BRC
www.brc.amu.edu.pl

Biodiv. Res. Conserv. 3-4: 320-323, 2006

Is pollen of ragweed (*Ambrosia* L.) a threat to people with allergies in the Wielkopolska region?

Alicja Stach

Laboratory of Aeropalynology, Adam Mickiewicz University, Umultowska 89, 61- 614 Poznań, Poland, e-mail: ambrozja@man.poznan.pl

Abstract: The strongly allergenic ragweed pollen has been detected in the air of Poznań city (W Poland), in August and September, since 1995 up to date, although this alien plant is not present in Poznań. Thus the presence of ragweed pollen in the air of Poznań is probably a result of long-distance transport. Aiming to solve this question, the purpose of the study was to analyse the variation in ragweed pollen concentration in the air of Poznań in successive years of the past decade (1995-2004) and to compare this with wind directions. By using a volumetric trap, pollen concentration was estimated. Wide variations in pollen concentration were found in the study period, ranging from 17 (in 2000) to 374 (in 1999). Peaks of pollen concentration in those months were associated with E, NE, SE, and SW wind directions. This might account for the presence of ragweed pollen in the air of Poznań, when the plant itself is absent.

Key words: pollen, *Ambrosia*, allergenicity, wind directions, Poznań, Wielkopolska

1. Introduction

Allergens of *Ambrosia* L. pollen cause 50-75% cases of hay fever in eastern Canada and are considered the primary cause of allergies in the USA. Allergic rhinitis is estimated to affect more than 10% of the North American population (Malone *et al*. 1997). Within the last 20 years an increase in the threat posed by pollen allergens of this plant has been observed in Europe (Rybnicek *et al*. 2000; Jäger 2000). Ragweed seeds reached Europe with cereal grain. At present, *Ambrosia* pollen constitutes a serious allergological threat in Hungary, Ukraine, Belarus, Slovakia, Bulgaria, Slovenia and France (Yankova *et al*. 2000; Rybnicek *et al*. 2000; Jäger 2000; Laaidi & Thibaudon 2003). In Poland small populations of *Ambrosia artemisiifolia* L. have been found near Bydgoszcz, Szczecin, Gdańsk and Kraków (Zając & Zając 2001). Pollen grains of ragweed have also been detected in the air in Polish cities conducting volumetric monitoring (Kasprzyk 1996; Stach & Silny 1999; Stępalska *et al*. 2002; Malkiewicz & Wąsowicz 2003; Weryszko-Chmielewska *et al*. 2003; Puc 2004).

The increasing allergological threat posed in Europe by ragweed pollen has contributed to enhanced interest in this plant. In numerous European countries, detailed studies are being undertaken on ragweed pollen concentration in the air, but many researchers are also searching for new localisations in the field. It is likely that the prolonged trend towards global warming, manifested in increased mean annual temperatures in Europe, may contribute to the extension of the limits of ragweed.

In the area of the city of Poznań and in its environs, at present there are no sites of *Ambrosia*, but its pollen has been detected on a regular basis in August and September starting from 1995, i.e. since permanent volumetric monitoring was initiated.

The aim of this study was to examine the variation in ragweed pollen concentration in the air of Poznań in relation to wind directions in each year of the past decade and to undertake an attempt to find the source of the pollen.

2. Material and methods

Aerobiological monitoring using the volumetric method has been conducted in Poznań since 1995. Measurements have been taken with a volumetric apparatus (Hirst 1952), which was located on the roof of a 13-storey building of the Provincial Office in 1995, 36 m above the ground level (52°24'34"N and 16°55'20"E).

ECOLOGY

Since 1996 another apparatus, purchased by the Allergy Disease Diagnostics Centre, University of Medical Sciences, has been operating in Poznań, on the roof of a building of the University, 33 m above the ground level (52°24'N and 16°53'E). Monitoring at these points has been conducted on a permanent basis up to the present. Measurements of concentrations of plant pollen and fungal spores recommended by the International Association for Aerobiology are taken worldwide, primarily in Europe and North America (Mandrioli *et al.* 1998). Such a measurement method makes it possible to determine the concentration of aeroplankton at any time, to measure mean daily pollen and spore concentrations at a given measuring point, and it facilitates the monitoring of daily and seasonal fluctuations in their concentrations (BAF 1994; Mandrioli *et al.* 1998).

Gelvatol stained with basic fuchsin and micro cover glasses of 24 mm × 60 mm were used to prepare slides. Microscopic analysis of aeroplankton on slides in 1995-1999 was conducted vertically at 2h intervals. Starting from 2000, the material was analysed on the surface of 4 horizontal tapes and the obtained results were recorded on an hourly basis (Domínguez Vilches *et al.* 1991).

