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Types of Ectomycorrhizae from Kočevska Reka

By

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Summary

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Types of ectomycorrhizae were determined (identified or briefly characterized by anatomical characteristics) in soil samples from two permanent forest research plots of the Slovenian Forestry Institute in Kočevska Reka. These two plots (540 and 670 m/a.s.l.) are situated in the vicinity of an EMEP meteorological station at Iskrba as part of the background integral monitoring programme. They differ regarding the ground rock material, resulting in differences in the soil water regime and other soil and site characteristics. The main associations are *Lamio orvalae* - *Fagetum* (Preža, on limestone) and *Blechno* - *Fagetum* (Moravške gredice, on silicates). In two replicate soil samples per plot (taken 0-20 cm deep by 274 ml soil cores) 5,689 (Preža) and 4,281 (Moravške gredice) roots were counted, less than 1 % of which were nonmycorrhizal, and 79 % and 63 % respectively were old, nonturgescent ectomycorrhizae. In the rest, 29 types of ectomycorrhizae were determined, only 4 of which were identical in both plots. Two of these are briefly characterized as yet undescribed types.

Introduction

Mycelia of mycorrhizal fungi are the main spatial and temporal linkage between different constituents in a forest ecosystem (AMARANTHUS & PERRY 1994, SIMARD 1996). The continuous flow of energy through a protective ecosystem depends upon maintenance of nutrient supplies to the primary producers, derived mainly from a balanced cycle within the ecosystem, in which the crucial role is played by fungi (DIGHTON & BODDY 1988). Due to the physiological differences between mycorrhizal fungi, and their functional compatibility in the symbiosis

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(GOGALA 1991, GIANINAZZI-PEARSON 1984, KRAIGHER & al. 1991, 1993), the abundance of ectomycorrhizal types is important when studying such complex ecosystems as the temperate forest ecosystem.

Types of ectomycorrhizae were studied as a contribution to biodiversity studies on two forest research plots, where the ground rock material was used as the primary source of differences in the soil water cycle, resulting in different decomposition rates, microbiological activity and biodiversity in the soils.

Materials and Methods

A mycobioidication method for forest site pollution was used (KRAIGHER & al. 1996). The sampling was done in July 1998. Types of ectomycorrhizae were determined (identified or briefly characterized by anatomical characteristics; if the types were similar to the described ones, but not identical, the applied types name was marked with a question mark (?) in soil samples from two permanent forest research plots of the Slovenian Forestry Institute in Kočevska Reka. These two plots (540 and 670 m/a.s.l.) are situated in the vicinity of an EMEP meteorological station at Iskrba as part of the background integral monitoring programme. The main associations on the two plots are *Lamio orvalae* - *Fagetum* (Preža, on limestone) and *Blechno* - *Fagetum* (Moravške gredice, on silicates) (KUTNAR & URBANČIČ 1999). All short roots in the soil cores were counted and separated into two groups. One group consisted of mycorrhizal types, where mycorrhizae were fully developed, so these types could be further analysed for determination. The second group consisted of specimens in which the ectomycorrhizal types were too old or too young for identification (others). The determination followed the procedures from the "Colour Atlas of Ectomycorrhizae" (AGERER 1997) and other primary sources of identification.

Results and Discussion

5,689 root tips were counted in the soil core from Preža 1 and 16 types of ectomycorrhizae were identified and briefly characterized. In the soil core from Moravške gredice 13 types of ectomycorrhizae were briefly characterized from the total of 4,281 root tips.

From 25 different types of ectomycorrhizae, 12 were identified to the species level, 3 to the genus level, 2 showed characteristics similar but not identical to already described types, and for 8 similarities were not found with any of the already described types.

Only 4 types of ectomycorrhizae were identical for both plots: *Cenococcum geophilum*, *Russula ochroleuca*, *Cortinarius bolaris* and *Dermocybe cinnamomea*?. The first and the second of these have been found previously to be common in beechwood (BRAND 1991).

Cenococcum geophilum has a world-wide distribution on a wide range of plants (SMITH & READ 1997). Its mycorrhizae is very common on seedlings and mature trees but rarely dominate root system (INGLEBY & al. 1990). Our data confirm these statements. We found C.g. in these soil cores from Kočevska Reka (nearly 10 %). The problem is, that it has been shown previously, that it may include several types. Therefore, it should be considered as a 'group type' (AL SAYEGH PETKOVŠEK 1997, AL SAYEGH PETKOVŠEK & KRAIGHER 1999).

Table 1. Percentage and types of ectomycorrhizae (according to all determined mycorrhizal roots).

