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Microfungal communities in Mediterranean evergreen forests of Central Italy

Abstract

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A list of all species of dematiaceous hyphomycetes found in the litter of five plots of Mediterranean evergreen forest in Tuscany is presented and commented. Relative frequencies by plots, and in three distinct layers of the litter, are given for all species. Species numbers as well as inter-plot floristic affinities are tabulated.

Introduction

In a previous paper (Perini & al. 1989), data pertaining to a mycocoenological study of macromycetes found in five *Quercus ilex* L. groves in the hills adjacent to the Maremma coastline in Tuscany (Central Italy) were published. The results of a new investigation, focused on the micromycetes (dematiaceous hyphomycetes) present in the litter of the same plots, are reported here and placed in the context of the previous research.

A bibliographic search has evidenced that few papers on micromycetes in Mediterranean evergreen forests have been published so far. Bartoli & Massari (1985) studied the *Quercus ilex* forest soil on the Monte Argentario promontory, also in Tuscany, from which they isolated a small number of strains; in the same paper they also studied the soils of *Myrtus communis* L. and *Pistacia lentiscus* L. communities near Tolfa (Latium, Central Italy), where species richness was greater. The succession of soil microfungal populations subsequent to fire, on the Monte Argentario promontory, was later described by Bartoli & al. (1991).

The litter fungi of an *Orno-Quercetum ilicis* association in northern Greece was studied by several different methods by Vardavakis (1988). The distribution of fungi occurring on leaves of some evergreen sclerophyllous shrubs in Greece, with their tannino-cellulolytic activity, has been studied by Marakis & Diamantoglou (1990).

Finally, the saprotrophic microfungal communities of *Pistacia lentiscus* leaf litter in some coastal plots in S. Sardinia (Italy) were investigated by Mulas & al. (1989, 1990)

and Rambelli & Pasqualetti (1991a-b). In the latter papers, the authors present some considerations on the adaptive strategies of the species they had found.

Description of the studied plots

The five studied plots (P1: Cala Martina; P2: Poggio Carpineta; P3: Zinghera; P4: Collacchia; P5: Monticello), all located in the hills bordering the Maremma coast near Grosseto (Fig. 1), belong to the *Viburno-Quercetum ilicis ornetosum* and are fairly homogeneous with respect to their structure, age and inclination. However, they differ in several other parameters such as altitude, position, and distance from the sea.

- The altitude ranges from 20 m above sea level (P1) to 250 m (P5), with intermediate values of 50, 125, and 150 m for P2, P3 and P4, respectively.
- The minimum distance from the coast varies from 50 m (P1) to 11 km (P5). The geological substratum is sandstone, except for P5 which is situated on limestone.
- The average thickness of the litter varies from a minimum of 3.4 cm in P1 to a maximum of 6.2 cm in P4, with intermediate values of 3.5, 3.7, and 4.9 cm for P2, P3 and P5, respectively.

