

Monitoring of *Ambrosia* pollen concentration in the atmosphere of Bratislava (Slovakia) during years 2002–2007

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Abstract *Ambrosia* pollen represents a significant allergenic risk for pollen-sensitive people also in Slovakia. The aim of this study was to compare the results of the monitoring of *Ambrosia* pollen concentrations and pollen seasons in Bratislava during years 2002–2007. Measurements were performed by the volumetric method using Burkard volumetric spore trap at the height of 10 m above ground level. During six monitored years, a total of 11,334 *Ambrosia* pollen grains per cubic meter of air were recorded. The highest total ragweed pollen amount was detected in 2002 (2,577 pollen grains of the total annual pollen concentration) and the lowest ragweed pollen concentration (1,213 pollen grains) was determined in 2007. However, mentioned year was represented as the year with the longest pollen season among the all monitored years in Bratislava (41 days). The pollen season peak day of 2002, 2004, 2005 and 2006 was recorded at the beginning of September; in 2003 and 2007 the peak was at the second half of August. The highest daily amount of *Ambrosia* pollen grains (more than 100 grains per cubic meter of air) was in 2002 (12 days). The results can be utilized to help to prevent symptoms of allergic reactions to *Ambrosia* pollen and improve

quality of life during seasonal allergic diseases in ragweed pollen-sensitive people.

Keywords Ragweed (*Ambrosia*) · Pollen grains · Pollen concentration · Pollen allergy · Bratislava

1 Introduction

Ragweed (*Ambrosia* L.) is one of the most noxious hay fever plants in the world. It is a highly allergenic annual, an anemophilous genus of the *Asteraceae* family, composed of about 35–40 species. Among them, five species are present in Europe: *Ambrosia artemisiifolia* L. (= *A. elatior*), *A. trifida* L., *A. tenuifolia* Spreng., *A. coronopifolia* (= *A. psilostachya*) Tott et Gray and *A. maritima* L. (Tutin et al. 1976).

According to Genton et al. (2005), *Ambrosia* was introduced to Europe in the eighteenth century and became invasive in several countries, especially in the Rhône Valley of France. Analyses of molecular variance (AMOVA) indicate that genetic variation was poorly structured geographically as in the native, as in the introduced range. Within a population, levels of genetic variability were lower (85%) in native than in invasive French populations (97%). Genton et al. (2005) confirms that introduced species are able to invade their new environment despite expected reduced genetic diversity.

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Wide spread progression of ragweed through Europe has been related with human activities. *Ambrosia* was probably imported to Europe from North America in form of ragweed seeds carried with American cereals. This genus spreads very rapidly due to the high production of dormant seeds, which can remain in the soil for decades (Basset and Crompton 1975; Comtois 1998). The climate changes and correspondingly a high degree of phenotypic plasticity and local adaptation of *Ambrosia* can support to spread of ragweed through Europe (D'Amato et al. 1998; Fumanal et al. 2005). According to Makra et al. (2004), *Ambrosia* may be regarded as the main aeroallergenic plant in Hungary. Jäger (1991, 2000) suggested that a lot of *Ambrosia* pollen grains were imported from Hungary to Vienna mainly by long-distance transport. The presence of ragweed pollen in central Italy is also probably due to long distance transport of pollen grains from southern Hungary as a possible source of *Ambrosia* pollen (Lorenzo et al. 2006). Pollen of this genus is the most abundant pollen type in the atmosphere of north-eastern Croatia (Stefanic et al. 2005) and the third most abundant pollen type of central Croatia (Peternel et al. 2005). Expansiveness of this taxon spreading to new areas and also the long-distance transport of pollen grains were the main reasons of ragweed distribution in Poland (Stępalska et al. 2002; Puc 2004) and in the Czech Republic (Rybníček et al. 2000a, b). *Ambrosia artemisiifolia* (= *A. elatior*), *A. trifida* and *A. coronopifolia* (= *A. psilostachya*) are the most prevalent ragweed species in Slovakia (Dostál and Červenka 1992) likewise in Britain (Rich 1994).

