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MONITORING OF *ALTERNARIA* NESS AND *CLADOSPORIUM* LINK AIRBORNE SPORES IN LUBLIN (POLAND) IN 2002

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Abstract: The concentration of *Alternaria* and *Cladosporium* spores was monitored throughout the year 2002 in Lublin (Eastern Poland). Fungal spores were sampled with Lanzoni VPPS 2000 volumetric spore trap. The total annual spore concentrations of *Alternaria* and *Cladosporium* reached 30,880 and 865,254 spores/m^3, respectively. The majority of *Alternaria* spores was collected between 17:00–20:00, whereas *Cladosporium* spores were caught between 9:00–10:00.

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INTRODUCTION

Alternaria and *Cladosporium* spores are the most common airborne particles of fungal origin in outdoor air. *Alternaria* and *Cladosporium* belong to mitosporic fungi. They are common saprotrophes or obligate parasites found on many cultivated plants. Their spores are responsible for infecting and causing plant diseases such as purple blotch, damping-off (*Alternaria* spp.) and scab of cucumber (*Cladosporium* spp.) [10].

The city were the survey was carried out is surrounded by intense harvesting areas, which may provides suitable media for conidial production. Monitoring of spore content in the air in Lublin is on a great importance due to the agricultural character of this region.

It has been demonstrated that many airborne fungi are allergenic, and an inhalation exposure to their spores may lead to adverse health effects such as rhinitis or asthma [5]. Although, the mould spores are present in the atmosphere in a concentration considerably greater than those of pollen grains, the frequency of allergic respiratory diseases due to moulds is usually much lower than that to pollens [3].

Alternaria and *Cladosporium* spores have been regarded as the main allergenic fungi. Their threshold concentration in the air for evoking allergic symptoms were estimated to be 100 and 3,000 spores/m^3, respectively [4]. Fungal spore monitoring seems to be essential for matters of both medical and plant pathology.

The presented study is a preliminary report of one-year *Alternaria* and *Cladosporium* spore monitoring from a 3-year research project. The aim of the investigation was to estimate daily and hourly concentrations of these fungi in the air in Lublin and to create a data base for further research.

MATERIALS AND METHODS

The survey of Alternaria and Cladosporium spore concentration was carried out in Lublin, Eastern Poland, between 1 January–31 December 2002. The samples were collected using Lanzoni VPPS 2000 volumetric spore

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trap. The sampler was situated on the roof of the Agricultural University building in the centre of the city, about 18 m above ground level.

The drum of the sampler, with adhesive tape covered with silicon solution, was changed regularly at midday every Monday. The tape was then cut into segments corresponding to 24-hour sampling (48 mm). Daily slides were mounted in a mixture of glycerol (50%), jelly (7%) and phenol (1%) stained with safranine. Quantitative and qualitative slide scanning was conducted on one longitudinal band under a light microscope at magnification ×400. Identification of fungal spores was based on morphological features presented by Bassett *et al.* [1] and Southworth [9].

The hourly counts of spores were carried out for the main period of sporulation, as recommended by Mäkinen [6]. These data were obtained by separating every hourly sample (2 mm) from the longitudinal band.

Estimated absolute values were transformed into the number of spores in each cubic metre per day. Statistical analysis of multiple regression was carried out, using Statgraph 5.0 programme.

RESULTS

Monitoring of airborne spores in Lublin in 2002 detected the highest concentration of *Alternaria* reaching 1,582 spores/m^3 in July (23.VII) (Fig. 1a).

The spore concentrations of this fungus exceeded threshold values for evoking allergic symptoms in the third decade of June (26.VI), i.e., at the beginning of the main sporulation period. Such high concentrations were noted for the last time in the third decade of September (24.IX). In the remaining months, the content of *Alternaria* spores in the air was low, not exceeding 100 spores/m^3. The total annual spore concentration of this fungus in 2002 was 30,890 spores/m^3. The hourly pattern of *Alternaria* spores concentration indicated maximum value between 17:00–20:00. Minimum counts were noted between midnight and 7 am.

Cladosporium spores were present in the air throughout the whole year (Fig. 1b). From April, *Cladosporium* spore counts increased gradually. The above concentration suggested that threshold values were observed in the second decade of May (23.V) and lasted till the first few days of October (3.X). Within this period, the maximum concentration, reaching 24,444 spores/m^3 (21.VII), was recorded. From the last decade of December till the second decade of January, only single spores appearance was noted. The total annual concentration of *Cladosporium* in 2002 was 865,254 spores/m^3. The hourly analysis of samples reflected the highest concentration in the morning, between 09:00–10:00. The lowest spore counts followed *Alternaria* pattern and were noted between midnight and 06:00.

