Thaiszia - J. Bot., Košice, 22 (2): 155-161, 2012
http://www.bz.upjs.sk/thaiszia

THAISZIA
JOURNAL OF
BOTANY

Allergenic trees and their effects in the spa forest park Dudince

BLAŽENA BENČAŤOVÁ[1], TOMÁŠ KISS[2] & TIBOR BENČAŤ[3]

[1] Department of Phytology, Faculty of Forestry at Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic; bbencat@vsld.tuzvo.sk

[2] Department of landscape planning and design, Faculty of Ecology and Environmental Sciences at Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic; tomi.kt.kiss@gmail.com

[3] Department of landscape planning and design, Faculty of Ecology and Environmental Sciences at Technical University in Zvolen, T. G. Masaryka 24, 960 53 Zvolen, Slovak Republic, tel.: 045/5206 311; ben@vsld.tuzvo.sk

Benčaťová B., Kiss T. & Benčať T. (2012): Allergenic trees and their effects in the spa forest park Dudince. – Thaiszia – J. Bot. 22 (2): 155-161. – ISSN 1210-0420.

Abstract: The paper deals with the locality of the spa forest park Dudince in perspective of allergenic trees. The aim of our investigation was to find out what the percentage of the tree species composition in three storeys is (shrub layer, subordinate tree layer, and above-level) of the spa forest park. Furthermore, we tried to determine the origin, way of pollination and potential of trees causing pollinosis. Only pollen of four species was characterized as highly allergenic, while only pollen of the birch (*Betula pendula*) achieves the highest level of allergenic potential. From the results we can conclude that the tree species composition of the spa forest park Dudince is suitable for the recovery of the patients.

Keywords: Dudince, forest park, tree species composition, origin, pollination

Introduction

Higher plants produce a large number of substances that repel or inhibit other organisms (WHITTAKER, 1970). Mutual relations – interactions of organisms can be divided into two basic groups – positive and negative (ČABOUN, 1990). The negative effects of plants to the human body are referred as allergic reactions.

Nearly 500 million people currently suffer from allergic diseases (SOFIEV et al. 2009). In recent times, the degree of plant species allergic effects on human body was being often discussed, either by direct contact – touch or sharp odour, but particularly by negative to harmful pollen actions. The pollen particles of this plant group contain specific antigen type of allergens that causes pollinosis. This is considered as a civilization disease with growing trend particularly among children. According to the allergists, the pollinosis predominates over other types of allergies up to 20%. The allergies affect mainly the population living in large industrial agglomerations. Pollen allergens do not cause only symptoms of allergic respiratory diseases, but cause also an allergic nasal mucous membrane irritation, conjunctivitis, lack of concentration and mental states of depression as well, according to the individual patient response (BENČAŤOVÁ, KRIŽO 1996). While designing the spa forest parks should be these aspects be taken into account, especially the feature of tree pollen causing pollinosis. Allergy inducing effects of the trees were not taken into account when establishing most of today's forest parks in Slovakia. This is due to the fact that the allergy reactions appeared in population only in recent decades, so after built most of our forest parks.

Material and methods

Dudince town lies at an altitude of 140 m, on the north-eastern edge of the Ipelska pahorkatina-heights, in between Danube Lowland and a volcanic mountain Krupinská planina - plain. The geological structure of Dudince town is characterized by older formations reaching the surface. They are called volcanic breccia of Sebechleby formation. The main part of the plain is covered with river clay and sandy clay of Holocene. Therapeutic significance of Dudince is based on balneology use of natural healing waters. Unique combination of high concentrations of CO_2 and H_2S categorize this water into one of the most valuable mineral waters in Slovakia and Europe. Similar structures have waters only in Vichy in France and Japan. It treats the musculoskeletal system, cardiovascular system, rheumatism, high blood pressure, skin and gynaecology diseases (GALVÁNEK 2011).

Spa forest park is located at the south of the town on the slope of the northeastern exposure, of 140 -170 amsl. It is 13.52 ha area and consists of 11 to 80 years old vegetation. This includes the Special-Purpose Forests and forests in the protected zone of natural healing resources (NLC 2012).

