

## Fungi Colonizing Various Organs of Lemon Balm (*Melissa officinalis* L.) Cultivated in South-East Poland

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### Abstract

On one-year-old and two-year-old plantations of lemon balm observations on the occurrence of plants showing symptoms of fungal diseases were made in 1998–2001. Many fungi were isolated from roots, stem bases and leaves separately on mineral medium. Species of *Fusarium*, *Phoma* and *Rhizoctonia solani* were obtained from the roots and stem bases whereas *Alternaria alternata*, *Phoma* spp., *Septoria melissae* and *Botrytis cinerea* were most often isolated from the leaves showing symptoms of necrosis.

**Keywords:** lemon balm; fungi; occurrence

### INTRODUCTION

Lemon balm belongs to more important herbs cultivated in South-East Poland. Disease symptoms are known to occur on lemon balm in spite of all antibacteriostatic and antifungistatic properties resulting from biologically active substances specific for this plant. *Septoria melissae* Desm. makes the leaves cover with spots and dry up. The fungus seriously threatens lemon balm plantations with damage in different geographic regions (ZECHINI *et al.* 1995; MIKOŁAJEWICZ & FIŁODA 1998). Also *Botrytis cinerea* Pers. happens to be very harmful to the leaves and petioles of lemon balm. *Botrytis cinerea* and *Erysiphe galeopsidis* DC. Ex Mérat were recorded to occur on the aboveground organs of this plant under cultivation in Italy (ZECHINI *et al.* 1995; GARIBALDI *et al.* 1997). The latter pathogen was earlier reported to occur on lemon balm in South-East Poland (SALATA 1985). Recently, species of *Alternaria*, *Aspergillus*, *Cladosporium* and *Penicillium* were found to colonize schizocarps of lemon balm (MACHOWICZ-STEFANIAK & ZIMOWSKA 2000). Taking into account the above, the present study on diseases of lemon balm cultivated in the Lublin region was carried out in 1998–2001.

### MATERIAL AND METHODS

Five one-year-old plantations and five two-year-old ones, 20 to 50 are of area each, were surveyed in

the years 1998–2001. The state of health plants was estimated on the former plantations when the plants were 6 weeks old and before the first harvest whereas on the latter plantations estimations were made just after the plants had overwintered and before the last harvest. Forty plants from the each of one-year-old plantations and twenty plants from each of two-year-old plantations were taken to the study in laboratory conditions. A five-degree scale was used to evaluate infections on stem bases of the plants: 0° – no symptom of necrosis, 1° – a trace of necrosis, 2° – single necrotic spots very low on the base of surface, 3° – necrosis at half base stem surface, 4° – necrosis at all the base of stems surface. Then the index of infection was calculated and statistical analysis of data was applied using Tukey's HSD test.

Superficially disinfected roots, stem bases and leaves showing symptoms of necrosis were taken to isolate pathogenic fungi on mineral medium (ŁACICOWA & KIECANA 1978). To identify the fungi malt-agar cultures were used, but *Fusarium* spp. were cultured on PDA and SNA media (NELSON *et al.* 1983) whereas *Phoma* spp. were cultured on malt-agar, oat-agar and cherry-agar (BOEREMA 1976).

### RESULTS

Numbers of plants with disease symptoms on the plantations surveyed varied from 19% to 62% (Table 1). Six-week-old seedlings showed an inhibition

in their growth and symptoms of necrosis; their leaves were covered with spots and their roots were shortened. Symptoms of necrosis on the leaves and roots of one-year-old plants increased in the period of full vegetation whereas at the end of summer the plants died all over. Values of the index of infection varied from 14% to 33% (Table 1). Similar disease symptoms occurred on two-year-old plants, however, values of index of infection varied from 26% to 50% and often surpassed those occurring on the one-year-old plants.

During the period of investigations 5451 isolates of fungi, classified to 53 species, were obtained (Table 2). All the organs of lemon balm were found to be infected by *Alternaria alternata*, which dominated among all the species of fungi. It was most often isolated from the leaves and the isolates ranged to 81% of all fungi obtained in one-year-old plants and to 85% in two-year-old plants. Also from all the organs *Fusarium* spp. were isolated but most often from stem bases. The following species were found: *F. avenaceum* (Fr.) Sacc., *F. culmorum* (W. G. Smith) Sacc., *F. equiseti* (Corda) Sacc., *F. oxysporum* Schlecht. emend. Snyder et Hans., and *F. subglutinans* (Wollenw. et Reinking) Nelson, Toussoun et Marasas. Various species of *Phoma* were isolated, particularly from stem bases and roots of two-year-old plants of lemon balm, but *P. exigua* var. *exigua* Desm. was most common with isolates ranging to 29% and 15% of all fungi from the above mentioned organs, respectively. *Septoria melissae* was isolated from the leaves and stem bases of one-year-old plants only in the year 2000. *Botrytis cinerea* was isolated from all the examined organs of two-year-old plants. *Rhizoctonia solani* and *Phyllosticta decidua* were often recorded, their isolates being most

often obtained from stem bases. From all the examined organs of lemon balm each year *Trichoderma* spp. were isolated, particularly from stem bases.

