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ORIGINAL ARTICLE

Assessment of the risks associated with the invasive weed *Ambrosia artemisiifolia* in urban environments in Romania

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Abstract

Ambrosia artemisiifolia (common ragweed) is an invasive weed with rapid spread during the last decades in many European countries, representing an important problem for the environment and for public health, due to its highly allergenic pollen. Data from the European Aeroallergen Network (EAN) confirm the continuous increase of infested areas and of the atmospheric ragweed pollen load. *A. artemisiifolia* is responsible for significant health and economic impact in the most infested areas from Central Europe, mainly Hungary and neighboring countries, including Romania. Despite generally occurring in dry and abandoned fields, along railways and roadsides, *Ambrosia* is now recognized as part of urban vegetation in some big cities, contributing to increased risk of air pollution and of respiratory diseases. The aim of our paper is to review the data regarding spread and problematic of *Ambrosia* in some big cities of Romania, mainly the capital and the actual public activities undertaken to reduce its consequences. Our data showed that *Ambrosia* is a real and increasing danger for human health in Romania, mainly due to its rapid spread in urban environment and increasing number of affected persons. There is an urgent need for more coordinated efforts and sustainable management of this problem, to reduce impact of *Ambrosia* in urban environment, to establish a national aerobiology network and to continue collaboration with European institutions and specialists in this field.

Keywords: air pollution, allergenic pollen, *Ambrosia*, public health, urban environment

Introduction

Ambrosia artemisiifolia (common ragweed) is an invasive weed with rapid spread during the last decades in many European countries, representing an important public health problem, due to its highly allergenic pollen. Being originally from North America and first mentioned in Europe during the second half of the 19th century, ragweed was imported in Central Europe mainly after the World War I, with contaminated seed shipments (Juhász, 1998). Ragweed expansion increased dramatically after the 1980s, being recognized as an important danger for human health in many infested countries, mostly Hungary and neighboring countries from Pannonian Plain, Northern Italy and France (Oswalt et al., 2008). Information from the European pollen count database, established in 1988 and coordinated from Vienna, confirmed the continuous increase of both the intensity of ragweed atmospheric pollen load and the size of affected

areas (Rybnicek et al., 2001). Monitoring of ragweed pollen and studies of its spread have been performed since long time in Western European countries: since early 1980s in France, Switzerland and Italy (Laaïdi et al., 2003, Tamarcaz et al., 2005, Mandrioli et al., 1998) followed by Austria and later in many ex-communist countries after 1990 (Makra et al., 2004, Juhász et al 2004, Rybnicek et al., 2000, Peternel et al., 2005, Sauliene et al., 2011). Health data from allergists confirmed that the number of people sensitized to *Ambrosia* pollen is continuously increasing, from about 30% in France and Austria, up to 80% of pollen allergic patients in Hungary (Burbach et al., 2009). Actual data from the literature reveal the complex effects of pollen on human health, being considered more than an allergen carrier and from this perspective ragweed pollen is one of the most intensively studied allergenic pollen (Traidl-Hoffmann et al., 2003). The actual *Ambrosia* pollen map in Europe is depicted in Figure 1.

Ambrosia in Romania

Romania is included among the most *Ambrosia* infested European countries and this plant is now considered a real danger for human health and the environment, rising an important public concern. First notification of *Ambrosia* in Romania is dated in 1908 in Orsova (at that time part of the Kingdom of Hungary) railway station, Mehedinti county, situated in the South-East region, on the Danube riverside (Sirbu et al., 2011). In 1943 the presence of *Ambrosia* was notified in many regions from the West, South-West, North-West, and South, followed by almost all regions of the country.

