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Temporal variations and spatial differentiation in the black alder and silver birch pollination pattern and the occurrence of alder and birch pollen in the air in relation to the meteorological and climate conditions

Summary

Allergens contained in alder (*Alnus*) and birch (*Betula*) pollen grains are one of the most frequent causes of pollen allergies in Poland. Additionally, they cross-react with pollen allergens of other taxa in the family Betulaceae and with food allergens. Despite that pollen grains of these both genera are a frequent subject of research, the relationship between their concentrations and timing of their occurrence in the air and factors such as inter- and intra-population variation in the pollination patterns, the weather factors, climate or the location of the aerobiological station in relation to the distance from the pollen sources, still remains an issue that is not fully explained.

The main aim of the dissertation is to determine the temporal and spatial variation in the pattern of *Alnus glutinosa* (Gaertn.) and *Betula pendula* (Roth.) pollination pattern as well as in the dynamics and intensity of occurrence of airborne *Alnu*s and *Betula* pollen. Special attention is devoted to biotic and abiotic factors, primarily meteorological ones, which can affect the above-mentioned variation.

Phenological observations of male inflorescences pollination of *A. glutinosa* and *B. pendula* trees were carried out over four growing seasons (2013-2016). The observation sites were located in several districts within the city of Rzszów. The places differed in prevalent land use types and the level of urbanization. The phenological phases: the beginning, the fullness and the end of pollination were determined according to the BBCH coding system. In order to determine the spatial variability of thermal conditions in the city, the maps of land surface temperature were created using satellite images obtained from Landsat satellites. Diurnal and hourly pollen concentrations for the period 2014-2016 were obtained from three volumetric traps: one trap located in the city center at the roof level (12 m) and two traps situated in the suburbs at the roof level (12 m) and at the nose level (ca. 1.5 m). The sites where the aerobiological stations were located differed in the proximity and the abundance of alder and birch pollen emission sources. Meteorological data were collected from the stations situated in the vicinity of the traps and from synoptic reports obtained from the Rzeszów-Jasionka station. To analyze the data, non-parametric statistical tests (Spearman's rank correlation,

Mann-Whitney U test, Kruskal-Wallis test), multidimensional techniques (PCA, RDA), and circular statistics methods were predominantly used.

It was found that there was no strict relationship between the timing of pollination phases of both species and local thermal conditions (ground surface temperature and air temperature) as well as relative to the land use types. The great variations in the pollination pattern within the same population indicates that the phenological variability was predominantly influenced by biotic factors such as phenotypic plasticity of individuals or their genetic differentiation. The dynamics of alder and birch pollen seasons showed much smaller spatial variation than their intensity. The spatial differences in the diurnal concentration values between the aerobiological stations were significant in the years of high intensity of pollen seasons. More frequently, the values of airborne pollen concentrations of both taxa were lower in the city center than in the suburbs, where pollen emission sources were more numerous. The concentration values also differed in the vertical profile – they were lower at the nose level than at the roof level. The variation concerned mainly the concentrations higher than threshold values to cause allergy symptoms. For this reason the risks for allergy sufferers were similar in both city districts and at both levels. There were no significant spatial differences in the intradiurnal pattern of pollen concentrations for both taxa. The lowest pollen concentrations occurred in the morning, but it is difficult to determine the time of the day with the highest frequency of maximum concentrations. People sensitive to the pollen of these taxa, in particular birch pollen, can also be exposed to high concentrations at night. It is also difficult to determine which meteorological factor has the greatest impact on daily and hourly concentrations. Although temperature seems to be a crucial factor that influences the pollen concentrations in the air, a set of other factors such as: relative air humidity, sunshine duration and rainfall, is not without significance, either. The phenomenon of thermal convection can also contribute to the occurrence of night peaks and to a momentary increase in pollen concentration during convective rainfall.