Fl. Medit. 25 (Special Issue): 143-156
doi: 10.7320/FlMedit25SI.143
Version of Record published online on 26 November 2015

G. Venturella, M. L. Gargano & R. Compagno

The genus *Pleurotus* in Italy

Abstract

Venturella, G., Gargano, M. L. & Compagno, R.: The genus *Pleurotus* in Italy. — Fl. Medit. 25 (Special Issue): 143-156. 2015. — ISSN: 1120-4052 printed, 2240-4538 online.

On the basis of personal observations, herbarium specimens and, data reported in the literature the authors report morphological, ecological and distributive data on *Pleurotus* taxa from Italy. New descriptions are here provided based on the most distinctive-discriminating eco-morphological characters of twelve *Pleurotus* taxa.

Key words: oyster mushrooms, descriptions, ecology, distribution.

Introduction

In modern taxonomy the genus *Pleurotus* (Fr.) P. Kumm is placed under the family *Pleurotaceae* Kühner (*Agaricales*, *Basidiomycota*). The *Pleurotaceae* are a family of small to medium-sized mushrooms which have white spores including 6 genera and 94 species (Kirk & al. 2008).

The genus *Pleurotus* is a cosmopolitan group of fungi which comprises ca. 30 species and subspecific taxa also known as oyster mushrooms. The genus *Pleurotus* also represents the second main group of cultivated edible mushrooms in the world (Zervakis & Labarère 1992). The *Pleurotus* species are efficient colonizers and bioconverters of lignocellulosic agro-industrial residues into palatable human food with medicinal properties (Philippoussis 2009). Some white-rot fungi of the genus *Pleurotus* are able to remove lignin with only minor attack on cellulose (Cohen & al. 2002). Besides *Pleurotus* species demonstrates significant nutritional values (La Guardia & al. 2005; Venturella & al. 2015a) and their bioactive compounds (mainly polysaccharides) possess antibacterial (Schillaci & al. 2013), antibiotic, antitumor, hypocholesterolemic and immunomodulation properties (Wasser 2002). *Pleurotus* species establish a wide range of interactions with plants, animals and other microorganisms (Tsuneda & Thorn 1995). *Pleurotus* species are also nematophagous and they derive nutrition by consuming nematodes (Thorn & al. 2000). This is made possible by hyphae that may have drops or adhesive knobs that attach to passing nematodes and secrete nematotoxic compounds (Koziak & al. 2007).

In past times the assessments of *Pleurotus* diversity in Europe supported by biochemical, molecular and compatibility studies revealed the existence of eleven species, i.e. *P. abieticola* R.H. Petersen & K.W. Hughes, *P. calyptratus* (Lindblad ex Fr.) Sacc., *P. cornucopiae* (Paulet) Rolland, *P. dryinus* (Pers.) P. Kumm., *P. eryngii* (DC.) Quél., *P. ferulaginis* Zervakis, Venturella & Cattarossi, *P. fuscosquamulosus* D.A. Reid & Eicker, *P. opuntiae* (Durieu & Lév.) Sacc., *P. nebrodensis* (Inzenga) Quél., *P. ostreatus* (Jacq.) P. Kumm. and, *P. pulmonarius* (Fr.) Quél. (Zervakis & al. 2001).

P. abieticola, *P. fuscosquamulosus* and, *P. opuntiae* are infrequent to very rare species. The former was collected from east Russia (Petersen & Hughes 1997) whereas *P. opuntiae* is distributed in Mediterranean Europe and, particularly, in southern Italy (Venturella 1991). *P. fuscosquamulosus* was reported for the first time in Greece by Zervakis & al. (1992).

This paper deals with the distribution and ecology of *Pleurotus* species growing in Italy on the wood of broadleaved trees, on trunks of *Agavaceae* and on the fiber of fallen cladodes of *Cactaceae* and, as weak parasites on the roots of herbaceous plants of family *Apiaceae*.

Materials and Methods

In the last ten years field collections on lignicolous and saprotrophs *Pleurotus* species, combined with observations on several herbarium specimens belonging to *P. calyptratus*, *P. cornucopiae*, *P. dryinus*, *P. eryngii* var. *elaeoselini*, *P. eryngii* var. *eryngii*, *P. eryngii* var. *ferulae*, *P. ferulaginis*, *P. nebrodensis*, *P. opuntiae*, *P. pulmonarius*, *P. ostreatus*, and *P. thapsiae*, and kept in the Italian universities (AQUI, BOLO, CAT, FI, GDOR, GE, PAL, PAV, PERU, RO, SAF, and TO) and the herbaria of the main Italian mycological amateur groups (Associazione Micologica Bresadola and Unione Micologica Italiana) allowed the macro- and micromorphological characterization of twelve *Pleurotus* taxa in the Italian territory. The macro-morphological characteristics of the basidiomes were evaluated with a Leica MS5 binocular microscope while the microscopic features were evaluated with a Leica DLMB microscope using tap water. In particular we observed the habit and the habitat, the color, the odor, the shape and the size of pileus and stipe, the cuticle of pileus, the type of lamellae, the stipe position, the hyphal system (monomitic or dimitic), the type of wall, the shape and the size of basidia and basidiospores, the pileipellis, the presence of pileocystidia, the hymenophoral trama combined with a well developed subhymenium, the reaction of basidiospores in Melzer's solution. The nomenclature of vascular plants follow The Euro+Med PlantBase - The Information Resource for Euro-Mediterranean plant diversity (http://www.emplantbase.org/home.html) while the nomenclature of fungi is referred to Zervakis & al. (2014).

