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# HEALTH IMPACT OF *AMBROSIA ARTEMISIIFOLIA* REFLECTED BY ALLERGISTS PRACTICE IN ROMANIA. A QUESTIONNAIRE –BASED SURVEY

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**ABSTRACT**
*Ambrosia artemisiifolia (ragweed) is an invasive weed with pollen representing one of the most potent seasonal aeroallergenes. Romania is considered a ragweed infested country, based on field observations performed in different regions, pollen counts done in the West region and some clinical reports from allergists in the West and South parts. The aim of this paper is to evaluate the situation of allergies induced by Ambrosia artemisiifolia from the perspective of allergists practice in Romania and to draw some conclusions regarding consequences and possible measures to reduce this burden. The study was based on a questionnaire addressed to allergists attending the national annual allergology conference in 2013. The answers showed that part of the allergists are aware of the importance of allergies induced by Ambrosia pollen. We concluded that research projects in this field, application of eradication measures and public information are important for increase awareness of people about health impact of Ambrosia pollen in Romania.*
**KEY WORDS:** *allergy, Ambrosia artemisiifolia, health impact*

## INTRODUCTION

Respiratory allergic diseases, mainly allergic rhinitis and asthma represent an important health problem in Europe. It is estimated that about 40% of European population suffer different forms of pollen-induced allergies. Pollen-induced allergies have an increasing trend and significant consequences on quality of life of sensitized population. Climate changes, cultural factors, changes in agricultural practice and intensification of international traffic are contributing to the expansion of some allergenic pollens, such as *Ambrosia artemisiifolia* (ragweed) in many European countries rise important problems for both national health systems and European authorities (D'Amato *et al*, 2007**).** Biodiversity loss, exposure to ozone and air pollution has also been shown to influence allergic disease (Oswalt & Marshall, 2008; Haahtela *et al*, 2013). Artificial environment with life style in urban areas may contribute to increasing frequency of respiratory allergy and asthma (D'Amato, 2011).

*Ambrosia artemisiifolia* is one of the most common causes of respiratory allergy in North America. Over 20% of people in the United States are sensitized to

ragweed pollen and this percentage is rising (Katz & Care, 2014). The efforts to ‘‘eradicate’’ ragweed from several regions in the United States were unsuccessful (Oswalt & Marshall, 2008).

The expansion of ragweed species into European countries has been well has been documented. In Europe, the countries with the highest concentrations of ragweed are Hungary, Romania, Serbia, Croatia, Slovenia, Slovakia, Ukraine, France (Rhône-Alpes region and Burgundy), Italy (north-western Milan and south Varese) and the south-western part of the European Russia (Juhasz *et al*, 2004; Peternel *et al*, 2006; Reznik, 2009; Šikoparija *et al*, 2009; Thibaudon *et al*, 2010; Skjøth *et al*, 2010; Rodinkova *et al*, 2012; Bonini *et al*, 2012; Ianovici *et al*, 2013). Less extended habitat areas with smaller pollen levels occur in Switzerland (Clot *et al*, 2002), Germany (Zink *et al*, 2012), Czech Republic (Rybníček *et al*, 2000), Poland (Kasprzyk *et al*, 2011), Bulgaria (Yankova *et al*, 2000), Austria (Jäger, 2000), Lithuania (Šaulienė & Veriankaitė, 2012), Spain (Fernandez-Llamazares *et al*, 2012), Sweden (Dahl *et al,* 1999), United Kingdom, Denmark, Belgium (Bullock *et al*, 2010). The human health impacts were estimated to affect around 4 million people with total estimated medical costs of €2,136 million per year for European countries (Bullock *et al*, 2010).

Ragweed is an annual, herbaceous and wind-pollinated plant. This dangerous invasive non-native plant in Europe has a wide ecological tolerance and can colonize a large range of disturbed habitats (Kazinczi *et al*, 2008). They can reach average densities of up to 16 plants per $m^2$ (Simard & Benoit, 2010). Is a prolific producer of pollen and long distance transport is possible and can be a significant source of allergenic pollen at great distances (Makra *et al*, 2011; Šikoparija *et al*, 2013). A single plant can generate an average of 3000 to 6000 seeds (D'Amato *et al*, 2007). Its invasion is also facilitated by it’s the lack of natural enemies (MacKay & Kotanen, 2008) and the high genetic variability of invasive populations (Chun *et al*, 2010). *Ambrosia* has less sensitivity to herbicides than other weeds (Patzoldt *et al*, 2001).

The aim of this paper is to evaluate the situation of allergies induced by *Ambrosia artemisiifolia* from the perspective of allergists practice in Romania.

## MATERIALS AND METHODS

A questionnaire with 20 questions was addressed to the 150 allergists attending the annual National Allergology Conference in 2013. We obtained a number of 50 completed questionnaires, representing a 30% response rate. The gender and age distribution was 78% women and 22% men. Regarding the place of work, 22% of allergists worked in hospitals, 44% in ambulatory and 34% in both hospital and ambulatory. The monthly patient population is equally represented by adults and children for almost half of the allergists.

