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**RAGWEED AND MUGWORT POLLEN (ASTERACEAE FAMILY) -  
MONITORING AND COMPARATIVE ANALYSIS OF SEASONAL  
DYNAMICS DURING 2011-2017**

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**ABSTRACT**

In addition to appearing in crops, weeds may pose a risk to human health, indirectly due to the widespread use of herbicides and directly, because they are source of pollen that in susceptible people can cause allergic reactions. Among the weed species, the main allergens are the species of the botanical family: Asteraceae, Amaranthaceae, Urticaceae, Euphorbiaceae and Plantaginaceae. Asteraceae family includes 1,100 genera and 20,000 species, which is one of the largest flowering plants. However, in our area as a potential allergen the most important is Ambrosia and Artemisia pollen. Sampling of ragweed and mugwort pollen during the pollination period 2012-2017 was conducted in urban part of Banja Luka in PI AIRS, BL with Hirst sampler using the method defined by the International Association for Aerobiology (IAA). The first mugwort pollen grains in 2011 were recorded at the end of May, during 2012 and 2016 in the first decade of June, and from 2013 to 2015, as well in 2017 in the second decade of June. Mugwort pollination period lasted for an average of 55 days and it was characterized by low (1-10 p/m<sup>3</sup>) to moderate (11-50 p/m<sup>3</sup>) concentrations. The ragweed period pollination during the seven-year monitoring lasted, on average, about 115 days. High concentrations (51-500 p/m<sup>3</sup>) were recorded between the second decade of August to the third decade of September, while very high concentrations (>501 p/m<sup>3</sup>) were recorded only in 2011. On an annual basis not only the season of ragweed pollination lasted longer, but the results of the monitoring and comparative analysis showed significantly higher % share of ragweed pollen within the weed species in the family Asteraceae in the city of Banja Luka.

**Keywords:** *pollen, ragweed, mugwort, seasonal dynamics, Banja Luka.*

**INTRODUCTION**

In addition to appearing in crops, weeds may pose a risk to human health, indirectly due to the widespread use of herbicides and directly, because source of pollen that in susceptible people can cause allergic reactions. Among the weed

species, the main allergens are the species of the botanical family: Asteraceae, Amaranthaceae, Urticaceae, Euphorbiaceae and Plantaginaceae. Asteraceae family includes 1,100 genera and 20,000 species, which is one of the largest flowering plants (Gadermaier *et al.*, 2004). However among species belonging to Asteraceae family, in our area as a potential allergen the most important is *Ambrosia* and *Artemisia* pollen. The genus *Ambrosia* belongs to the tribe Heliantheae in the Asteraceae family (= Compositae, daisy family). It consists of about 40 species, 22 of which occur naturally in North America. Today it is common in agricultural ecosystems, in urban-industrial ruderal sites and along roadsides (Lavoie *et al.*, 2007; Otto *et al.*, 2008). They are expanding their range in both their native areas and other parts of the world, including Europe, where the most abundant species in Europe is *Ambrosia artemisiifolia* L. (common ragweed) (EFSA, 2010). In addition, a number of authors Makovcová *et al.* (1998), Dahl *et al.* (1999), Rybníček *et al.* (2000), Laaidi *et al.* (2003), Makra *et al.* (2004), Peternel *et al.* (2005) and Tamaracaz *et al.* (2005) stated Bosnia, among many countries, as one of the most contaminated place in Europe with *Ambrosia artemisiifolia* L., the highly allergenic plant, while Puši *et al.* (2012) also state that ambrosia is very widespread and it is in expansion in the area of Banja Luka. Never the less, Trkulja *et al.* (2012) stated that ragweed presents one of the most invasive weed species in our area. However, one of the largest genera of the family Asteraceae is genus *Artemisia* (McArthur and Plummer, 1978; Valles and McArthur, 2001). Regarding to sensitivity to weed pollen, research in our area, as many in Europe, state ragweed pollen as main one (Wopfner *et al.*, 2005). But, after ragweed pollen, the second most significant weed pollen is mugwort pollen (*Artemisia vulgaris*). Considering that ragweed and mugwort have almost identical flowering season, clinical and serological studies indicate that the sensitivity to these two pollen often are associated (Asero *et al.*, 2006). Considering the above mentioned, the main aim of this study was to analyze the seasonal dynamics of ragweed and mugwort pollen during seven year monitoring (2011-2017).