Species distribution and ecological notes

The Checklist of Italian Fungi (Onofri & al. 2005) listed eleven taxa (8 species and 3 varieties): *P. calyptratus* (Lindbald) Sacc., *P. cornucopiae* (Paulet) Rolland, *P. dryinus*

(Pers.) P. Kumm., *P. eryngii* (DC.) Quél. var. *eryngii*, *P. eryngii* var. *elaeoselini* Venturella, Zervakis & La Rocca, *P. eryngii* var. *ferulae* Lanzi, *P. eryngii* var. *thapsiae* Venturella, Zervakis & Saitta, *P. nebrodensis* (Inzenga) Quél., *P. opuntiae* (Durieu & Lév.) Sacc., *P. ostreatus* (Jacq.) P. Kumm. and, *P. pulmonarius* (Fr.) Quél.

P. ferulaginis Zervakis, Venturella & Cattarossi was recently described as new species for Italy (Zervakis & al. 2014) increasing the number of *Pleurotus* species in Italy to twelve.

The updated distribution in Italy of the taxa mentioned above is shown in Figs. 1-3.

The lignicolous *Pleurotus* species mainly grows in broadleaved and conifer woods, on cultivated and ornamental plants, on living and dead trees, branches and logs.

P. calyptratus (Fig. 4) is currently reported only from Trentino Alto Adige (Vigo di Ton, Trento) on dead fallen trunks of *Populus tremula* L. The period of fructification is spring-summer and the altitude range of 350 and 910 m a.s.l. On the contrary, *P. cornucopiae* is widely distributed in Italy and it can be observed from summer to autumn, and in different altitudinal levels, on stumps and trunks of different broad-leaved trees (i.e. *Ulmus* ssp., *Fagus sylvatica* L.). Even *P. dryinus* is widely collected in Italy, from summer up to winter and in different altitudinal levels, on living trees, dead trees, and trunks of *Abies alba* Miller, *Acer negundo* L., *Alnus glutinosa* (L.) Gaertn., *Betula pendula* Roth, *Fraxinus ornus* L., *Picea abies* (L.) H. Karst., *Populus termula* L., *Quercus ilex* L., *Q. pubescens* Willd., *Salix alba* L. and, *Yucca aloifolia* L. *P. ostreatus* have a wider distribution and can be collected all year round from 0 to 1450 m a.s.l. in large tufts on living broad-leaved trees, logs, stumps, or fallen trunks of various broadleaved trees [*A. alba*, *Castanea sativa* Miller, *Fagus sylvatica*, *Morus nigra* L., *P. alba* L., *P. tremula*, *Q. pubescens*, *Q. petraea* (Matt.) Liebl., and *S. alba*].

A more restricted distribution is that of *P. pulmonarius* (Fig. 5) which can be collected, from 400 to 1600 m, from late summer up to autumn, on trunks, stumps and logs of various deciduous trees (i.e. *Populus alba*, *P. tremula*, *Sorbus aucuparia* L.), in Piedmont, Trentino Alto Adige, Veneto, Friuli Venezia Giulia, Emilia Romagna, Abruzzo, Basilicata and, Calabria.

P. opuntiae is an interesting and infrequent mushroom from southermost Italian regions (Calabria and Sicily), growing as parasite or saprotroph, from 0 to 500 m, on fibers of fallen cladodes of *Opuntia ficus-indica* Haw., and on trunks of *Agave americana* L. and *Yucca elephantipes* Hort ex Regel. (Venturella 1991).

Other *Pleurotus* species grows as weak parasites on the roots of herbaceous plants of family *Apiaceae*. *P. ferulaginis*, recently collected in northeast Italy (Campoformido, province of Udine, 78 m a.s.l.), is associated with *Ferulago campestris* (Besser) Grecescu. This is a vernal species which can be observed in dry meadows, cliffs, rocky and calcareous areas, at an elevation of 0-900 metres. The basidiomes of *P. eryngii* var. *eryngii* grows in all the Italian regions in autumn, on calcareous soils and sandy shores, on root residues of *Eryngium campestre* L. and *E. maritimum* L., from 0 to 1500 m (Venturella & al. 2015a). *P. eryngii* var. *elaeoselini* can be collected in autumn and spring, in different Italian regions, in pasture and meadows of calcareous soils and a nutrient-rich substrate, at an altitude of 0-2100 metres, on *Elaeoselinum asclepium* (L.) Bertol. subsp. *asclepium*, *Laserpitium latifolium* L. and, *L. siler* L. *P. eryngii* var. *ferulae* grows in Tuscany, Lazio, Molise, Campania, Basilicata, Apulia, Calabria, Sicily and, Sardinia, in pastures and meadows of arid and calcareous soils on *Ferula communis* L., at an altitude of 0-1200 metres.