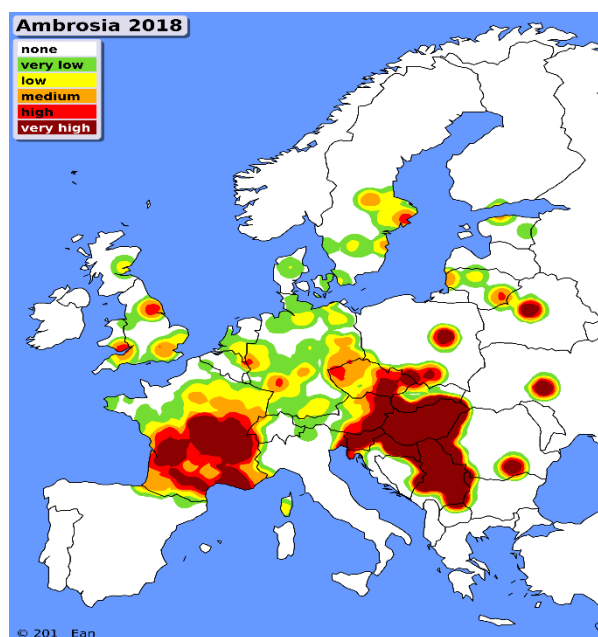


Figure 1. Ambrosia pollen map in Europe (www.polleninfo.org, 2018)

The consequence of *Ambrosia* pollen on human health was mentioned in 1965 (Topa et al., 1965) and the first map of the plant spread was done in 1971 (Vicol, 1971). More recent field observations performed in different regions of the country during the last two decades and some clinical reports from allergists confirmed the rapid and extensive spread of *Ambrosia* to large plain and hill regions, from all Romanian provinces (Anastasiu et al, 2005, Sarateanu et al., 2010). Despite being initially considered a problem of the West regions of Romania, *Ambrosia* was also notified in the East and South regions, mostly along the roadsides, railway embankments, cultivated fields, construction sites and pastures with dry soil, such as in Dobrogea, but also in the Danube Delta from the South-East (Anastasiu et al, 2009).

The map of *Ambrosia* spread in Romania since its first notification in 1908 until 2012 was done by Sirbu, based on botanical literature, public herbarium (Holmgren et al, 1990) and field observations of the author, using the method according to Universal Transverse Mercator system (UTM) (Lehrer, 1990) (Figure 2). The author has continued the field

observations and research after 2012 and is working on an update of the map to be published soon.

Monitoring of the airborne pollen concentration, including *Ambrosia*, was performed in the western city Timisoara between 1999 and 2010, demonstrating a high amount of ragweed pollen in that area (Ianovici, 2012). The annual pollen counts have shown an increasing trend, indicating an important local population, with maximum of pollination season during August and September (Ianovici et al, 2009; Ianovici, 2008). Concomitant clinical data from allergists showed that sensitization rate to ragweed in population of Timisoara was 34 % in 2009 and this pollen was the etiological agent in up to half of respiratory allergies in late summer and autumn. Allergists data about sensitization rate to *Ambrosia* pollen from the north-west region and from the Romanian Plain in the south region have been published and confirmed high rate of sensitization in these regions also (Bocsan et al., 2010, Popescu et al, 2011). No pollen data from other regions of Romania were available until 2014 and the national aerobiology network is still missing.

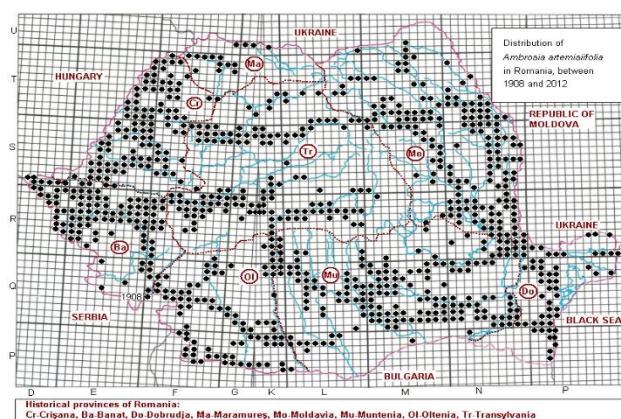


Figure 2. The map of *Ambrosia* spread in Romania between 1908-2012 (Culita Sirbu, 2012, unpublished, reproduced with author's permission).

