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Dematiaceous *Hyphomycetes* from Circeo National Park Mediterranean maquis litters

Abstract

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Sixteen species of Dematiaceous *Hyphomycetes* were found and described on litter of Mediterranean maquis at Circeo National Park; three of them are proposed as new species: *Dictyochaeta circei, Circinotrichum mediterraneum* and *Penzigomyces ilicis*.

Key words: Circeo National Park, Dematiaceous Hyphomycetes.

Introduction

Investigations on fungi suggest that the imput of different types of plant litter, as litter productivity of plant communities, varies with ecosystem types. In Mediterranean ecosystem sclerophyllous vegetation is considered a physiological adaptation against dehydration and nutrient availability. Leaves from these contain peculiar substances with different degrees of antimicrobial and antifungal activity, that play an important role on fungal colonization with different degrees of enzimatic competence. In this context the study of *Dematiaceous Hyphomycetes* litter colonization can provide useful informations to improve the knowledge on such ecosystem.

Two contributions on saprotrophic *Dematiaceous Hyphomycetes* from Mediterranean maquis located in Pantelleria island were recently carried out by Rambelli & al. (2008, 2009). The researches in this ecosystem so well preserved will continue in other sites with Mediterranean maquis and suggest to consider Pantelleria as base of comparison to other study areas. In this work several samples of litter collected at Torre Paola (locality within Circeo National Park characterized by Mediterranean maquis comparable to Montagna Grande in Pantelleria) were investigated.

Material and methods

In this research we punctually applied the same techniques previously utilized in previous works. It is important to remind that the drawings are obtained from a single picture of all the morphological characters, so repeated for the different fungi found, just to obtain a perfect correspondence of the dimensions and proportions.

Samples were collected from February to May 2009. The natural substrata colonized by species of *Dematiaceous Hyphomycetes* proposed as new were deposited in the *Herbarium Mediterraneum Panormitanum* (PAL).

The study area

The Circeo Promontory shows different ecological environments. Anthropic pressure has deeply transformed the vegetation cover and soils with an increase of community diversity. According to data reported by Blasi & Spada (1984) and Filesi & al. (1998) the main vegetation types of the Circeo National Park (Central Italy) are represented by Mediterranean evergreen vegetation, coastal-plain deciduous oak-forest and vegetation of inundated and drain canals. The Mediterranean evergreen vegetation is characterized by a sclerophyllous forest with typical elements of the Mediterranean maquis such as *Quercus ilex* L., *Arbutus unedo* L., *Phillyrea latifolia* L., *Erica arborea* L. and, less frequently, *Pistacia lentiscus* L. and *Fraxinus ornus* L. *Q. suber* L. and *Q. pubescens* Willd. are also common while in the more undisturbed vegetation *P. lentiscus* L., *Cistus monspeliensis* L., *C. salvifolius* L., *Rosmarinus officinalis* L., *E. multiflora* L. and *Juniperus phoenicea* L. play an important role. Towards the top of the dunes, *Juniperus oxycedrus* subsp. *macrocarpa* (S. & S.) Ball communities can be observed while in the less anthropized areas the dunes are colonized by *J. phoenicea* L. The deciduous oak-forests are characterized by *Q. frainetto* Ten. and *Q. cerris* L., with scattered stands of *Q. robur* L. s.s. and *Q. petraea* (Mattuschka) Liebl. Also *Q. crenata* Lam. could be observed in the investigated area. Among the communities of inundated and drain canals, the presence of *Ricciocarpus natans* L. is noteworthy.

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Taxonomic part

Dictyochaeta sp. (D.1) (Fig. 1)
Type species: *Dictyochaeta fuegiana* Speg., 1923.

Colonies effuse, very large and crowded, brown, composed by regular groups of conidiophores. Setae absent. Conidiophores macronematous, mononematous, straight or gently

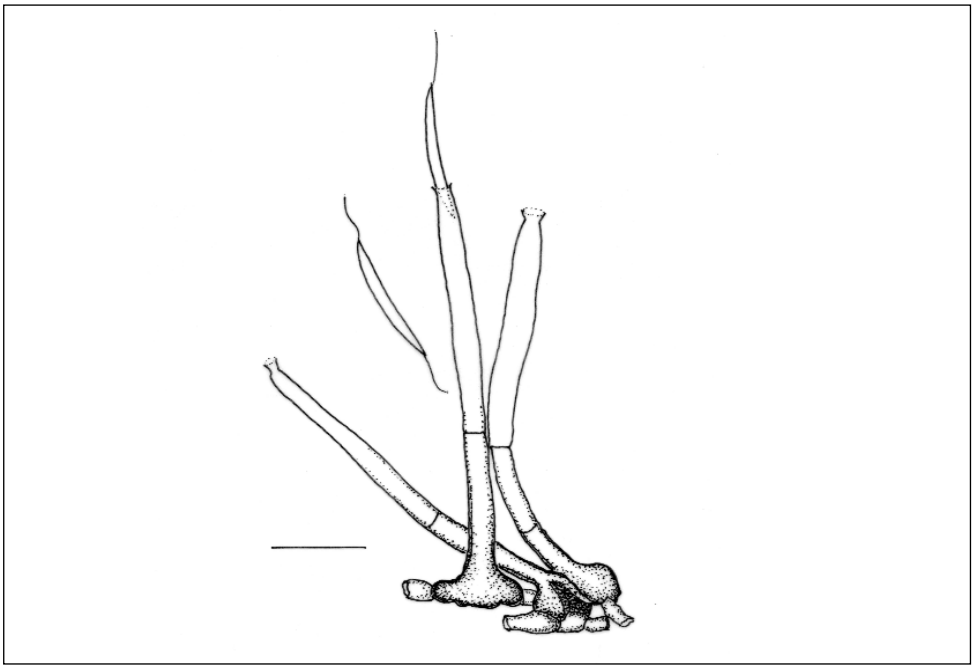

Fig.1. *Dictyochaeta* sp., a monophialidic and not setose species. Bar 12 µm.

flexuous, not branched, septate, smooth, brown, paler towards the apex, 50-65x4 µm. Conidiogenous cells monophialidic, integrated, terminal, cylindrical, with collarettes. Conidia aggregated at the apex of the conidiogenous cells, 0-septate, hyaline, smooth, falcate, with apices slightly acuminate, setulated, 18-20x2 µm, setules 4-9x0,9 µm.
On dead leaves of *Rhamnus catharticus* L. and *Phillyrea latifolia* L.
Deposited: PAL.

Our monophialidic strain has conidia similar to *D. simplex* (Hughes & Kendr.) Hol.-Jech. (1984) in shape and dimensions, but differs in the conidiogenous cells (polyphialidic in *D. simplex*), and in conidiophores dimensions.
Dictyochaeta circei Tempesta & Ramb. sp. nov. (Fig. 2)
Type species: *Dictyochaeta fuegiana* Speg. 1923.
Etymology: *circei* from Circeo National Park the locality were the holotype was collected.

Coloniae effusae, dispersae, ex conidiophora solitaria constituta. Setae erectae, recta vel leniter flexuosa, brunneae, basin versus atrobrunneae, apicem versus pallidiora, septatae, leaves, 190-320 µm longae, ad basin 5-6 µm latae. Conidiophora singulariter, macronematosa, mononematosa, recta, erecta, brunnea, apicem versus brunneis, laevia, septata, ab eadem basi setarum oriuntur, 47-110x4-6 µm. Cellulae conidiogenae sympodiales et percurrentia, collis cilindrico terminantia. Conidia leniter curvata, hyaline, 0-septata, non

setulata, apicem versus attenuate, 16-19x1.8 µm.
Ad foliis emortuis *Rhamnus catharticus* L.
Colonies effused, composed by not crowded conidiophores. Setae erect, gently flexuous, brown, dark brown near the base and clearer towards the apices, septate, smooth, 190-320x5-6 µm near the base. Conidiophores growing near the base of the setae, macronematous, mononematous, straight, erect, brown, clear brown towards the apices, smooth, septate, 47-110x4-6 µm, conidiogenous cells included. Conidiogenous cells growing sympodially and percurrently. Collarettes cylindrical. The first conidiogenous locus become lateral by a new growing point and then the conidiogenous cell growth percurrently up to a new fertile locus, preserving laterally the residuals of the previous loci. Conidia slightly falcate, with apices gently pointed, hyaline, 0-septate, without setules, 16-19x1,8 µm.
On dead leaves of *Rhamnus catharticus* L.
Holotype deposited: PAL.