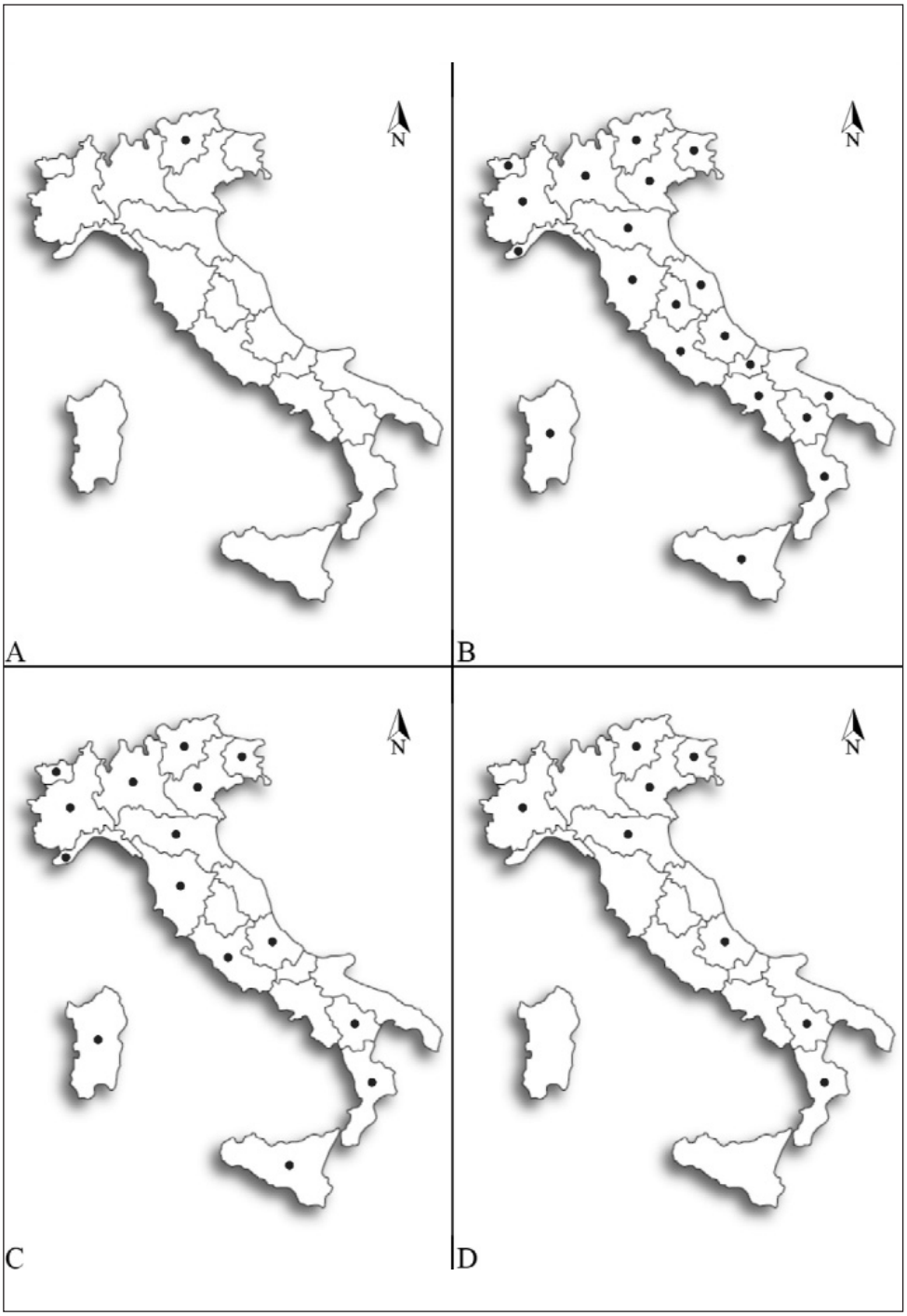

Fig. 1. **A.** *Pleurotus calyptratus*; **B.** *P. cornucopiae*; **C.** *P. dryinus*; **D.** *P. pulmonarius*.

