

## POLLEN COUNTS IN SLAVONSKI BROD, CROATIA DURING THE POLLINATION PERIOD 2008 TO 2010

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Hay fever or pollinosis is the allergic reaction of the human body to allergic pollen grains and is a seasonal phenomenon. Pollen concentrations depend on the climate, geographic features, and vegetation. Trees, grass, and weed pollinosis is frequent in Croatia, common ragweed (*Ambrosia artemisiifolia* L.) pollinosis in particular. Continuous monitoring of pollen air concentrations can provide timely information to the general public and can help sensitised patients and their physicians to prevent or alleviate allergic reactions. This is the task of health ecology services such as our Public Health Institute of the Brod-Posavina County. This article reports pollen concentrations in Slavonski Brod measured in March 2008 to November 2008, March 2009 to October 2009, and April 2010 to October 2010 and discusses the increasing exposure to ragweed and ways to control it.

**KEY WORDS:** *aerobiology, allergy, Europe, grass pollinosis, ragweed, tree pollinosis, weed pollinosis*

Europe faces an increasing incidence of pollen allergy, particularly in the urban areas (1). Hay fever or pollinosis is the allergic reaction of the human body to allergenic pollen grains and is a seasonal phenomenon (2). From spring to autumn, pollen is in the air and its concentrations depend on the climate, geographic features, and vegetation (3-6). Pollinosis in Croatia is between the typical Mediterranean and central European, with grass (central European) and cypress pollen (Mediterranean) as the most frequent causes of pollinosis (1). Over the past few years, however, Croatia has seen a strong increase in the pollination of common ragweed (*Ambrosia artemisiifolia* L.), the source of the most potent pollen allergen in the country (7).

Information about the levels of pollen grains in the air could be very useful for sensitised patients and

physicians, as it can improve prevention and therapy of seasonal allergic symptoms (9-11).

The aim of this study was to establish air levels of tree, grass, and weed pollens in Slavonski Brod during pollination in 2008 to 2010.

### METHODS

This study reports pollen concentrations in Slavonski Brod measured in March 2008 to November 2008, March 2009 to October 2009, and April 2010 to October 2010. For pollen sampling we used a seven-day Hirst-type volumetric pollen and spore trap (Lanzoni s.r.l., Italia) (12). The sampler was placed on the roof of the general hospital "Dr Josip Benčević" in Slavonski Brod. It uses a vacuum-pump to pass 10 L

of air through the orifice (2 mm x 14 mm) always directed into the wind. Inside is a drum with a tape coated with silicon oil to catch pollen grains. This adhesive tape moves at the speed of 2 mm h<sup>-1</sup>. Twice a week (on Mondays and Thursdays), we removed this tape, cut it to 48 mm strips that correspond to 24-hour pollen sampling. The strips were placed on glass slides and embedded in a medium prepared by dissolving 70 g polyvinyl alcohol (Gelvitol, Burkard Scientific, UK) with 4 g phenol (*p. a.*, Kemika, Croatia), in 200 mL of distilled water. After the overnight rest, 100 mL of glycerol (GRAM-MOL d.o.o., Croatia) was added and warmed up in a water bath until the solution turned liquid and clear. Then we added four drops of alcohol solution of basic fuchsin (Kemika, Croatia) per 100 mL of the medium. Two hours later, samples were examined under a light microscope (Olympus Corporation, Japan) at 400x magnification to determine pollen type against laboratory standards and bibliographical sources (13-16) and count per day. Pollen count is the number of pollen grains per cubic meter of air. We compared the pollen count with a standard pollen rating scale (PRS, Table 1) to determine whether it was low, moderate, high, or very high (17, 18).