The multiple regression analysis of spore concentrations, diurnal and hourly variables gave R^2=23% for *Cladosporium* and R^2=17% for *Alternaria*. As appears, spore concentrations depend on the day and hour at low percentages. To complete the view of factors affecting spore concentration, more variables have to be examined (i.e., meteorological data).

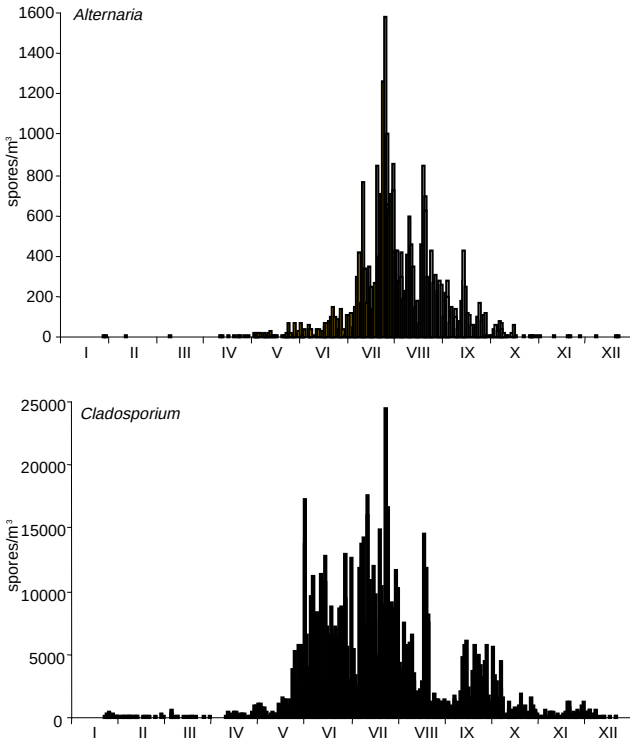

Figure 1. Seasonal variability of fungal spore concentration in Lublin in 2002.

DISCUSSION

On the basis of the investigation carried out in Lublin in 2002, a very high total annual concentration of *Cladosporium* airborne spores was documented which reached 865,254 spores/m^3. The abundance of airborne spores in this region may be caused by availability of host plants, or other sources of media.

The research conducted in Stockholm by Rubulis [8] showed total annual of daily spore counts at the highest level (533,980 spores/m^3) in 1980 and the lowest (296,030 spores/m^3) in 1981. A similar situation was observed in Eskilstuna (Central Sweden). Local climatic conditions have a great impact on spore concentration; thus, the southern localization of Poland in comparison to Sweden seems to be favourable for intense spore distribution. According to surveys carried out in Stockholm and Eskilstuna, spore concentration in one year may differ other years. For this reason, the presented study has to be continued

Similar observations were made by Nikkels *et al.* [7] in Leiden (Netherlands). The measured concentration of *Cladosporium* spores was 1,895,250 spores/m^3, i.e., twice as high as in the presented study. However, in 1988 the total annual concentration was significantly lower (583,240 spores/m^3). Within 10-year observations, the

total annual spore concentration in Leiden was mostly lower then the obtained data in Lublin, ranging from 448,005–834,890 spores/m^3 (excluding the year1989).

The same authors also analysed the concentration of *Alternaria* spores. According to them, the total annual spore concentrations (ranging 10,735–23,020 spores/m^3) in the years 1880–1989 (excepting 1989) were also lower as that in Lublin (30,880 spores/m^3). Supposedly, "dry spores", such as *Alternaria* and *Cladosporium* are produced and liberated in considerably greater amounts in the conditions of the continental (drier) climate in Lublin.

Fernandez *et al.* [3] recorded in Léon (Spain) the same time - midday–14:00 - of major *Alternaria* and *Cladosporium* spore distribution. *Alternaria* spore concentration showed a clear maximum at 13:00 (61% of the total daily spores), whereas the majority of *Cladosporium* spores were collected between midday–14:00 (20%). In Lublin, however, the highest concentration of *Alternaria* and *Cladosporium* spores appeared at different times of the day. The presented study reflects the necessity for widening the spectrum of factors which may determine the level of spore concentrations, such as weather variables.

CONCLUSIONS

1. The highest spore concentrations of *Cladosporium* and *Alternaria* spores in the air in Lublin were measured in July, probably due to the vegetation season of the majority of host plants for these fungi.

2. The period of high *Cladosporium* spores concentration was longer than *Alternaria*, 5 and 3 months, respectively. In this case, it is difficult to determine the primary factor affecting the duration of sporulating season without more precise analyses.

3. The hourly spore appearance showed different patterns which may suggest various demands of particular fungus towards temperature, humidity or sunlight.

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