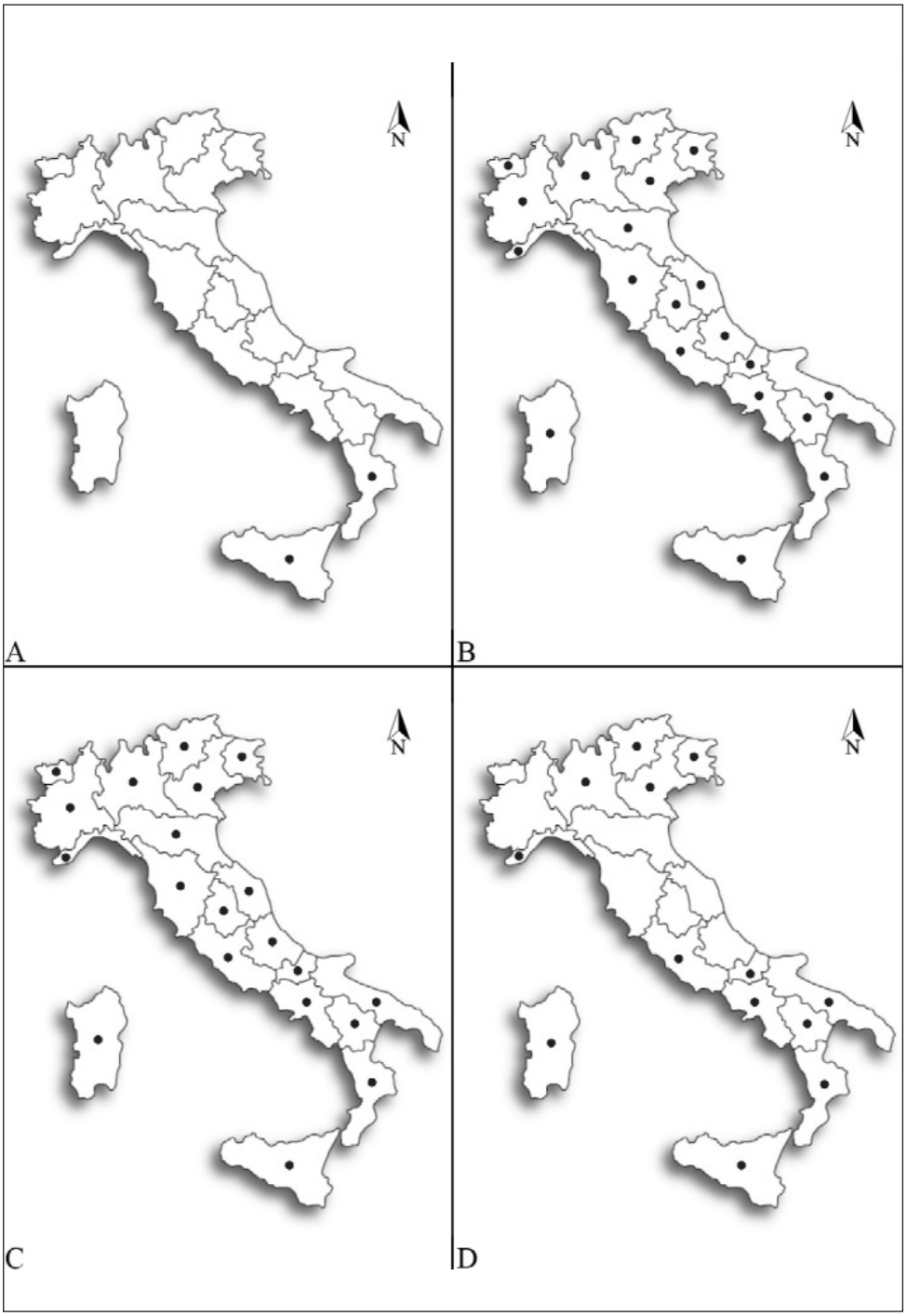

Fig. 2. **A.** *Pleurotus opuntiae*; **B.** *P. ostreatus*; **C.** *P. eryngii* var. *eryngii*; **D.** *P. eryngii* var. *elaeoselini*.

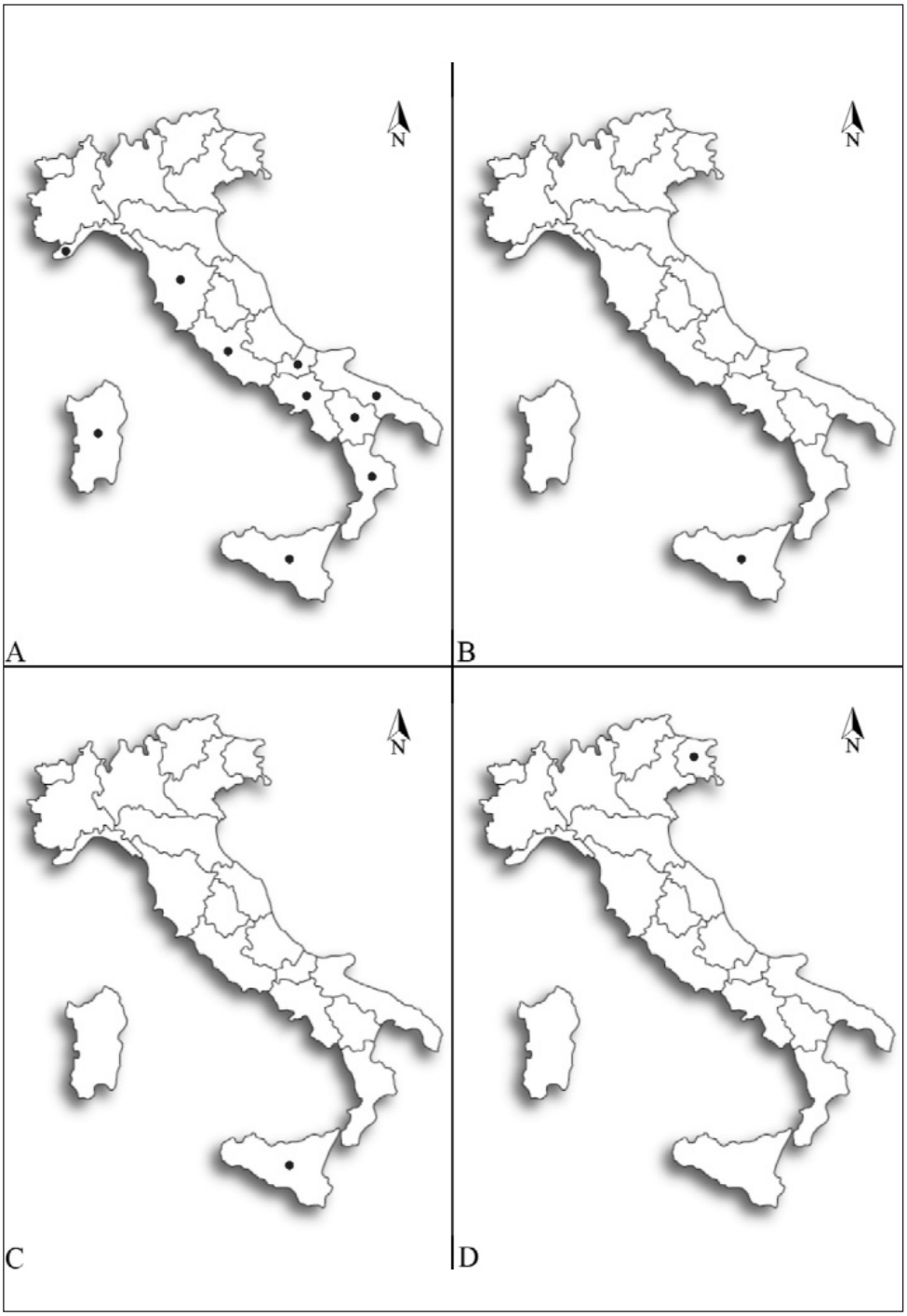

Fig. 3. **A.** *Pleurotus eryngii* var. *ferulae*; **B.** *P. eryngii* var. *thapsiae*; **C.** *P. nebrodensis*; **D.** *P. ferulaginis*.