**RESULTS AND DISCUSSIONS**

The most frequent diseases encountered in allergists practice are allergic rhinitis for all responders, followed by conjunctivitis and urticaria for 98%, athma for 84% and dermatitis for 62% of allergists (Fig.1).

Regarding the importance of respiratory allergies induced by *Ambrosia artemisiifolia* pollen, 94% of respondents considered it important or very important (Fig.2) and 84% considered *Ambrosia* a health problem in Romania (Fig.3).

Regarding the number of patients with hypersensitivity and/or allergy to *Ambrosia* in their current recordings, 64% of responders had more than 20 patients and 36% had less than 10 patients (Fig.4).

The proportion of pollinosis induced by *Ambrosia* was considered to be 20% by 52% of responders, more than 30% by 34% and less than 10% by 24% of allergists (Fig.5).

Referring to the regions of Romania where *Ambrosia* is mostly spread, 62% of allergists considered the West, 30% the South, 24 % the North and 10% the East (Fig.6). The distribution between rural and urban areas was considered equal by 52% and predominantly rural by 36% of responders (Fig.7).

To the question about factors that have influenced the spread of *Ambrosia artemisiifolia* in Romania, 40% of responders considered first the abandoned land and buildings, followed by pollution by 20% and climate change by 24%, while 16% did not know (Fig.8).

The diagnosis of allergies induced by *Ambrosia* pollen is based on skin prick tests for 72% of allergists, on anamnesis for 8% and on serum specific IgE for 5% (Fig.9). The recommended treatment is mainly antihistamines for 60% and immunotherapy for 22% of responders (Fig.13).

The answer to the question regarding prevention of allergies induced by *Ambrosia* revealed that 64% of allergists did not know any measure, while 20% agree some eradication measures and 8% mentioned public information (Fig. 11).

The factors responsible for reducing health impact of *Ambrosia* in Romania are equally considered Health Ministry, allergy clinics and doctors by 32% responders for each (Fig. 12).

Referring to research projects in the field of allergy to *Ambrosi*a, 96% of allergists considered them useful and important (Fig.13) and 62% expressed their interest to be involved in such projects (Fig.14).

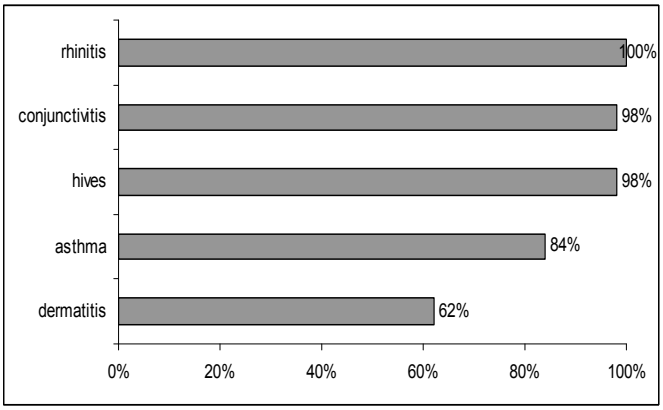


**FIG. 1** Recorded answers to the question "How many patients with allergic diseases do you see monthly ?"

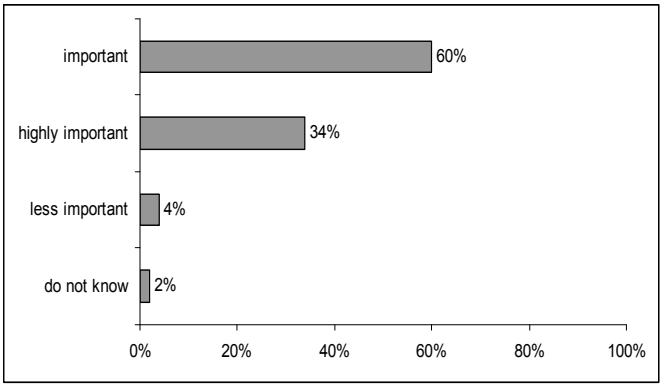


**FIG.2** Recorded answers to the question „How do you consider the importance of allergies induced by *Ambrosia artemisiifolia* pollen in Romania?"

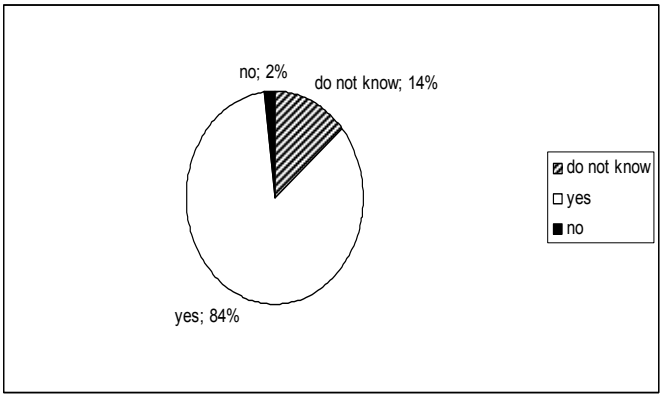


**FIG. 3** Recorded answers to the question "Do you believe that *Ambrosia artemisiifolia* represents a real danger for human health in Romania?"

