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INTERESTING HARVEST OF FOUR SPECIES OF MACROMYCETES FROM MOROCCAN FORESTS

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Abstract

Macromycetes species are observed during prospections carried out since 2004 in the Cedray of the Middle Atlas (Morocco). These species include *Melanoleuca electropoda* Maire & Malençon, Cortinarius cedretorum Maire, *Geopora sumneriana* (Cooke) De La Torre and *Psathyrella candolleana* (Fr. Fr.) Mayor. Through their lifestyles, these Macromycetes exert an influence on their biotope, and thus contribute to the maintenance of cedaroid ecosystem. The description and the illustration of the different species of Macromycetes encountered were carried out on the basis of the macro and microscopic. The role of each is also reported.

Keywords: Morocco, Cedar, Macromycetes.

1. INTRODUCTION

The investigations and prospections we carry out in the various regions of Morocco for several years in order to help fill the gaps observed in the fungal diversity in Morocco often allow us to harvest interesting species. The interest of these harvests lies particularly in the harvesting of new species for Moroccan mycoflora, or the harvesting of rare species or even the harvesting of species not yet described in Morocco, although the latter were already mentioned in previous works.

Among the investigations and prospections carried out, trips to the Middle Atlas have made it possible to harvest several species, among them Melanoleuca *electropoda Maire* & Malençon, *Cortinarius cedretorum* Maire, *Lepista nuda* (Bull. ex Fr.). Cooke, *Geopora sumneriana* (Cooke) De La Torre and *Psathyrella candolleana* (Fr. Fr.) Mayors were met under pure or mixed cedars.

The description and illustration of the systematic macroscopic and microscopic characters of the Moroccan specimens of these four species were carried out. The systematic position is discussed from the literature. The distribution, ecology, and importance each the four species were also given.

2. PRESENTATION OF THE STUDY ENVIRONMENT AND MATERIALS AND METHODS

2.1 Presentation of the study environment

The Middle Atlas (M.A.) is a mountain range stretched over 350 km, from south-west to north-east Morocco, it is located between the Rif and the High Atlas, and covers an area of 2.3 million hectares. The M.A. chain belongs to the Moroccan Atlas massif. The main provinces of MA are Khenifra, Ifrane, Boulman, Sefrou and El Hajeb. As well as part of the provinces of Taza and Beni Mellal. The Middle Atlas is a territory characterized by a wealth of wild life and flora.

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The cedar ecosystem consists mainly of the Atlas (*Cedrus atlantica* Manetti) which is a forest species endemic to the mountains of North Africa. The cedar of Atlas is undoubtedly the noble essence of Morocco's forests. The Middle Atlas Cerda's range from about 100,000 to 130,000 hectares and range from 1600 to 2600 m [1].The mycological studies of M.A. were carried out mainly by [2], Malençon and Bertault [3,4], Abourouh [5] and Larouz [6]. In this work, prospections have been carried out to contribute to the recognition of the fungal biodiversity of this forest ecosystem. Thus, several stations (the Jâaba forest the Ifrane and Michlifène and the Azrou forest) were explored during the various outings (Plate 1 and 2). These stations are located in the central M.A.

Plate 1: Michlifen cedar grove

Plate 2: Jbel Hebri cedar grove

2.2 Equipment and Method

In order to continue the determination of the fungal diversity of Morocco, we carried out excursions in the Middle Atlas. In order to meet fungal species that can eventually grow in this region, prospections were carried out during the wet seasons of each year.

In the field, information on the different biotopes (the nature of the vegetation cover, soil moisture data, and climatic conditions) is recorded for the different stations visited.

On site, for each fungal species encountered, specimens are photographed in *situ* (before and after harvest), the plant species present, the nature of the substrate of the fungal species are noted. Systematic macroscopic or magnifying glass characters are also noted; thus, the dimensions of basidiocarps and ascocarps, organoleptic characteristics, colour and type of hymenophore and other systematic criteria are determined and noted.

For each species, the samples collected are stored separately in carton boxes. The necessary information and a provisional name of the species are also stored with the collected specimens.