The main period of fructification is from summer to autumn. In winter the appearance of basidiomes is less frequent and then it resumes in early spring. *P. eryngii* var. *thapsiae* is an infrequent species currently reported only from Sicily, on root residues of *Thapsia garganica* L., in pastures on calcareous soils, at an altitude of 0-1500 m a.s.l. *Pleurotus nebrodensis*, a rare species at risk of extinction (Rossi & al. 2014), growing in Sicily in arid pastures, is associated only with *Prangos ferulacea* (L.) Lindl. and its fructification period is restricted from the middle of April to the first ten days of June. Recently many reports of *P. nebrodensis* in Italy were re-identified as *P. eryngii* var. *elaeoselini*, a taxon with a much wider distribution in Europe than was previously assumed (Chinan & Venturella 2012).

Systematic arrangement and descriptions of taxa

The first references on the systematics of the genus *Pleurotus* in Italy are attributed to Saccardo (1915) and Baglietto (1972). Saccardo provided a systematic arrangement based on the position of the cap compared to the stipe. In particular, the species of *Pleurotus* were distinguished in three main groups: resupinate, dimidiate (shield-like) and, excentric. The systematic arrangement proposed by Baglietto was based instead on the ecology of the species with a clear separation between lignicolous species and the species growing on dead roots of plants of the family *Apiaceae*.

A modern systematic arrangement was recently proposed for *Pleurotus* taxa, including those growing in Italy, and new taxa were described and new investigations have been carried out by combining the traditional identification techniques with molecular analysis (Zervakis & al. 2014).

In this paper we propose new descriptions for the species of *Pleurotus* growing in the Italian territory based on the most distinctive-discriminating eco-morphological characters:

Lignicolous fleshy species, saprotrophs or weak parasites, on living and dead trunks, deciduous and coniferous trees, solitary, imbricate, gregarious, in large clusters or in small groups.

Pleurotus calyptratus

Pileus 4-11 cm, hygrophanous grayish-blue, grayish-brown to brown, then beige to light beige, cream to almost white, convex or semicircular to kidney-shaped then circular. Cuticle smooth, silky-fibrillose, slightly viscid. Veil fleeting. Lamellae thin, crowded, decurrent to the top of the stipe, entire, without anastomoses but with numerous lamellulae and often forked, at first white then cream to light beige. Stipe absent, rudimentary or lateral. Trama homogeneous. Basidiospores cylindric to elliptic, thin-walled, with a small and broad apiculus, containing yellow oily drops and granules, 10.0-15.5 × 4-5.5 µm. Solitary or in small groups, on dead fallen trunks of *Populus tremula*.

Pleurotus cornucopiae

Pileus 4-15 cm, cream to pale yellowish brown, ivory sometimes grayish, convex, smooth to velvet-like centre, circular to kidney-shaped, distinctly depressed at the centre in mature specimens, with inrolled margin. Cuticle smooth, slightly viscid. Lamellae thin,

Fig. 4. *P. calyptratus* on fallen trunks of *Populus tremula* (Photo M. Floriani).

Fig. 5. *P. pulmonarius* on wood of *Sorbus aucuparia* (photo M. Donnini).

wide, crowded, deeply decurrent up to the base of the stipe, with conspicuous anastomoses below. Stipe 3.0-11.0 × 1.0-2.5 cm, central to eccentric, rarely almost lateral, broader at top. Basidiospores 7.0-11.5 × 3-5.5 µm, subcylindric to ellipsoid, thin-walled. Imbricate often in large clusters with several pilei, on stumps and trunks of different broad-leaved trees.

Pleurotus dryinus

Pileus 4.5-16 cm, cream to light or darker gray, convex to cap-shaped in unripe basidiomes then plane. The margin inrolled when young, hung with partial veil remnants. Cuticle dull, fibrillose-tomentose, squamose in ripe basidiomes. Lamellae white then cream-colored to yellowish. Stipe eccentric, 2-6.5 × 1.5-4 cm. Trama homogeneous. Basidiospores cylindric to cylindric-elliptic, smooth, hyaline, with drops, 9.8-14.0 × 3.8-4.2 µm. Solitary to imbricate, in forests and parks, on living trunks of broad-leaved trees.

Pleurotus ostreatus

Pileus 4-20 cm, lingulate to spatulate, convex then conchate to hemicircular or flabellate. Cuticle smooth, dull silky, very variable in color from cream-beige to lilac-blackish. Lamellae whitish to cream, decurrent. Stipe rudimentary, laterally attached. Hymenophoral trama not completely irregular, thin-walled, 2.5-4-2 µm diam. Basidiospores broadly elliptic, smooth, hyaline, 6.2-8 × 4-6.5 µm. Solitary to gregarious, in forests and parks, on stumps, fallen trunks and living broad-leaved trees.