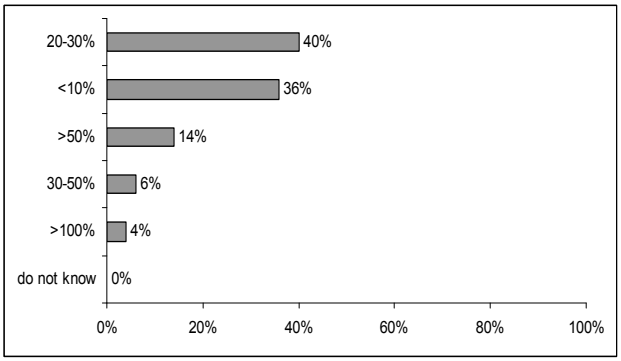


**FIG. 4** Recorded answers to the question "How many patients with hypersensitivity or clinical allergy to *Ambrosia* do you have in medical recordings?"

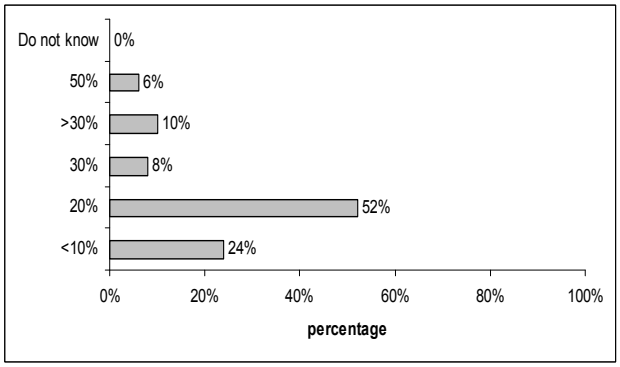


**FIG. 5** Recorded answers to the question **"**What percentage of the patients with pollinosis do you attribute to *Ambrosia* pollen in Romania?"

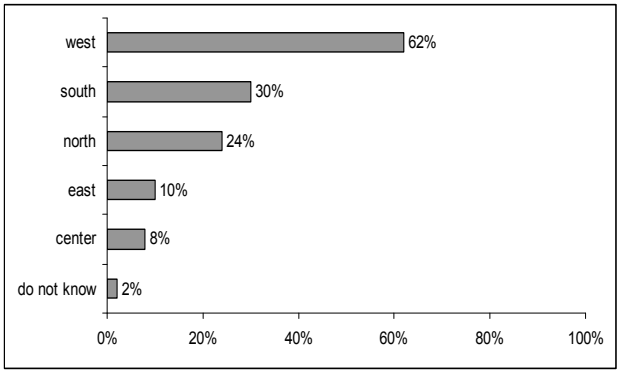


**FIG. 6** Recorded answers to the question **"**In what regions of Romania do you think that *Ambrosia* pollen is more prevalent?"

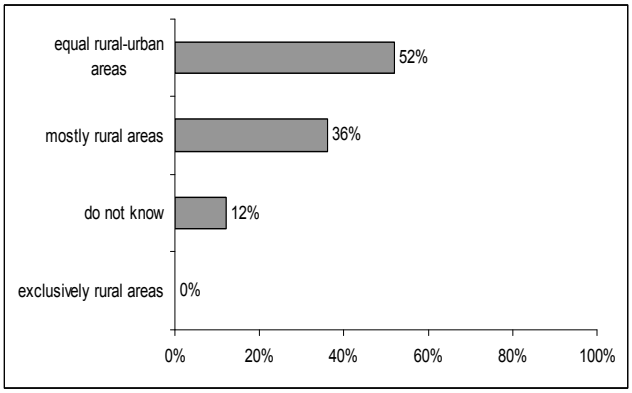


**FIG. 7** Recorded answers to the question "How do you appreciate the spread of *Ambrosia* in rural versus urban environment in Romania?"

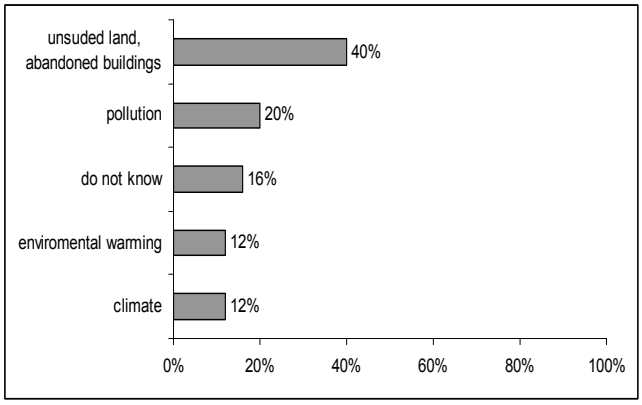


**FIG. 8** Recorded answers to the question "What factors do you consider that may influence the spread *Ambrosia* in Romania?"

