Agrimonia eupatoria</i> | Bulgaria |
| <i>D. aquatica</i> | <i>Betula</i> sp., <i>Castanea</i> sp., <i>Eriobotrya japonica</i> , <i>Juglans nigra</i> , <i>Sparganium erectum</i> | France, Italy |
| <i>D. jordanovii</i> | <i>Robinia</i> sp. | Italy |
| <i>D. laurina</i> | <i>Laurus nobilis</i> | France, Italy, Spain |
| <i>D. petrakii</i> | <i>Ceratonia siliqua</i> | |
| <i>D. quercicola</i> | <i>Castanea</i> sp., <i>Fagus sylvatica</i> , <i>Quercus peduncu-</i> <i>lata</i> | France, Italy |
| <i>D. saccardoii</i> | <i>Fagus sylvatica</i> | France, Italy |
| <i>D. lamiacearum</i> | <i>Ajuga reptans</i> , <i>Glechoma hirsuta</i> , <i>Salvia glutinosa</i> | Bulgaria |
| <i>D. placentula</i> | <i>Crataegus monogyna</i> , <i>Pyrus pyraeaster</i> , <i>Rosa</i> sp., <i>Sorbus domestica</i> | France, Italy |
| <i>D. arxii</i> | <i>Fraxinus americana</i> | Italy |
| <i>D. ostiolata</i> | <i>Ilex aquifolia</i> | France |
| <i>D. pleurochaeta</i> | <i>Arbutus unedo</i> , <i>Cinnamomum camphora</i> , <i>Laurus</i> <i>nobilis</i> , <i>Phillyrea latifolia</i> , <i>Rhododendron ponticum</i> | Algeria, Italy, Turkey |
| <i>D. smilacina</i> | <i>Smilax aspera</i> | Italy |
| <i>D. strobilina</i> | <i>Abies alba</i> , <i>Picea abies</i> , <i>Pteridium aquilinum</i> , <i>Fagus sylvatica</i> | France, Italy |
| <i>D. theae</i> | <i>Camellia sinensis</i> | Italy |

of the both hemispheres, but figures are tentative because these regions are relatively poorly studied.

In a Mediterranean context, thanks to the study of over 1500 relevant herbarium specimens, the following data on species composition, distribution and hosts or nutritive substratum requirements now exist for *Discosia*.

From the Mediterranean area 19 species are known, classified into sections as follows: *D.* sect. *Discosia*, with 5 species; *D.* sect. *Laurina*, with 7; *D.* sect. *Clypeata*, with 1; and *D.* sect. *Strobilina*, with 6 (Table 1, Fig. 1). There are no representatives of *D.* sect. *Libertia* and *D.* sect. *Poikilomera* in Mediterranean countries.

The number of Mediterranean *Discosia* species is 51 % of that known from the whole of Europe (37), and 25 % of the world total (77), i.e. more than half of the species so far known for Europe and 1/4 of those known for the world are found in the Mediterranean region. For *D.* sect. *Discosia* alone, the percentage is 31 % and 32 %, respectively; for *D.* sect. *Laurina*, 79 % and 29 %; for *D.* sect. *Clypeata*, 50 % and 25 %; for *D.* sect. *Strobilina*, 67 % and 19 %. The high species diversity of *Discosia* in the Mediterranean indicates that area as a possible formative centre of the genus. Support for this hypothesis comes from the fact that during our study four species new to science were described from that region: *D. arxii* Vanev, *D. jordanovii* Vanev, *D. petrakii* Vanev (Vanev 1993a-b, 1995), and *D. lamiacearum* Vanev (unpubl.).