The species described is characterized by an alternation of sympodial and percurrent development. This beaviour is different from what is described for many species of *Dictyochaeta* in which the percurrent development is realized through the apical funnel or cylindrical conidiogenous locus (Whitton & al. 2000: Kuthubutheen & Nawawi 1991; Morgan-Jones1982; Rodrigues da Cruz & al. 2008; Kirschner & Chen 2002; Hughes &

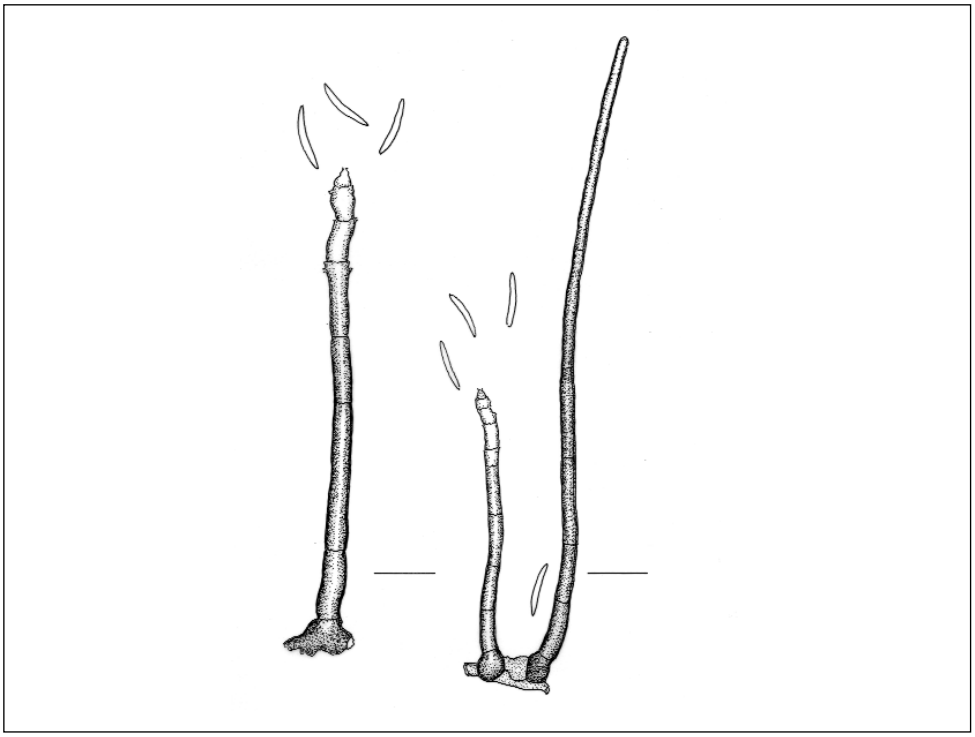

Fig. 2. *Dictyochaeta circei* sp. nov. Left bar 15.5 µm, right bar 20 µm.

Kendrick 1968). Since morphology and dimentions of the conidia of the species described seems different from the others mentioned in the references examined and for the particular sympodial and percurrent proliferation of the conidiogenous cell, we propose the new species *Dictyochaeta circei* for our strain.

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Dictyosporium freycinetiae McKenzie, 2008 (Fig. 3)
Type species: *Dictyosporium elegans* Corda, 1836.

Colonies sporodochial like, punctiform, not crowded, clear gray. Conidiophores micronematous and conidiogenous cells almost indistinguishible. Conidia very clear yellow, smooth, collected in great number all around the spododochial point, not complanate and composed by three rows closely appressed and originating from a basal cell (5x5 µm) approximately rounded but with pointed base, rows frequently not of the equal lengh and differing each other by one cell in number, each row is composed by 6-10 cells constricted at septa, 27-40x5-6 µm. The apical cell of each row is hyaline, inflated, irregularly subglobose, 7-10x7-9 µm.
On dead leaves of *Phillyrea latifolia* L.

This species was recently described by McKenzie (2008) and the small differences in the morphological characters of our strain could be presumably the result of a different substratum and mainly of the different ecological environment.

From the examined references this is presumably the first finding of the species in the European Mediterranean area.

Dictyosporium sp. (D.1) (Fig. 4)
Type species: *Dictyosporium elegans* Corda, 1836.

Colonies effuse. Conidiophores micronematous and conidiogenous cells almost indistinguishable. Conidia brown, red-brown, smooth, complanate and composed by four rows closely appressed, originating from a roundish basal cell and with the outer two rows longer; rows composed by 8-9 cells constricted at the septa, 22.5-25x14-16 µm.
On dead leaves of *Rhamnus catharticus* L.

The species is closed to *Dictyosporium brahmaswaroopii* M. D. Mehrotra (1990), but, owing to the poor material examined, we cannot identify it, hoping in the opportunity of future findings.
Deposited: PAL.

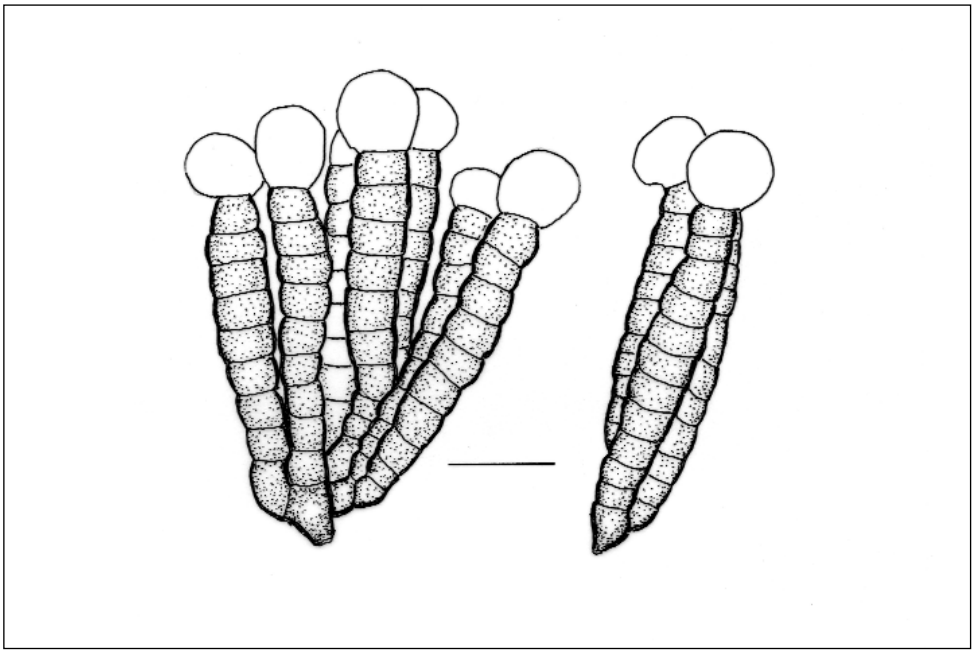

Fig. 3. *Dictyosporium freycinetiae* McKenzie, not complanate conidia. Bar 10 μm.