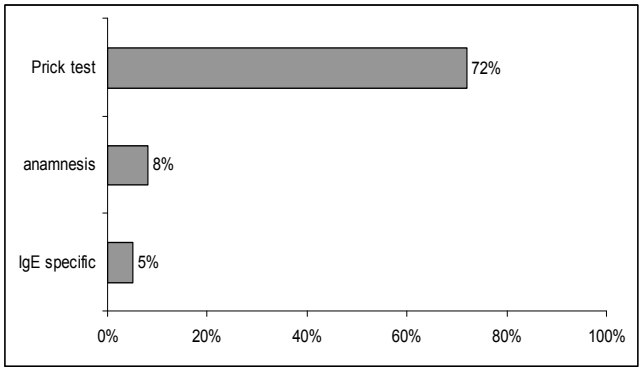


**FIG. 9** Recorded answers to the question "What diagnostic tools do you currently use to confirm hypersensitivity / allergy induced by *Ambrosia* in your practice?"

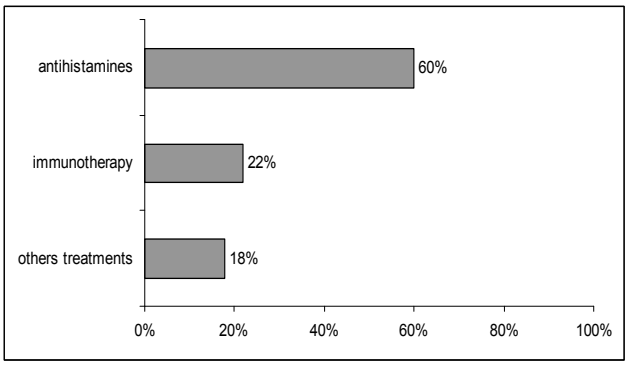


**FIG. 10** Recorded answers to the question "How you treat patients with allergies induced by *Ambrosia* in your current clinical practice?"

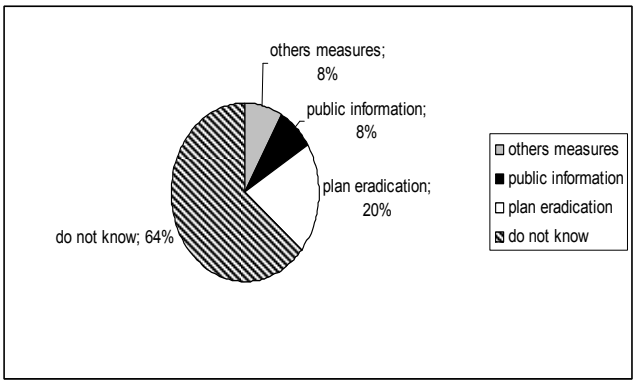


**FIG.11** Recorded answers to the question "What measures should be taken to prevent allergies caused by *Ambrosia?"*

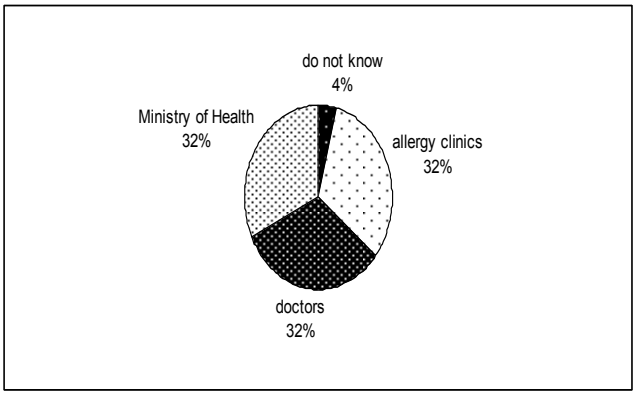


**FIG. 12** Recorded answers to the question **"**What are the main responsible factors for reducing the *Ambrosia* impact on human health (listed in descending order of responsibility)?"

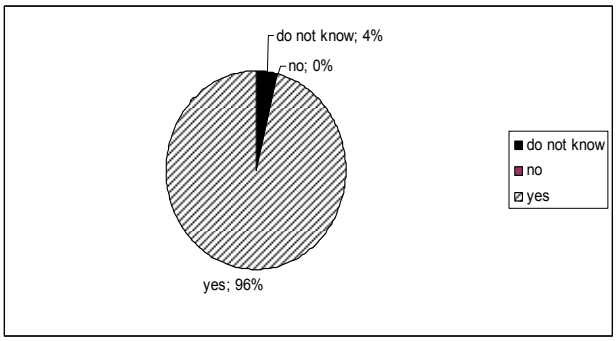


**FIG. 13** Recorded answers to the question **"**Do you consider relevant for your practice to develop national and/or international research projects refering to *Ambrosia* impact and management?"