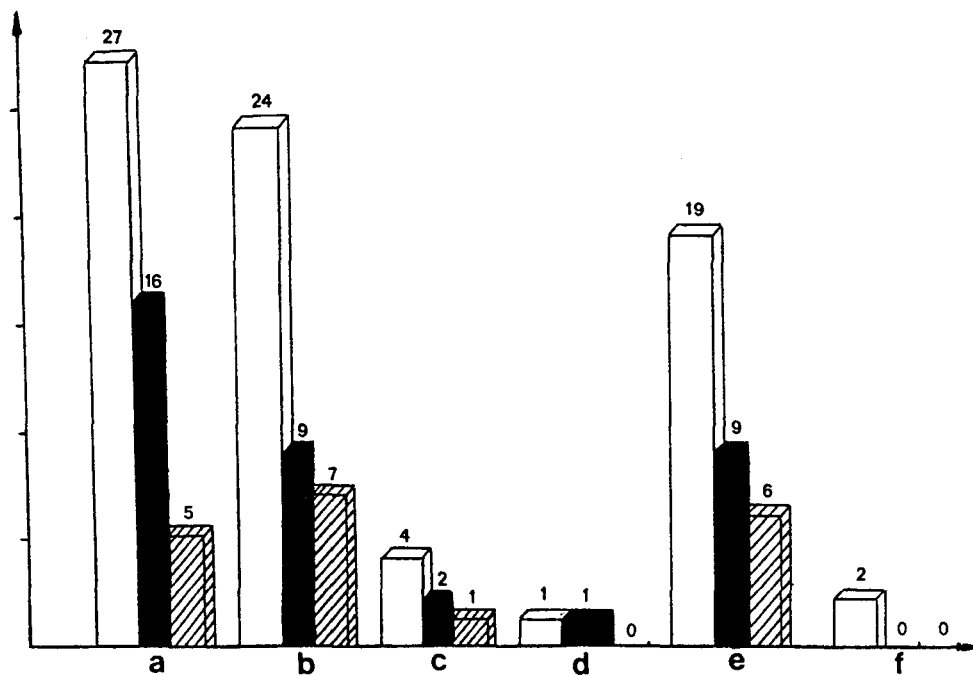


Fig. 1. Total numbers of *Discosia* species found world-wide (blank columns), in Europe (black columns), and in the Mediterranean region (hatched columns). – a, *D.* sect. *Discosia*; b, *D.* sect. *Libertia*; c, *D.* sect. *Clypeata*; d, *D.* sect. *Libertia*; e, *D.* sect. *Strobilina*; f, *D.* sect. *Poikilomera*.

During our investigation, we found that there are typically Mediterranean species of *Discosia*: *D. jordanovii*, *D. laurina* Caldesi and *D. petrakii*, all of *D. sect. Laurina*, characterized by certain common morphological features such as thin, arch-shaped, evenly falcate conidia. This morphologically well differentiated group of three species is only found in the Mediterranean zone of Europe (Spain, Italy, France), which indicates their common origin in that formative centre.

Also to be observed in the Mediterranean region are some tropical and subtropical species, characterized by thick-walled, coloured conidia – an adaptation to high temperatures and to prolonged periods of draught. These species belong to *Discosia* sect. *Strobilina* and also grow in other tropical and subtropical regions of both hemispheres. Belonging to that group are *D. ostiolata* Berk. & M. A. Curtis, occurring along the Mediterranean (S. France), Africa (Zambia) and the southern U.S.A. (South Carolina); *D. pleurochaeta* Durieu & Mont., distributed both around the Mediterranean (Italy, France, Turkey, Algeria) and in subtropical Asia (India, Pakistan); *D. smilacina* De Not., found in the Mediterranean region (Italy), the southern U.S.A. (Mississippi) and the Hawaii Islands.

The largest group, in the Mediterranean area, is that of mesophilous species, most of which belong to *Discosia* sect. *Discosia*: *D. artocreas* (Tode) Fr., *D. faginea* Lib., *D. minuta* Ces., and *D. ludwigii* Vaney, but some also to other sections: *D. aquatica* Fautrey, *D. saccardoi* Vaney and *D. quercicola* De Not. to *D. sect. Laurina*, *D. arxii* and