## DISCUSSION

Plants of lemon balm can suffer from fungal diseases as results from the present study. Higher values of the index of infection demonstrated by two-year-old plants of lemon balm indicate that two years' plantations can be more threatened with fungal diseases than one-year plantations, which probably results from an accumulation of soil-borne fungi, particularly species of *Fusarium*, *Rhizoctonia* and *Botrytis* (ŁACICOWA & KIECANA 1978; NELSON *et al.* 1983; PAPPAS & ELENA 1997). Among the fungi isolated from lemon balm, *Fusarium* spp. are more important as causes of necroses occurring on the roots and stem bases. Results of a mycological analysis and pathogenicity tests confirm the above statement (own not published data). The isolates of *Phoma exigua* var. *exigua* from mortified roots and stem bases of lemon balm indicate on the occurrence of this fungus in the cultivation habitat of that plant. The fungus can colonize external and internal tissues of seeds of various herbs destined for sowing (MACHOWICZ-STEFANIAK & ZIMOWSKA 2000). *Alternaria alternata*, *Botrytis cinerea* and *Septoria melissae* colonizing the leaves of lemon balm often cause a decrease in the quality of herb products (ZECHINI *et al.* 1995; GARIBALDI *et al.* 1997; MIKOŁAJEWICZ & FILODA 1998). On the other hand, *Rhizoctonia solani* and *Colletotrichum gloeosporioides*, known as serious herb pathogens (BERBEĆ & PIĘTA 1996; GÄRBER & SCHRENK 2001), may run the risk of heavy losses on plantations of lemon balm.

Table 1. The healthiness of lemon balm (*Melissa officinalis* L.) on the plantations

Years of observation	Percent of plant with diseases symptoms		Index of infection (%)	
	one-year-old plants	two-year-old plants	one-year-old plants	two-year-old plants
1998	53.16 bc	62.05 c	33.6 bcd	42.10 bcd
1999	20.49 a	57.74 c	14.19 a	50.90 d
2000	30.04 a	37.32 ab	14.50 a	44.87 cd
2001	19.23 a	26.27 a	24.73 ab	26.14 abc
	LSD = 18.2074		LSD = 18.9627	
Means	30.73 a	45.85 b	21.75 a	41.00 b
	LSD = 5.81343		LSD = 3.8766	

Values marked with the same letter do not differ significantly

Table 2. Fungi isolated from various organs of lemon balm (*Melissa officinalis* L.) in 1998–2001

Fungi	Number of isolates						Total	
	roots		base of stems		leaves		a	b
	a	b	a	b	a	b		
<i>Acremoniella atra</i> (Corda) Sacc.	–	–	–	5	–	–	–	5
<i>Acremonium breve</i> (Sukap. et Thirum.) W. Gams	–	6	–	13	–	–	–	19
<i>Acremonium strictum</i> W. Gams	–	–	–	2	–	18	–	20
<i>Alternaria alternata</i> (Fr.) Keissler	15	60	129	216	811	1386	955	1662
<i>Botrytis cinerea</i> Pers.	–	31	–	39	–	33	–	103
<i>Chaetomium funiculum</i> Cooke	–	–	–	3	–	–	–	3
<i>Cladosporium cladosporioides</i> (Fres.) de Vries	2	6	11	–	18	44	31	50
<i>Colletotrichum gloeosporioides</i> (Penz.) Sacc.	–	–	6	–	–	2	6	2
<i>Culvularia brachyspora</i> Boedijn	12	–	7	–	–	–	19	–
<i>Culvularia lunnata</i> (Wakker) Boedijn	–	–	–	–	–	1	–	1
<i>Cylindrocarpon</i> spp.	11	42	7	15	–	–	18	57
<i>Drechslera fugax</i> (Wallr.) Schoemaker	–	–	–	–	2	–	2	–
<i>Drechslera pedicellata</i> (Henry) Subram. et Jain	–	–	–	–	–	3	–	3
<i>Epicoccum purpurascens</i> Ehrenberg	1	3	2	4	21	25	24	32
<i>Fusarium</i> spp.	106	90	151	411	30	40	287	541
<i>Gilmaniella humicola</i> Barron	–	–	4	14	5	2	9	16
<i>Gliocladium catenulatum</i> (Gilman et Abbott)	20	10	22	2	4	–	46	12
<i>Gliocladium roseum</i> Bainier	–	8	–	–	–	–	–	8
<i>Humicola grisea</i> Traaen	–	–	–	8	–	–	–	8
<i>Papulospora</i> sp.	–	–	–	9	–	–	–	9
<i>Penicillium</i> spp.	37	28	12	56	1	3	50	87
<i>Phoma</i> spp.	4	208	24	244	29	35	57	487
<i>Phyllosticta decidua</i> Ellis et Kellerm.	–	4	4	26	–	4	4	34
<i>Rhizoctonia solani</i> Kühn	2	27	12	16	2	10	16	53
<i>Septoria melissae</i> Desm.	–	–	4	–	42	–	46	–
<i>Talaromyces flavus</i> (Köcker) Statk et Samson	12	–	2	–	1	–	15	–
<i>Trichoderma</i> spp.	27	93	222	246	20	4	269	343
Nonsporulating brown fungi	4	19	5	5	2	5	11	29
Total	253	635	624	1334	990	1615	1867	3584

a – one-year-old plants, b – two-year old plants

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