## MATERIAL AND METHOD

Monitoring the concentration of ragweed and mugwort pollen during the pollination period (2011-2017) was conducted at the PI Agricultural Institute of Republic of Srpska, Banja Luka (N 44°47'41.0'', E 017°12'22.6''), by Hirst's type pollenometer (Hirst, 1952). Sampling of aero allergenic pollen was conducted in urban, industrial part of Banja Luka, using the method defined by the International Association for Aerobiology (IAA). The trap brand Burkard (Burkard Manufacturing Co., Uxbridge, Middlesex, England) is calibrated for sampling 10 liters of air/min through a orifice 14 x 2 mm diameter, which always faces the wind direction and it is protected from direct rainfall. As air passing through the orifice, pollen grains are fixed on glass slides coated with silicone gel, which moves at the rate of 2 mm/h.

Visual identification, or qualitative and quantitative assessment, of sampled ragweed and mugwort pollen grains was carried out on a daily basis after 24 hours, based on

the morphological characteristics under a light microscope Olympus BX51 at magnification x400, according the International Association for Aerobiology and converting the obtained results in the concentration of pollen grains per m<sup>3</sup> of air. Immediately prior to screening, microscopic slide with 24-hour segment, is prepared by placing polyvinyl alcohol substrate (Gelvatol), phenol, and glycerol, which allows color fuchsin staining of pollen grains and easy separation of the same from dust particles and fungus spores. After preparation and drying microscopic slide determining the number of pollen grains is carried out by the method of longitudinal lines in two-hour intervals and reviewing the 3 horizontal lines. At the end of the analysis, the obtained values are converted to daily concentrations determined by multiplying the number of pollen grains by a factor F, depending on the characteristics of the device for sampling, surface of 24 hour segment, characteristics of the microscope and the surface of the inspected sub-sample. Concentration of the pollen grains per m<sup>3</sup> of air is important for symptoms occurrence of allergic reactions. Thus the monitoring results are presented to the public in the form of daily aero pallinological reports or so called "Pollen traffic light" on the official web site of City of Banja Luka (Table 1).

Tab. 1. Number of weed pollen grains in the air with the corresponding percentage of persons in whom is possible occurrence of symptoms of allergic reactions (Forsyth County Environmental Affairs Department Pollen Rating Scale, PRS)

Level of pollen	<i>Number of pollen grains /m<sup>3</sup> air</i>	<i>Occurrence of symptoms of allergic reactions</i>
	<b>Weeds</b>	
Not present	0	No symptoms
Low	1-10	Only in extremely sensitive individuals
Moderate	11-50	In 50% of sensitive individuals
High	51-500	Almost all allergic people
Very high	>500	In all allergic people

## RESULTS AND DISCUSSION

During the seven-year sampling (2011-2017) of aeroallergen ragweed and mugwort pollen in the city of Banja Luka dynamics, i.e. the beginning, duration and end of the pollination period with presenting daily low, moderate, high or very high concentrations (p/m<sup>3</sup>) as well as a total weed pollen number on annual level (p/m<sup>3</sup>) was monitored. Annual total concentrations of mugwort pollen grains was 664 p/m<sup>3</sup> in 2011, 664 p/m<sup>3</sup> in 2012, 246 p/m<sup>3</sup> in 2013 and 2014, 273 p/m<sup>3</sup> in 2015,

302 p/m<sup>3</sup> in 2016 and 187 p/m<sup>3</sup> in 2017 (Figure 1). Annual total concentrations of *Ambrosia* pollen grains was 9587 p/m<sup>3</sup> in 2011, 8993 p/m<sup>3</sup> in 2012, 5004 p/m<sup>3</sup> in 2013, 4970 p/m<sup>3</sup> in 2014, 5478 p/m<sup>3</sup> in 2015, 5256 p/m<sup>3</sup> in 2016 and 6166 p/m<sup>3</sup> in 2017 (Figure 2). In addition, high concentrations in six years of monitoring (2012-2017) were recorded from third decade of August to the second decade of September; while in the same period very high concentrations (>501 p/m<sup>3</sup>) were recorded only during 2011.

The first mugwort pollen grains in 2011 are recorded at the end of May, during 2012 and 2016 in the first decade of June, and from 2013 to 2015, as well in 2017 in the second decade of June. Mugwort pollination period lasted for an average of 55 days and it was characterized by low (1-10 p/m<sup>3</sup>) to moderate (11-50 p/m<sup>3</sup>) concentrations. The high concentrations are recorded only in 2011 and 2012, and lasted for two days with peak of 84 p/m<sup>3</sup> in second decade of August. The maximum, i.e. moderate and high concentrations are recorded from first until the third decade of August.

