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POTENTIALLY PATHOGENIC, PATHOGENIC, AND ALLERGENIC MOULDS IN THE URBAN SOILS*

ABSTRACT: The dynamics of soil mould populations that can compromise the human immune system was evaluated in experimental plots located at different distances (100, 300, 500, 700 and 900 m) from the main source of pollution – the Podgorica Aluminum Plant. Soil samples were collected in July and October 2008 from three different plot zones at a depth of 0-10 cm. The count of potentially pathogenic, keratinolytic and allergenic (melaninogenic) moulds was assessed, which can significantly contribute to both diagnosis and prophylaxis.

The count of medically important moulds was higher in the urban soil than in the unpolluted (control) soil. Their count decreased with increasing distance from the main pollution source (PAP). Their abundance in the soil was considerably higher in autumn than in spring.

KEY WORDS: moulds, pollution, soil

INTRODUCTION

Many microscopic moulds produce biologically active substances – enzymes, vitamins, antibiotics and toxins. Micromycetes account for 50% of the total microbial biomass in some soils (Mirčnik 1988; Zvjagincev, 1999). They play an important role in the mineralisation of organic substances and maintenance of soil fertility. Many micromycete species are toxic (Bilai, 1989) since they produce antibiotics and phyto- and zootoxins (Bilai and Pidopličko, 1970).

Anthropogenic activities in urban areas lead to the formation of specific soils that show disturbance in the cycle of biogenic elements, depletion of the

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biodiversity of saprotrophic microorganisms (composition, structure, function) and an increase in the presence of pathogenic microorganisms, moulds in particular (I s l a m et al., 2004; Đ u k i ć et al., 2009 a, b). Pathogenic moulds lead a saprophytic existence in the soil, but they can cause disease in animals and humans under certain conditions.

Urban soils are inhabited by a few hundred moulds, which can be potentially pathogenic (opportunistic), pathogenic or allergenic (L i t v i n , 1990; H o o g et al., 2000; Đ u k i ć et al., 2011), depending on the state of the immune system of the organism (K u r u p and S c h m i t t , 1970; M a r f e n i n a , 1996, 2000). As yet, very little is known about the distribution of medically important moulds in different soil types (M a r f e n i n a , 1996, 2000), notwithstanding the intensification of research over the past few decades, most notably due to the high importance of knowledge of the geographical distribution of diseases, which specifically contributes to their timely diagnosis and prophylaxis (K u r u p and S c h m i t t , 1970; H a d a y a t i et al., 2005).

Soil moulds of medical importance were evaluated in this study in order to provide disease prevention and health protection in urban populations, primarily those who are exposed to polluted soil more frequently.

MATERIAL AND METHODS

Our aim was to study potentially pathogenic, keratinolytic and allergenic moulds in the urban soil; experimental plots were selected according to their distance (100, 300, 500, 700, 900 m) from the main source of pollution i.e. the Podgorica-based Aluminum Plant (PAP). The control soil was located outside the urban zone and was typical of the region before intensive industrialisation and urbanisation – 2100 m away from the PAP. Plot size was 25 m^2. Soil samples were collected in July and October 2008 from three different plot zones at a depth of 0-10 cm. The count of potentially pathogenic and allergenic (melaninogenic) moulds was determined by inoculation of 0.5 cm^3 of diluted soil suspension on Sabouraud dextrose agar supplemented with dermatophytes and adequate antibiotics (cycloheximine and chlortetracycline). Keratinolytic moulds and related dermatophytes were determined using the 1952 Vanbreuseghem method (C h r i s t e n s e n , 1989).

