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SEASONAL DYNAMICS OF AMARANTHACEAE (*AMARANTHUS* AND *CHENOPODIUM*) POLLEN IN THE ATMOSPHERE OF ANDIJAN AND ITS RELATIONSHIP WITH METEOROLOGICAL FACTORS

Annotation

The seasonal dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen in the atmospheric air of Andijan were investigated during the spring, summer, and autumn seasons of 2025. Aerobiological monitoring was carried out using the volumetric method. The total pollen concentration reached 71.315 grains/m³, with the highest values recorded in August–September. Spearman correlation analysis revealed a statistically significant negative relationship ($p < 0.05$) between pollen concentration and relative humidity as well as precipitation, whereas no significant relationship was found with temperature and wind speed. The obtained results indicate that humidity and precipitation act as limiting factors in the dispersion of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen.

Key words: *Chenopodium* L., *Amaranthus* L., pollen, seasonal dynamics, aerobiology, atmospheric air, meteorological factors, Spearman correlation, Andijan.

СЕЗОННАЯ ДИНАМИКА ПЫЛЬЦЫ AMARANTHACEAE (*AMARANTHUS* И *CHENOPODIUM*) В АТМОСФЕРЕ АНДИЖАНА И ЕЁ СВЯЗЬ С МЕТЕОРОЛОГИЧЕСКИМИ ФАКТОРАМИ

Аннотация

Сезонная динамика пыльцы Amaranthaceae (*Amaranthus* и *Chenopodium*) в атмосферном воздухе Андижана была изучена в весенний, летний и осенний периоды 2025 года. Аэробиологический мониторинг проводился с использованием волюметрического метода. Общая концентрация пыльцы составила 71,315 зерен/м³, при этом наибольшие значения были зарегистрированы в августе–сентябре. Корреляционный анализ Спирмена выявил статистически значимую отрицательную связь ($p<0{,}05$) между концентрацией пыльцы и относительной влажностью, а также осадками, тогда как значимой связи с температурой и скоростью ветра не обнаружено. Полученные результаты показывают, что влажность и осадки выступают в качестве лимитирующих факторов распространения пыльцы Amaranthaceae (*Amaranthus* и *Chenopodium*).

Ключевые слова: *Chenopodium* L., *Amaranthus* L., пыльца, сезонная динамика, аэробиология, атмосферный воздух, метеорологические факторы, корреляция Спирмена, Андижан.

ANDIJON ATMOSFERASIDAGI AMARANTHACEAE (*AMARANTHUS* VA *CHENOPODIUM*) GULCHANGINING MAVSUMIY DINAMIKASI VA METEOROLOGIK OMILLAR BILAN BOG‘LIQLIGI

Annotatsiya

2025 yil bahor–yoz–kuz mavsumlarida Andijon atmosfera havosida Amaranthaceae (*Amaranthus* va *Chenopodium*) gulchangining mavsumiy dinamikasi o‘rganildi. Aerobiologik monitoring volumetrik usul asosida amalga oshirildi. Umumiy gulchang miqdori 71,315 dona/m³ ni tashkil etdi, eng yuqori konsentratsiya avgust–sentabr oylarida qayd etildi. Spearman korrelyatsiya tahlili gulchang konsentratsiyasi bilan nisbiy namlik va yog‘ingarchilik o‘rtasida statistik ahamiyatli manfiy bog‘liqlikni ($p<0{,}05$) ko‘rsatdi, harorat va shamol tezligi bilan ahamiyatli bog‘liqlik aniqlanmadi. Natijalar mazkur gulchang tarqalishida namlik va yog‘ingarchilik cheklovchi omillar ekanini tasdiqladi.

Kalit so‘zlar: *Chenopodium* L., *Amaranthus* L., gulchang, mavsumiy dinamika, aerobiologiya, atmosfera havosi, meteorologik omillar, Spearman korrelyatsiyasi, Andijon.

Introduction. The Chenopodiaceae/Amaranthaceae families are widely distributed worldwide and form a stenopalynological group characterized by morphologically similar pollen grains [1]. The genus *Chenopodium* L. includes more than 100 species distributed on all continents except Antarctica and belongs to the Amaranthaceae family, subfamily Chenopodioideae [2,3]. Most species are annual herbaceous plants.

Many representatives of these families are known to cause pollinosis [4]. Due to anemophilous pollination, *Chenopodium* pollen is dispersed by wind over long distances and is considered an important aeroallergen associated with allergic rhinitis and bronchial asthma. However, its allergenicity remains controversial, being reported as low, moderate, or high in different studies [5,6].