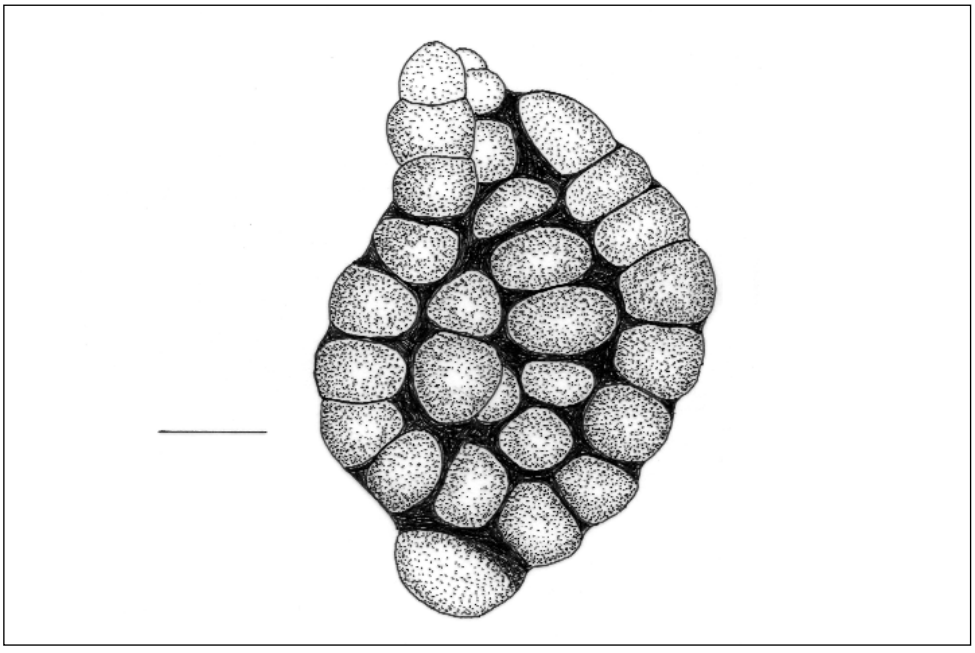

Fig. 4. *Dictyosporium* sp., complanate conidia. Bar 8 μm.

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Pseudodictyosporium wauense Matsushima, 1975 (Fig. 5)
Type species: *Pseudodictyosporium wauense* Matsushima, 1975.

Colonies effused, frequently composed by isolated conidiophores. Conidiophores macronematous, mononematous, solitary, erect, branched, clear brown, 27-61x3-4 µm conidiogenous cells included. Conidia composed by 3 parallel and appressed rows of 12-15 cells, brown, clear brown, smooth, 23x14-15 µm.
On dead leaves of *Rhamnus catharticus* L.

The species described has morphological characters very closed to *P. wauense* Matsushima (1975).

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Circinotrichum mediterraneum Rambelli & Tempesta sp. nov. (Fig. 6)
Type species: *Circinotrichum maculiforme* Nees, 1816.

Coloniae solitariae, in pulvinis aut sporodochia gregaria nitide marginata. Setae simplicia, modice flexuosa, recta haud circinata vel spiralata, intense brunnea, laevia, interdum basim inflata, ad marginem zonae fertilis insidentia, obscure phaeoseptata usque ad 350 micron et ultra elongata et circa 6 micron basim crassa. Conidiophora cylindrica, simplicia, semi-macronematica, ex textura hymeniale basim orientia, percurrentia, dilute brunnea, 9x5 micron. Cellulae conidiogenae monoblasticae, obclavatae, pallide brunnea, 16-20x5 micron. Conidia fusiformia, leniter flexa, haud bucinaeformia, unicellularia, biapiciacuta, ad centrum coloniarum vel ad saetarum basim in conspicuas massas lecta, 25-28x4 micron. Ad foliis emortuis *Hedera helix* et *Quercus ilex L.*

Colonies solitary, tufted, sporodochial like, very well circumscribed. Setae simple, erect, not circinate or spirally coiled, slightly flexuous, very dark brown, smooth, sometimes with a bulbous base, commonly around the fertile part of the colony, with septation obscured by a strong pigmentation, up to 350 µm and more long and 6 µm wide near the base. Conidiophores semi-macronematous, cylindrical, not branched and arising from the basal mycelium, percurrent, clear brown, 9x5 µm. Conidiogenous cells monoblastic, obclavate, clear brown, 16-20x5 µm. Conidia fusiform, slightly curved, not corniform, with apices slightly pointed, not septate, hyaline, in large masses at the center of the colony and at the base of the setae, 25-28x4 µm.

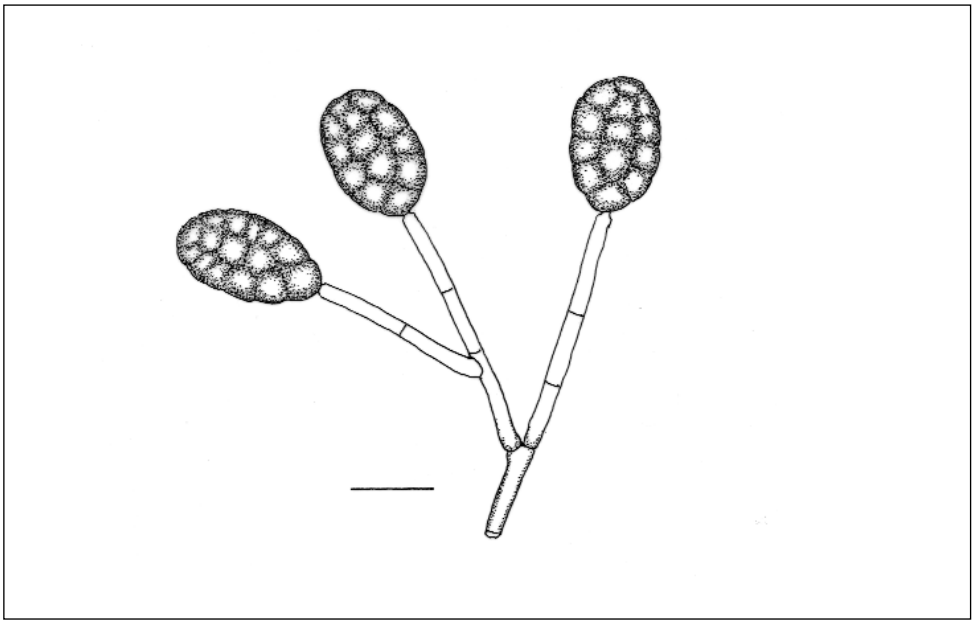

Fig. 5. *Pseudodictyosporium wauense* Matsush. Bar 15 µm.

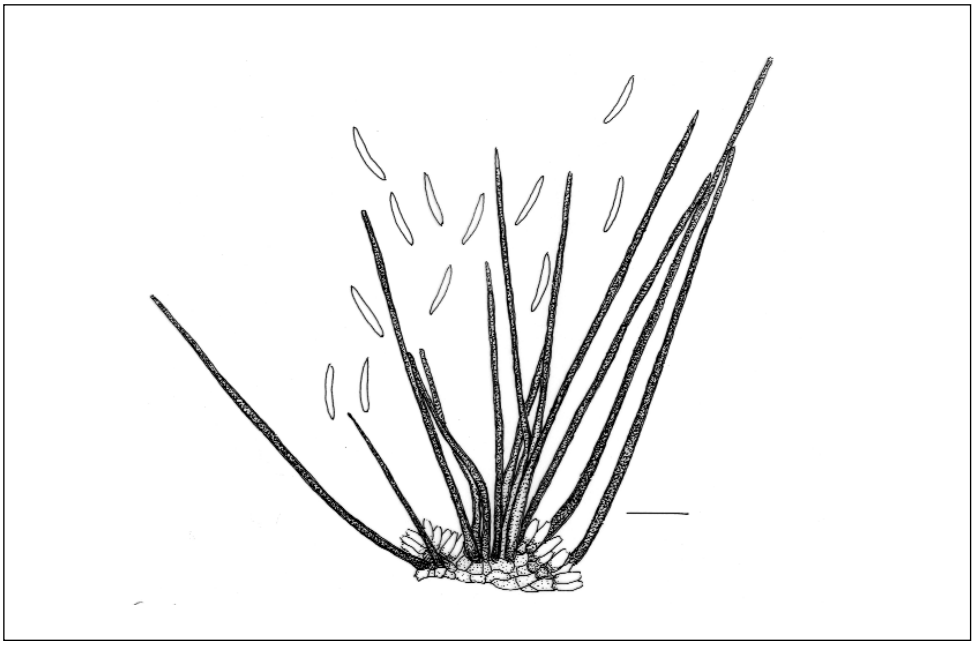

Fig. 6. *Circinotrichum mediterraneum* sp.nov. Ramb. & Tempesta.Sporodochium like colony with conidiophores, setae and conidia. Bar 35 µm.

On dead leaves of *Hedera helix* and *Quercus ilex* L.
Holotype deposited: PAL.

