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## DYNAMICS OF RAGWEED POLLEN CONCENTRATION IN THE AIR OF IVANO-FRANKIVSK

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**Abstract.** The article updates the conduct of aeropalynological monitoring in Ukraine because today, there are only a few studies in the country that cannot be automatically extrapolated to other regions, as the diversity of climatic zones affects the duration of pollination and pollen grains in the air. Furthermore, this type of research is needed due to the increasing number of people suffering from pollen allergies (hay fever).

The research was conducted in the city of Ivano-Frankivsk (western Ukraine) from early February to mid-October 2019, using a gravimetric Durham pollen collector installed on the roof of the Faculty of Natural Sciences of Vasyl Stefanyk Precarpathian National University (24 m from the ground). The pollen grains were counted using an Olympus CX-300 light microscope (magnification  $\times 400$ ). The main goal was to study the aeropalynological spectrum of the city and the dynamics of concentrations of ragweed pollen grains (the most important plant allergen).

The study determined the aeropalynological spectrum of Ivano-Frankivsk and provided data on pollination of the following taxa: *Betula*, *Quercus*, *Acer*, *Fraxinus*, *Pinus*, *Juglans*, *Carpinus*, *Alnus*, *Populus*, *Urticaceae*, *Poaceae*, *Artemisia*, and *Ambrosia*; conducted a comparative characterization with the spectra of the cities of Vinnytsia (central Ukraine) and Zaporizhia (southern Ukraine); determined the beginning and end of pollination of ragweed and the peak of its flowering, as well as conducted a comparative description with last year's data.

Seeing an alarming trend, there is a need to continue to conduct aeropalynological monitoring to create calendars of sawing and alleviate the course of allergies in people prone to it.

**Keywords:** aeropalynological monitoring, Durham pollen collector, aerospectrum, *Ambrosia artemisiifolia* L.

### 1. INTRODUCTION

Pollen is one of the main components of biological pollution in atmospheric air. Due to the presence of allergen proteins, pollen is a factor in the emergence and exacerbation of diseases - hay fever. Therefore, the quantitative dynamics of allergenic pollen are the local basis for assessing and forecasting the air allergen situation. To establish the palynological spectrum's regional features, allergen plant aeromonitoring studies should have a territorially permanent character [5-6].

Quarantine weeds cause significant damage to agrophytocenoses and also human health. One of the most dangerous quarantine plants is *Ambrosia artemisiifolia* L. - in addition to harmful effects on the rural economy, ragweed during flowering also causes human allergic disease (ragweed hay fever). For the first time in the Ivano-Frankivsk region, ragweed was found on a small plot in one of the villages in 2007, in Ivano-Frankivsk - in 2009. Now the plant has spread to five districts of the region and the city of Ivano-Frankivsk. It grows up in gardens, along roads, in fields, etc. Therefore, systematic observations of qualitative and quantitative dynamics of allergenic ragweed pollen atmospheric air is an urgent task [6, 9, 13].

Today, Europe has a well-functioning network of aeropalynological monitoring. Old ones are being improved, and developed new approaches to the problem of determining the pollen spectrum of allergenic plants, methods of harvesting and processing of pollen grains, research of their allergens properties, compiled color electronic atlases, sawing calendars, and seasonal pollen distribution maps of different taxa, etc. [2]

In Ukraine, unlike other European countries, including Poland, aeropalynological studies have not gained popularity and have fragmentary nature [2]. The systematic pollen monitoring using the volumetric method is conducted in three cities: Vinnytsia [11-12], Zaporizhzhia [7-9], and Kyiv [4] (Fig. 1). The cities of Vinnytsia and Zaporizhzhia are part of the European Airborne Allergy Network (EAN). In the city of Lviv [1, 13] (from the beginning of the 2000s) and the city of Ivano-Frankivsk [5-6] (2013-2015), aeropalynological studies were performed by the gravimetric method using the self-designed Durham pollen collector.

Our work aimed to restore aeropalynological monitoring in the city and investigate the aeropalynological spectrum and dynamics of allergenic pollen ragweed in the city's air in 2019.