TYPES OF ECTOMYCORRHIZAE	Moravške g. 2 %	Preža 1 %
SLO 803 – SA3 " <i>black types</i> " (C.g)	10.6	11.8
SLO 804 – SA4	17.6	/
SLO 811 – SA11 <i>Tylospora fibrillosa</i>	/	6.5
SLO 814 – SA14 <i>Cortinarius bolaris</i>	0.6	2.7
SLO 817 – SA17 <i>Russula ochroleuca</i>	10.3	4.9
SLO 822 – SA22 <i>Tricholoma sciodes</i>	6.4	/
SLO 823 – SA23 <i>Piceirhiza conspicua</i>	6.2	/
SLO 824 – SA24 <i>Dermocybe cinnamomea</i> ?	14.6	12.2
SLO 825 – SA25	0.2	/
SLO 827 – SA27 <i>Elaphomyces granulatus</i>	11.6	/
SLO 828 – SA28	0.1	/
SLO 829 – SA15 <i>Piceirhiza nigra</i> ?	10.4	/
SLO 830 – SA30	4.3	/
SLO 831 – SA31	7.1	/
SLO 832 – SA32 <i>Piceirhiza oleiferans</i> ?	/	4.6
SLO 833 – SA33 <i>Rhizopogon</i> sp.	/	9.7
SLO 834 – SA7	/	0.4
SLO 835 – SA35 <i>Piceirhiza chordata</i>	/	5.8
SLO 837 – SA37 <i>Russula</i> sp.	/	4.0
SLO 838 – SA38 <i>Piceirhiza gelatinosa</i>	/	0.1
SLO 839 – SA39 <i>Fagirhiza globulifera</i>	/	5.1
SLO 840 – SA40	/	3.9
SLO 841 – SA41	/	6.6
SLO 842 – SA42 <i>Piloderma croceum</i>	/	4.6
SLO 843 – SA43 <i>Russula xerampelina</i>	/	17.1
SNT (others)	62.8 %	79 %
nonmycorrhizal short roots	0.6 %	0.6 %
% of identified mycorrhizal short roots	36.6 %	20.4 %

Russula ochroleuca occurred frequently in both plots (Moravške gredice - 10 % and Preža 5 %). The type *Cortinarius bolaris* x *Fagus sylvatica* has been shown to occur sporadically in previous studies (BRAND 1991). In our study was found on both plots at a low percentage (less than 3 %).

Two interesting types with reference numbers SLO 804 – SA4 and SLO 833 – SA33 do not correspond to any other descriptions. Therefore, they could be yet - undescribed types of ectomycorrhizae. The brief descriptions are presented below.

Type of ectomycorrhizae SLO 804 – SA4

Morphology: Bright yellow mycorrhizae with woolly (Fig. 1), emanating mycelium and frequent, bright ochre rhizomorphs dividing into several finer filaments. Emanating hyphae are of a bright yellow to ochre colour. The surface is covered with adhering soil particles which sometimes cover the mycorrhizal tip completely so that mycorrhizal root tips look like “small yellow clouds”. Ramification: simple, unramified or monopodial – pyramidal. Length of mycorrhizal system is 3.5 – 6 mm, diameter of axis is 0.2 mm. Unramified ends are 1 – 3.5 mm long (diameter 0.2 mm) and slightly bent.

Anatomical characteristics of emanating elements: *Hyphae* frequent, cells and cell walls colourless, diameter of emanating hyphae (5.5) 8 – 10 µm, frequently with a short distance between septa (3.5) 10 to 60 µm, diameter of cell walls 0.5 to 1 µm, sometimes 3 µm thick, without clamps, septa with a Woronin body-like structure, hyphae branched, intrahyphal hyphae present, tips of hyphae sometimes globular. *Rhizomorphs:* cell colourless, undifferentiated, type B (according to AGERER 1997), diameter up to 120 µm. *Cystidia* are rare, globular to fusiform (type F). Sometimes, cystidia-like emanating hyphae are present on the surface, with a globular basal cell with thick walls (3 µm).

Anatomical characteristics of the mantle in plan views: The mantle is colourless, plectenchymatous, often with adhering soil particles. *Outer mantle layers* (Fig. 2): plectenchymatous and transitional type between plectenchymatous and pseudoparenchymatous mantle with irregularly-shaped hyphae, diameter of cells 5.5 to 10 µm, colourless, cell walls slightly grey and up to 2 µm thick, septa without doliporus. *Inner mantle layers:* Densely plectenchymatous, partly parallelly arranged hyphae, thinner in comparison to upper layers (3 to 4 µm), septa simple. Anastomosis type A present (according to AGERER 1997).