This beautiful species is characterized by large dimensions if compared with many known *Circinotrichum* species. Peculiar are the long, thick and sizeable apices of the conidiogenous cells. The particular substratum on which we have found our strain, dead leaves of *Hedera helix* and *Quercus ilex*, plants of the Mediterranean maquis vegetation, could be, presumably, selective for the species. Owing to the described characters we propose for our strain the name *Circinotrichum mediterraneum* as new species.

Circinotrichum papakurae Hughes & Pirozynski, 1971 (Fig. 7)
Type species: *Circinotrichum maculiforme* Nees, 1816.

Colonies amphigenous, developing regularly from immersed and superficial mycelium and with conidiophores and setae not crowded, brown, dark brown. Setae erect or gently flexuous, dark brown at the base and clearer towards the very thin apex, with septa difficult to observe, up to 340 µm long and 4-5 µm large near the base and tapering up to 1 µm wide at the apex. Conidiogenous cells growing from the superficial mycelium near the base of the setae, obclavate, lageniform, percurrent, very clear brown, 7-13x3-4 µm. Conidia forming a white amount at the base of the setae, cylindrical, with gently rounded apices, not corniform, 0-septate, hyaline, 14-18x2-4 µm.
On dead leaves of *Rhamnus catharticus* L.

The original description of *Circinotrichum papakurae* (Hughes & Pirozynski 1971) is referred to a strain with some morphological and mainly dimensional characters not completely corresponding to those observed in our studies. In the Mediterranean strain the setae can be very long (up to 300 µm and more), dark brown and with the fine above part flexous; nevertheless the size of the conidia and of the conidiogenous cells are well corresponding to the original description.

Gyrothrix sp. (G.1) (Fig. 8)
Type species: *Gyrothrix podosperma* (Corda) Rabenhorst, 1844.

Colonies well circumscribed, composed by several setae and reproductive structures very crowded, brown, dark brown. Setae growing from the basal mycelium, erect, thick-walled, dark brown, with septa very difficult to observe, twisted on the first basal branches and sinuous in the upper branches, branches slightly rough, 225-400x6-8 µm. Conidiogenous cells growing on micronematous conidiophores near the base of the setae, obclavate, lageniform, 7-14x5 µm. Conidia aggregated at the base of the setae, falcate, with apices gently pointed, not corniform, 0-septate, hyaline, 19-23x3 µm.
On dead leaves of *Rhamnus catharticus* L.
Depopsited: PAL.

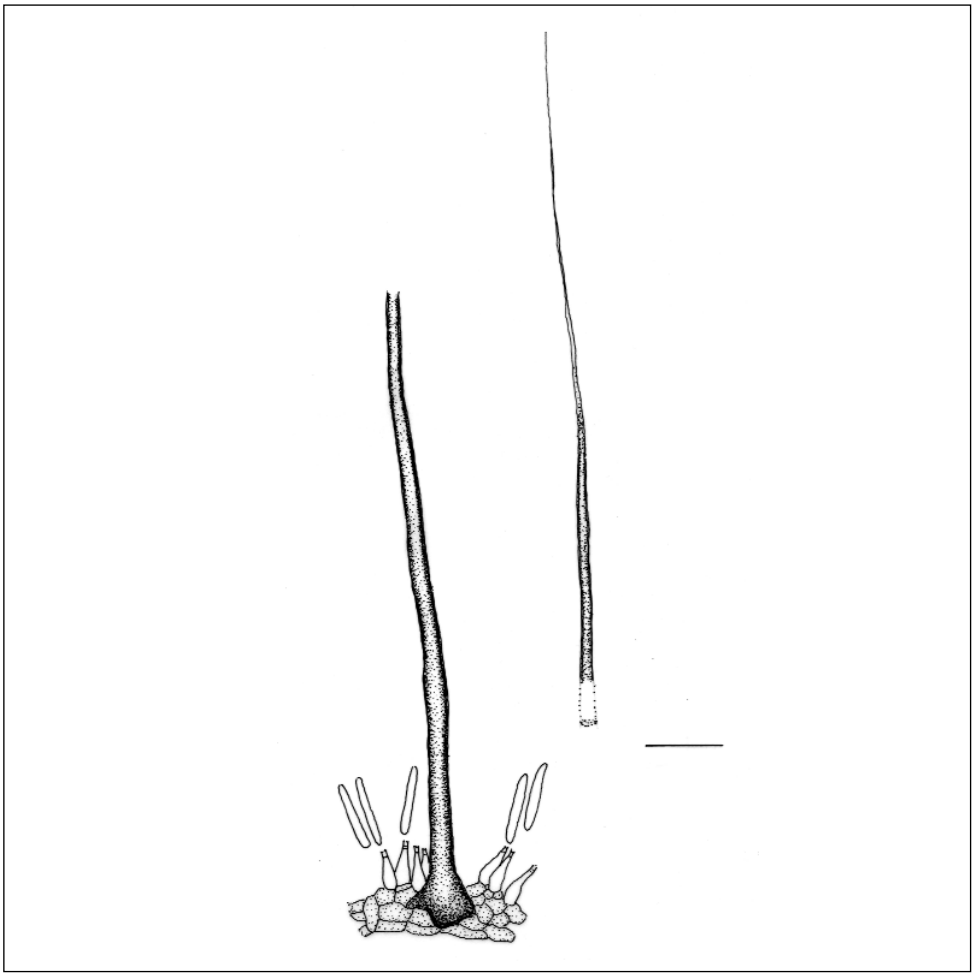

Fig. 7. *Circinotrichum papakurae*. Conidia, conidiogenous cells and setae. Bar 20 μm.

The strain described has some morphological characters coinciding with *Gyrothrix macroseta* Pirozynski and *G. flexuosa* Rambelli, like the dimension of the setae, the presence of basal twisted and apical sinuous branches as in *G. macroseta*, but differs for the dimensions of the conidia that, in our strain are also clearly falcate and not corniform. Nevertheless, the opportunity to propose our strain as a variety of *G. macroseta* seems not suggestible due to striking morphological differences at conidial level between these two species as well as versus *G. flexuosa*. But, considering that the Mediterranean maquis vegetation is exposed to strong seasonal climatic conditions, and of course the same is for the saprotrophs colonizing the dead leaves, the morphological characters observed in our strain could be the result of particular ecological conditions. In this situation we prefer to leave our strain undeterminate, hoping in the possibility to observe new material.

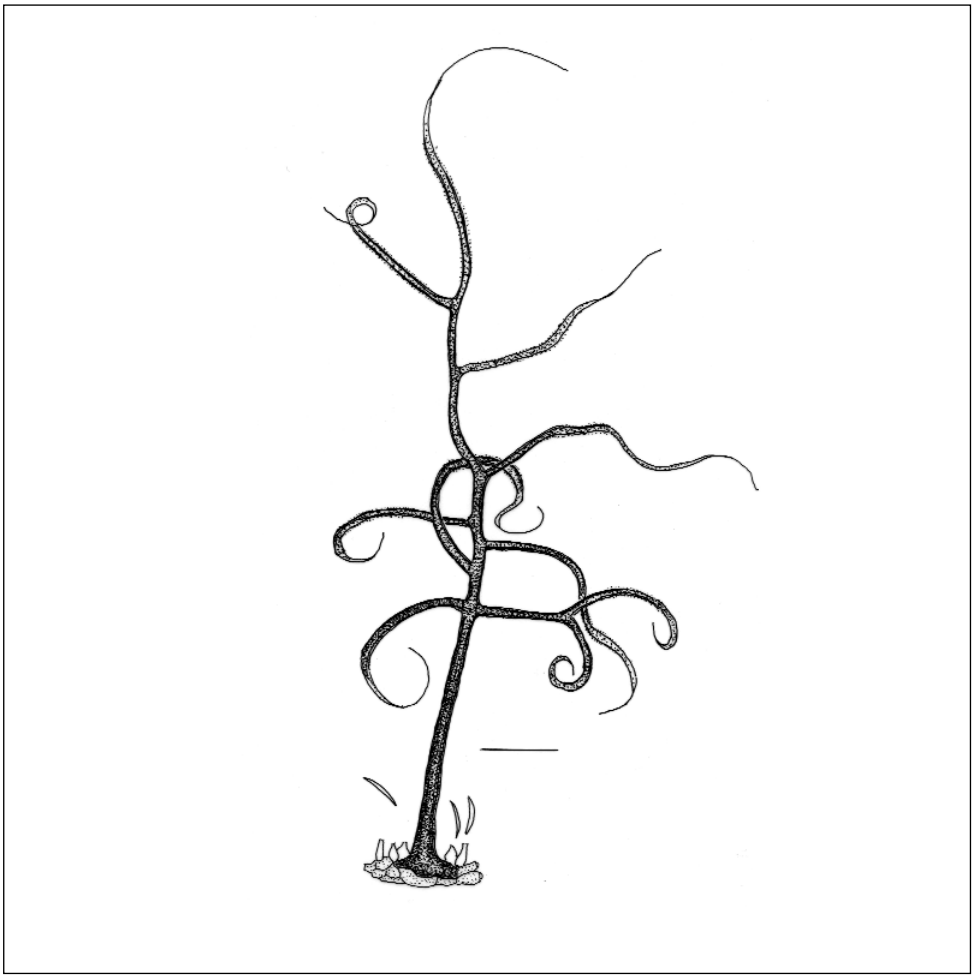

Fig. 8. *Gyrothrix* sp. Conidia, conidiogenous cells and setae. Bar 40 µm.