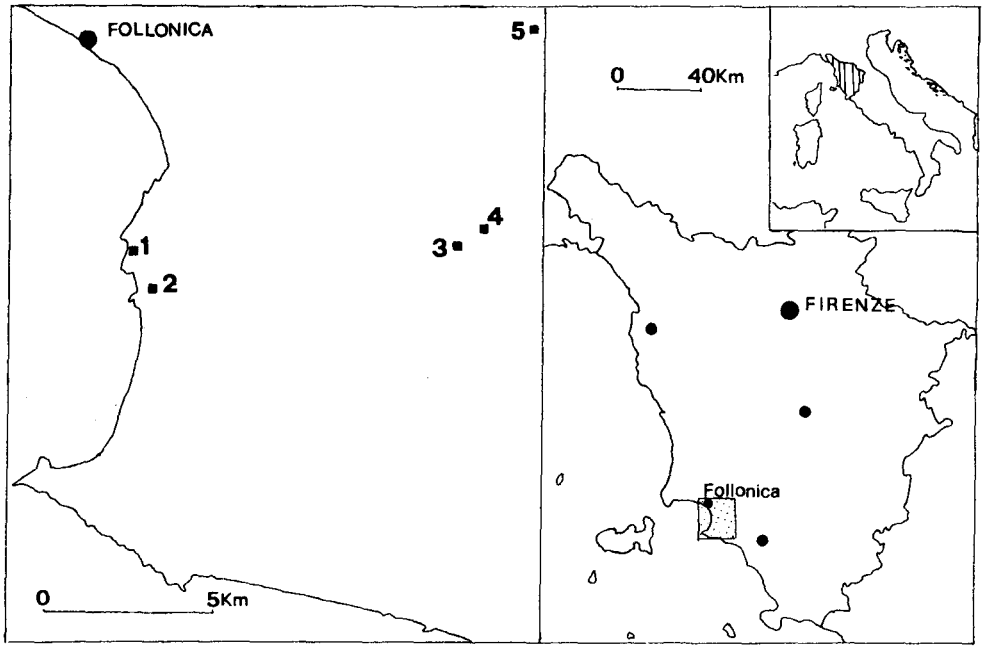

Fig. 1. Map of the investigated area, with plots numbered 1-5. – 1, Cala Martina; 2, Poggio Carpineta; 3, Zinghera; 4, Collacchia; 5, Monticello.

Materials and methods

Three layers were identified in the litter of each plot: a superficial, an intermediate and a deep layer, corresponding to the different stages of decay. The superficial layer consists of newly fallen leaves, the intermediate layer to partly discoloured and decomposed leaves, and the deep layer to strongly decomposed and fragile leaves, with minute soil particles adhering to their surface. For each layer 100 leaves were analysed, resulting in a total of 300 leaves per plot. The material was observed after incubation in a humid chamber for one week.

The samples were collected in May, in the spring season when, same as in autumn, large amounts of leaf litter are produced (Vardavakis 1988).

The relative frequency is given as the percent ratio of number of specimens of the species in the sample per total number of specimens of all species in the sample. The Sørensen similarity index (K) was calculated with the formula $K = 2c / a + b$, where c = number of species common to two plots, a = number of species of one plot and b = number of species of the other plot (Hawksworth 1974).

Results and discussion

Table 1 lists all species identified (or distinguished) that were found during the present study in the three layers of each plot, with their relative frequency. In Table 2 the total number of species and specimens is reported for each plot and each layer.

The most important fact emerging from Table 1 consists in the presence, in all the plots, of a few dominant species with very high relative frequencies. They are *Beltrania rhombica, Mycoenterolobium* sp., *Subulispora britannica, Triposporium elegans,* and *Ulocladium alternariae,* two of which are present in all three layers of all five plots. They all could be considered as "ruderals" (Pugh 1980), being able to act as primary colonizers, and they presumably characterize the litter of the five evergreen oak woods here studied. The spring collecting probably makes colonization of the litter by ruderal species easier, as already observed in the same environmental conditions in Sardinia by Rambelli & Pasqualetti (1991a). It is also interesting to observe that Vardavakis (1988) reported that the highest decomposition percentages occur in spring. These species, moreover, seem to be good "competitors" (Pugh 1980), judging from their presence, always with high values, in the intermediate and deep layers.

Beltrania rhombica shows a marked morphological dimorphism. In the studied material, and occasionally on the same leaf, two strains are almost always present that differ in dimensions, shape and colour – a strain with darker and wider conidia being more frequent (62 %) than a strain with less pigmented and longer conidia (38 %). This phenomenon, already observed in the Mediterranean vegetation by other authors (Rambelli & Pasqualetti 1990, 1991a; Di Pietro & Rambelli 1992), reflects the general variability of this species and may be the consequence of adaptation to the plant matrices and to the favourable environmental conditions of the area.

Table 1. List of the species from the superficial (S), intermediate (I) and deep (D) layers of leaf litter from the five plots (P1-5), with their relative frequencies (percent values).