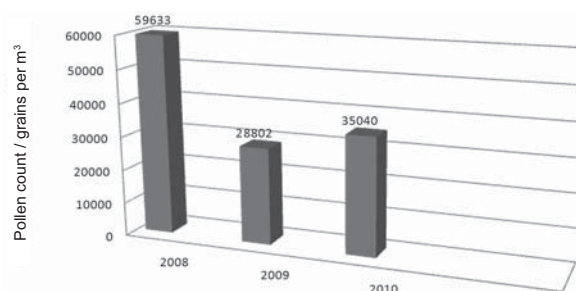
The start of the pollen season was defined as the first date on which at least one pollen grain per cubic meter of air was recorded for at least five consecutive days (19).

## RESULTS

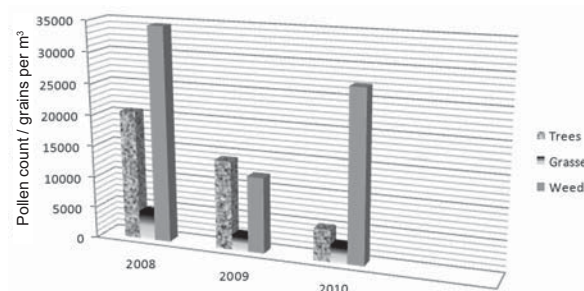
We identified 25 pollen taxa with moderate and highly allergenic grains, including: *Abies* (fir), *Aesculus* (chestnut), *Alnus* (alder), *Ambrosia* (ragweed), *Artemisia* (mugwort), *Betula* (birch), *Carpinus* (hornbeam), *Castanea* (chestnut), *Chenopodium* (goosefoot), *Corylus* (hazel), *Fagus* (beech), *Fraxinus* (ash), *Juglans* (nut), *Picea* (spruce), *Pinus* (pine),

*Plantago* (plantain), *Platanus* (plane), *Poaceae* (grass), *Populus* (poplar), *Quercus* (oak), *Salix* (willow), *Taxus/Juniperus* (cypress/juniper), *Tilia* (lime), *Ulmus* (elm), and *Urtica* (pellitory).

The highest pollen count of all pollen grain types (trees, grasses, weeds) was recorded in 2008 (Figure 1). Weed pollen dominated in every pollination period with the exception of 2009, when tree pollen prevailed (Figure 2).



**Figure 1** Total pollen counts of all types of plants in the air of Slavonski Brod during the pollination period 2008 to 2010

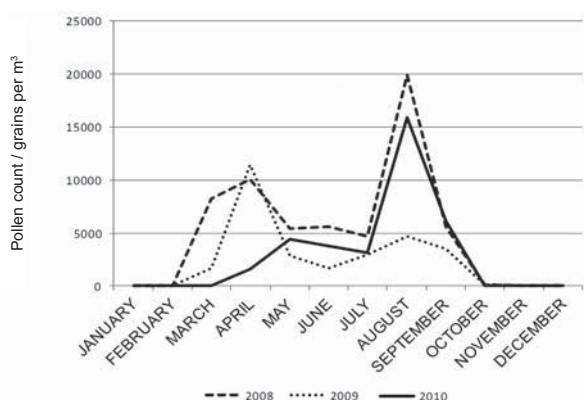


**Figure 2** Total pollen counts for trees, grasses, and weeds in Slavonski Brod during the pollination period 2008 to 2010

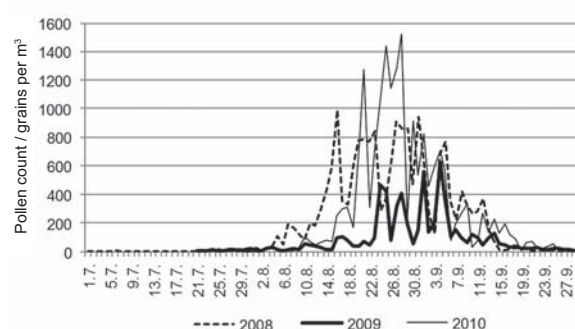
Figure 3 shows the pollination season for all pollens and all three years. In 2008, tree pollination started in the beginning of March. By the beginning of the summer, it declined and was replaced by much lower grass pollination. This explains why the curve has dropped. In August, weed pollen took over with

