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AMBROSIA POLLEN TYPE: A NEW ALLERGEN IN THE SPANISH ATMOSPHERIC SPECTRUM

Tipo polínico Ambrosia*: un nuevo alérgeno en el espectro atmosférico español*

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INTRODUCTION

Ambrosia L. is a genus of plants of the Asteraceae family with bioinvasive behaviour in several European countries, whose distribution has never been studied in Spain as a whole. Nevertheless, the compilation of the biogeographical citations in the Iberian Peninsula reveals the outcome of the species throughout the territory. The invasive character of this plant poses a serious environmental problem, aggravated by the fact that its pollen is highly allergenic. Since this bioinvader seems to have reached Spain and be widely spreading through different pathways, it is time to alert the policy makers and start facing its management in the region. This, of course, cannot be

done without a proper documentation of the species, not only in biogeographical terms, but also concerning public health.

Ambrosia species are not very widespread in Spain, but some populations appear to be spreading in the territory, having encountered ideal conditions for their expansion. At an aerobiological level, the first citation of *Ambrosia* in Spain dates back to 1996, when peak levels of pollen were detected at most of the Catalan sampling stations, caused by a long-range transport episode (BELMONTE *et al.*, *Aerobiologia*, 16: 93-99. 2000). This phenomenon proved to be relevant from an allergological point of view, since in heavy infested areas, *Ambrosia* pollen can be considered one of the main aeroallergens (MAKRA *et al.*, *Grana*, 44: 57-64. 2005; TARAMARCAZ *et al., Swiss Medical Weekly*, 135: 538-548. 2005). The aim of this work is to give cause for concern about the spread of the plant in Spain and the dynamics of the pollen in the air, based on data of eight sampling stations from the Aerobiological Network of Catalonia (Xarxa Aerobiològica de Catalunya, XAC), from 1983 to 2010. The ownership of one of the oldest airborne pollen databases in Spain makes possible the identification of tendencies in the expansion of *Ambrosia* pollen type.

MATERIALS AND METHODS

The pollen sampling was performed using the Hirst method (HIRST, *Annals of Applied Biology*, 39: 257-265. 1952) and the pollen counts were obtained following the norms established by the Spanish Aerobiology Network (REA) (GALÁN *et al.*, *Manual de Calidad y Gestión de la REA*. 2007), at the Palynological Laboratory of the Universitat Autònoma de Barcelona.

RESULTS AND CONCLUSIONS

The Annual Pollen Index (API, sum of the mean daily pollen concentrations of a year) for *Ambrosia* showed a slightly decreasing trend during the study period in 4 out of the 8 sampling stations. This was not in accordance with other studies showing noticeable increasing trends of the contents of *Ambrosia* pollen in most parts of Europe already invaded by ragweed. Nevertheless, it is important to note that the API showed an irregular outline, depending also on the years considered. From 1983 to 1995, the *Ambrosia* pollen levels observed in Catalonia were insignificant, but from 1996 onward, the pollen counts have become a constant in most of the Catalan aerobiological sampling stations. On the other hand, the number of long-range transport episodes of *Ambrosia* pollen, marked by a sudden peak in the daily concentrations occurring at the same time at all or most of the Catalan aerobiological stations, seems to be increasing in the last years. Climate change could be playing a role in this trend, as it does in the dispersal of the genus (ZISKA & CAULFIELD, *World Resource Review*, 12: 449-457. 2000). In any case, as shown in Figure 1, the API values for Catalonia appeared to be closely linked to the peak

concentrations, resulting from long-distance transport pollen intrusions. In line with this assumption, the fact that a big proportion of the API comes from the peak dates (up to 60% in the episode of 7 September 2004 in Tarragona, and a rate of 32% for all the stations and the period under study) reinforces the theory that long-distance transport plays a key role in the *Ambrosia* pollen records in Catalonia.

In order to better understand the role of long-range transport of *Ambrosia* pollen in Catalonia, the provenance of the air-masses transporting pollen was examined using backward atmospheric trajectories. Isentropic 120-h back-trajectories at 500, 1000 and 1500 m a.s.l. starting at 12UTC from the coordinates of each monitoring site were computed using the Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT-4) of the National Oceanic and Atmospheric Administration (NOAA) (available at http://www.arl.noaa.gov/ready/hysplit4.html, DRAXLER & ROLPH, 2003) from the gridded meteorological fields of the FNL and GDAS archive data. According to the area crossed by the backward trajectories, the air-mass provenance was classified following the cardinal directions. Moreover, to validate these results, a source-receptor model based on the Seibert methodology (SEIBERT *et al.*, *Transport and transformation of pollutants in the troposphere*. 1994) was applied to map the most probable source areas of the *Ambrosia* pollen reaching Catalonia during the peak dates. In this study, two daily backward trajectories (at 00 and 12 UTC) were considered, at 500 and 1500 m during *Ambrosia* flowering period (25th June to 10th October) for the period 1997-2009. A grid of 2601 cells of 1ºx1º latitude and longitude was then superimposed on the integration region of the trajectories in order to map the contributing areas.

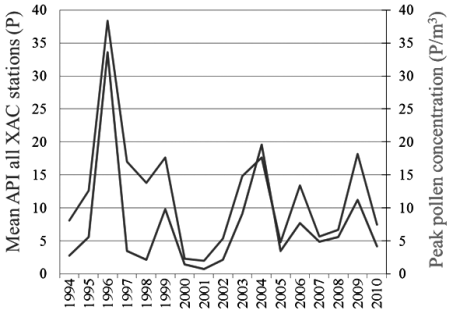

FIGURE 1. Comparison between the mean Annual Pollen Index (API) of all XAC stations and the absolute peak pollen recorded each year.