In the laboratory, samples are reviewed. The study of the microscopic criteria of the different parts of the carpophores and of the hymenophore is carried out in water, cotton blue and iodized water. The macro chemical reactions are carried out (the reactants tested are in particular potassium hydroxide (5%), iodized water, ammonia and iron sulphate, the spore coloration is determined after deposition of the carpophores on sheets of paper. Microphotographs and diagrams were made for the anatomical structures of the species.

The keys used for species determination include those of Lanieral [7]; Kühner and Romagnesi, [8]; Romagnesi, [9] and Courtecuisse and Duhem [10].

The determination of different regions of Morocco where the species was previously encountered was made on the basis of consultation of previous work. Among the works consulted were those of Mayor& Werner [2]; Malençon and Bertault [4], Abourouh [5], El-Assfouri [11] and Larouz [6].

The discussion of the systematics of the specific species as well as the ecological data and the richness of each ecosystem visited are drawn from the literature.

3. RESULTS AND DISCUSSION

3.1 *Melanoleuca electropoda* Mayor& Malençon (1975).

Harvest of 17 4 2007 near Ifrane.

Several specimens are scattered ashore in a reforestation at *Cupressus arizonica* near the town of Ifrane in the Middle Atlas.

The hat (2 to 5 cm on average) is circular, brownish to brownish grey beige with olive, matte and hydrophane tones. It is convex, planed or dug on disc, in old specimens. The pileic surface becomes wrinkled. The cuticle is dry and separable from the flesh. The pilaceous margin is straight, thin, elastic and non-striated, it is wound and orange ochre (amber) before the spreading of the hat, it becomes, flat, concolorous with the hat, slightly surplus and revolted in the old individuals. The pillow flesh is gray under the cuticle, white, fibrous, thin and elastic. The blades (4 to 4.5 mm) are uneven, indented - rounded and decurrent by a net. They are white at first then they become creams, they are thin tight. The foot (2 - 5 x 0.3 - 0.5 cm) is cylindrical, central, rigid, confluent and not separable from the cap, it is substantially flared under the cap and swollen at the base. It is orange ocracate (deep golden yellow or reddish = amber color). The stem is also fibrous, striped and a little prickly under the blades, the flesh

of the stem is pale inside and colored outwards, the foot is first full and then it becomes fissile. The spore is white.

The section of the blades shows a hymenium consisting of cylindrical and tetrasporic basides (20-30 × 7.5-10 µm), the sterigmates are 3 to 5 µm high, the sub-hymenium is cellulose and a sub-gulius. Spores (7.5 -9 × 5 µm) are wart, largely elliptical to subglobulous and amyloid.

Among the main distinguishing features of the species of the genus *Melanoleuca* Patouillard (1897) (subfamily Tricholomatoideae Fay.), family Tricholomataceae Roze and order Tricholomatales), the saprophytic lifestyle; the less fleshy hat, usually nippled, more or less hydrophane and without bright colors; sub adnate and white or pale blades; zero cystides or the presence of particular cystides (crystal lifers and barbed wire, called nettle hair); absence of loops and spores amyloid warts but withs mooth and bare supra-apicular beach. The distinction between species of the genus Melanoleuca *is essentially* based on microscopic criteria [8, 9,10]. According to Kühner & Romagnesi [8], the genus Melanoleuca is so homogeneous and forms a continuous chain that most of its types could be considered as a variety of a single species.