**Table 1** Pollen rating scale categories (18)

Pollen rating scale (PRS)	Pollen density / grains m <sup>-3</sup>			Allergy sufferers
	trees	grasses	weeds	
low	1 to 15	1 to 5	1 to 10	extremely sensitive people will have symptoms
moderate	16 to 90	6 to 20	11 to 50	many sensitive people will have symptoms
high	91 to 1500	21 to 200	51 to 500	most sensitive people will have symptoms
very high	>1500	>200	>500	almost all sensitive people will have symptoms



**Figure 3** Pollination period of all plant types (trees, grasses, weeds) in Slavonki Brod from 2008 to 2010



**Figure 4** Ragweed pollen counts in Slavonki Brod during the pollination period 2008 to 2010

a high ragweed pollen count and this is why the curve has risen again. The curve for 2009 looks slightly different, with a higher peak in the spring than in the late summer and autumn, because tree pollen count was higher than weed pollen count. The highest peak in 2010 was reached in August and September, because ragweed pollen count was particularly high that

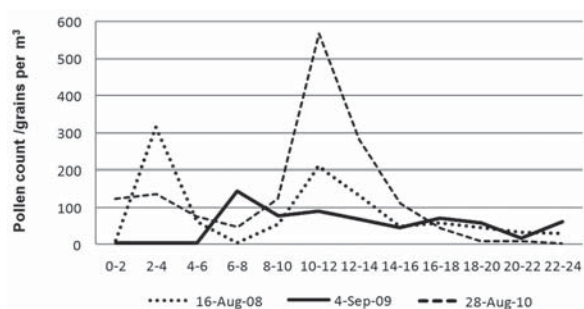
season, which is even clearer in Figure 4 that shows the pollination of ragweed for all three years.

Figure 5 shows the daily variations in ragweed pollen counts on peak days for every year. The peak concentrations were recorded in the mornings.

Table 2 shows quantitative trends of the main pollen types (period of occurrence, duration, concentration on a peak day, and peak day).

**Table 2** Levels of eight dominating plant taxa dominated in Slavonki Brod during the pollination period 2008 to 2010

Taxa	Period of occurrence	Duration / days	Concentration in a peak day / grains m <sup>-3</sup>	Peak day
<i>Taxus</i>	2008: 5 March to 1 May	57	134	29 March
	2009: 17 March 17 to 29 May	73	1456	3 April
	2010: 23 April to 30 May	37	51	1 May
<i>Betula</i>	2008: 9 March to 25 May	77	1836	29 March
	2009: 28 March to 15 May	48	276	5 April
	2010: 23 April to 27 May	34	47	1 May
<i>Acer</i>	2008: 13 March to 1 June	80	105	11 April
	2009: 26 March to 17 May	52	227	12 April
	2010: 23 April to 29 May	36	41	1 May
<i>Platanus</i>	2008: 10 March to 4 June.	86	548	11 April
	2009: 9 April to 3 May	24	194	17 April
	2010: 23 April to 30 May	37	66	6 May
<i>Quercus</i>	2008: 11 March to 11 June	92	135	27 May
	2009: 2 April to 30 May	58	137	17 April
	2010: 23 April to 1 June	39	115	4 May
<i>Poaceae</i>	2008: 1 April to 13 September	165	249	30 May
	2009: 13 April to 13 September	153	165	19 May
	2010: 26 April to 11 September	138	156	26 May
<i>Urtica</i>	2008: 14 March to 10 September	190	410	14 August
	2009: 8 April to 15 September	160	159	16 July
	2010: 29 April to 29 September	153	185	15 August
<i>Ambrosia</i>	2008: 22 June to 26 October	126	994	16 August
	2009: 13 July to 15 October	94	625	4 September
	2010: 26 July to 15 October	81	1520	28 August



**Figure 5** Daily variation of ragweed pollen counts in Slavonki Brod on peak days from 2008 to 2010

## DISCUSSION

Tree pollen types dominated by the taxa *Quercus*, *Betula*, *Platanus*, *Acer*, and *Taxus* in the spring coincide with earlier findings in other two continental towns of Vinkovci and Bjelovar (10, 20). Grass pollen took over in May and June, as tree pollen counts subsided. Grass pollen counts dominated until July and August to be taken over by weeds, mostly ragweed, followed by the taxa *Artemisia*, *Plantago*, and *Chenopodium*.