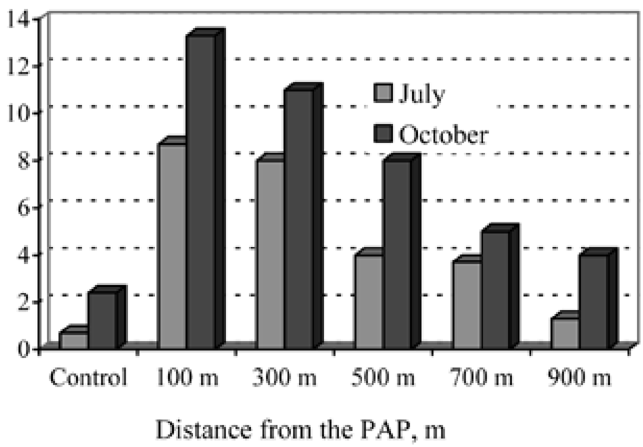
The evaluation of the relative abundance of potentially pathogenic, allergenic, and keratinolytic moulds was performed following the recommendations of H o o g et al. (2000) and M c G i n n i s (2004).

RESULTS AND DISCUSSION

The soil in the urban city zone was found to contain a substantially higher presence of potentially pathogenic moulds of the genera *Aspergillus, Paecilomyces* and *Fusarium* as compared to the control soil (Tab. 1, Graph 1), which was in agreement with the research conducted by M a r f e n i n a (1996) who reported a 25%–30% increase in their count in urban soils. The count of potentially pathogenic microfungi in the soil was higher in autumn than in summer. Moreover, it was observed to decrease with increasing distance from the main source of pollution, which was as expected, given the fact that potentially pathogenic moulds easily survive in polluted ecosystems (Ž d a n o v a et al., 1994).

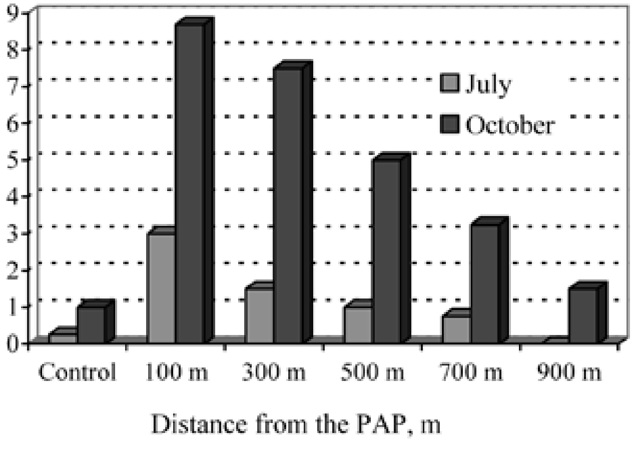
Tab. 1 – Total counts of potentially pathogenic, pathogenic, and allergenic moulds in the urban soils of Podgorica (in g absolutely dry soil)

Moulds isolated	Soil plot distance from the Podgorica Aluminum Plant, m											
	100		300		500		700		900		Control	
	July	Oct.	July	Oct.	July	Oct.	July	Oct.	July	Oct.	July	Oct.
Potentially pathogenic												
Aspergillus fumigatus	12	17	12	15	7	14	8	9	2	9	1	4
Fusarium oxysporum	5	12	3	8	–	3	–	3	2	2	1	2
Paecilomyces variotii	9	11	9	10	5	7	3	3	–	1	–	1
$\bar{X}$	8.7	13.3	8.0	11.0	4.0	8	3.7	5.0	1.3	4.0	0.7	2.4
Keratinolytic												
Microsporum gypseum	4	13	2	12	2	7	1	4	–	2	–	1
Trichophyton terrestre	5	15	4	13	–	11	2	6	–	2	1	2
Chrysosporium keratinophylum	1	4	–	3	1	2	–	2	–	1	–	–
Ctenomyces serratus	2	3	–	2	1	1	–	1	–	1	–	1
$\bar{X}$	3.0	8.7	1.5	7.5	1.0	5.0	0.75	3.25	–	1.5	0.25	1.0
Allergenic (melaninogenic)												
Alternaria alternata	17	22	17	18	13	17	6	11	–	5	–	2
Cladosporium herbarum	11	9	6	6	3	7	2	7	–	7	1	4
Trichocladium asperum spp.	6	16	6	11	2	5	2	2	2	3	–	2
$\bar{X}$	11.3	15.7	9.7	11.7	6.0	9.6	3.3	6.7	0.7	5.0	0.3	2.7