Taxon	P1			P2			P3			P4			P5		
	S	I	D	S	I	D	S	I	D	S	I	D	S	I	D
Alternaria sp.	1.9	2.4	2.7	3.7	3.2	1.0	1.2	1.0	1.2	1.6		1.2			
Anungitea sp.		0.8													
– *longicatenata* Matsush.		0.8													
– *triseptata* Matsush.		0.8													
Beltrania rhombica Penz.	24.3	24.6	26.0	28.4	26.5	25.0	37.5	29.2	31.0	29.0	24.0	25.0	23.3	27.7	31.5
Cercospora sp.		0.8													
Cercosporidium sp.			0.9												
Chalara unicolor S. Hughes		0.8													
– *stipitata* Nag Raj & W. B. Kendr.				2.1	1.2	3.2	5.9	3.6	1.6		1.8				
Chalara sp.		0.8	0.9				1.6								
Chloridium sp.	1.0	0.8		2.5	2.1									1.4	1.8
– *virescens* (Pers.) W. Gams & Hol.-Jech.		0.8	0.9			1.0									
Circinotrichum sp.		1.2	1.0												
– *olivaceum* (Speg.) Piroz.	1.0			1.2	1.1										
Cladosporium sp.		1.1								1.6					
– *cladosporioides* (Fresen.) de Vries	1.9		0.9	1.2	1.1								1.6	2.7	
– *inaequiseptatum* Matsush.		0.8													
Dactylaria sp.						1.2		1.6	3.7						
– *naviculiformis* Matsush.		0.8													
Dictyochaeta sp.		3.2								1.6	3.6				
Dictyosporium toruloides (Corda) Guég.				1.0											
Drechslera sp.		4.0	0.9		1.1	1.0		1.0	2.4	3.2		2.4			
– *australiensis* (R. G. Bagn.) Subram. & Jain						1.2									
[*Drechslera* state of] *Cochliobolus specifer* Nelson	1.8		1.0												
Endophragmia sp.	1.0														
– *alternata* Tubaki & Saito		4.0	2.7	6.2	5.3	1.0	3.7	3.1	3.6	1.6	4.7	4.7			
– *elliptica* (Berk. & Broome) M. B. Ellis						1.2									
Endophragmiella sp.						1.0									
Everhartia hymenuloides Sacc. & Ellis						1.2									
Gyrothrix circinata (Berk. & M. A. Curtis) S. Hughes							1.4								
– *citricola* Piroz.						1.4									
– *magica* Lunghini & Onofri	0.8														
– *verticiclada* (Goid.) S. Hughes & Piroz.	3.9	2.4	1.8			1.0							1.6	2.7	1.8
Helicosporium sp.		1.2													
– *vegetum* Nees		1.6					1.2							1.4	
Humicola sp.		0.9			4.2		2.1	1.2		1.2			1.4	1.8	
Kylindria sp.						1.6									
Menispora sp.							3.7								
Mycoenterolobium sp.	5.8	4.0	5.3	6.2	3.2	12.5	11.2	14.6	9.5	12.9	8.3	14.3	11.6	9.7	
Paecilomyces sp.	1.0	0.8	0.9		1.1									2.7	
Phaeoramularia sp.		0.8													
Pleurophragmium sp.		2.5													
Pleurothecium recurvatum (Morgan) Höhn.		0.8													
Pseudospiropes rousselianus (Mont.) M. B. Ellis	1.0														
Rhinocladiella sp.		0.8													
– cf. *cellaris* (Pers.) M. B. Ellis		0.8													
Scolecobasidium sp.		1.2													
Scytalidium lignicola Pesante									1.8						

Table 1 continued).