The first ragweed pollen grains in 2011 are recorded in the second decade of July, during 2012 in the third decade of July, in 2013, 2014, 2016 and 2017 at the end of June and during 2015 at the beginning of July. Low to moderate concentration are registered until the second decade of August to the third decade of September. During that period high concentrations (51-500 p/m<sup>3</sup>) were recorded, while very high concentrations (>501 p/m<sup>3</sup>) were recorded only in 2011. The ragweed period pollination during the seven-year monitoring lasted, on average, about 115 days (Figure 3-9).

On an annual basis not only the season of ragweed pollination lasted longer, but the results of the monitoring and comparative analysis showed significantly higher % share of ragweed pollen within the weed species in the family Asteraceae in the city of Banja Luka.

Thus, according to a annual comparative analysis of recorded ragweed and mugwort pollen in the city of Banja Luka the participation of ragweed pollen was 94% in 2011, 93% in 2012 and 95% in 2013, 2014, 2015, 2016 and 97% in 2017.

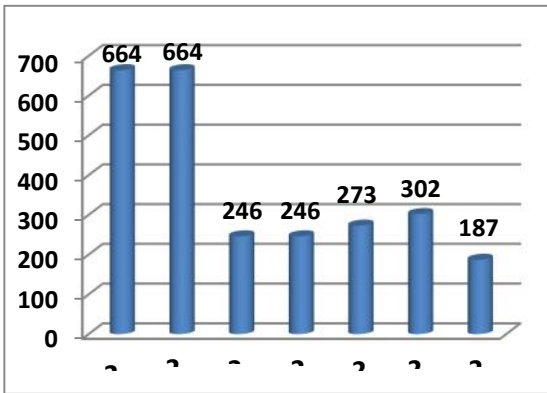


Figure 1. Annual total concentrations of mugwort pollen grains in Banja Luka, 2011-2017

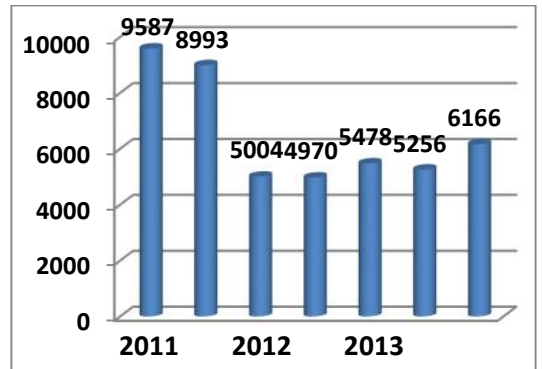


Figure 2. Annual total concentrations of ragweed pollen grains in Banja Luka, 2011-2017.