The highest ragweed concentration in our study of 1520 pollen grains per cubic meter was recorded on 28 August 2010. For comparison, the highest concentration recorded in continental Zagreb in 2003 was 883 pollen grains per cubic meter (18). In Zadar, a Mediterranean-type town of Croatia, the highest ragweed pollen count in 2008 was 435 grains per cubic meter (21).

Even when ragweed pollination was not in the season (July/August), its pollen count dominated over other weed and in the peak days exceeded 600 to 1500 grains per cubic meter, that is, the threshold (see pollen rating scale in Table 1) associated with symptoms of hay fever or asthma that develop in sensitised patients. This is not surprising, as every single plant of ragweed produces enormous amounts of pollen (18).

On peak days, ragweed pollen counts were the highest in the morning. This pattern is similar to patterns reported in the continental towns of Zagreb, Samobor, and Ivanić Grad (18) and may reflect variations in meteorological parameters, as observed by Recio et al. (9).

## CONCLUSIONS

Considering that the prevalence of allergic diseases is on the rise, and that it is largely related to

sensitisation to pollen, there are several ways to reduce the risk of exposure for the general public. One of the measures is stern control of *Ambrosia artemisiifolia* L. as the most potent allergen source, decreed by the Croatian Ministry of Agriculture, Forestry and Water Management in 2006 (25). This control includes pulling young plants out at the end of May and the beginning of June when they reach 20 cm in height. Alternatively, during the vegetation period, the plants should be mowed before the pollination season starts (26). Another measure is making information on pollen levels public and regular; this is the task of health ecology services such as our Public Health Institute of the Brod-Posavina County. Clearly, this information should contain advice to physicians and sensitised patients about how to keep exposure at bay and adjust their daily activities and treatment, where necessary (27).

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**Sažetak****KRETANJE PELUDNIH ALERGENA NA PODRUČJU SLAVONSKOG BRODA ZA VRIJEME POLINACIJSKIH SEZONA 2008.-2010.**

Svrha je ovog rada prikazati kretanje peludnih alergena na području grada Slavanskog Broda, s obzirom na to da je pelud jedan od najčešćih prirodnih alergena koji može uzrokovati velike zdravstvene teškoće. Služba za zdravstvenu ekologiju Zavoda za javno zdravstvo Brodsko-posavske županije od kolovoza 2007. godine provodi monitoring koncentracije peludnih zrnaca u zraku na području Slavanskog Broda. Metodologija uzorkovanja peluda standardizirana je volumetrijska metoda. Dnevna koncentracija svih vrsta peluda izražava se kao broj peludnih zrnaca u kubnom metru zraka. Utvrđeno je 25 biljnih vrsta koje se dijele prema podrijetlu na drveće, trave i korove. Najviše peludnih zrnaca (svih vrsta zajedno) zabilježeno je 2008. godine. Prevladao je pelud korova, s naglaskom na ambroziju. U proljeće se u zraku pojavljuje samo pelud drveća, početkom ljeta pelud trava i korova, dok tokom samog ljeta i jeseni dominira pelud korova. S obzirom na to da se Slavonski Brod nalazi u kontinentalnom dijelu Hrvatske, moglo bi se očekivati da će se tijekom godine u zraku pojaviti pelud svih biljnih vrsta. Kontinuirano praćenje koncentracije peluda u zraku omogućuje pravodobno obavješćivanje javnosti i uvelike može pomoći i liječnicima i pacijentima u preveniranju alergijskih reakcija.

**KLJUČNE RIJEČI:** *aerobiologija, alergija, ambrozija, biljke, Europa*

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