Table 1 lists data characterizing the pollen seasons of ragweed. The beginning of the pollen season is defined by the day in which the cumulated value of the annual pollen total was 1%; the end of the season is defined by the day on which the cumulated value was 95% (Jäger 2003).

Meteorological data were obtained from the Institute of Meteorology and Water Management in Poznań.

3. Results and discussion

Ambrosia is one of 69 taxa registered in Poznań during aerobiological studies extending over a 10-year period. It appeared in the air in Poznań each year, although pollen counts in successive years varied considerably (Table 1). The highest annual total was recorded in 1999, reaching a value of 374. The lowest annual total was 22-fold lower and amounted to 17, in 2000 (Table 1). The pollen season in the study period generally begun in mid or late August; only in 1999 and 2003 was pollen detected earlier. The main pollen period for ragweed in Poznań usually lasted from late August till early September. Seasonal peaks were recorded between 18 August (in 1996) and 11 September (in 2004). These were extreme dates, but in the other years, the seasonal peaks were recorded primarily in the last week of August.

The presence of *Ambrosia* pollen in the air of Poznań in most seasons was not continuous. There were breaks of 1, 2 or several days between successive days on which pollen was recorded.

Analysis of wind directions in individual years showed that the seasonal peak was found on days when the wind in Poznań was blowing from the E, NE, SE or SW (Table 1). A change in wind direction to a westerly wind was sometimes connected with a lack of *Ambrosia* pollen in the air of Poznań as soon as a day after the seasonal peak.

Ragweed probably originates from the southern part of North America (Comtois 1998). In the 19th century, *Ambrosia* was known in Europe only in several herbaria: as *Ambrosia artemisiifolia* in Montmoron 1877, Saint Galmier 1878, Turicens 1878, Hamburg 1882, Innsbruck 1883, and Brunschweig 1885, and as *Ambrosia maritima* L. in Brno 1800, Lesina 1830, Pescara 1874, Cyprus 1883, Aix-en-Provence 1891, Messina 1901, and Mannheim 1907. Ragweed appeared on a larger scale in Europe after World War II. It reached Europe with transports of cereal grain from America and probably started its expansion from principal ports, such as Rijeka, Trieste, Genoa, Marseille and Odessa (Juhász 1998). It appeared in Poland in the same way and was found in the vicinity of railway stations and grain elevators.

Ambrosia artemisiifolia was first reported in Poznań at the Poznań Górczyn Railway Station in the 1960's by Żukowski (1960) and later by Jackowiak (1993). At present ragweed is not found at those sites, although its pollen has been regularly recorded in the air since 1995 (Stach & Silny 1999; Stach *et al.* 2000; Stach 2002).

Table 1. Pollen seasons of *Ambrosia* in Poznań in 1995-2004

Year	Start date	Peak		End date	SPI	Wind directions on:		
		date	P/m^3			DBP	PD	DAP
1995	24 Aug	8 Sep	61	3 Oct	108	E	SE	W
1996	11 Aug	18 Aug	22	3 Sep	151	N	NE	NE
1997	14 Aug	26 Aug	44	17 Sep	190	SE	E	SE
1998	31 Aug	6 Sep	12	11 Oct	44	SE	SE	SE
1999	4 Aug	5 Sep	109	10 Sep	374	E	E	E
2000	28 Aug	28 Aug	12	1 Oct	17	E	E	NW
2001	15 Aug	31 Aug	41	31 Aug	84	E	SE	S
2002	11 Aug	28 Aug	92	5 Sep	249	E	E	E
2003	31 Jul	29 Aug	9	30 Aug	25	W	E	W
2004	19 Aug	11 Sep	6	18 Sep	28	S	SW	SW

Explanations: DBP – day before peak, PD – peak day, DAP – day after peak, SPI – Seasonal Pollen Index

Studies conducted in Europe (Jarai-Komlodi 2000; Jäger 2000) showed that its centres of occurrence and highest pollen release are found in Hungary, as well as in the south of France, near Lyon (Laaidi & Thibaudon 2003). Jäger (2000), while coordinating studies conducted by specialists from different countries, emphasized that ragweed found excellent conditions for development in those regions of Europe and the process of extension of its limits was observed. The rate of its expansion from east to west in Austria was then 6-20 km per year.