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Penzigomyces ilicis. Ramb. & Ciccarone. sp. nov. (Fig. 9)
Type species: *Penzigomyces nodipes* (Penz. & Sacc.) Subram., 1992.
Etym. *ilicis* since growing on dead leaves of *Quercus ilex.*

Coloniae effusae, dispersae, rarae, ex conidiophora solitaria constituta. Mycelium partim in substrato immersum. Conidiophora macronematosa, mononematosa, solitaria, erecta or saepe leniter flexuosa et nodosa, septata, numquam ramosa, laevia, brunnea vel aurata, 190-250x7 µm. Cellulae conidiogenae cylindricae, dilute brunneae, apicitruncatae, mono-

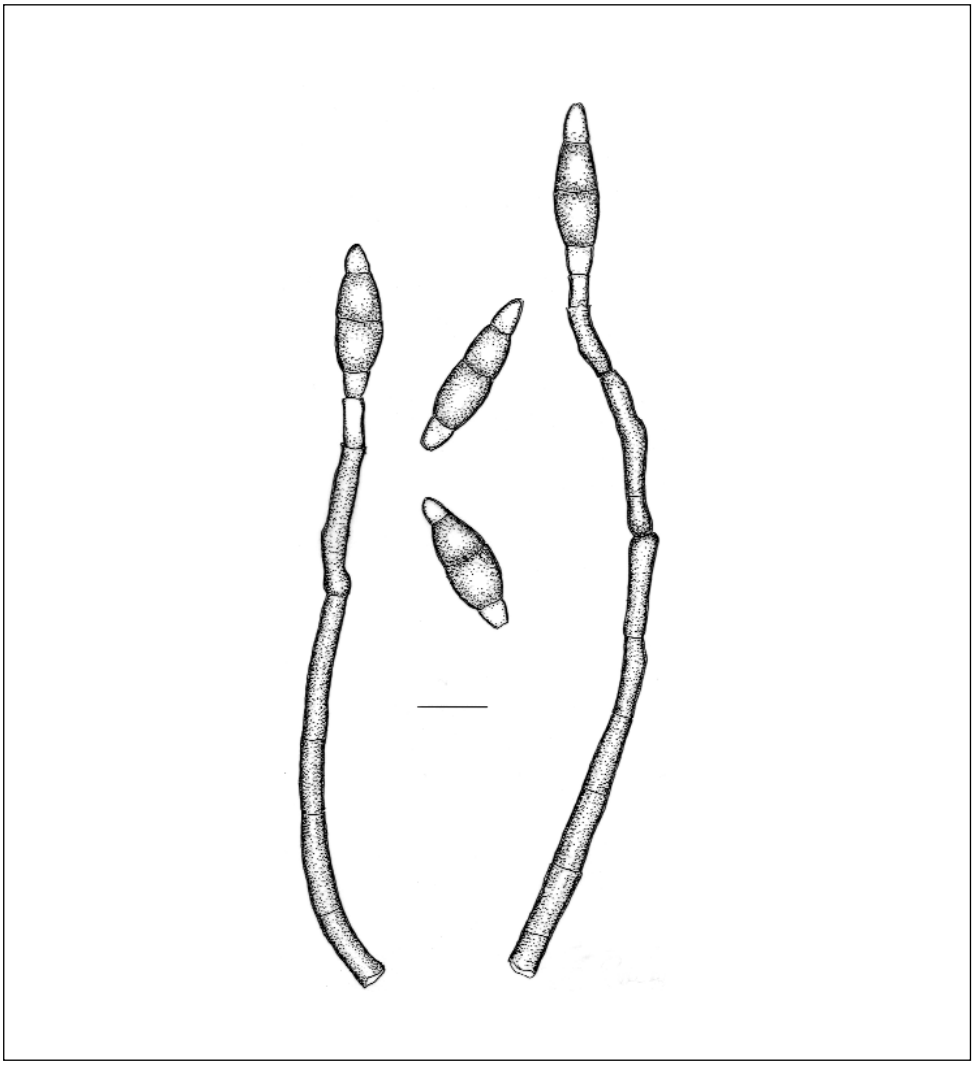

Fig. 9. *Penzigomyces ilicis* sp.nov. Percurrent conidiogenous cells on nodose conidiophores. Bar 20 µm.

blasticae, in conidiophoris incorporatae, terminales, percurrentia, 1-2 axialiter successive per schizolitica seiunctione 1-2 prolifera, in apice conidia solitaria ferentes. Conidia acrogena, 3-euseptata, solitaria, laevia, navicularia, ad septa leniter constricta, cum cellula apicali rotundata, cellula basali anguste conico-truncata, pallide brunnea capitate et cum cellulae interstiziali brunneae, 41-49x12-14 μm.
Ad foliis emortuis *Quercus ilex* L.

Colonies effused, not crowded, composed by solitary conidiophores. Mycelium partly immersed. Conidiophores macronematous, mononematous, solitary, erect, frequently gently flexuous and nodose, not branched, septate, brown, yellow-brown, smooth, 190-250x7 μm, conidiogenous cell included. Conidiogenous cells monoblastic, integrated, terminal, with 1-2 percurrent proliferations, with conidia schizolytic secession, cylindrical, with truncate apex, clear brown. Conidia solitary, acrogenous, 3-euseptate, with apical and lower cells clear brown and central cells brown, smooth, navicular, slightly constricted at the septa, apex rounded and base conico-truncate not protruding, 41-49x12-14 μm.
On dead leaves of *Quercus ilex* L.
Holotype deposited: PAL.

According to Subramanian (1992), because of the percurrent-nodose proliferation of the conidiophores and conidiogenous cells, our species must be included into the genus *Penzigomyces*. For some morphological characters is similar to *P. coprophilus* (Matsush.) Subram. (Basionym: *Sporidesmium coprophilum* Matsush, 1975) like the general morphology of conidiophores, but differs in the conidia shape, dimensions and colours. Since we don't find any species with morphological characters of our strain we propose the new species *Penzigomyces ilicis*.

Penzigomyces sp. (P.1) (Fig. 10)
Type species: *Penzigomyces nodipes* (Penz. & Sacc.) Subram. 1992.

Colonies inconspicuous, composed by isolated conidiophores. Mycelium partly immersed. Conidiophores macronematous, mononematous, solitary, erect, straight or slightly flexuous, not branched, septate, sometimes nodose and with a percurrent-irregular anellation, smooth, brown, clear towards the apex, up to 43 μm long (conidiogenous cell included) and 6 μm wide near the base. Conidiogenous cells, monoblastic, integrated, terminal, cylindrical, with truncate apex, brown, clear brown, with 1 or 2 sometimes nodose percurrent proliferations. Conidia solitary, acrogenous, 8-10 euseptate, straight, fusiform, obpyriform, brown, yellow-brown, with clear apex, smooth, 42-60x7-13 μm.
On dead leaves of *Pistacia lentiscus* L.
Deposited: PAL.

The species described presents morphological characters of the genus *Penzigomyces* (Subramanian 1992), but since we observed only poor material we leave the species indeterminate hoping in other findings.