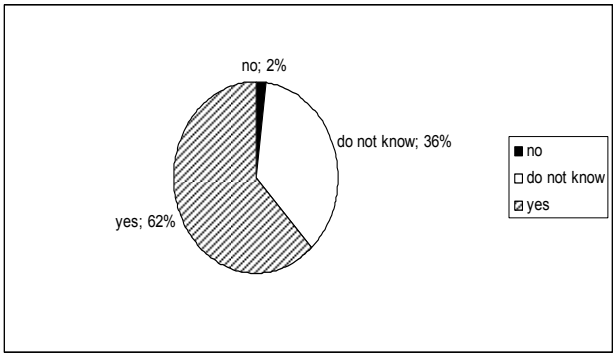


**FIG. 14** Recorded answers to the question **„**Are you interested to be involved in any research project about the impact assessment of *Ambrosia* pollen on human health?"

The answers highlight some gaps in knowledge about this aeroallergen, in the evaluation of the role of the allergens in sensibilisation, in the orientation of specific prophylaxis measures, in the directing of immediate and long term therapeutic plans, including specific immunotherapy with allergens vaccine.

Romania is considered a ragweed infested country, based on field observations performed in different regions and some clinical reports from allergists in the West, North-West and South parts (Ianovici *et al*, 2009; Bocsan *et al*, 2010; Popescu & Tudose, 2011; Bocsan *et al*, 2012; Ianovici *et al*, 2013; Panaitescu *et al*, 2014; Florincescu-Gheorghe *et al*, 2014). Till now it has indicated from all Romanian provinces. The spreading of the *Ambrosia artemisiifolia* has been studied by a high number of romanian biologists and many articles have been written on this topic (Sîrbu, 2008; Ianovici, 2009; Ianovici, 2011; Andrei & Ianovici, 2011). Ragweed is common along roadsides, railway embankments, cultivated fields, vacant lots, construction sites and pastures. The infestations on waste land or roadsides are rarely controlled. The pollination season in Romania begins in July and ends in October, with

maximum in August and September. Increasing concentrations of pollen in the atmosphere has been reported since 2000 (Faur *et al*, 2001; Faur & Ianovici, 2001; Juhasz *et al*, 2001; Ianovici & Faur, 2001). The annual pollen counts show an increasing tendency, indicating an increased local population (Ianovici & Sirbu, 2007; Ianovici, 2014).

*Ambrosia artemisiifolia* is an invasive weed with pollen representing one of the most potent seasonal aeroallergenes. There are 22 known allergens, with 6 considered major (Laaidi *et al*, 2003; Gadermaier *et al*, 2008). *Ambrosia* and *Artemisia* plants are flowering nearly at the same time of the year. *Ambrosia* pollen cross react with almost all other Asteraceae, especially with *Artemisia* pollen (Faur *et al*, 2001; Asero *et al,* 2014). Throughout the pollen season, winds can carry pollen for many miles and produce high concentrations in urban areas, far from their rural and suburban sources. In another train of thoughts, the literature contains data that there are racial inequities in the allergenic impact of this taxa (Wegienka *et al*, 2012). Research is needed to determine which is the real prevalence of this allergy in the population of our country. It is also necessary to determine which are the protein fractions responsible for producing pollen allergy symptoms (Kanter *et al*, 2013). It requires the intensified public information through media channels. It is necessary to create a system to monitor pollen concentrations in the atmosphere since the only station belonging West University of Timisoara is not enough. The use of temporary stations has indicated high allergenic load for other areas of the country (Ianovici *et al*, 2013b).

*Ambrosia* pollen is the aetiological agent in about half of cases of pollinosis in late summer-autumn. The sensitization rate for ragweed in Timisoara was 34% in 2009 (Ianovici *et al*, 2013a). The number of sensitized individuals might significantly increase in the near future. Prevention of ragweed allergy depends on informing and educating the public through reports and updates. Anthropogenic influence in the last 25 years has allowed excessive spread of this species in our country. But it is possible that the influence of topography (latitude) and the climatic factors to be equally important. *Ambrosia* plants are very widespread in Romania where having encountered ideal conditions for their expansion (Ianovici, 2011; Ianovici & Sîrbu, 2013; Ianovici, 2015).

At present, *Ambrosia* pollen constitutes a serious allergological threat in Romania. Limiting the expansion is made possible by plucking and repeated mechanical cutting on public and private lands. Realizing the danger, must be the urgent need for legislative action and to introduce anti-*Ambrosia* campaigns under the control of the national and local authorities.

## CONCLUSIONS

Our study showed that most of the allergists are aware of the importance of allergies induced by *Ambrosia* pollen and of the danger represented by this invasive

weed. The real prevalence of sensitization and allergy to *Ambrosia* in Romania is not known, the number of specialists and allergy centers is significantly lower than in other European countries and there are no coherent measures to reduce its health impact. Research projects in this field are considered useful and important and increase awareness at national level looks imperative.