Pleurotus pulmonarius

Pileus 3-11, convex then flat, spathulate to kidney-shaped. Cuticle light brown, beige-brown, beige-buff, orange-brown, margin inrolled. Lamellae thin, crowded, decurrent to the top of the stipe and often intervenose along its entire length, with rare anastomoses, white to cream to ivory. Stipe absent or short, 1.5-2.0 × 2-4 cm, eccentric to lateral cylindrical to connate. Hymenophoral trama completely irregular, with clamped sclerified hyphae, 5.2-7.8 µm diam. And thin-walled hyphae 3.5-10.4 µm diam. Basidiospores 7.5-14.5 × 2.5-5.0 µm, subcylindrical to cylindrical to bacilliform, thin-walled. Solitary or usually in clusters and groups, on trunks, stumps and logs of various deciduous trees.

On trunks of Agavaceae *and on the fiber of fallen cladodes* of Cactaceae

Pleurotus opuntiae

Pileus 5-15 cm, sub-globose then shell-shaped. Cuticle smooth, thin, white, cream, yellowish in ripe basidiomes: Lamellae white-cream, narrowed, decurrent, with numerous lamellulae. Stipe 1.5-3 × 1.0-1.5 cm, lateral, hard, white and felted. Basidiospores 7.5-10 × 3-5.5 µm, oval and elongated. Solitary or in clusters, on fiber of fallen cladodes of *Opuntia ficus-indica* and on trunks of *Agave americana* and *Yucca elephantipes*.

Associated with plants of family Apiaceae

Pleurotus eryngii* var. *eryngii

Pileus 5-15 cm, fleshy, convex then depresse, brown to red-brown, warm brown, light beige to beige-brown. Cuticle velvety, pruinose, with pigments and terminal club-like

cells. Lamellae decurrent, cream to light beige, anastomoses at stipe. Stipe 2.0-4.0 × 1.0-3.0 cm, central to eccentric. Basidiospores 9.0-13.5 × 4.5-6.5 µm, cylindric-elliptic, smooth, hyaline, with drops. Basidiomes appearing from autumn to late winter, occurring mostly in groups, from 0 to 1500 m, in pastures and sandy shores, on limestone soils. Associated with *Eryngium campestre* and *E. maritimum*.

Pleurotus eryngii* var. *elaeoselini

Pileus 5-15 cm, fleshy, convex then flat, whitish to white-cream, sometimes light beige, with alutaceous tones. Cuticle smooth, thick, velvety, opaque, lacerated in small appressed areolae. Lamellae deeply decurrent, whitish to pale yellow. Stipe 4.0-8.0 × 1.0-3.0 cm, central to eccentric, radicating. Basidiospores 10.0-14.0 × 5.2-7.0 µm, cylindric-elliptic, smooth, hyaline, with drops. Basidiomes appearing in spring and autumn (March-May, October-November), occurring mostly in clusters, from 0 to 1200 m, in pastures and meadows, on limestone and silicaceous soils. Associated with *Elaeoselinum asclepium* subsp. *asclepium*, *Laserpitium latifolium* and, *L. siler*.

Pleurotus eryngii* var. *ferulae

Pileus 5-25 (-30) cm, fleshy, convex then flat, dark brown to chestnut brown to grey brown. Cuticle with innatae fibrillae, thick, velvety, pruinose, heavily pigmented. Lamellae decurrent, cream to light beige, anastomoses at stipe. Stipe 3.0-10.0 × 1.0-4.0 cm, central to eccentric. Basidiospores 9.6-13.8 × 4.5-7.0 µm, cylindric-elliptic, smooth, hyaline, with drops. Basidiomes appearing almost all year round, from 0 to 1200 m, in garrigues, pastures and meadows, on limestone, silicaceous and, volcanic soils. Associated with *Ferula communis*.

Pleurotus eryngii* var. *thapsiae

Pileus 3-5 cm, fleshy, convex, dark brown to warm brown. Cuticle with scattered squammules, thin, with pigments, velvety, pruinose. Lamellae deeply decurrent, grayish white, anastomoses at stipe. Stipe 3.0-5.0 × 1.0-3.0 cm, central. Basidiospores 9.6-13.8 × 4.5-7.0 µm, cylindric-elliptic, smooth, hyaline, with drops. Basidiomes appearing in spring and autumn (March-May, October-November), from 0 to 1500 m, in garrigues, pastures and meadows, on limestone and silicaceous soils. Associated with *Thapsia garganica*.

Pleurotus ferulaginis

Pileus 3-15 cm, fleshy, circular to kidney-like with wavy edges and often inrolled margin, fleshy, convex then almost flat and later infundibuliform, white to cream to ivory to light brown to beige-brown to beige-buff to warm brown to brown. Cuticle smooth, then often unevenly fibrillose or with small brown squamules towards the outer half. Lamellae crowded, thin, entire, broad, and dense, decurrent to the top of the stipe, without anastomoses, white to cream to ivory. Stipe 2.5-10.5 × 1.0-3.0 cm, central and rarely subcentral, robust, cylindric to spindle-shaped and often rounded towards the base, white to cream to ivory. Basidiospores 11.0-16.0 × 4.0-6.0 µm, cylindrical to bacilliform, smooth, thin walled, hyaline, with one or more drops. Basidiomes appearing singly or in small groups, in May and June, from 0 to 700 m, in meadows, on limestone and silicaceous soils. Associated with *Ferulago campestris*, distribution restricted to NE Italy.