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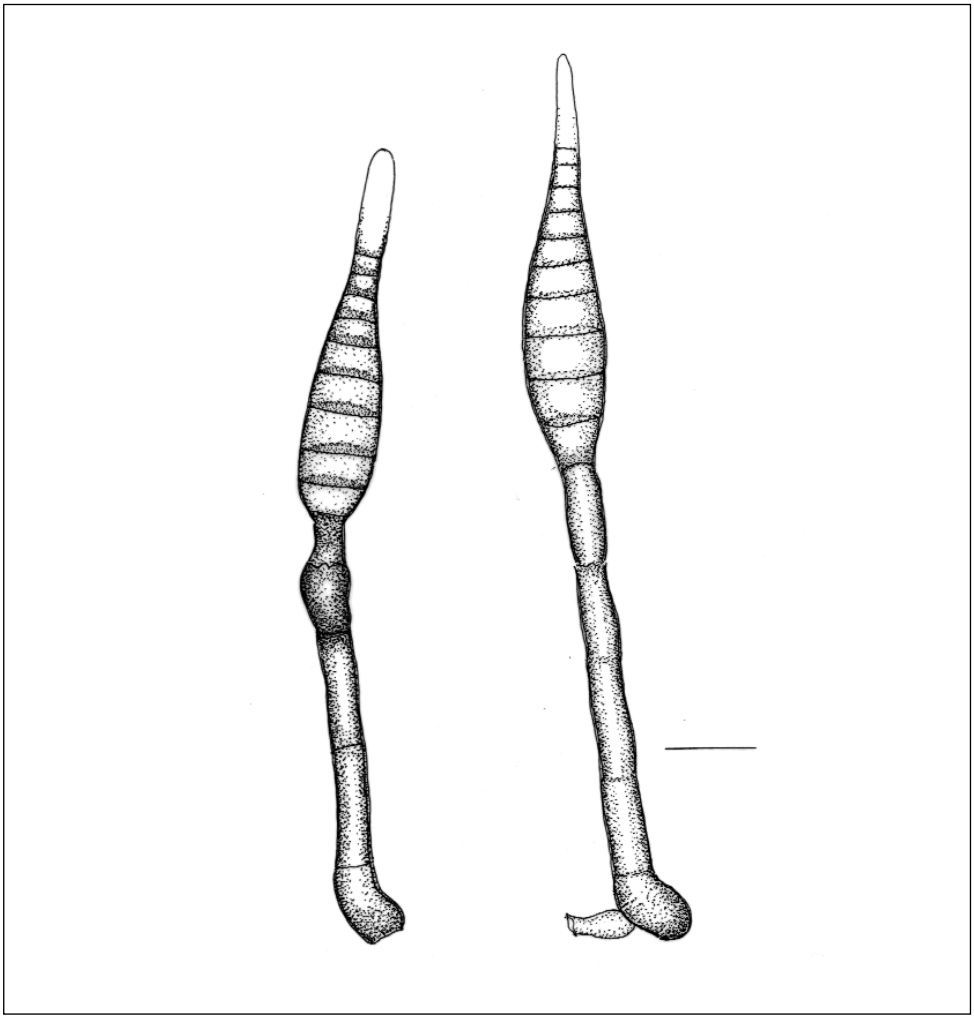

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Chaetopsina fulva Ramb. 1956 (Fig. 11)
Type species: *Chaetopsina fulva* Ramb. 1956.

Colonies effused, composed by isolated conidiophores.Conidiophores macronematous, mononematous, straight, setiform, smooth, yellow-brown or red-brown, septate, branched in the middle lower part, apices very rarely fertile, 135-185x5-7 µm. Branches hyaline or light yellow, adering to setiform conidiophores and originating in the proximity of a septum, 24-40x3 µm. Conidiogenous cells monophialidic, on the lateral branches, discrete, determinate, ampulliform, hyaline, 6-7x4 µm. Conidia rod shaped, cylindrical, simple, not septate, with rounded apices, hyaline, smooth, in slimy masses, 11-13x1.8 µm.
On dead leaves of undeterminate species.

The species described has some dimensional and morphological characters not exactly metking with the original description (Rambelli 1956), like a frequent variability in the setiform conidiophores and in its pigmentation varying from light yellow-brown to clear red-brown.

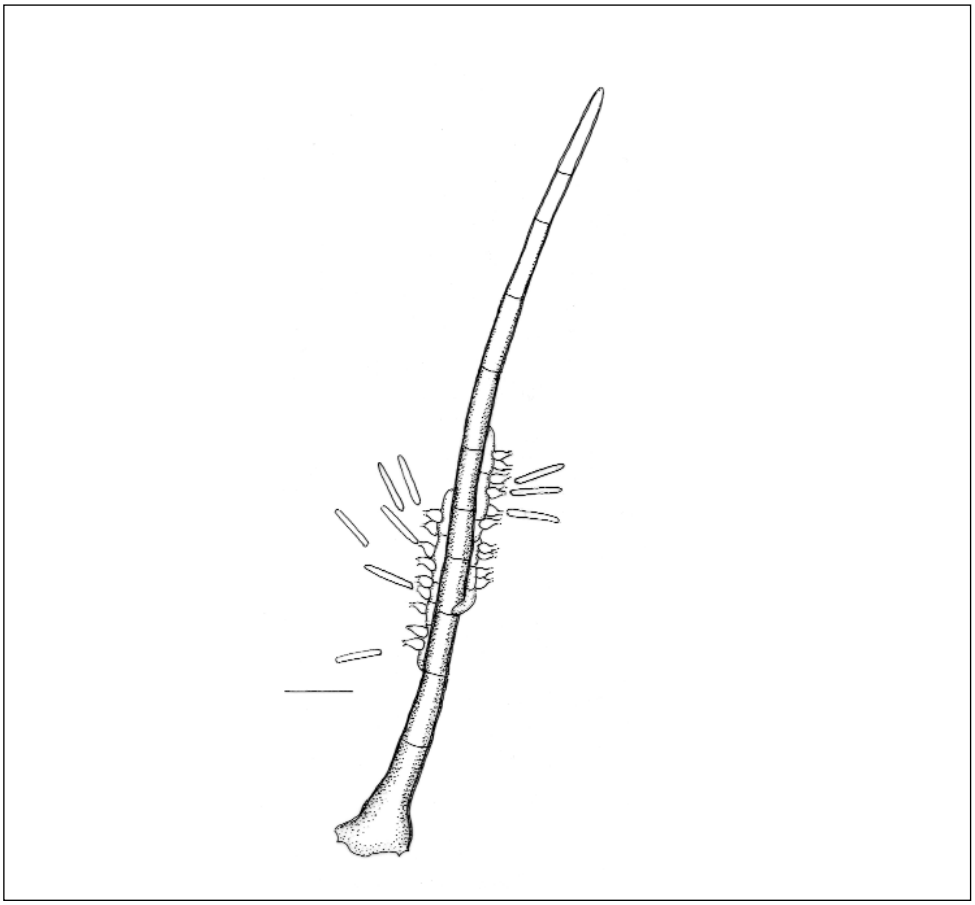

Fig. 11. *Chaetopsina fulva* Ramb. Conidiophores and conidia. Bar 18 µm.

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Arachnophora fagicola Hennebert, 1963 (Fig. 12)
Type species: *Arachnophora fagicola* Hennebert, 1963.

Colonies effused. Conidiophores macronematous, mononematous, solitary, straight, septate, brown in the lower part, clearer in the upper part, 67-83x4-7 µm. Conidiogenous cells integrated, terminal, monoblastic, percurrent. Conidia solitary, composed by a central body, with a medium septum, brown, smooth, upper cell 5-18x7-13 µm, lower cell 11-18x8-12 µm; the two main cells present lateral protuberances pale brown, 5-7x5-7 µm: each protuberance is adorned by 2 or more invardly curved , hyaline, spines, 9-14x2-3 µm. On dead leaves of *Quercus ilex* L.