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## REFERENCES


- Andrei M., Ianovici N. (2011). Ambrosia – o buruiană oportunistă, periculoasă (I), Sănătatea plantelor, 163: 36.
- Asero R, Bellotto E, Ghiani A, Aina R, Villalta D, Citterio S. (2014). Concomitant sensitization to ragweed and mugwort pollen: who is who in clinical allergy?Ann Allergy Asthma Immunol 113 307-313
- Bocsan IC, Bujor IA, Barbinta C, Deleanu D (2012). Allergic Rhinitis to Ragweed Pollen, World Allergy Organ J. Feb 2012; 5(Suppl 2): S27.
- Bocsan, IC, Bujor I, Barbinta C (2010). Sensitisation to ragweed pollen in north-west region of Romania, Allergy 65 (Suppl. 92): 84.
- Bonini M., Albertini R., Brighetti M.A., Ugolotti M., Travaglini A. (RIMA-Italian Monitoring Network in Aerobiology) (2012). Ragweed pollen spreading in Italy. Second International Ragweed Conference, Lyon (France), March 28-29, 2012. http://www.internationalragweedsociety.org/2ndIRC/2ndIRC2012.html.
- Bullock J.M., Chapman D., Schafer S., Roy D., Girardello M., Haynes T., Beal S., Wheeler B., Dickie I., Phang Z., Tinch R., Čivić K., Delbaere B., Jones Walters L., Hilbert A., Schrauwen A., Prank M., Sofiev M., Niemelä S., Räisänen P., Lees B., Skinner M., Finch S., Brough C. (2010). Assessing and controlling the spread and the effects of common ragweed in Europe. Final report: ENV.B2/ETU/2010/0037, Natural Environment Research Council, UK, 456 p. https://circabc.europa.eu/sd/d/d1ad57e8-327c.../Final_Final_Report.pdf.
- Chun Y.J., Fumanal B., Laitung B., Bretagnolle F. (2010). Gene flow and population admixture as the primary post-invasion processes in common ragweed *(Ambrosia artemisiifolia*) populations in France. New Phytologist, 185, 1100-1107.
- Clot B., Gehrig R., Peeters A., Schneiter D., Tercier P., Thibaudon M. (2002). Ambrosia pollen in Switzerland: Local production or transport? European Annals of Allergy &Clinical Immunology, 34, 126-128.
- D' Amato G, Cecchi L, Bonini S, Nunes C, Annesi-Maesano I, Behrendt H, Liccardi G, Popov T, Van Cauwenberge P (2007). Allergenic pollen and pollen allergy in Europe. Allergy 62: 976-990.
- Dahl A., Strandhede S.O., Wihl J.A. (1999). Ragweed: an allergy risk in Sweden? *Aerobiologia,* 15, 293-297.
- D'Amato G. (2011). Effects of climatic changes and urban air pollution on the rising trends of respiratory allergy and asthma. Multidisciplinary Respiratory Medicine, 6, 28-37.
- Faur A, Ianovici N. (2001). Dinamica polenului de *Ambrosia artemisiifolia,* Conferinţa Naţională de Alergologie şi Imunologie Clinică "*Alergia - o problemă de sănătate publică"*, Târgu- Mureş, p. 8.
- Faur A., Ianovici N., Rotundu M. (2001). Aerobiologic study on some composites allergen pollen in Timisoara. Proceeding of 4rd International Symposium Regional Multidisciplinary Research (Hungary, Romania, Yugoslavia), Section Biological Sciences, Agriculture and Environment – 16-18 November 2000, Timişoara, 172-177.
- Fernández-Llamazares A., Belmonte J., Alarcón M., López-Pacheco M. (2012). Ambrosia L. in Catalonia (NE Spain): expansion and aerobiology of a new bioinvader. Aerobiologia, 28, 435-451.
- Florincescu-Gheorghe NA, Popescu F, Alexandru DO (2014).Treatment Evaluation with Mometasone Furoate,Alone or in Combination with Desloratadine/Montelukast in Moderate Severe Allergic Rhinitis, Acta Medica Marisiensis 60(3):106-108.
- Gadermaier G., Wopfner N., Wallner M., Egger M., Didierlaurent A., Regl G., Aberger F., Lang R., Ferreira F., Hawranek T. (2008). Array-based profiling of ragweed and mugwort pollen allergens, Allergy 63: 1543–1549.
- Grudnicki M., Ianovici N. 2014. *Noţiuni teoretice şi practice de Fiziologie vegetală*, Ed. Mirton, 289 p.