Fig. 1 Pollen monitoring sites in Ukraine (orange color - research is conducted by gravimetric method, blue - volumetric)

Object of research - pollen of allergenic plants.

Subject – dynamics concentrations of allergenic pollen in the air of the urban ecosystem Ivano-Frankivsk.

## 2. MATERIALS AND METHODS OF RESEARCH

The study was conducted in 2019 in the city of Ivano-Frankivsk (geographical coordinates -  $48^{\circ} 55'$  northern latitude and  $24^{\circ} 42'$  eastern longitude, height above sea level - 260 m). The city is located on the Pokut plain of southwestern Ukraine between the rivers Bystritsa Nadvirnyanska and Bystritsa Solotvynska. The climate of the city Ivano-Frankivsk is temperate-continent. The average temperature in July is  $17 - 19^{\circ} \text{C}$ , in January is  $-5 - 0^{\circ} \text{C}$ , average humidity is 68–70%, and average annual rainfall is

600–700 mm. With landscape position of the city is considered an urbanized territorial complex. This is a part of the natural landscape that has been greatly transformed by buildings, communications, and other material elements of civilization. The most significant air pollutant in the urban ecosystem of Ivano-Frankivsk is road transport, which accounts for 83% [3].

The Durham pollen collector was installed at 24 m from the surface land (Fig. 2). Glycerin-lubricated slides were replaced daily from early February to mid-October. Pollen grains were calculated using the Olympus CX-300 light microscope (400x magnification) using continuous vertical transects. Data on the number of pollen grains per 1 cm of the slide were transformed into pollen grains in 1 m<sup>3</sup> of air (p.g./ m<sup>3</sup>) [10, 14].



Fig. 1.1 - Wireless weather station  
2 - Durham pollen catcher



Fig. 2. Durham pollen collector

### 3. MAIN PART OF THE WORK

As a result of research, it was found that the composition of the aeropalynological spectrum of the city is dominated by pollen of 23 taxa (16 trees, 7 herbal). In 2019 the aeropalynological spectrum was quantitatively dominated by pollen grains of *Carpinus* (17%), *Poaceae* (12.8%), *Betula* (12.2%), and *Pinus* (10.2%). The following taxa in pollen content were *Ambrosia* (8.9%), *Quercus* (6.3%), and *Piceae* (5.6%). The share of other pollen producers was less than 5% (Fig. 3).