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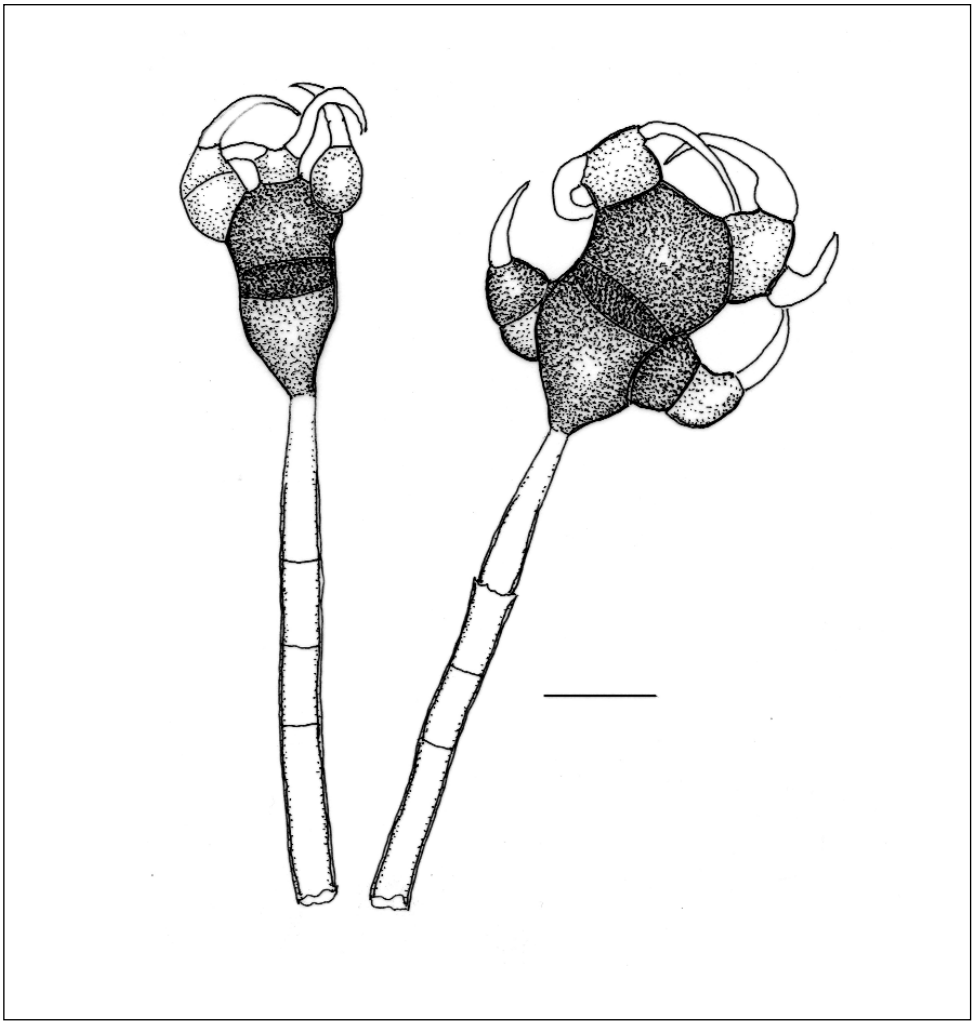

Fig. 12. *Arachnophora fagicola* Hennebert. Arachnoid conidia. Bar 12 µm.

Hansfordia pulvinata (Berk. & Curt.) Hughes, 1958 (Fig. 13)
Type species: *Hansfordia ovalispora* S.Hughes, 1951.

Colonies hairy, composed by solitary conidiophores. Conidiophores macronematous, mononematous, repeatedly branched, straight, pale brown in the lower echinulated part and paler in the upper smooth part, very variable in lenght. Conidiogenous cells as branches of the conidiophores, subhyaline, echinulate, sympodial, polyblastic, integrated, terminal, cylindrical, denticulated with denticles as separating cells, 25-34x4-5 µm. Conidia spherical, very clear brown, echinulate, 8-9x7-9 µm.
On dead leaves of *Arbutus unedo* L.

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Subramaniomyces fusisaprofiticus (Matsush.) P.M. Kirk, 1982 (Fig. 14)
Type species: *Subramaniomyces indicus* Varghese & Rao 1980.

Colonies effused, very crowded and composed by several conidiophores, white or clear buff. Mycelium partly immersed. Conidiophores macronematous, mononematous, erect, straight, smooth, septate, clear brown, paler towards the apex, 22-65x2-5 µm, conidiogenous cell included. Conidiogenous cells integrated, terminal, polyblastic, sympodial, with cylindrical denticles. Conidia dry, in acropetal chains, fusiform, smooth, hyaline, 18-

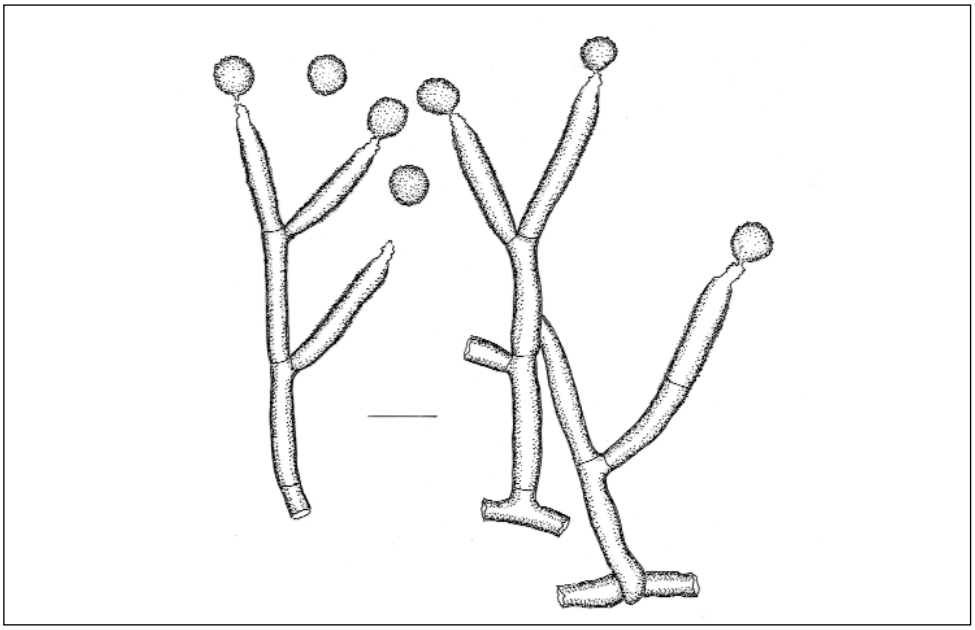

Fig. 13. *Hansfordia pulvinata* (Berk. & Curt.) Hughes. Conidiophores and conidia. Bar 16 µm.

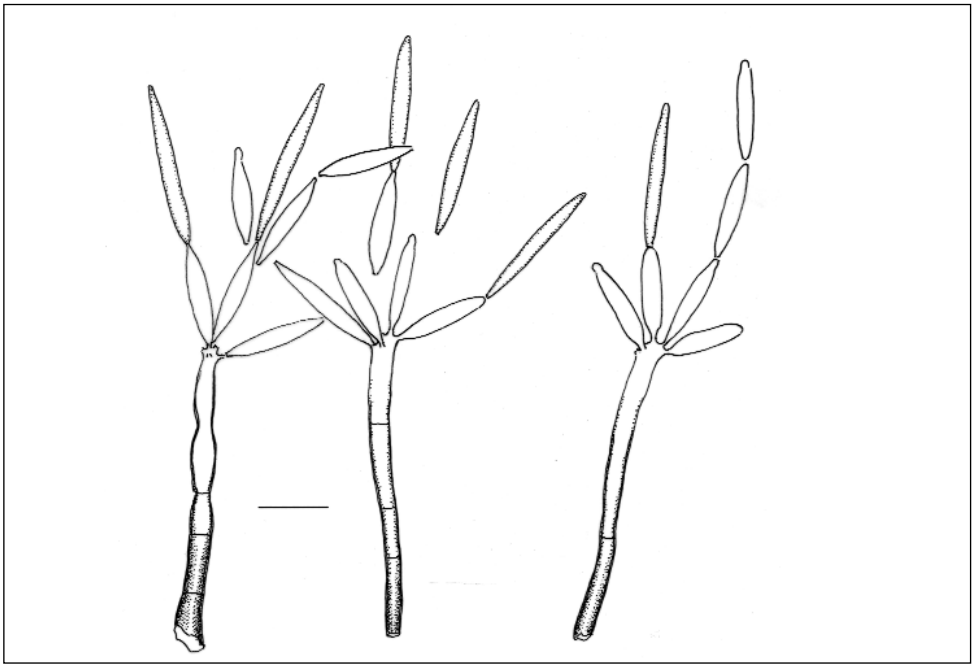

Fig. 14. *Subramaniomyces fusisaprofiticus* (Matsush.) P.M. Kirk. Bar15 µm.