Each plant of this genus alone produces from tens to hundreds of millions of pollen grains that easily become airborne and contain one of the most potent allergens known (Comtois 1998).

Similarly Hrubíško (1998) confirms that *Ambrosia artemisiifolia* is one of the strongest allergenic plants of Slovakia.

Ragweed pollen grains can induce different kinds of symptoms in sensitive people during flowering period such as sneezing, itching, running nose and watering eyes, which can develop into asthma (Spieksma 1993).

The presented study was focused on the monitoring of ragweed pollen season dates and intensity during 2002–2007. Presented results may be used in order to prevent symptoms of allergic reactions to

Ambrosia pollen and to improve quality of life during seasonal allergic diseases in ragweed pollen-sensitive people.

2 Materials and methods

2.1 Monitored area

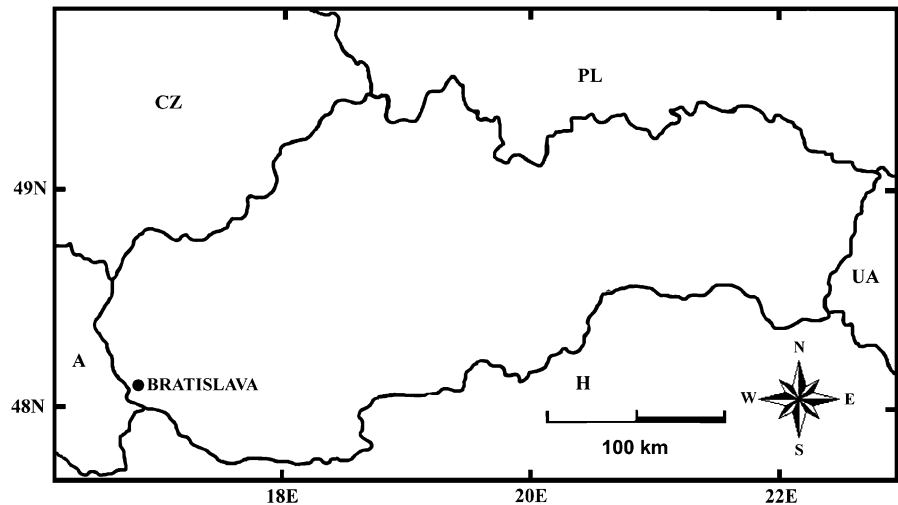
In Slovakia, ragweed generally grows in dry fields and pastures, vineyards, waste grounds, along rivers, brooks and canals, near railway stations, agriculture and industrial objects, along roads and railway lines. *Ambrosia* grows especially in the southern and eastern part of Slovakia (Jehlík 1998).

Bratislava is situated in south-western part of Slovakia (Fig. 1). This city has a warm and a moderate dry lowland climate with average temperatures ranging from -1 to -4°C in January and from 19.5 to 20.5°C in July. Annual precipitations vary from 530 to 650 mm. Vegetation in the Bratislava surrounding area is at the border between two phytogeographical areas—the perimeter of the authentic Pannonian flora (*Eupannonicum*) and the perimeter of the outside Carpathian flora (*Praecarpaticum*) and fits into four phytogeographical districts: Záhorská nížina Lowland, Devínska Kobyla Mts., Podunajská nížina Lowland, Malé Karpaty. Mts. Special status is reflected in the high concentration of Pannonian, Pontic and Sub Mediterranean species.

Native vegetation in the area has been dominated by ash-alder alluvial forests of temperate Europe (*Salicion albae*), elm floodplain forests of lowlands (*Ulmion*) Carpathian oak-hornbeam forests Karpatské (*Carici pilosae-Carpinenion betuli*), partially intervening and Pannonian oak-hornbeam forests (*Quercu robori-Carpinenion betuli*).

Present vegetation and flora emerged from both processes florogenetic integrated phytogeographical position of the territory and the physical-geographical, living conditions; but in significant long-term and extensive human intervention, particularly in the way the land use in the present. In the evaluated territory, the additional plant communities are also located, such as the fields, gardens, parks, lines of trees, small anthropogenic woodlands, weed communities of recently abandoned urban and extractive industrial sites, waste deposits too.