- Haahtela T., Holgate S., Pawankar R., Akdis C.A., Benjaponpitak S., Caraballo L., Demain J., Portnoy J., von Hertzen L. and WAO Special Committee on Climate Change and Biodiversity. (2013). The biodiversity hypothesis and allergic disease: world allergy organization position statement, World Allergy Organization Journal 6:3
- Ianovici N, Maria C, Răduțoiu MN, Haniş A, Tudorică D (2013). Variation in airborne fungal spore concentrations in four different microclimate regions in Romania, Not Bot Horti Agrobo, 41(2):450-457
- Ianovici N, Sîrbu C. (2007). Analysis of airborne ragweed (*Ambrosia artemisiifolia* L.) pollen in Timişoara, 2004, Analele Universităţii din Oradea, Fascicula Biologie, XIV: 101-108.
- Ianovici N. (2007). The principal airborne and allergenic pollen species in Timişoara, Annals of West University of Timişoara, ser. Biology, 10: 11-26.
- Ianovici N. (2009). Approaches on the invasive alien taxa in Romania - *Ambrosia artemisiifolia* (ragweed) I, Annals of West University of Timişoara, ser. Biology, 12: 87-104.
- Ianovici N. (2011). Approaches on the invasive alien taxa in Romania - *Ambrosia artemisiifolia* (ragweed) II, Annals of West University of Timişoara, ser. Biology, 14: 93-112.
- Ianovici N. (2014). 15 years of research on invasive and allergenic plant: *Ambrosia artemisiifolia*, International Conference "Practice and Experience in Environmental Protection" - 12th Edition of ECOMEDIU, 15-17 October, Arad.
- Ianovici N., Bunu C., Marusiac L. (2009). *Ambrosia artemisiifolia* in Romania, Journal of Romanian Society of Alergollogy and Clinical Immunology, 6 (4): 146
- Ianovici N., Faur A. (2001). Semnificaţia monitorizării calitative şi cantitative a polenului alergen aeropurtat, Simpozionul "ARMONII NATURALE", Ediţia a V-a, Arad, 80 – 87.
- Ianovici N., Panaitescu Bunu C., Brudiu I. (2013a). Analysis of airborne allergenic pollen spectrum for 2009 in Timişoara, Romania, Aerobiologia, 29 (1): 95-111
- Ianovici N., Birsan M.-V., Tudorică D., Baliţa A. (2013b). Fagales pollen in the atmosphere of Timişoara,Romania (2000-2007), *Annals of West University of Timişoara, ser. Biology*, XVI (2), 115-134
- Ianovici N. (2015). Introducere in biomonitorizare – caiet pentru practica de teren, Ed.Mirton, Timisoara, 93 pp.
- Ianovici N., Sîrbu C. (2013). *Ambrosia* facts-Romania, Report for "Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)", COST Action FA1203, February 2013.
- Jäger S. (2000). Ragweed (*Ambrosia*) sensitisation rates correlate with the amount of inhaled airborne pollen. A 14-year study in Vienna, Austria, Aerobiologia 16: 149–153.
- Juhasz M., Juhasz Imola Eszter, Gallovich E., Radisič P., Ianovici N., Peternel R., Kofol-Seliger A. (2004). Last year`s ragweed pollen concentrations in the southern part of the Carpathian Basin, The 11th Symposium on Analitical and Environmental problems, Szeged, 24 September 2004, 339-343.
- Juhász M., Oravecz A., Radisic P., Ianovici N., Juhász I.E. (2001). Ragweed pollen pollution of Danube-Cris-Mures-Tisza Euroregion (DCMTE). Proceeding of the 8th Symposium on Analytical and Environmental Problems, Szeged (Hungary), 210-215.
- Kanter U, Heller W, Durner J, Winkler JB, Engel M, Behrendt H, Holzinger A, Braun P, Hauser M, Ferreira F, Mayer K, Pfeifer M, Ernst D. (2013). Molecular and Immunological Characterization of Ragweed (*Ambrosia artemisiifolia* L.) Pollen after Exposure of the Plants to Elevated Ozone over a Whole Growing Season, PLOS ONE, 8 (4), e61518
- Kasprzyk I., Myszkowska D., Grewling L., Stach A., Šikoparija B., Skjøth C.A., Smith M. (2011). The occurrence of *Ambrosia* pollen in Rzeszów, Kraków and Poznań, Poland: investigation of trends and possible transport of Ambrosia pollen from Ukraine. International Journal of Biometeorology 55, 633-644.
- Katz D.S.W., Carey T.S. (2014). Heterogeneity in ragweed pollen exposure is determined by plant composition at small spatial scales, Science of the Total Environment 485:435–440.
- Kazinczi G., Béres I., Novák R, Bíró K, Pathy Zs. (2008). Common ragweed (*Ambrosia artemisiifolia*): A review with special regards to the results in Hungary. I. Taxonomy, origin and distribution, morphology, life cycle and reproduction strategy. Herbologia, 9, 55-91.
- Laaidi M, Laaidi K, Besancenot J, Thibaudon M. (2003). Ragweed in France: an invasive plant and its allergenic pollen. Ann Allergy Asthma Immunol 91:195–201.
- Leru PM, 2014, Allergy to *Ambrosia* pollen as public health problem in Romania. International Conference "Practice and Experience in Environmental Protection" - 12th Edition of ECOMEDIU, 15-17 October, Arad.
- MacKay J., Kotanen P.M. (2008). Local escape of an invasive plant, common ragweed (*Ambrosia artemisiifolia* L.), from above-ground and below-ground enemies in its native area. Journal of Ecology, 96, 1152-1161.