In Poznań, as in the whole Wielkopolska region, winds from the W and SW sector predominate. Most frequently, winds are light (up to 2 m/s) or gentle (2-5 m/s). Strong and near gale winds of over 10 m/s appear occasionally (Woś 1994). Only 2% of air masses reaching Poznań are tropical, of which the majority come in August. In the 10-year period, in days of the seasonal peak of *Ambrosia* pollen in the air of Poznań, the predominance of E, SE, NE and SW winds was observed (Table 1). Probably air masses reaching Poland from areas where *Ambrosia* is found in abundance brought the pollen that has been recorded on tapes in the apparatus. The analysis of pollen presence in the air of Poznań in terms of wind directions suggests that probably pollen could have been blown to Poznań from Hungary, the Czech Republic, Slovakia or Ukraine (Stach & Silny 1999). The seasonal peak of *Ambrosia* pollen in 1996 was detected when winds blew from the NE, which could suggest that pollen grains were transported from Polish sources of *Ambrosia* near Bydgoszcz.

Additionally, the hypothesis of long-distance transport is supported by the fact that the highest pollen concentrations were recorded at night and in the early morning, e.g. on 8 September 1995 between 4 and 6 a.m. In countries where *Ambrosia* grows, daily maxima are detected at noon and in the afternoon (Jarai-Komlodi 2000; Jäger 2000).

In Poland, ragweed pollen has been recorded in Ostrowiec Świętokrzyski, Kraków, Rabka, Warszawa, Zakopane, Gdańsk, Szczecin and Lublin (Kasprzyk 1996; Góra 1998; Piotrowska-Weryszko 2001; Stępalska *et al*. 2002). In Kraków, over 50% of examined patients who are allergic to plant pollen have positive results in tests for *Ambrosia* (Obtułowicz *et al*. 1995). Similar results were found in the Czech Republic, where sensitization to ragweed occurred in over 20% of the allergic population (Rybnicek *et al*. 2000). Ragweed pollen allergens cross-react with mugwort pollen (Hirschwehr *et al*. 1998; Perrin *et al*. 1977). The allergic patients for mugwort pollen allergens from Poland who go on trips in the second half of August and September to Hungary, Ukraine, Slovakia, the Czech Republic, Slovenia or southern France, are at risk of exposure to high concentrations of ragweed allergens in the air.

4. Conclusions

There is a potential allergological risk posed by *Ambrosia* pollen at the end of August and the beginning of September during tropical circulation in the Wielkopolska region. The question of the source of the ragweed pollen still remains open, and needs further detailed studies of the back trajectories of air masses.

Acknowledgments. I wish to thank Professor Kazimierz Szczepanek from the Institute of Botany, Jagiellonian University, Kraków, for his kind permission to use the results from 1995. The study was partly financed within the framework of inter-university projects UAM-AM PU-II/27 in 2000-2004, next within the framework of project MTKD-CT-2004-003170, AEROTOP in 2004 and 2005, and finally in 2005 by the Ministry of Science and Information Society Technologies 128/E-366/6. PR UE/DIE 265.

References

BAF – British Aerobiology Federation 1994. Airborne Pollens and Spores. A guide to trapping and counting, pp. 1-56.

Comtois P. 1998. Ragweed (*Ambrosia* sp.): the Phoenix of allergophytes. Satellite Symposium Proceedings: Ragweed in Europe. 6th International Congress On Aerobiology, Perugia Italy 31.08-5.09.1998, pp. 3-5.

Domínguez Vilches E., Galán Soldevilla C., Villamandos de la Torre F. & Infante Garcia-Pantaleón F. 1991. Handling and evaluation of the data from the aerobiological sampling. Monografías REA/EAN 1: 1-13. Editia: Dep. De Biología Vegetal y Ecología. UCO, España.

Góra M. 1998. Pyłek roślin i zarodniki grzybów w atmosferze Trójmiasta w latach 1994-1996. Ph. D. Thesis, Chair of Plant Ecology and Nature Conservation of the University of Gdańsk.

Hirschwehr R., Heppner C., Spitzauer S., Sperr W. R., Valent P., Berger U., Horak F., Jäger S., Kraft D. & Valenta R. 1998. Identification of common allergenic structures in mugwort and ragweed pollen. J. Allergy Clin. Immunol. 101(2): 196-206.

Hirst J. M. 1952. An automatic spore trap. Ann. Appl. Biol. 39: 257-265.

Jackowiak B. 1993. Atlas of distribution of vascular plants in Poznań. Publications of the Department of Plant

Taxonomy of the Adam Mickiewicz University of Poznań 3: 1-409.

JÄGER S. 2000. Ragweed (*Ambrosia*) sensitisation rates correlate with the amount of inhaled ambrosia pollen. A 14-year study in Vienna, Austria. Aerobiologia 16: 149-153.

JÄGER S. 2003. The European Pollen Information System (epi). Data bank (EAN), Web sites and forecasting. Postępy Dermatologii i Alergologii 20(4): 239-243.