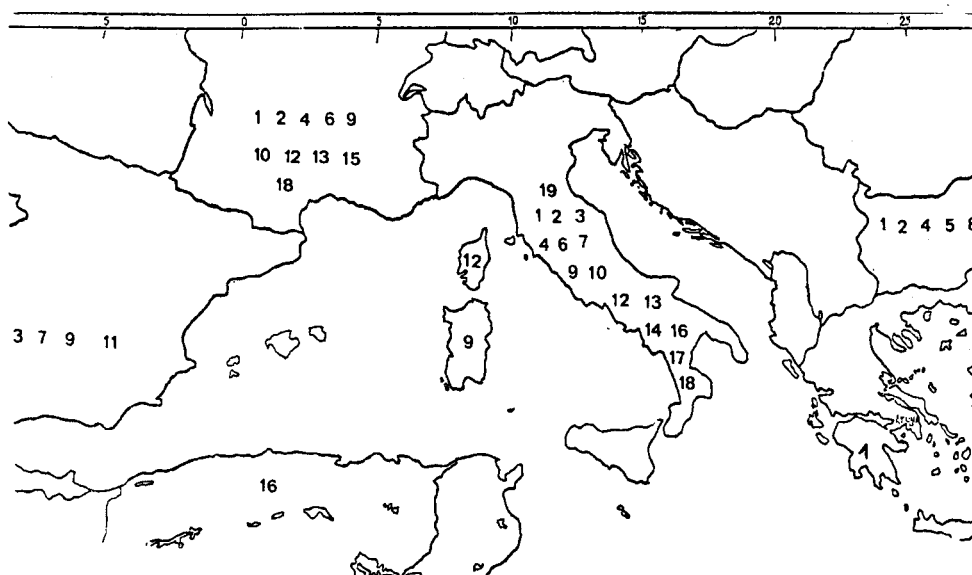


Fig. 2. Distribution of *Discosia* species in the Mediterranean countries: 1, *D. artocreas*; 2, *D. faginea*; 3, *D. ludwigii*; 4, *D. minuta*; 5, *D. potentillae*; 6, *D. aquatica*; 7, *D. jordanovii*; 8, *D. lamiacearum*; 9, *D. laurina*; 10, *D. quercicola*; 11, *D. petrakii*; 12, *D. saccardoi*; 13, *D. placentula*; 14, *D. arxii*; 15, *D. ostiolata*; 16, *D. pleurochaeta*; 17, *D. smilacina*; 18, *D. strobilina*; 19, *D. theae*.

D. strobilina Lib. to *D. sect. Strobilina*. The species of this group are widely spread, predominantly in the temperate regions of the Northern Hemisphere, some of them extending to the subarctic region (Finland, Scandinavia) but most reaching their northern boundary in Central-Europe (Germany, Poland, Austria, Czechia, Slovakia, etc.). The southern boundary of their European range most often runs along the southern coasts of the Iberian, Apennine and Balkan peninsulas, the western coasts of Asia minor, and may include the Mediterranean islands (Fig. 2).

In the individual Mediterranean countries the number of species so far recorded is 15 for Italy, 11 for France, 5 for Bulgaria, 3 for Spain, and 1 each for Greece, Turkey and Algeria (Table 1), but the inventory in this region is definitely incomplete and these data are therefore merely tentative.

Of the 19 species known so far from the Mediterranean region, those most widely distributed are *D. artocreas* (Bulgaria, Kerkira in Greece, Italy, France), *D. faginea* (Bulgaria, France, Italy, Spain), *D. pleurochaeta* (Algeria, Italy, Turkey), and *D. laurina* (France, Italy, Spain); other species, like *D. arxii* (Italy), *D. petrakii* (Spain), and *D. smilacina* (Italy) have a much more limited distribution (Fig. 2).

Mediterranean *Discosia* species are saprotrophs, more rarely also biotrophs, mostly growing on trees and shrubs, seldom on herbs. Most often the conidioms are formed on living or dead leaves, rarely on dead wood. The parasitic species form spots of various sizes, shapes and colours, but these features are not stable and have little taxonomic value.

Host specificity of the biotrophic species, experimentally tested by cross infections, is most often to a given plant family. Most probably some parasitic species may attack plants from different families, but further studies are required to confirm this.

Some of the saprotrophic species show varying degrees of trophic specialization. For instance, *D. laurina* has been found only on dead leaves of *Laurus nobilis* L., regardless of its widespread occurrence in the Mediterranean region; *D. placentula* develops only on dry leaves of *Rosaceae* species: *Sorbus domestica* L. (in Italy), *Pyrus pyraeaster* Burgsd., *Crataegus monogyna* Jacq. and *Rosa* sp. (in France). The tropical *D. pleurochaeta* has been observed only on dry leaves of evergreen representatives of the *Ericaceae*, *Lauraceae*, and *Oleaceae*. Most of the saprotrophic species show no preference of a particular nutrient substrate: they develop on vegetative debris of different origin, most often on dry leaves of plants of various families.

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