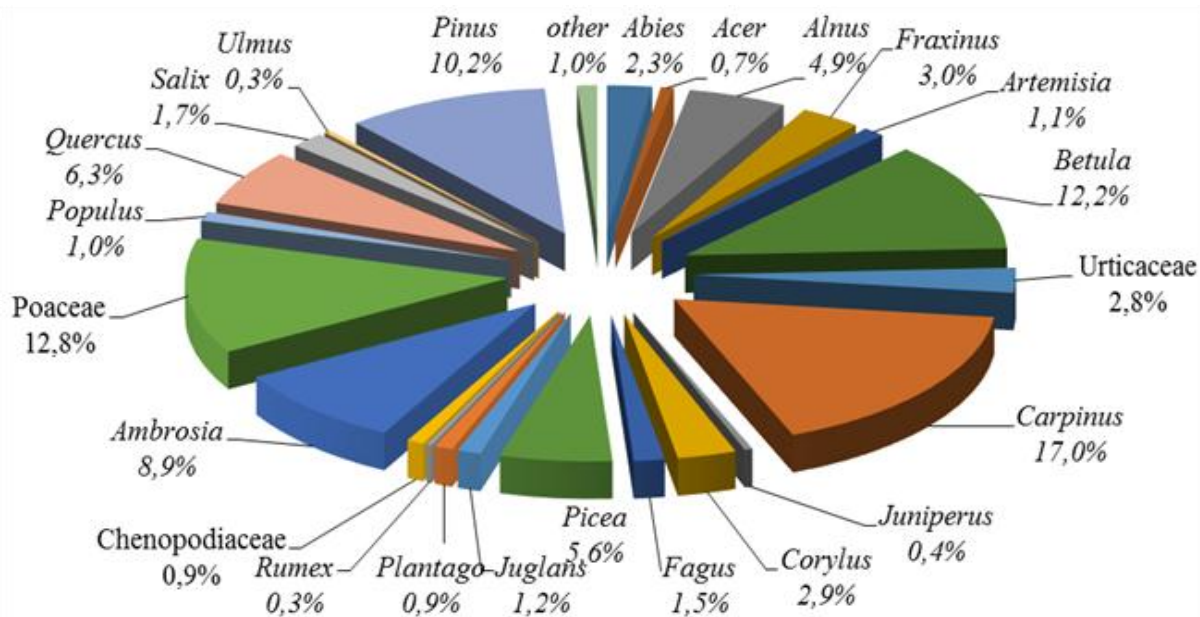


Fig. 3. Ivano-Frankivsk aeropalynological spectrum in 2019

The obtained research results are consistent with the results of airborne monitoring in Vinnytsia (Central Ukraine). The results of pollen studies of the aeropalynological spectrum of Vinnytsia, as well as Ivano-Frankivsk, are formed by plants of the genera *Betula*, *Quercus*, *Acer*, *Fraxinus*, *Ulmus*, *Pinus*, *Juglans*, *Carpinus*, *Alnus*, *Populus*, *Urticaceae*, *Poaceae*, *Artemisia*, and *Ambrosia* [7-8].

Unlike the Ivano-Frankivsk, in the south of Ukraine (Zaporizhzhia), the main component of the annual aeropalynological spectrum is grass pollen dominated by allergenic ragweed pollen. Results of the research conducted by O. B. Prikhodko and co-authors in Zaporizhzhia indicate dominance in the aeropalynological spectrum of the city with a share of 45% of extremely dangerous allergenic pollen of genus *Ambrosia* [7-9].

Pollen of the genus *Ambrosia* (Fig. 4) in the air of Ivano-Frankivsk for the first time in 2019 was recorded on 19.07. By the end of the first decade of August, single pollen grains of ragweed were recorded in the air. The increase in concentration has been noticed since the second decade of August. High concentrations of allergenic pollen were observed in the city's air from 25.08 to 06.09 ( $>50$  p.g./m<sup>3</sup>). The peak of pollination was recorded on 03.09 (873 p.g./m<sup>3</sup>). With the second decade of September, the concentration of pollen in the city air gradually decreased, one-day growth was recorded on 17.09 (123 p.g./m<sup>3</sup>). From the third decade of September and early October, single pollen grains of ragweed were recorded in the air (Fig. 5).

According to aeropalynological studies, the concentration of ragweed pollen in Ivano-Frankivsk in previous years was much lower (the recorded maximum ragweed pollen in 2015 was 52 p.g./m<sup>3</sup>) [6], which indicates the expansion of these extremely dangerous quarantine species and the need of monitoring its spread.



Fig. 4. Pollen grains of genus *Ambrosia* plants, September 2, 2019, Ivano-Frankivsk, 400x