The intragenic position of *Melanoleuca electropoda is* still questionable. Indeed, some authors classify this species among the subgenus Melanoleuca characterized by more or less differentiated, fusiform or lageniform unicellular cystides [10]. Others consider *M*. *electropoda* to be part of the subgenus *Urticocystis* Boekhout [12]. The species making up this subgenus are characterized by cystides in nettle hair, sometimes short, narrow, lanceolate and more or less partitioned. We could not observe these cystides in the collected specimens probably because they are very rare and can only be detected in the bottom of the inter-lamellar as Malençon & Bertault reported in 1975 [4] and also short and narrow as Gerault pointed out in [12] 2005. The representation of these hymenal structures by Malençon & Bertault in 1975 [4] shows partitioned cells at their bases and lined with crystalline beards at the top. The Section, *Rasilinae* Bon *Sub-Section* and *the Melanoleuca rasilis* Group (Fr.) Sing. *(*1939), to which *Melanoleuca electropoda* belongs, are essentially characterized by typical nettle-haired cystides (swollen base, cylindrical and narrow neck) and isolated and coarsewart spores [12]. According to the latter author, *Melanoleuca rufipes* Bon (1978)**,** characterized by an orange fawn tint, is the European equivalent of *Melanoleuca electropoda* of North Africa.

In Morocco, thirteen representatives of the 85 species of the genus Melanoleuca [10] were described by Malençon and Bertault [4]. Melanoleuca *electropoda is* one of eleven taxa represented in the Middle Atlas.

Melanoleuca electropoda is a rare Mediterranean species [10]. It is a species of pure or mixed ceder weed from the Middle Atlas and Rif that develops in the fall [4]. However, this fungus was harvested during spring under *Cupressus arizona*. This spring harvest confirms the observations of the latter authors who state that *Melanoleuca electropoda* is normally an autumn species with some spring appearances and also this harvest shows that this species has been maintained in reforestation at *Cupressus arizona*.

The main macroscopic characteristic of *Melanoleuca electropoda* remains the shaded coloration of its foot which contrasts with the greyish coloration of the hat.

Figure 1: *Melanoleuca electropoda* Maire & Malençon (1975).

3.2 Cortinariuscedretorum R. Mayor.

Harvest of 25 11 2005 under *Cedrus atlantica* near Ifrane (Medium Atlas).

The carpophores are solitary or gregarious.

The hat (13 cm) is hemispherical, first vaulted, then spread and finally depressed. The cuticle is light yellow in colour, under the effect of light, it shows red fauve tones. It is viscous and separable. Dry, it is shiny. The margin is more or less lobed, it is firm and thick. The flesh is odour less, soft and purple, it has a greenish line under the cuticle. It is yellow to yellow in the bulb. Under the action of NaOH the flesh blushes.

The hemenophore consists of unequal blades, rounded to sub libre and moderately tight. The blades are olive-yellow, then dark; in the end they become olivaceous brown cannel.

The stipe (5 − 8 × 1.5 − 3 cm) is cylindrical central, equal, solid and ends in napiform bulb, yellowish to reddish. The stipe is whitish and menu of a filamentous ring, the latter becomes rusty by the spores. The hymenium consists of claviform and tetrasporic basides (30-40 × 10 µm). Spores (10-15 × 7-8.5 µm) are amygdaliform, obese, smooth, or wart-like. Spores show a supra-apicular range.

Cortinarius cedretorum R. Maire is reported and described by [6] from a fall 2006 harvest. We note that we have already harvested in November 2005.

According to Mayor [13] 1937, a variety: C. *cedretorum var. suberetorum* develops under *Quercus suber* in the forest of the Mamora. According to Malençon and Bertault [4], this variety is uncommon and is found under *Quercus suber* in the forest of Mamora, under *Quercus pyrenaica* in the vicinity of Larache, under *Quercus rodundifolia* in the massif of Tazeka (Bab bou-Ider) and under *Quercus faginea* in Tamrabta (Middle Atlas). But the two authors are undecided as to the maintenance of this variety. Indeed, according to the two authors, R in 1937, R. Mayor relied on habitat and non-violaceous lamellae, the unstained bulb, and smaller spores to define this new variety of the species. However, the authors point out that the staining of the blades is a criterion of reduced value because even in the type the intensity of the staining is variable. However, this coloration is not reported in the original diagnosis, nor in the type nor in the variety Malençon and Bertault, [3]. According to the same authors, the habitat is also not decisive because *C. cedretorum* also *occurs* under the different oaks of Morocco and not only under Q. Suber. Malençon also met him in the

beech trees of Europe. Based on these observations Malençon and Bertault [3] suggest simply splitting *C. cedretorum* into two types: A macrospore type under conifers and a microspore type under hardwoods. But again, the authors state that the boundaries between macrospore and microspore are not obvious. According to the two authors the microspore type is found mainly under hardwood but the reciprocal is not true. Malençon and Bertault specify that the maintenance of variety for *C. suberetorum* should only be done on the basis of the size of the spores, noting that in this variety the small spores (i.e. those with dimensions less than 9.5 - 11 x 5 - 6.5 µm) must include at least 50% of the spore.