Ambrosia in the capital city Bucharest

Bucharest is the largest town of Romania, with an actual population of about 1.926.000 inhabitants and an area of 228 square km, from which 70% is building area. It is situated in the Romanian Plain, at about 60 m altitude. Awareness of *Ambrosia* spread and its health impact on the population of the capital city Bucharest came about ten years ago. Two international symposia dedicated to *Ambrosia* were organized in 2009 and 2012 during the annual conference of Romanian Society of Allergology and Clinical Immunology (RSACI). In 2012 Romania was invited for the first time to take part in a global European project dedicated to ragweed, due to clear expansion of this invasive weed to Eastern European countries and the need for global evaluation of the danger (COST project Sustainable management of *Ambrosia artemisiifolia* in Europe – SMARTER FA 1203).

In the frame of this COST project, we established a long-time collaboration with the Réseau National de Surveillance Aerobiologique (RNSA) from France and in 2014 we started to perform pollen monitoring on regular basis for the first time in Bucharest. We used a Burkard pollen trap placed on the roof of the four levels building of the Research Development Pavilion (CDPC), from Colentina Clinical Hospital, based on the volumetric method. The analysis was done weekly and results expressed in pollen grains per cube meter air were sent to European Aeroallergen Network from Vienna and posted on polleninfo.org. Results of the first three years pollen monitoring in Bucharest have been published in 2018 and showed significant amount of *Ambrosia* pollen, with a maximum total monthly amount of 754 grains/m³ air during September 2014. These pollen recordings confirmed that *Ambrosia* is an important part of the biologic pollution in the big city from the south region of the country, contrary to the previously published studies considering it to be more prevalent in Western regions and rural areas (Leru et al, 2018). The peak of the daily values has reached 231 pollen particles /m³ air in early September 2014, which was comparable with the amount of 292 particles /m³ air reported in the Western city of Timisoara in August 2009 (Ianovici, 2012).

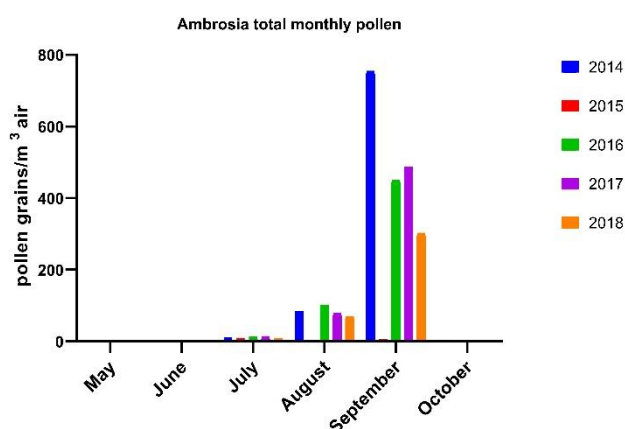


Figure 3. *Ambrosia* total monthly pollen grains/m³ air during 2014-2018 in Bucharest (Observation: data corresponding to August and September 2015 were distorted by some technical problems of the pollen trap).

Our pollen data for the period of five years between 2014-2018 showed slightly lower levels of *Ambrosia* pollen during the next years after 2014, but still significantly high (Leru et al, 2019). We have no explanation for these findings showing lower pollen concentration after 2014, despite a clear extension of the plant in the city and we consider that more pollen traps situated in different districts of the city and correlation with meteorological data may bring important information and clarifications.

We can explain the surprisingly massive spread of the weed in the biggest city of the country by the great development of the city area since the early 1990s, followed by the economic

crisis in 2008, when many constructions have been stopped and the terrains remained abandoned, offering ideal conditions for *Ambrosia* invasion.