- Makra L, Matyasovszky I, Deák J.Á. (2011). Trends in the characteristics of allergenic pollen circulation in Central Europe based on the example of Szeged, Hungary. Atmospheric Environment, 45, 6010-6018.
- Oswalt M.L., Marshall G.D. (2008). Ragweed as an Example of Worldwide Allergen Expansion, Allergy, Asthma, and Clinical Immunology, 4 (3): 130–135.
- Panaitescu C, Ianovici N, Marusciac L, Cernescu LD, Tamas PT, Lazarovicz RA, (2014). Sensitisation to *Ambrosia* pollen and other airborne allergens in the population of the Western region of Romania, ALLERGY, 69: 434.
- Patzoldt W.L., Tranel P.J., Alexander A.L., Schmitzer P.R. (2001). A common ragweed population resistant to cloransulam-methyl. Weed Science, 49, 485-490.
- Peternel R., Čulig J, Hrga I., Hercog P. (2006). Airborne ragweed (*Ambrosia artemisiifolia* L.) pollen concentrations in Croatia, 2002-2004. Aerobiologia, 22, 161-168.
- Popescu F.D., Tudose A.M. (2011). *Ambrosia* pollen sensitization in allergic rhinitis patients from the central part of the Romanian Plain, Romanian Journal of the Rhinology, 1(1): 26-30.
- Reznik S.Y. (2009). Common ragweed *(Ambrosia artemisiifolia L.)* in Russia: spread, distribution, abundance, harmfulness and control measures. http://www.zin.ru/labs/expent/pdfs/Reznik_2009_Ambrosia.pdf
- Rodinkova V., Palamarchuk O., Kremenska L. (2012). The most abundant *Ambrosia* pollen count is associated with the southern, eastern and the northern-eastern Ukraine. Alergologia et Immunologia, 9, 181.
- Rybníček O., Novotná B., Rybníčkova E., Rybníček K. (2000). Ragweed in the Czech Republic. Aerobiologia, 16, 287-290.
- Šaulienė I., Veriankaitė L. (2012). Analysis of high allergenicity airborne pollen dispersion: common ragweed study case in Lithuania. Annals of Agricultural and Environmental Medicine, 19, 415-419.
- Šikoparija B., Smith M., Skjøth C.A., Radišić P., Milkovska S., Šimić S., Brandt J. (2009). The Pannonian plain as a source of *Ambrosia* pollen in the Balkans. International Journal of Biometeorology, 53, 263-272.
- Šikoparija B., Skjøth C.A., Alm Küblerd K., Dahl A., Sommer J., Grewling Ł., Radišić P., Smith M. (2013). A mechanism for long distance transport of *Ambrosia* pollen from the Pannonian Plain. Agriculrural and Forest Meteorology, 180, 112-117.
- Simard M, Benoit D. (2010). Distribution and abundance of an allergenic weed, common ragweed (*Ambrosia artemisiifolia* L.), in rural settings of southern Quebec, Canada. Can J Plant Sci 90(4):549–57.
- Sîrbu C. (2008). Chorological and phytocoenological aspects regarding the invasion of some alien plants, on the Romanian territory. Acta Horti Bot. Bucuresti, 35:60-68.
- Skjøth C.A., Smith M., Šikoparija B., Stach A., Myszkowska D., Kasprzyk I., Radišić P., Stjepanović B, Hrga I, Apatini D, Magyar D˙, Páldy A, Ianovici N. (2010). A method for producing airborne pollen source inventories: An example of *Ambrosia* (ragweed) on the Pannonian Plain, Agricultural and Forest Meteorology, 150: 1203-1210
- Thibaudon M., Hamberger C., Guilloux L., Massot R. (2010). Ragweed pollen in France: origin, diffusion, exposure, Eur Ann Allergy Clin Immunol, 43 (6): 209-215.
- Wegienka G, Joseph CLM, Havstad S, Zoratti E, Ownby D, Johnson CC. (2012). Sensitization and allergic histories differ between black and white pregnant women. J Allergy Clin Immunol 130(3):657–62.
- Yankova R., Zlatev V., Baltadjieva D., Mustakov T., Mustakov B. (2000). Quantitative dynamic of Ambrosia pollen grains in Bulgaria. Aerobiologia, 16, 299-301.
- Zink K, Vogel H, Vogel B, Magyar D, Kottmeier C. (2012). Modeling the dispersion of *Ambrosia artemisiifolia* L. pollen with the model system COSMO-ART. Int J Biometeorol 56(4): 669–680.