Pleurotus nebrodensis

Pileus 4-20 cm, fleshy, convex, white-cream to white ochraceous with alutaceous tones. Cuticle smooth, cracked in ripe basidiomes, thin, velvety, opaque. Lamellae deeply decurrent, whitish to pale yellow. Stipe 4.0-9.0 × 2.0-4.0 cm, central to eccentric, radicating, with a small reticulum at stipe. Basidiospores 12.2-17.4 × 5.5-8.2 µm, cylindric-elliptic, smooth, hyaline, with drops. Basidiomes appearing usually singly during spring or early summer, in altitudes from 1200 to 2000 m, in pastures of *Prangos ferulacea* on limestone soils. Distribution restricted only to Sicily.

Discussion and Conclusions

The *Pleurotus* species show an high level of diversity in the Italian territory. Some *Pleurotus* species (i.e. *P. ferulaginis*, *P. nebrodensis*) are endemic to restricted territories of southern regions some others are organisms of significant importance not only for the crucial roles they undertake in nature but also for many human activities that are strictly dependent on them. As white-rot fungi *Pleurotus* species are actively involved in wood decomposition, as weak parasites and saprotrophs they actively degrade the herbaceous plants residues while as edible mushrooms are also involved and/or exploited in forestry, pharmaceutical industry and food production. Furthermore, some *Pleurotus* species for their valuable organoleptic qualities are much appreciated by mushroom hunters. In addition, most of these species are suitable for cultivation and can be proposed to farmers as an alternative to traditional crops nowadays unprofitable. Apart from *P. ostreatus* that is already cultivated throughout the Italian territory and has an economic importance equal to that of champignon, a rapid spread, especially in southern Italy, is having the cultivation of "cardoncello" mushrooms (*P. eryngii* var. *eryngii*) (Venturella & al. 2015b). Tests of cultivation were also carried out in Sicily on other *Pleurotus* saprotrophs species such as *P. eryngii* var. *elaeoselini*, *P. eryngii* var. *ferulae* and, *P. eryngii* var. *thapsiae* and in other regions (Basilicata, Piedmont, Friuli Venezia Giulia) on the lignicolous *P. cornucopiae* (Venturella & Ferri 2001). Also *P. nebrodensis* is a potential cultivated species but most of the fungal strains currently available for cultivation are referable to *P. eryngii* var. *elaeoselini* and therefore they require a more precise morphological and genetic characterization (Venturella & al. 2015c). Recently some *Pleurotus* species were also tested for their anticancer and antibacterial activities (Schillaci & al. 2013). For all the reasons mentioned above we believe that the modern descriptions of *Pleurotus* taxa growing in Italy here reported is appropriate in order to provide an easier field identification by mycologists and mycological amateurs and for a more precise identification of fungal strains for molecular analysis and medicinal uses.

Acknowledgments

The authors wish to thank Marco Floriani for providing additional data on *P. calyptratus*.

References

Baglietto, C. 1972: Saggio di flora micologica analitica con particolare riguardo per la flora ligustica. Note sulla biologia e sulla sistematica, discussione di specie rare o critiche, Funghi superiori. – Genova.

Chinan, V. C. & Venturella, G. 2012: *Pleurotus eryngii* var. *elaeoselini*, first record from Romania. – Mycotaxon **122:** 221-224. doi: 10.5248/122.221

Cohen, R., Persky, L.·& Hadar, Y. 2002: Biotechnological applications and potential of wood-degrading mushrooms of the genus *Pleurotus*. – Appl. Microbiol. Biotechnol. **58:** 582–594. http://dx.doi.org/10.1007/s00253-002-0930-y

Hilber, O. 1982: Die Gattung *Pleurotus* (Fr.) Kummer unter besonderer Berücksichtigung des *Pleurotus eryngii*-Formenkomplexes. – Bibl. Mycol. **87.** – Vaduz.

Kirk, P. M., Cannon, P .F., Minter, D. W. & Stalpers, J. A. 2008. Ainsworth & Bisby's Dictionary of the Fungi. Tenth Edition. – Wallingford, UK.

Koziak, A. T. E., Cheng, K. C. & Thorn, R. G. 2007: Phylogenetic analyses of *Nematoctonus* and *Hohenbuehelia* (*Pleurotaceae*). – Canad. J. Bot. **85:** 762-773. doi: 10.1139/B07-083

La Guardia, M., Venturella, G. & Venturella F. 2005: On the chemical composition and nutritional value of *Pleurotus* taxa growing on Umbelliferous plants (*Apiaceae*). – J. Agr. Food. Chem. **53(15):** 5997-6002. doi: 10.1021/jf0307696

Onofri, S., Bernicchia, A., Filipello Marchisio, V., Padovan, F., Perini, C., Ripa, C., Salerni, E., Savino, E., Venturella, G., Vizzini, A., Zotti, M. & Zucconi, L. 2005: Checklist of Italian fungi *Basidiomycetes* (*Basidiomycota*). – Sassari.

Petersen, R. H. & Hughes, K. W. 1997: A new species of *Pleurotus*. – Mycologia **89(1):** 173-180. doi: 10.2307/3761186

Philippoussis, A. 2009: Production of mushrooms using agro-industrial residues as substrates. – Pp. 163-196 in Nigam, P. S. & Pandey, A. (Eds.): Biotechnology for Agro-industrial Residues Processing. – Dordrecht.