Figure 2: *Cortinarius cedretorum* R. Maire.

3.3 Geoporasumneriana (Cooke) De La Torre 1895.

Synonym: *Sepultaria sumneriana* (Cooke) Massee 1887

Harvest of 18 4 2007 under *Cedrus atlantica* (Manetti) in Ras -el- Ma near Ifrane (Middle Atlas)

The ascocarps of *Geopora sumneriana* (Cooke de La Torre) (1-7.5 cm) are lonely or gregarious, first hypogene and closed and then semi-hypogene. They are also sessile, globular or subglobulous, hollow and cupuliform. They open by random or star-shaped tears, forming irregular lobes on the surface of the soil. The outer face of the ascocarp is brown, the flesh is bistratified, whitish (excipulum ectal) and cream inward (medullary excipulum). The hymenium is whitish, cream, pink or grayish. The spore is cream.

The asks (320 − 360 × 18 − 20 µm) are operculated, cylindracted, pleurorynic, octasporic and non-amyloid. The paraphyses (about 5 µm wide) are hyaline, seperate and often swollen at the top. Ascospores (28-37 × 14-18 µm) are uniseriate, hyaline, smooth, elliptical, and generally biguttulate, lipid droplets are generally accompanied by small granulations.

*Geopora sumneriana*is an Ascomycete *of* the order Pezizales *(Eumycota, Ascomycotina* currently, this order comprises about 15 families of operculated Discomycetes, 150 genera and 900 species and under the order of the Pezizineae. Pezizineae are generally terrestrial's species with thin walls, non-anastomosing paraphyses, and the axial seal and texture of the excipulum as well as the reaction of the asks to iodine are variable [10].

The species (about fifteen) of the genus *Geopora* Harkness [14] Emend. Burdsall [15] (synonymous*: Sepultaria* (Cooke) Lambotte, [16] live in or on the ground under various tree and shrub species, most often associated with conifers. The apothecia of the constituent species of this genus are semi-hypogene and completely closed at the beginning, then they open by a tearing often star or irregular (except in the species *Geopora tenuis (*Fuckel) Schumach.). The outer surface of ascocarps is sometimes wart and covered with a brown tomentum [17]

Geopora sumneriana is a gregarious species, the ascocarps are sometimes even compressed against each other. It appears in the spring (April - May); it is a thermophilic species infused with cedars; some authors consider this species mycorrhizal [3, 4, 18], cited by Larouz, [6]. Others such as Nezzar Houcine *et al.* [19] and Lanier *et al.* [7], it to be specific to cedars, but without forming mycorrhizae. *G. sumneriana* grows particularly on limestone soils. And it is considered of no edible or even toxic interest if the ascocarps are consumed raw.

In Morocco, until now the genus Geopora is represented by three species: *G. arenicola* (Lev.) Cooke Mayor & Werner, [2], *G. sumneriana* **(**Cooke de La Torre) encountered in the altitude cedraies, between Azrou and Ifrane in the Middle Atlas [2,5] cited in 2003 by El-Assfouri et al.[11] and by Larouz [6] and finally *G. foliacea* (Schaeff.) harvested in the Rif [4].

Figure 3: *Geopora sumneriana* (Cooke) De La Torre1895

3.4 *Psathyrella candolleana* (Fr.: Fr.) Mayor (1913).

Harvest of 17/ 4/ 2007 near Ifrane.

Several specimens are scattered ashore in a reforestation at *Cupressus arizona* near the town of Ifrane in the Middle Atlas.