Discussion: Perhaps the type of ectomycorrhizae SLO 804 - SA4 is not described yet. Taking into account the Woronin body-like structure we presume that the type SLO 804 – SA4 belongs to the Ascomycetes. This type of ectomycorrhizae occurred frequently in samples from Moravské gredice 2 (17.6 %).

Type of ectomycorrhizae SLO 833 – SA33

Morphology: Ochre to orange - ochre mycorrhizae is tuberculate with very compact structure (like a “bandage” which is colourless so cortical cells can be seen) (Fig. 3). The mycorrhizal system is globular and very often elongated. The surface is often covered with soil particles and with few, large, yellow emanating hyphae. Ramification: often simple, unramified, rarely monopodial - pyramidal. Length of the mycorrhizal system is up to 4 mm, diameter of axis is 1 mm. Unramified ends are 0.5 - 1 mm long.

Anatomical characteristics of emanating elements: Emanating hyphae are thick (diameter 6 to 20 µm) and densely covered with soil particles. Some thinner hyphae (diameter 5 µm) have wall thickenings. *Rhizomorphs:* not observed. *Cystidia:* not observed.

Anatomical characteristics of mantle in plan views: The mantle is plectenchymatous in all layers, hyphae are thin-walled, colourless to bright greyish, clamps are lacking. *Outer mantle layers:* (Fig. 4): between plectenchymatous hyphae there is a gelatinous matrix, hyphae form loose network without any pattern, diameter is 2.5 to 4 µm. Some hyphae form globular inflations (up to 12 µm). *Inner mantle layers:* densely plectenchymatous, without pattern.

Anatomical characteristics, cross section: Mantle is very thick (70 – 250 µm, max. 330 µm) and plectenchymatous with a gelatinous matrix. *Tannin cells* in 1 – 2 rows, oval, tangentially 8 – 20 µm, radially 4 – 10 µm.

Discussion: The type of ectomycorrhizae SLO 833 – SA33 resembles *Rhizopogon melanogastoides* on *Pinus mugo* Turra, but there are some differences: coralloid ramification (known to occur mainly on pines) is not characteristic for type SLO 833 – SA33; rhizomorphs were not observed; very thick mantle is characteristic for type SLO 833 – SA33; some morphological differences (colour and shape of tubercles). Ectomycorrhizae SLO 833 – SA33 were frequent in the soil core from Preža (9.7 %). We presume that the ectomycorrhizae SLO 833 – SA33 belongs to the genus *Rhizopogon*.



Fig. 1. Type of ectomycorrhizae SLO 804 - SA4, habit (bar = 1 mm).

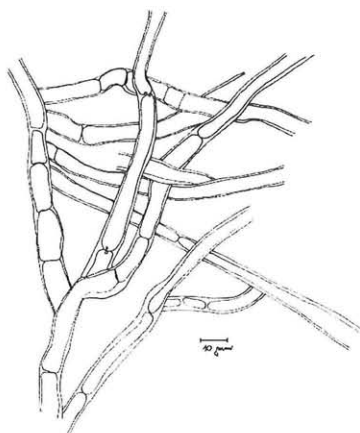


Fig. 2. Type of ectomycorrhizae SLO 804 - SA4: outer mantle layer (bar = 10 µm).

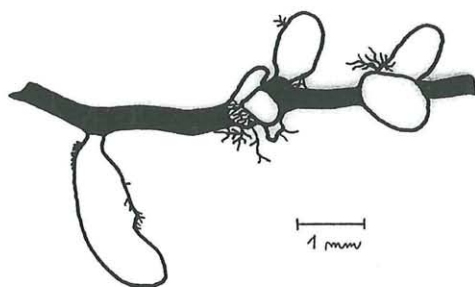


Fig. 3. Type of ectomycorrhizae SLO 833 - SA33, habit (bar = 1 mm).

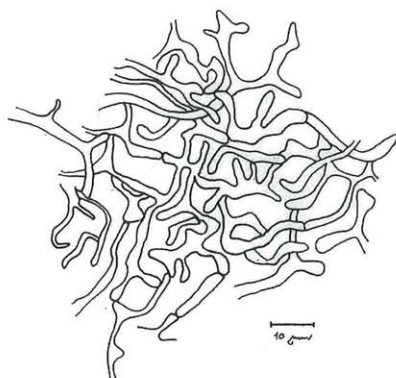


Fig. 4. Type of ectomycorrhizae SLO 833 - SA33: outer mantle layer with gelatinous matrix (bar = 10 µm).

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