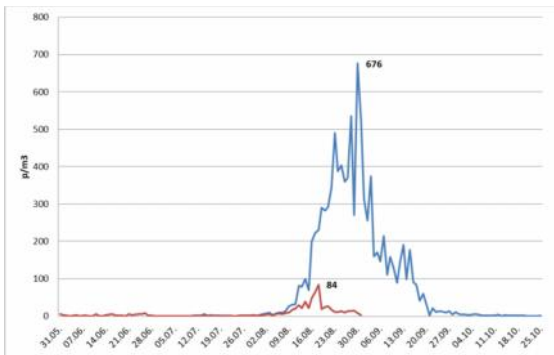


Figure 3. Seasonal dynamics of mugwort and ragweed pollen in 2011

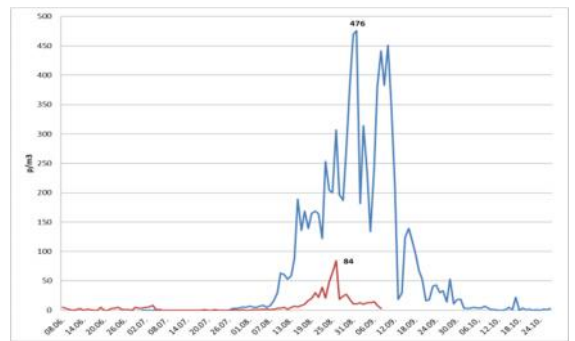


Figure 4. Seasonal dynamics of mugwort and ragweed pollen in 2012

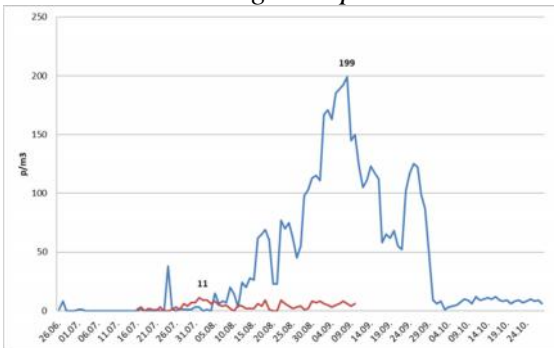


Figure 5. Seasonal dynamics of mugwort and ragweed pollen in 2013

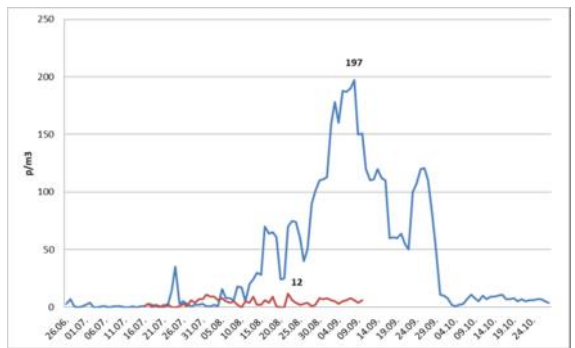


Figure 6. Seasonal dynamics of mugwort and ragweed pollen in 2014

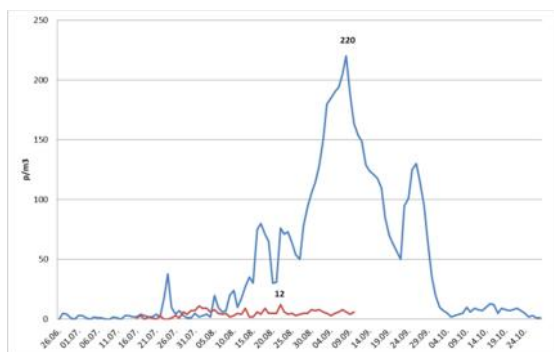


Figure 7. Seasonal dynamics of mugwort and ragweed pollen in 2015

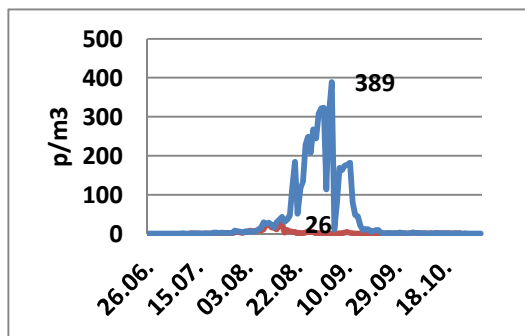


Figure 8. Seasonal dynamics of mugwort and ragweed pollen in 2016

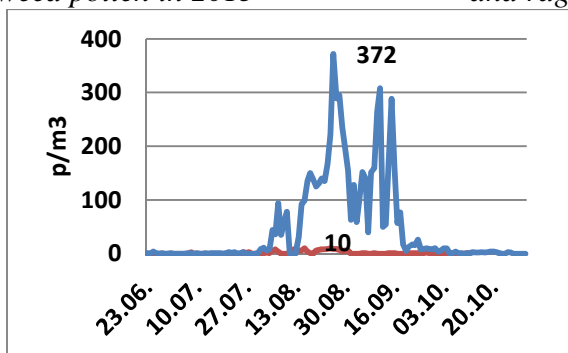


Figure 9. Seasonal dynamics of mugwort and ragweed pollen in 2017

### CONCLUSION

On an annual basis the season of ragweed pollination lasted longer than mugwort pollination. Also significantly higher % share of ragweed pollen within the weed species in the family Asteraceae (>90%) is registered in the city of Banja Luka during seven year monitoring. Nevertheless, previous results of the population analysis (late adolescence patients) by skin *prick* test to pollen from Clinical Center Banja Luka conducted in the ten-year period (2001-2010) shown that from the individual weed pollen in the total sample and by groups of respondents *prick* test is mainly positive to ragweed, but on the second place among weed pollen is mugwort pollen rated (Balaban *et al.* Balaban, 2012). According to Asero (2011) in the '80s of the last century, before the sudden appearance of ragweed, mugwort sensitization was rarely observed; subsequently, the prevalence of mugwort sensitivity increased dramatically in parallel with the spread of ragweed. Thus, as well that ragweed is wide spread in our area, previous results from Clinical Center Banja Luka and conducted monitoring pointed out on *Ambrosia* and *Artemisia* pollen as a growing health and social problem in our country.

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