Health impact of *Ambrosia*

In order to evaluate allergists opinion about health impact of *Ambrosia* pollen and allergic patients' situation in Romania, in 2015 we performed a survey during the annual Romanian Society of Allergology and Clinical Immunology (RSACI) conference and published a paper (Leru et al, 2015). The results showed a high interest and concern for this topic, but also some gaps in managing this health problem, in terms of prevention and public management. An intensive and increasing concern regarding *Ambrosia* became clear in all media at the national and local level during the summertime of the last years, leading specialists and stakeholders to pay more attention to the phenomenon of air pollution in the urban environment. Allergists from Bucharest have reported an increasing number of patients with respiratory allergies from one year to another during summer and autumn and have been invited for television and internet discussions on this topic. During summer 2017, the Romanian Society of Allergology and Clinical Immunology launched a television campaign called Stop *Ambrosia*, aiming to increase population awareness of this danger. Patients were encouraged to be active on social groups and to post photos with the plant from different districts of Bucharest. It became clear that *Ambrosia* is almost everywhere, from periphery to the city center, very close to parks and crowded places. Most of the patients diagnosed with allergies to *Ambrosia* pollen are young and active persons, living in new districts built-in large areas from the periphery of the city and close to agricultural fields.

Public actions against *Ambrosia* in Romania

Following previous proposals of two deputies, the Law no. 62/2018 regarding control of the weed *Ambrosia* was adopted by the Romanian Parliament on 14 March 2018 and the implementation rules, published later, started to be applied since 1st January 2019 (Lex 62 adopted by the Parliament of Romania, published in the Official Monitor 227 on March 14, 2018). This law stipulates the obligation of fields owners and administrators to identify *Ambrosia*, to clean their properties until June 30 of each year and to undertake preventive tasks for avoiding the plant spread. The law includes an article referring to financial sanctions: fines between 750-5.000 RON (approx.160-1060 Euro) for residents who do not destroy *Ambrosia* from their properties and between 5.000-20.000 RON (approx.1060-4280 Euro) for legal entities who are not involved in prevention, control and mitigation of *Ambrosia* on their properties.

Discussion

The strategy to control *Ambrosia* in Europe and in the world looks complex and difficult, proved by the much longer experience of the European countries, which are more advanced in this activity field (Thibaudon et al., 2004).

Recent data from the literature showed that pollen measurement and biological particle monitoring is a neglected aspect of air quality monitoring in the world (Buters JTM et al., 2018). The information about spatial and temporal variations in airborne *Ambrosia* pollen between European countries can be used for the management and evaluation of the consequences of this invasive weed and underline the importance of pollen monitoring networks in all countries (Sikoparija et al., 2016). There are two important aspects regarding trends of ragweed distribution: geographical extension of the infested areas to the Northern and Eastern Europe, due to climate change and the ability of ragweed pollen to be transported at long distances, possibly situated at hundreds of kilometers from the source areas (Grewling et al., 2019).

Ambrosia invasion in the urban environment and the impact of global climate change is another important aspect to note. It was proved that ragweed pollen production was much higher in plants grown in elevated CO₂ environments, this finding anticipating an increased ragweed pollen production, as a result of global warming (Wayne et al., 2002). Data from the literature mentioned greater ragweed biomass and atmospheric pollen counts in urban area, which had 30 to 31% higher daily CO₂ concentrations and a 1.9 degrees Celsius temperature increase compared to the rural area and an earlier ragweed flowering season was also noted in the urban compared to rural sites (Ziska et al., 2003).

Taking together all these observations, it becomes clear that biologic pollution can be controlled and a healthier environment can be provided also by planning urban green spaces, based on vegetation specialists' advice, aimed to avoid and restrict allergenic species. The recommendations of specialists from RNSA from France may be used as a model by local urban administrators (Thibaudon et al., 2013). It is important to integrate local pollen data in regional and European research projects, that may contribute to better global management of *Ambrosia* worldwide (Manyoki et al., 2017).

Conclusions

Based on our research during the last ten years in Bucharest, it becomes clear that *Ambrosia* pollen represents an important part of biological pollution and a serious allergenic threat in big cities from Romania, mainly in the capital. The occurrence and spread of this invasive weed in urban environment is an important issue that imposes specific measures, a complex and more coherent strategy. We consider that the financial penalties imposed by the law are not enough for combating *Ambrosia*, there is an urgent need to establish a National Aerobiology Network and to develop national and international research projects, gathering all specialists and stakeholders involved in the environment control, prevention, and public health.

Conflict of interest: the authors declare no conflict of interest in relation to this manuscript.

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