Our aims were to determine the species composition percentage of the forest park and then to determine the origin, way of pollination and potential of trees causing pollinosis. The allergenic potential of trees was determined according to the works of RIEGER (1989), HRUBIŠKO (2003) and JÄGER (2004) and was included into the seven categories. The first rate includes trees with the most aggressive pollen and in the seventh grade where are trees with the lowest pollen allergenic potential. Tree species with unknown pollen allergenic potential were marked with minus sign (-). The way of pollination was taken from BENČAŤ (2009). We considered this indicator as an important one because the way the pollination refers to the quantity, size and weight of pollen that affect the period of presence of pollen grains in the air. The tree species composition was investigated in the three layers of the spa forest park. Shrub layer constituted all trees up to 5 metres. Subordinate tree layer includes all trees over 5 meters up to the line which is touching the top of the crowns of all the relatively highest trees which are mostly represented on the plot. Among above-level tree layer were included all trees higher than the trees at subordinate tree layer. During the fieldworks, we tried to estimate species composition percentage as accurately as possible and therefore the investigated area was divided into smaller polygons. Paths delimited the polygon borders. Firstly, we estimated the percentage of the species composition within each floor in each polygon separately. Then we estimated the tree species percentage within the each layer in the polygons and we calculated the ratio of the number of tree species in each polygon to the number of the tree species of the whole investigated area. Finally we summed the values of the similar species from all the polygons. Within the Tables 1, 2 and 3 there are mentioned the tree species with the occurrence more than 1% in the each tree layer arranged in the descending order. Species with a share of less than 1% were not stated because, in our opinion, allergenic effects in respect of their low incidence in the spa forest park has an insignificant impact on the health of spa guests.

Results and discussion

The most represented tree species in the shrub layer were the *Tilia cordata* (9.9 %), *Sambucus nigra* (9.7 %) and *Quercus rubra* (9.1 %) which accounted for almost one third of the total percentage of shrubs (Tab. 1). Alochthonous origin was found only within species *Quercus rubra, Juglans regia* and *Robinia pseudoacacia*, which together constitute 15.2 %. Anemophilous pollination has also been demonstrated only in three species, which are *Quercus rubra, Ulmus minor,* and *Fraxinus excelsior.* The species with the most aggressive pollen in the shrub layer are *Quercus rubra* (2), *Ligustrum vulgare* (2) and *Fraxinus excelsior* (3) which together accounted for 17 %. We could not find the pollen allergenic potential within *Swidasanguinea, Prunus spinosa, Euonymus europeus, Crataegus spp.* and *Cerasus avium.*

The largest part in the subordinate tree layer (Tab. 2) consisted of *Tilia cordata* with more than a quarter-representation and of *Acer campestre* with 13.5 %. The species with the share of less than 1 % have accounted for 6.6 %. Alochthonous tree species are represented 16.3 % (*Quercus rubra, Robinia pseudoacacia*) and anemophilous 27.7 % (*Ulmus minor, Quercus rubra, Fraxinus excelsior a Betula pendula*). The highest pollen allergenic potential (1) has got the species *Betula pendula* with share of 3.3 % and the unknown pollen allergenic potential was at genus *Crataegus spp.* and species *Cerasus avium.*

Within the above-level tree layer (Tab. 3) we have found out the highest presence of *Quercus rubra* (25.7 %). The important percentage (13.1 %) also has the species *Pinus sylvestris* and *Tilia cordata.* The share of the tree species

Tab. 1. Characterization of shrub layer

species	%	origin	pollination	allergenic potential
Tilia cordata	9.9	autochthonous	entomophilous	5
Sambucus nigra	9.7	autochthonous	entomophilous	7
Quercus rubra	9.1	alochthonous	anemophilous	2
Acer campestre	8.6	autochthonous	entomophilous	4
Swida sanguinea	8.3	autochthonous	entomophilous	-
Prunus spinosa	8	autochthonous	entomophilous	-
Acer platanoides	6.6	autochthonous	entomophilous	4
Ulmus minor	6.2	autochthonous	anemophilous	5
Fraxinus excelsior	6.1	autochthonous	anemophilous	3
Euonymus europeus	4.5	autochthonous	entomophilous	-
Juglans regia	3.1	alochthonous	entomophilous	6
Robinia pseudoacacia	3	alochthonous	entomophilous	4
Crataegus spp.	2.3	autochthonous	entomophilous	-
Cerasus avium	1.9	autochthonous	entomophilous	-
Ligustrum vulgare	1.8	autochthonous	entomophilous	2
Acer pseudoplatanus	1.7	autochthonous	entomophilous	4
together	**90.8**			