The hat (2 to 8 cm on average) is first hemispherical or bell and circular. It is beige or brownish, matte and hygrophan, bleaching, becoming cream or whitish by water loss. It is convex and spreads out at age. The cuticle breaks into large scales more or less trapezoids. The pilaceousis straight, thin, often striolae and lined with white flakes. Pilaceous flesh is pale beige grey, it is very thin and gives off a banal and a little fruity smell, its flavor is sweet. The blades are adnate to decurrent by a tooth, they are grey

- brown with purple reflections. They are thin tight. The foot (6 - 9 x 0.3 - 1.4 cm) is cylindrical, central, it is substantially flared under the hat and bulged at the base, it is brittle, white and shows fibrils. It is white, the foot is first full and then quickly becomes hollow.

The spore is brownish with purple reflections

Hymenium showed cystides (45-65 x 18-25 µm) of two types: keyed cheilocystides and pleurocystides with green exudates in ammonia. The cystides are mixed with rare Sphero pedunculated cells (25-30 × 15-20 µm). The basides are tetrasporic and keywords.

*Psathyrella candolleana*is a species belonging to: Division Basidiomycota, Class Homobasidiomycetes, Subclass Agaricomycetideae, Order: Agaricales, Family: *Coprinaceae* and genus *Psathyrella*. This common species, but rather variable, gave rise to an incredible synonymi; indeed, there are about 18 synonyms for *P. candolleana*; of which, *Agaricus appendulatus var. P. candolleana is* a very common species that shows a ruderal tendency, it develops in troops with more or less cespitous individuals on soils rich in woody debris, on dead wood more *or* less buried. In the Middle Atlas, *P. candolleana* is harvested in the clearings of pure or mixed cedar.

P. candolleana is edible and characterized by medicinal properties. In fact, the polysacharrides extracted from the mycelium in culture of this species and administered at low doses (300 mg/kg) by intraperitoneal injection inhibit from 70% to 80% the growth of the cells of certain cancers. Also, *P. candolleana* has antibacterial notably against $Gram^+$ such as *Bacillus cereus, Bacillus subtilis, Staphylococcus aureus, Salmonella typhimurium* and *Candida albicans.*

Figure 4: *Psathyrella candolleana* (Fr. : Fr.) Maire (1913).

4. CONCLUSION AND RECOMMENDATIONS

In Morocco, from a biodiversity point of view, the Middle Atlas is considered among the most important regions. This importance is due to the presence of all types of Moroccan natural ecosystems (except those in arid and Saharan areas). The flora and fauna are very rich and diverse, and they contain a large number of endemic, rare or very remarkable species; vegetation is very diverse and phytocenose are lush and offer Morocco's greatest forest potential [1].

The Middle Atlas region is home to a site classified by ZIP (Plant Important Areas) as Priority Ifrane Park in the Middle Atlas. Indeed, the province of Ifrane is home to a forest heritage characterized by significant biodiversity (the main forest species are *Cedrus atlantica, Quercus rotundifolia, Quercus faginea, Pinus pinaster).* It one of the best woodlands in Morocco. Cedar is the priority tree be protected, as it is an important part of Morocco's cultural heritage.

In the Middle Atlas, approximately 1500 (1486) fungal species are inventoried [6] (Larouz 2007). Thus the fungal flora is well represented in this ecosystem.

The forest is the natural of mycoflora fungi, because of their different life styles (symbiotic mycorrhization, saprophytism and parasitism) are indispensable for forest trees. Thus, the relationships between fungal flora and forest trees in particular are crucial for fungal conservation and forest conservation.

Zip's report [20] highlights the importance of preserving forest species. Preserving forest species means determining fungal diversity with a view to preserving it as well. Fungi are closely associated with the forest and are considered to be an essential component of the forest [7]. Fungal diversity is one of the main factors in tree preservation. Without mushrooms, there would be no forest. Saving mushrooms is essential to save the forest.

The fungal species presented in this work may contribute to a better understanding of the fungal diversity of the Middle Atlas in particular and the Moroccan fungal diversity in general.

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