64 peak dates were reported during the study period, the absolute peak reaching a value of 34 pollen/m³ in Girona, the 8th September 1996. The backward atmospheric trajectories in the peak dates reported showed a predominantly northeastern (41%) and northern (36%) provenance, from the Lyon region, in France, and Hungary-Serbia. This is in clear concordance with the results obtained from the source-receptor model, revealing that the regions of Eastern France, Northern Italy and Serbia are the most probable *Ambrosia* pollen origin areas, as shown in Figure 2. It is important to note that *Ambrosia* is highly widespread in each of the three regions.

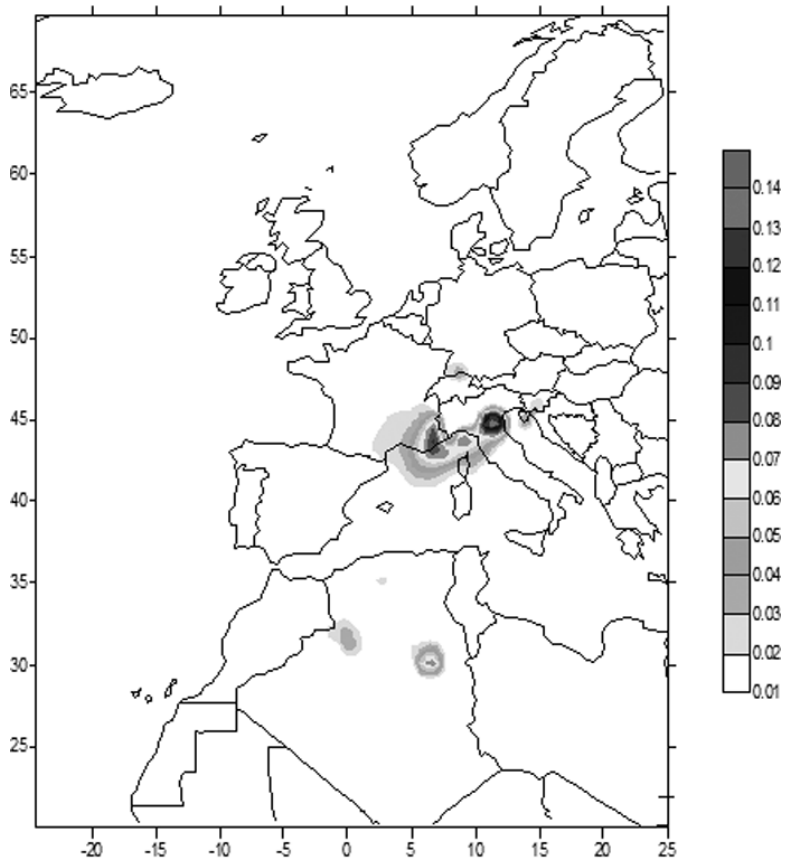

FIGURE 2. *Ambrosia* concentration field (p/m^3) for the period 1997-2009 (25th June to 10th October) computed at the height of 1500 m.

However, it is important to remind that, together with the long-range transport episodes, there could also be a substantial influence of the local populations on the pollen records. The API of *Ambrosia* pollen measured at a particular station can be considered as a first estimate of how much an area is infested by the species (SKJØTH *et al.*, *Agricultural and Forest Meteorology*, 150: 1203-1210. 2010). In other terms, the amount of pollen recorded at a specific site can reflect the local abundance of the species. In this sense, the fact that the highest APIS for the period 1994-2010 were recorded in Girona and Bellaterra (17 pollen grains, for both), where *Ambrosia* appears to be the most abundant, suggests that the *Ambrosia* expansion in Catalonia is already taking place.

This hypothesis was tested through a biogeographical sampling consisting on the monitoring of seven *Ambrosia* populations through the territory over a two-year period (2010-2011). This was made in order to determine how important the increase of the local *Ambrosia* populations is.

The results of the monitoring of the *Ambrosia* populations in Catalonia over a two-year period showed that *Ambrosia* populations are increasing at particularly high growing rates. In one year and considering the whole area studied, the *Ambrosia*-invaded surface increased in 3025 m^2, with percentages of growth up to 646% and a mean rate of 324% for the sampled territory in Catalonia. The locations of some of the infested areas may suppose a serious menace to public health, since they are located near some of the most popular beaches in the Catalan seashore and the pollination takes place by the end of August, when the beaches are still densely crowded. Furthermore, taking into account the low incidence of airborne *Ambrosia* pollen in Catalonia, it can be considered that small concentrations can be enough to sensitize the population. So, considering the 5 p/m^3 threshold proposed by the French Aerobiology Network (Réseau National de Surveillance Aérobiologique, RNSA) (THIBAUDON, *7th International Congress on Aerobiology*. 2003), there have been 23 days under risk of allergy in the eight Catalan aerobiological stations and all the yearly series (106, if we sum up the years of sampling for each of the stations) sampled in the period 1994-2010.

To sum up, even if *Ambrosia* pollen levels in Catalonia are still not very high, the species can become a serious menace for public health, since the genus is expanding over the territory at particularly high spreading rates. This, as well as the long-distance pollen transport episodes, may be enhancing the sensitivity of the population towards *Ambrosia* pollen. That is the reason why the authors propose that the Spanish Aerobiological Network (REA) include *Ambrosia* pollen type in the list of counted taxa, so that the expansion of the genus was surveyed and Spain could participate in the European networks for the control of *Ambrosia*.