Tab. 2. Characterization of subordinate tree layer

species	%	origin	pollination	allergenic potential
Tilia cordata	26.1	autochthonous	entomophilous	5
Acer campestre	13.5	autochthonous	entomophilous	4
Ulmus minor	9.5	autochthonous	anemophilous	5
Quercus rubra	9.1	alochthonous	anemophilous	2
Acer platanoides	8.8	autochthonous	entomophilous	4
Robinia pseudoacacia	7.2	alochthonous	entomophilous	4
Fraxinus excelsior	5.8	autochthonous	anemophilous	3
Acer pseudoplatanus	4.3	autochthonous	entomophilous	4
Crataegus spp.	3.8	autochthonous	entomophilous	-
Betula pendula	3.3	autochthonous	anemophilous	1
Cerasus avium	2	autochthonous	entomophilous	-
together	**93.4**			

Tab. 3. Characterization of above-level tree layer

species	%	origin	pollination	allergenic potential
Quercus rubra	25.7	alochthonous	anemophilous	2
Pinus sylvestris	13.1	autochthonous	anemophilous	7
Tilia cordata	13.1	autochthonous	entomophilous	5
Larix decidua	8.9	autochthonous	anemophilous	7
Robinia pseudoacacia	8.3	alochthonous	entomophilous	4
Betula pendula	6.4	autochthonous	anemophilous	1
Acer pseudoplatanus	3.9	autochthonous	entomophilous	4
Acer platanoides	3.7	autochthonous	entomophilous	4
Pinus nigra	3.3	alochthonous	anemophilous	7
Acer campestre	3.2	autochthonous	entomophilous	4
Fraxinus excelsior	3.2	autochthonous	anemophilous	3
Ailanthus altissima	1.4	alochthonous	anemophilous	6
Cerasus avium	1.2	autochthonous	entomophilous	-
Castanea sativa	1	alochthonous	anem.+ entom.	5
together	**96.4**			

with the occurrence less than 1% was 3.6 % from the whole investigated area. In this layer was the largest share of alochthonous trees (39.7 %) and they were represented by the species *Quercus rubra, Robinia pseudoacacia, Pinus nigra, Ailanthus altissima* and *Castanea sativa*. We recorded an increased proportion of conifers due to the predominance of wind-pollinated tree species. Representation of *Betula pendula* which was included into the first degree within allergenic potential of trees causing pollinosis, almost doubled unlike the subordinate tree layer, but we also recorded increasing of conifers (*Pinus sylvestris, Larix decidua, Pinus nigra*) which are in the seventh grade with the lowest pollen allergenic potential.

We can conclude that the tree species composition of the spa forest park Dudince is suitable in all three indicators. According to the origin of trees, nearly 85 % of the species are indigenous, which is related to the fact that the forest park was built up from the native forests and was gradually complemented with alochthonous trees.

An important criterion in the evaluation of the identified tree species is also a way of pollination which is related with dispersion of pollen into the environment. The pollen releasing from anthers and its subsequent spreading to the environment basically pursue in two ways: by wind (anemophilous plants) and by insects (entomophilous plants). Pollen grains of anemophilous tress are usually aerodynamic, lightweight, and are not linked together. They constitute a major problem for the susceptible patients, because they are often emitted in large quantities and can also affect people who are far away from the source of the pollen.

The pollen of entomophilous plants does not get into the air in such quantities. The cause is not the lower pollen production, but rather the characteristics and properties of pollen grains which are markedly different from the pollen of anemopholous plants. Pollen grains of these plants have various protuberances on the surface, which is often too sticky as well, so they are easily captured on the body of pollinators.

From this aspect in our results there is a moderate predominance of entomophilous trees (63%) and it is seemed that the amount of pollen in the air is not high.

Among the important factors of pollen air distribution are mainly climatic and meteorological factors such as temperature, wind speed and direction, turbulence, sunshine, humidity and rain. We found out a correlation between the temperature, humidity and air circulation and the period of presence of pollen grains in the air (RIBEIRO et al. 2003, NITIU 2003, JATO et al. 2001, FRENGUELLI et al. 2002, MALASPINA et al. 2007).

The most important criterion for evaluating of trees in the study area was the allergenic potential of their pollen grains. Our results showed that the species composition of the spa forest park Dudince is positive from this point of view as well. Only pollen of four species (*Betula pendula*, *Quercus rubra*, *Ligustrum vulgare*, *Fraxinus excelsior*) can be characterized as highly allergenic (1-3 grade), while only birch pollen (*Betula pendula*) achieves the highest level of allergenic potential.

An interesting and also very positive fact is that in the forest park were not found species of the genus *Platanus*, which are common planted in our cities and whose pollen is evaluated as a strong allergen by many authors (NITIU, MALTO 2002, SUBIZA et al. 1995, VARELA et al. 1997).