Rossi, G., Montagnani, C., Abeli, T., Gargano, D., Peruzzi, L., Fenu, G., Magrini, S., Gennai, M., Foggi, B., Wagensommer, R. P., Ravera, S., Cogoni, A., Aleffi, M., Alessandrini, A., Bacchetta, G., Bagella, S., Bartolucci, F., Bedini, G., Bernardo, L., Bovio, M., Castello, M., Conti, F., Domina, G., Farris, E., Gentili, R., Gigante, D., Peccenini, S., Persiani, A. M., Poggio, L., Prosser, F., Santangelo, A., Selvaggi, A., Villani, M. C., Wilhalm, T., Zappa, E., Zotti, M., Tartaglini, N., Ardenghi, N. M. G., Blasi, C., Raimondo, F. M., Venturella, G., Cogoni, D., Puglisi, M., Campisi, P., Miserere, L., Perrino, E. V., Strumia, S., Iberite, M., Lucchese, F., Fabrini, G. & Orsenigo, S. 2014: Are Red Lists really useful for plant conservation? The New Red List of the Italian Flora in the perspective of national conservation policies. – Pl. Biosyst. **148(2):** 187-190. doi: 10.1080/11263504.2013.868375

Saccardo, P. A. 1915: Flora italica cryptogama. Fungi *Hymeniales*, **1.** – Rocca San Casciano.

Schillaci, D., Arizza, V., Gargano, M. L. & Venturella, G. 2013: Antibacterial activity of mediterranean oyster mushrooms, species of genus *Pleurotus* (Higher Basidiomycetes). – Int. J. Med. Mushr. **15(6):** 591-594. doi:10.1615/IntJMedMushr.v15.i6.70

Singer, R. 1986: The *Agaricales* in modern taxonomy, 4th ed. – Koenigstein.

Thorn, R. G., Moncalvo, J.-M., Reddy, C. A. & Vilgalys, R. 2000: Phylogenetic analyses and the distribution of nematophagy support a monophyletic *Pleurotaceae* within the polyphyletic Pleurotoid-Lentinoid fungi. – Mycologia **92(2):** 241-252. doi: 10.2307/3761557

Tsuneda, A. & Thorn, R. G. 1995: Interactions of wood decay fungi with other microorganisms, with emphasis on the degradation of cell walls. – Canad. J. Bot. **73(S1):** 1325-1333. doi: 10.1139/b95-394

Venturella, G. 1991: A checklist of Sicilian fungi. – Bocconea **2:** 5-221.

—, Ferri, F. 2001: Progetto FUNGIS. Progetto di sviluppo per la funghicoltura in Sicilia. – Palermo, 118.
—, Palazzolo, E., Saiano, F. & Gargano, M. L. 2015a: Notes on a new productive strain of king oyster mushroom, *Pleurotus eryngii* (Higher basidiomycetes), a prized Italian culinary-medicinal mushroom. – Int. J. Med. Mushr. **17(2):** 199-206. doi: IntJMedMushrooms.v17.i2.110
—, Gargano, M. L., Compagno, R., La Rosa, A., Polemis, E. & Zervakis G. I. 2015b: Diversity of macrofungi and exploitation of edible mushroom resources in the National Park "Appennino Lucano, Val D'Agri, Lagonegrese" (Italy). Pl. Biosyst. Published online: 11 Feb 2015. http://dx.doi.org/10.1080/11263504.2014.1000997
—, Zervakis G. I., Polemis, E., Gargano M. L. 2015c: Taxonomic identitiy, geographic distribution, and commercial exploitation of the culinary-medicinal mushroom *Pleurotus nebrodensis*. P. 40 in: Abstract Book, The 8th International Medicinal Mushrooms Conference. August 24 to 27, 2015. Manizales (Caldas).
Wasser, S. P. 2002: Medicinal mushrooms as a source of antitumor and immunomodulating polysaccharides. – Appl. Microbiol. Biotechnol. **60:** 258-274. doi: 10.1007/s00253-002-1076-7
Zervakis, G. I. & Labarère, J. 1992: Taxonomic relationships within the fungal genus *Pleurotus* as determined by isoelectric focusing analysis of enzyme patterns. – J. Gen. Microbiol. **138:** 635-645.
— & Balis, C. 1996: A pluralistic approach on the study of *Pleurotus* species, with emphasis on compatibility and physiology of the European morphotaxa. – Mycol. Res. **100:** 717-731.
—, Dimou, D., Balis, C. 1992: First record of the natural occurrence in Europe of the basidiomycete *Pleurotus cystidiosus* on a new host. – Mycol. Res. **96(10):** 874-876.
—, Venturella, G. & Papadopoulou, K. 2001: Genetic polymorphism and taxonomic infrastructure of the *Pleurotus eryngii* species-complex as determined by RAPD analysis, isozyme profiles and ecomorphological characters. – Microbiology **147(11):** 3183-3194.
—, Moncalvo, J.-M. & Vilgalys, R. 2004. Molecular phylogeny, biogeography and speciation of the mushroom species *Pleurotus cystidiosus* and allied taxa. – Microbiology-SGM **150:** 715-726.
—, Ntougias, S., Gargano, M. L., Besi M. I., Polemis E., Typas M. A & Venturella, G. 2014: A reappraisal of the *Pleurotus eryngii* complex - New species and taxonomic combinations based on the application of a polyphasic approach, and an identification key to *Pleurotus* taxa associated with *Apiaceae* plants. – Fungal Biol. **118:** 814-834. doi: 10.1016/j.funbio.2014.07.001

Address of the authors:
Giuseppe Venturella, Maria Letizia Gargano & Riccardo Compagno,
Department of Agricultural and Forest Sciences, University of Palermo, Viale delle Scienze, Bld. 4, I-90128 Palermo (Italy). E-mails: marialetizia.gargano@unipa.it, giuseppe.venturella@unipa.it, riccardocactus@gmail.com