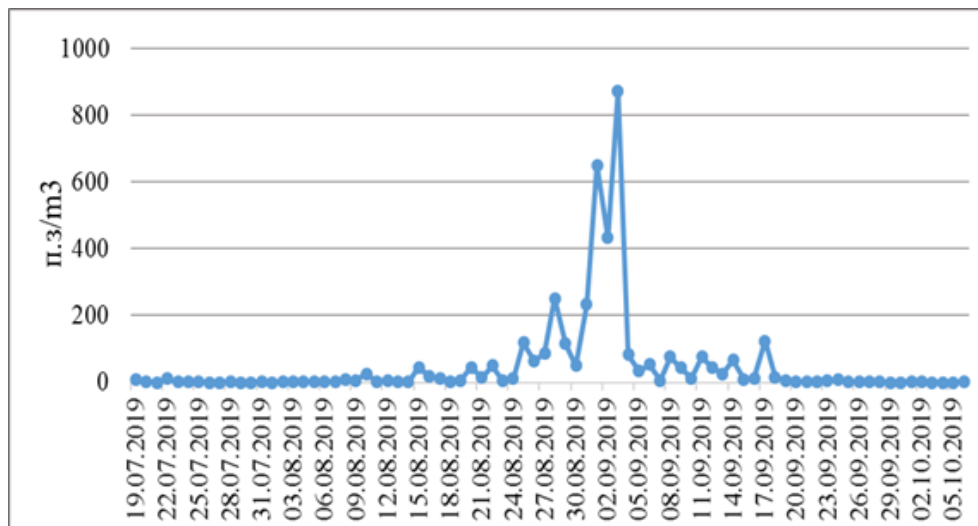


Fig. 5. Dynamics of ragweed pollen concentration in the air of Ivano-Frankivsk in 2019

#### 4. CONCLUSIONS

Pollination of allergenic plants lasts from the second decade of February until the beginning of October. Among herbs, the highest concentrations were recorded for representatives of families *Poaceae* and *Ambrosia*. High concentrations of allergenic ragweed pollen ( $>50$  p.g./m<sup>3</sup>) took place from 25.08 to 06.09. *Ambrosia* pollen is characterized by high allergenic potential and poses a threat of hay fever in vulnerable people in late August and the first decade of September. Therefore, it is necessary to monitor the allergenic situation in the city and carry out aeropalynological forecasting, considering meteorological factors and patterns of pollination of allergenic plants.

The creation of a national network is highly relevant for Ukraine's aeropalynological monitoring with the subsequent entry of surveillance sites to the European Airborne Allergy Network (EAN), which will significantly supplement and increase the informativeness of the latter, and will create favorable conditions for further development of this scientific field in Ukraine.

Prospects for further research:

1. study of the dynamics of the concentration of allergenic pollen by volumetric Burkard pollen collector;
2. informing the population about the aeropalynological situation through a specially created website;
3. cooperation with the European Airborne Allergy Network;
4. study of the dynamics of the concentration of other aerobiopollutants in the atmospheric air of the city (fungal spores, etc.);
5. study of the spatial structure, population distribution, and dynamics of habitats of quarantine plants (in particular, *Ambrosia artemisiifolia*) and their impact on the formation of the aeropalynological situation in the region.

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Мельниченко Галина, Грушка Вікторія, Іванова Ольга. Динаміка концентрації пилку амброзії в атмосферному повітрі міста Івано-Франківська. *Журнал Прикарпатського університету імені Василя Стефаника*, **8** (4) (2021), 45–51.

Стаття актуалізує проведення аеропалінологічного моніторингу в Україні, оскільки на сьогоднішній день в країні проводяться тільки поодинокі дослідження, які неможливо автоматично екстраполювати на інші регіони, адже різноманіття кліматичних зон впливає на термін палінації та кількість пилових зерен в повітрі. Необхідність проведення такого роду досліджень пов'язана із збільшення кількості людей, які страждають від алергії на пилок (поліноз).

Дослідження проводили в місті Івано-Франківську (захід України) з початку лютого до середини жовтня 2019 року, за допомогою гравіметричного пиловловлювача Дюрама, встановленого на даху факультету природничих наук Прикарпатського національного університету імені Василя Стефаника (24 м від поверхні землі). Підрахунок пилових зерен проводили за допомогою світлового мікроскопа Olympus CX-300 (збільшення  $\times 400$ ). Основною метою було дослідити аеропалінологічний спектр міста та динаміку концентрацій пилових зерен представників роду *Ambrosia*.

Впродовж дослідження визначили аеропалінологічний спектр міста Івано-Франківська; провели порівняльну характеристику із спектрами міст Вінниця (центральна Україна) та Запоріжжя (південь України); визначили початок та кінець палінації амброзії полинолистої та пік її пилення, а також провели порівняльну характеристику з минулорічними даними.

**Ключові слова:** аеропалінологічний моніторинг, пилокловлювач Дюрама, аеропалінологічний спектр, *Ambrosia artemisiifolia* L.