Acknowledgements

This research was supported by Scientific grant agency MŠ SR (projekt č. 1/0551/11).

References

BENČAŤ T. (2009): Dendrológia a ekológia drevín. Zvolen: Technická univerzita. Poniky: Janka Čižmárová – Partner, 2009. 108. p. ISBN 978-80-228-1996-1

BENČAŤOVÁ B. & KRIŽO M., (1996): Flóra a vegetácia sídiel z pohľadu výskytu peľových alergénov. In: SUPUKA J. & JANČURA P. (eds.) Krajina, človek, kultúra. I. celoslovenská konferencia. SAŽP, Banská Bystrica, p. 75–78

ČABOUN V. (1990): Alelopatia v lesných ekosystémoch, VEDA vydavateľstvo Slovenskej akadémie vied, Bratislava 1990, ISBN 80-224-0136-6, 118 p.

FRENGUELLI G., TEDESCHINI E.,VERONESI F. & BRICCHI E. (2002): Airborne pine (*Pinus* ssp.) pollen in the atmosphere of Perugia (Central Italy): Behaviour of pollination in the two last decades. Aerobiologia, 18: 223–228.

GALVÁNEK J. (2011): Geologický sprievodca po strednom Slovensku. Travertíny Slovenska. Dudinské travertíny. World Wide Web electronic publication. http://www.snm-em.sk/geosprievodca/lokality/travertinysk/dudincetr.html [accessed 04-Dec-2012]

HRUBIŠKO M. et al. (2003): Alergológia. Martin, Osveta, 2003. 519 p.

JATO V., DOPAZO A. & AIRA M. J. 2001: Airborne pollen data of *Platanaceae* in Santiago do Compostela (Iberian Peninsula). Aerobiologia, 17: 143–149.

JÄGER S. (2004): Europe.polleninfo.org. Home page at: http./www.polleninfo.org.

MALASPINA T. T., CECCHI L., MORABITO M., ONORARI M., DEMENEGHETTI M. P. & ORLANDINI S. (2007): Influence of meteorological conditions on male flower phenology of *Cupressus sempervirens* and correlation with pollen production in Florence. Trees 21: 507–514.

NITIU D. S. (2003): Annual, daily and intradiurnal variation of *Celtis* pollen in the city of La Plata, Argentina. Aerobiologia, 19: 71–78.

NITIU D. S. & MALO A. (2002): Incidence of allergenic pollen of *Acer* spp., *Fraxinus* spp. and *Platanus* spp. in the city of la Plata, Argentina: preliminary results. Aerobiologia, 18: 65–71.

NLC (2012): Lesnícky geografický systém. Národné lesnícke centrum, Zvolen. World Wide Web electronic publication. http://lvu.nlcsk.org/lgis/ [accessed 04-Dec-2012]

RIBEIRO H., CUNHA M. & ABREU I. (2003): Airborne pollen concentration in the region of Braga, Portugal, and its relationship with meteorological parameters. Aerobiologia, 19: 21–27.

RIEGER M. (1989): Alergologické ohodnocení dřevin používaných do výsadeb v obytných zónach města. Hlavní druhy alergizujúcich dřevin a bylin. Ms. Správa pro ÚHA Praha, 20 p.

SOFIEV M., BOUSZUET J., LINKOSALO. T, RANTA H., RANTIO-LEHTIMAKI. A, SILJAMO P., VALOVIRTA E. & DAMIALIS A. (2009): Pollen, Allergies and Adaptation. In: ELBI K. L. et al. (eds.): Biometeorology for Adaptation to Climate Variability and Change. Springer Science, Business Media B. V., p. 75–106

SUBIZA J., JEREZ M., JIMÉNEZ J. A., NARGANES M. J., CABRERA M., VARELA S. & SUBIZA E. (1995): Clinical aspects of allergic disease. Allergenic pollen and pollinosis in Madrid. J Allergy Clin Immunol, 96, 1: 15–23.

VARELA S., SUBIZA J., SUBIZA J. L., RODRIQUES R., GARCÍA B., JEREZ M., JIMÉNEZ J. A. & PANZANI R. (1997): *Platanus* pollen as an important cause of pollinosis. J. Allergy Clin. Immunol., 100, 6: 748–754.

WHITTAKER R. H. (1970): The biochemical ecology of higher plants. In SONDHEIMER E. & SIMEONE B. (eds.): Chemical Ecology. Acad. Press New York, 1977, p. 43-70.

Received: December 13th 2012
Revised: December 19th 2012
Accepted: December 31st 2012