Fig. 1 Map of position of Burkard 7-day recording volumetric spore trap in Slovakia



Based on our monitoring of vegetation in the Bratislava territory and in the surrounding of the city, the occurrence of *A. artemisiifolia* in ruderal vegetal communities of unions *Sisymbrium officinalis*, *Onopordion acanthii*, *Arctium lappae*, *Daucus-Melilotum*, *Convolvulus-Agropyron repens* and *Panicum-Setaria* was noted.

2.2 Pollen sampling

The aerobiological monitoring was performed by Hirst type volumetric spore trap (Burkard 7-day recording volumetric spore trap), which is situated on the roof of the building of the Department of Botany, Comenius University in the 1st Bratislava district (48°08'N, 17°04'E, 183 m a.s.l.). The pollen trap has the air-flow rate of 10 l per minute. The Melinex tape for catching pollen grains was replaced every Monday at 9 a.m. The daily average of pollen grains per cubic meter of air was expressed. The methods standardized according to the British Aerobiology Federation were used for sampling, slide preparation and pollen counting (British Aerobiology Federation 1995).

The pollen season according to the method described by Nilsson and Persson (1981) defined the main pollen season as the period from the day when the daily sum of ragweed pollen concentrations reaches 5% of the total annual ragweed pollen sum until the day when the daily sum reaches 95% of the total annual ragweed pollen sum.

3 Results and discussion

The pollen season start, duration and intensity at each of the years 2002–2007 are presented in Table 1 and Fig. 2.

In 2004 and 2005, the first pollen grains of *Ambrosia* were caught in volumetric spore trap during early spring season; probably representative of a pollen from the previous flowering period detected by resuspension or as a result of long distance transport from adjacent countries (Puc 2004). The similar effect of capability of ragweed pollen to long distance transportation has been detected also in the Czech Republic (Rybníček et al. 2000a, b), France (Laaidi and Laaidi 1999; Laaidi et al. 2003), Spain (Belmonte et al. 2000), Switzerland (Peeters 2000), Sweden (Dahl et al. 1999) and Great Britain (Rich 1994).

Ambrosia pollen season in 2003 (from 15 August to 23 September) lasted almost two times longer (40 days) in comparison with previous year. However, ragweed pollen grains in 2003 represented only 4.58% of the total annual pollen concentration, whereas ragweed pollen grains in 2002 show to markedly higher rate of the total annual pollen concentration (10.87%).

As seen in Fig. 2, the period from the end of August to the beginning of September represents notable contrast between the ragweed pollen season in 2002 and 2006. While at the beginning of September in 2002 was detected the ragweed pollen season peak day of this year (on 4 September), at the

Table 1 Characteristic data of ragweed pollen season in 2002–2007 in Bratislava

Year	Total sums of <i>Ambrosia</i> pollen grains	Percentage of <i>Ambrosia</i> pollen in total pollen sum	Pollen season	Peak day (daily average of pollen/m ³ on the peak day)	Number days with <10 pollen grains/m ³	Number days with 10–100 pollen grains/m ³	Number days with >100 pollen grains/m ³
2002	2,577	10.87	19/8–9/9	4/9 (342)	0	10	12
2003	1,437	4.58	15/8–23/9	29/8 (184)	19	16	5
2004	1,750	0.78	16/8–17/9	10/9 (174)	4	25	4
2005	2,113	5.25	20/8–16/9	6/9 (332)	4	18	6
2006	2,244	5.08	20/8–18/9	7/9 (243)	11	10	9
2007	1,213	3.12	15/8–24/9	21/8 (156)	15	25	1

end of August in 2006 only minimum concentration of ragweed pollen grains in the air was observed.

In 2005, the ragweed pollen season peak day was observed on 6th September with 332 pollen grains per cubic meter of air. In comparison with pollen season peak day on 10 September in the previous year (174 pollen grains per cubic meter of air), it represents almost double amount of the daily peak count.