20x4 µm; ramoconidia 16-18x4 µm; terminal conidia, at the top of the chains, acicular, smooth, very clear brown, 25-32x3-4 µm.
On dead leaves of *Rhamnus catharticus* L., *Phillyrea latifolia* L., *Quercus ilex* L.

The species described is very widely distributed on different dead leaves species of plants, like *R. catharticus* L., *P. latifolia* L., *Q. ilex* L. and others but without morphological characters variability. Nevertheless our strain differs in the conidiophores dimensions and in the conidia pigmentation from what reported by Kirk (1982). This is amazing because our strain growth in seasonal dry conditions not stimulating good growth but on the contrary that could support intense pigmentation.

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Triposporium elegans Corda, 1837 (Fig. 15)
Type species: *Triposporium elegans* Corda, 1837.

Colonies effused, but not crowded, composed by several conidiophores. Conidiophores macronematous, mononematous, unbranched, erect, straight, very dark brown, smooth, 126-252x6-7 µm. Conidiogenous cells monoblastic, integrated, terminal, percurrent. Conidia solitary, dry, acrogenous, 1-3 times branched, branches composed by conical 5-7 septate arms joined through a rounded base, arms 27-59x6-9 µm, dark brown at the base and clearer towards the apices.

On dead leaves of *Quercus ilex* L. and *Phillyrea latifolia* L.

The species described is present on dead leaves of several plants, but only on *Q. ilex* L. and *P. latifolia* L. with optimal colonizations and with poor and adaptive colonizations on other substrata. *T. elegans* was found also on dead leaves of *Arbutus unedo* L. at Montagna Grande, Pantelleria (Rambelli & al. 2009), with some dimentional differences concerning mainly the conidia and sometimes the conidiophores.

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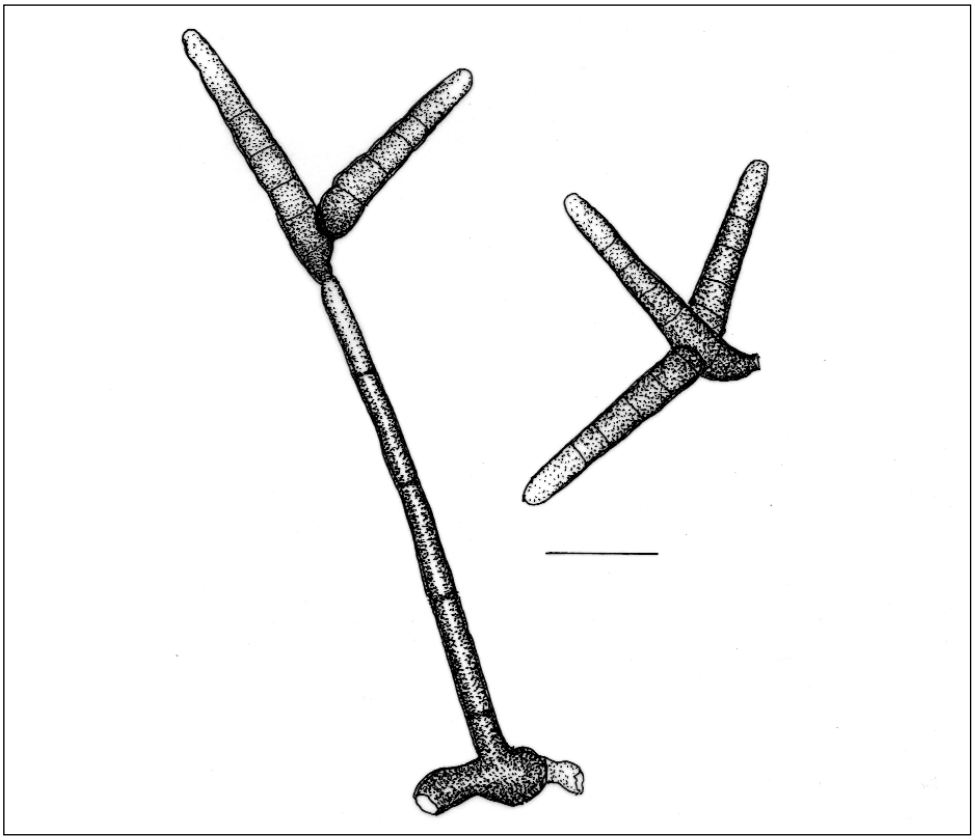

Fig. 15. *Triposporium elegans* Corda. Bar 20 μm.

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Beltrania querna Harkn., 1884 (Fig. 16)
Type species: *Beltrania rhombica* O.Penzig, 1882.

This strain of *B. querna* has reproductive structures with morphological and dimensional characters of the species as described by Harkness in 1884, but differs for the absence of setae in the whole colony examined. We are of the opinion that this character could be determined by the composition of the substratum.

On dead leaves of *Rhamnus catharticus* L.

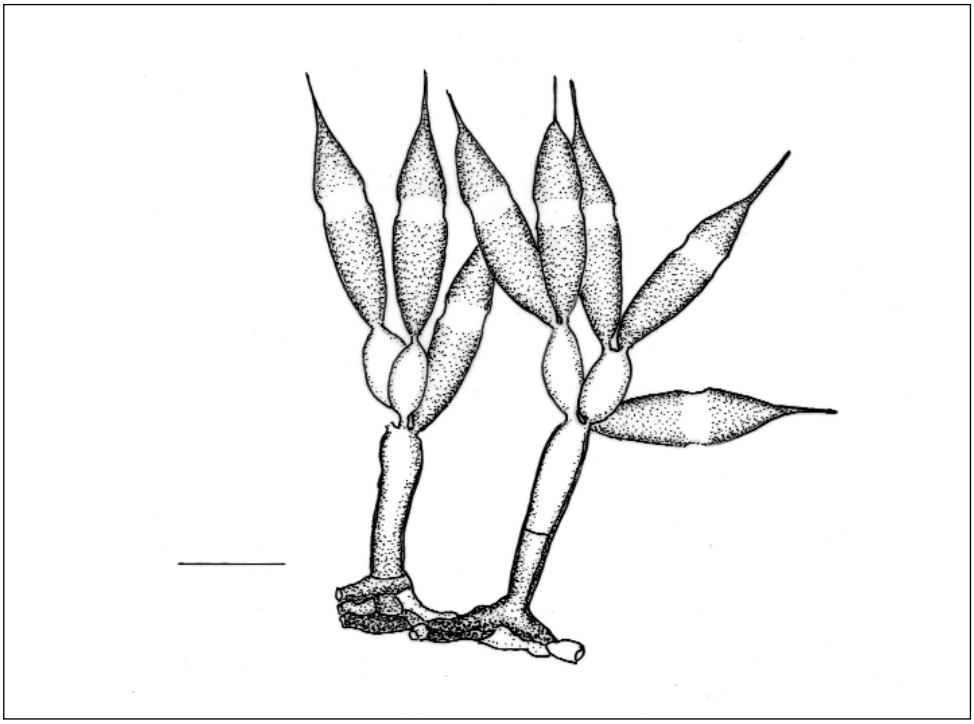

Fig. 16. *Beltrania querna* Harkn. Strain without setae. Bar 15 μm.

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Conclusions

In this work we analysed the fungal community of Dematiaceous *Hyphomycetes* in the mediterranean maquis of Circeo National Park with the aim to compare the data obtained with those collected in Pantelleria, mainly in the area of Montagna Grande that we selected as an area, very well preserved, as base for observations and comparisons with others. Obviously to attain this comparisons other samplings and observations will be necessary.

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Databases online

(CABI) http://www.indexfungorum.org.

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