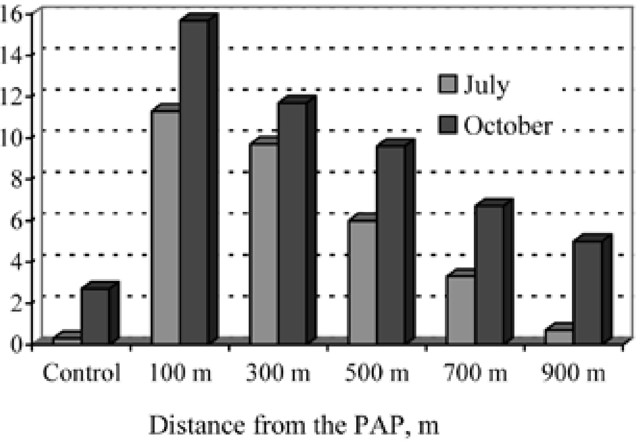
Graph 1 – The number potentially pathogenic moulds in the urban soils of Podgorica

Keratinolytic moulds are among the most important trophic groups of soil micromycetes that cause degradation of keratinous substances and skin disease. The estimated counts of medically important moulds (*Microsporium gypseum, Trichophyton terrestre, Chrysosporium keratinophylum, Ctenomyces serratus*) were found to be significantly higher in the polluted soil than in the control soil i.e. in October than in July, as well as to decrease with increasing distance from the pollution source (Tab. 1, Graph 2). This complied with the results of other authors (E m o n s , 1951; D e n t o n et al., 1961; K u r u p , S c h m i t t , 1970), most notably regarding the predominance of the species *Trichophyton terrestre* and *Microsporium gypseum*.



Graph 2 – The number keratinolytic moulds in the urban soils of Podgorica

The urban soil was also found to contain allergenic moulds such as melaninogenic *Alternaria alternata, Cladosporium herbarum,* and *Trchocladium asperum*. Their abundance was higher in the polluted soil than in the control soil i.e. in October than in July, and it decreased with increasing distance from the pollution source (Tab. 1, Graph 3). Similar results were obtained by S c h a t a et al. (1989), Ž d a n o v a et al. (1994), M a r f e n i n a (1996, 2000), K u l ' k o and M a r f e n i n a (1998) and D o m s c h et al. (1993), who suggested that the higher tolerance of melaninogenic moulds to toxic substances, radiation, drought, etc. results from the presence of melanin within their cell wall structures.



Graph 3 – The number allergenic (melaninogenic) moulds in the urban soils of Podgorica

CONCLUSION

The results of this study suggest that the count of the test moulds was significantly higher in urban soils than in the control soil, in October than in July, as well as that it decreased with increasing distance from the pollution source.

In order to prevent undesirable effects on human health, control of all soils, urban ones in particular, should be performed on a regular basis for the presence of medically important moulds.

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ПОТЕНЦИЈАЛНО ПАТОГЕНЕ, ПАТОГЕНЕ И АЛЕРГЕНЕ ПЛЕСНИ УРБАНИХ ЗЕМЉИШТА

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Резиме

Ради проучавања динамике бројности земљишних плесни, које могу компромитовати имунолошки систем човека, одабране су огледне парцеле на различитој удаљености (100, 300, 500, 700, 900 m) од основног извора загађења – КАП (Комбинат алуминијума Подгорица). Узорци земљишта су узимани у јулу и октобру 2008. године са три различита места огледних парцела на дубини 0–10 cm. Одређивана је бројност потенцијално патогених, кератинолизних и алергених (меланиногених) плесни, што може бити значајан допринос дијагностици и профилакси.

Бројност медицински значајних плесни знатно је већа у урбаном, него у незагађеном (контролном) земљишту. Њихова бројност се готово закономерно смањивала са удаљеношћу од основног извора загађења (КАП), док је њихово учешће у земљишту било знатно више у јесен него у пролеће.