Taxon	P1			P2			P3			P4			P5		
	S	I	D	S	I	D	S	I	D	S	I	D	S	I	D
Spiropes sp.	1.0		2.7	2.5						1.6	1.2		1.6		
Sporidesmium sp. "No. 10"	1.9	4.8	2.7	3.7	5.3	4.2	5.0	1.0				3.6		1.4	1.8
Sporidesmium sp.	2.9	0.8	0.9	1.2	2.1	1.0			1.2					1.4	
Stachybotrys chartarum (Ehrenb.) S. Hughes		1.2													
Stenella sp.		0.8										3.6	1.6	1.4	
Subramaniomyces fusisaprophyticus (Matsush.) P. M. Kirk	3.9	3.2					1.2	2.1	2.4						
Subulispora britannica B. Sutton	11.6	10.3	8.0	6.2	6.4		7.5	7.3	1.2	3.2	4.7	1.2	1.6	1.4	
Taeniolella sp.		0.8			1.1	1.0					1.2				
Torula sp.												1.2			
– *herbarum* (Pers.) Link												1.2			
Triposporium elegans Corda	22.3	19.8	18.7	21.0	22.3	14.6	17.5	25.0	33.3	24.2	20.2	21.4	20.0	12.5	24.0
Trochocladium asperum Harz			3.1												
Ulocladium sp.	4.8		5.3		1.1	10.4	2.5						1.6		
– *alternariae* (Cooke) R. B. Simmons	5.8		12.5	1.2	8.5	10.4	15.0	9.4	10.7	8.0	17.8	8.3	41.6	20.8	9.2
– *consortiale* (Thüm.) R. B. Simmons		1.2													
Zygosporium sp.		1.0													
demat. hyphomycete indet. "No. 1"		0.9													
demat. hyphomycetes indet.	2.9	0.8	1.8	6.2	6.4	4.2	3.7		1.2	8.0	4.7	5.9	5.0	8.3	1.8

From a comparison of the numbers of species and specimens in the three layers (Table 2), it appears that the number of specimens is often larger in the intermediate layer, whereas Table 1 shows that more species are confined to the intermediate layer (16) than are restricted to the deep (12) or superficial (8) layer. These data suggest that conditions for fungal activity are more favourable in the intermediate layer, with the contemporaneous presence of competitors and ruderals, the latter coming from the upper layer; conversely, competition phenomena may limit the number of species in the deep layer.

The total number of specimens per plot (Table 2) is highest in P1 and decreases progressively in the following plots – a phenomenon that is less evident for the total number of species present. This decrease may be due to the increasing distance from the sea and altitude of the five plots – a hypothesis to be tested by further investigations. Indeed, the data reported here must be considered as preliminary: in order to obtain a fully representative picture of fungal succession, it is necessary to study the fluctuation of fungal leaf litter colonization through the turn of the seasons.

Table 2. Total number of species and specimens for each plot (P1-5) and layer of leaf litter (Σ = total number per plot; S = superficial, I = intermediate, and D = deep layer).

	P1				P2				P3				P4				P5			
	Σ	S	I	D	Σ	S	I	D	Σ	S	I	D	Σ	S	I	D	Σ	S	I	D
No. of species	43	19	32	21	33	20	19	20	18	12	14	13	23	13	14	16	25	15	17	14
No. of specimens	341	103	126	112	271	81	94	96	260	80	96	84	230	62	84	84	186	60	72	54

Table 3. Sørensen similarity coefficients for the vascular flora (v, roman), the macro-mycoflora (*ma*, italics), and the micro-mycoflora (**mi**, bold) in the five studied plots (P1-5).

	P5			P4			P3			P2		
	v	*ma*	**mi**	v	*ma*	**mi**	v	*ma*	**mi**	v	*ma*	**mi**
P1	73.6	*58.7*	**48.5**	58.5	*58.8*	**46.9**	66.6	*62.3*	**50.8**	87.5	*60.8*	**59.5**
P2	63.1	*49.1*	**50.0**	68.2	*53.2*	**44.4**	66.6	*51.9*	**53.1**			
P3	57.7	*57.9*	**53.6**	79.1	*67.3*	**56.4**						
P4	59.6	*57.9*	**47.8**									

Table 3 surveys inter-plot affinities of the vascular flora, the macro-mycoflora and the micro-mycoflora, in terms of Sørensen similarity indices, of the *Quercus ilex* groves studied. The floristic affinities are almost always lower for micromycetes floras than for macromycetes and vascular plants. The observation by Perini & al. (1989) can be confirmed, that a high index of floristic affinity for vascular plants is more or less correlated with a high index of mycological affinity, for both macro- and micromycetes. Just as these authors had observed when comparing macromycetes and vascular plants, for micromycetes the highest affinities are found between plots closest to each other: that is, between P1 and P2 and between P3 and P4, while affinities are lower with P5 that is relatively far from the others. The fact that P5 , as reported by Perini & al. (1989), appears more similar to the coastal plots (P1-2) than to the nearer, inland ones (P3-4), is not confirmed by microfungal data.

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