JARAI-KOMLODI M. 2000. Some details about ragweed airborne pollen in Hungary. Aerobiologia 16: 291-294.

JUHÁSZ M. 1998. History of Ragweed in Europe. Satellite Symposium Proceedings: Ragweed in Europe. 6th International Congress On Aerobiology, Perugia Italy 31.08-5.09.1998, pp. 11-14.

KASPRZYK I. 1996. Palynological analysis of airborne pollen fall in Ostrowiec Świętokrzyski in 1995. Ann. Agric. Environ. Med. 3(2): 83-86.

LAAIDI M. & THIBAUDON M. 2003. Two statistical approaches to forecasting the start and duration of two pollen season of ambrosia in the area of Lyon (France). Int. J. Biometeorol. 48: 65-73.

MALKIEWICZ M. & WĄSOWICZ A. 2003. *Ambrosia* pollen grains in aeroplankton of Wrocław. Ann. UMCS, sectio EEE 13: 333-339.

MALONE D. C., LAWSON K. A., SMITH D. H., ARRIGHI H. M & BATTISTA C. 1997. A cost of illness study of allergic rhinitis in the United States. J. Allergy Clin. Immunol. 99: 22-27.

MANDRIOLI P., COMTIS P., DOMINGUEZ-VILCHES E., GALÁN-SOLDEVILLA C., SYZDEK L. D. & ISSARD S. A. 1998. Sampling: Principles and Techniques. In: P. MANDRIOLI, P. COMTOIS, V. LEVIZZANI (eds.). Methods in Aerobiology, pp. 47-112.

OBTUŁOWICZ K., SZCZEPANEK K. & MYSZKOWSKA D. 1995. *Ambrosia* pollen grains in aeroplankton of Kraków and their role in pollen allergy of this region. In: R. ŚPIEWAK (ed.). Pollens and Pollinosis: Current Problems, p. 56. Institute of Agricultural Medicine, Lublin.

PERRIN L. F., BRUNET J. K., DECHAMP C., ECIMOVIC R., LASNE Y. & CREYSSEL R. 1977. IgE totales et IgE specifique dans les pollinoses estivo-autumnales by Ambrosia et Armoise. Rev. Franc. Allergol 17: 265-267.

PIOTROWSKA-WERYSZKO K. 2001. Analiza zawartości ziarn pyłku w aeroplanktonie Lublina w latach 1995-1999. Ph. D. Thesis, The Department of Botany of the Agricultural University in Lublin.

PUC M. 2004. Ragweed and mugwort pollen in Szczecin, Poland. Pollen 14: 66-67.

RYBNICEK O., NOVOTNA B., RYBNICKOVA E. & RYBNICEK K. 2000. Ragweed in Czech Republic. Aerobiologia 16: 287-290.

STACH A. 2002. Pyłek roślin w aeroplanktonie Poznania w latach 1994-1997 ze szczególnym uwzględnieniem pyłku roślin taksonów alergogennych. Ph. D. Thesis, Institute of Botany the Jagiellonian University, Kraków.

STACH A. & SILNY W. 1999. Pyłek z dalekiego transportu w aeroplanktonie Poznania w latach 1995-1997 (wybrane taksony alergogenne). Bibliotheca Fragmenta Agronomica 6: 209-216.

STACH A., SILNY W. & CZARNECKA-OPERACZ M. 2000. Prawdopodobieństwo zagrożenia alergicznego pyłkiem *Ambrosia*. Alergia i Ty 3(6): 22-23.

STĘPALSKA D., SZCZEPANEK K. & MYSZKOWSKA D. 2002. Variation in *Ambrosia* pollen concentration in Southern and Central Poland In 1982-1999. Aerobiologia 18: 13-22.

WERYSZKO-CHMELEWSKA E., PIOTROWSKA K. & CZERNEČKYJ M. 2003: *Ambrosia* and *Iva* pollen in the air of Lublin and Lvov. Ann UMCS, section EEE 13: 341-348.

WOŚ A. 1994. Klimat Niziny Wielkopolskiej. 192 pp. Wyd. Nauk. UAM, Poznań.

YANKOVA R., ZLATEV V., BALTADIJEWA D., MUSTAKOV T. & MUSTAKOV B. 2000. Quantitative dynamics of *Ambrosia* pollen in Bulgaria. Aerobiologia 16: 299-301.

ZAJĄC A. & ZAJĄC M. (eds.). 2001. Distribution atlas of vascular plants in Poland. xii+714 pp. Edited by Laboratory of Computer Chorology, Institute of Botany, Jagiellonian University, Cracow.

ŻUKOWSKI W., 1960. Kilka interesujących gatunków synantropijnych z miasta Poznania. Przyr. Pol. Zach. 4: 141-145.