Ragweed pollen season peak day observed in 2002, 2004, 2005 and 2006 in Bratislava was similar to Croatia where the critical ragweed pollen season lasted from the beginning of August to the middle of September with a peak day at the beginning of September (Stefanic et al. 2005).

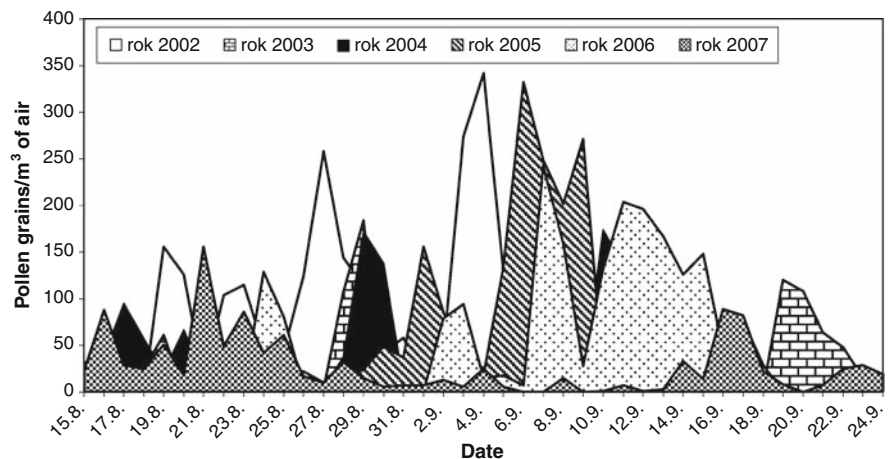
In comparison with previous monitored years, a lower concentration of *Ambrosia* pollen grains during 2007 was detected. A total of 1,213 ragweed pollen grains (3.12% of the overall annual pollen concentration) were counted. The first pollen grains of *Ambrosia* were determined by volumetric spore trap on 26 March and the last pollen grains on 10 October. The ragweed pollen season peak day was observed on 21 August (156 pollen grains per cubic meter of air). Although markedly lower concentration of *Ambrosia* pollen grains in 2007 was captured, the *Ambrosia* pollen season during this period represented the longest pollen season among of all previous monitored years yet.

From the allergological point of view, monitoring of daily, monthly and yearly variations of *Ambrosia* pollen concentration in the atmosphere is very important. Various authors reported several suggestions about symptomatological threshold value of ragweed pollen grains. According to Banken and Comtois (1992), symptoms should be expected with a level of 5–10 pollen grains per cubic meter of air. Jäger (1998) reported that the threshold value for clinical symptoms for sensitive patients is considered to be 20 pollen grains per cubic meter of air. Solomon (1984) noted that allergy symptoms begin with an average daily concentration between 10 and 100 grains per cubic meter of air. This range of pollen concentrations was used as an allergenic threshold value to induce symptoms in sensitive patients in presented study (Table 1).

4 Conclusions

Determined results of the monitoring of ragweed pollen season dates and intensity during 2002–2007

Fig. 2 *Ambrosia* pollen season in Bratislava in 2002–2007 according to the method by Nilsson and Persson (1981)



represented notable fluctuation related with marked discontinuity of daily sums of pollen grains in the air of Bratislava.

Consequently, presented pollen observation was not definitely the proof of the manifest progressing increase of quantity and *Ambrosia* pollen concentration in the air. Obtained results of the monitoring of pollen concentration in the air depend on comprehensive and abundant expansion of ragweed plants in Bratislava region. Simultaneously, dynamics of pollen concentration significantly is related to actual atmospheric situation in the studied environment.

Although ragweed pollen slightly exceeds the established limit, nevertheless at the recent season *Ambrosia* in Bratislava represents an increasing allergenic risk. The results confirm a significant assignment that the each monitored pollen season includes some days with markedly high concentration of ragweed pollen grains, which can indicate a pollinosis.

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