Pollen grains of *Amaranthus* and *Chenopodium* are morphologically very similar, typically spherical, pantoporate, and characterized by a finely granulate or nearly smooth exine. As noted by Gunnar Erdtman and later by P.D. Moore et al., distinguishing these genera using light microscopy is often difficult [7,8]. Therefore, they are frequently evaluated together as the Amaranthus–Chenopodium pollen type.

Previous studies have shown that Amaranthaceae pollen is an important airborne allergen contributing to seasonal allergic diseases such as allergic rhinitis and asthma [9,10]. Meteorological factors significantly influence pollen dispersion and seasonal dynamics [11,12].

The aim of this study is to determine the seasonal dynamics of *Chenopodium* pollen in the atmospheric air of the Andijan region during spring, summer, and autumn 2025 and to assess the influence of key meteorological factors on pollen concentration.

Materials and methods. The concentration and seasonal dynamics of airborne Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen were investigated during spring, summer, and autumn 2025 in the Andijan region, Uzbekistan, using the volumetric method.

According to modern classification, the genera *Amaranthus* L. and *Chenopodium* L. belong to the family Amaranthaceae (order Caryophyllales). The species *Amaranthus retroflexus*, *A. blitum*, *A. tricolor*, *Chenopodium album*, and *C. vulvaria* were identified in the study area.

Airborne pollen was collected using a Lanzoni VPPS 2010 volumetric trap installed at a height of 20–25 m on the roof of Andijan State University. The sampler operated continuously, capturing particles on a rotating adhesive tape coated with safranin-stained glycerin gelatin, which was replaced weekly.

Samples were processed under laboratory conditions, and slides were prepared following standard palynological procedures [13,14]. Pollen grains were examined under light microscopy, and Amaranthaceae pollen was identified based on key morphological characteristics. Pollen concentration was expressed as grains per cubic meter of air (grains/m³) and calculated volumetrically.

Meteorological data (air temperature, relative humidity, precipitation, and wind speed) were obtained from Uzhydromet (2025). The relationship between pollen concentration and meteorological factors was assessed using Spearman’s rank correlation coefficient (ρ), with significance levels set at 0.05 and 0.01. Statistical analyses were performed using standard methods [15].

Results and discussion. The weekly dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen from April to November 2025 showed a clear seasonal pattern. During weeks 1–5, concentrations remained very low (0–0.3 grains/m³). A gradual increase was observed in weeks 6–10, reaching 1.4 grains/m³, indicating the onset of flowering. From weeks 11 to 20, pollen levels increased steadily, reaching 3.5–4.7 grains/m³ during the active flowering stage. The main peak occurred in week 21 (11 grains/m³), followed by a slightly lower value in week 22 (9.6 grains/m³), representing the main pollen season.

After week 23, concentrations declined, although a short-term secondary peak (6.5 grains/m³) was observed in week 26, possibly due to delayed flowering or meteorological variations. After week 28, pollen levels decreased sharply, approaching near-zero values by weeks 30–32. Overall, Amaranthaceae pollen exhibited a predominantly unimodal seasonal pattern, with the main season occurring in late summer to early autumn.

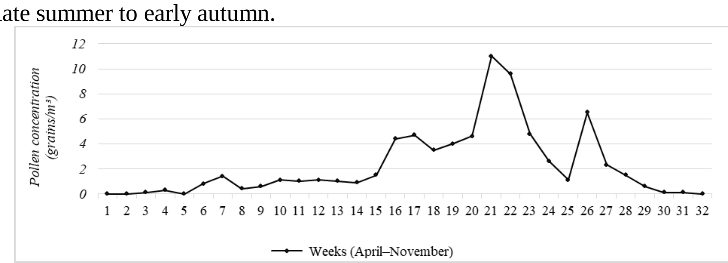

Figure 1. Weekly dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen concentration

The seasonal dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen were analyzed from April to November 2025. The total airborne pollen concentration reached 71.315 grains/m³. Low pollen levels were recorded in spring: 0.375 grains/m³ (0.525%) in April, 2.5 grains/m³ (3.5%) in May, and 3.835 grains/m³ (5.3%) in June, corresponding to the initial flowering phase. A noticeable increase occurred in July (7.75 grains/m³; 10.86%).

The highest concentrations were observed in August (16.835 grains/m³; 23.6%) and September (27.795 grains/m³; 38.9%), with September accounting for nearly 40% of the annual total and representing the main pollen season. In October, levels declined (11.39 grains/m³; 15.97%), while November showed minimal concentrations (0.835 grains/m³; 1.17%). Overall, the main pollen season occurred in late summer to early autumn (August–September), reflecting a typical continental seasonal pattern.

Table 1

Seasonal dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen (april – november 2025)

No	Months	Number of pollen grains	Percentage (%)	Peak week
1.	April	0.375	0.525%	4 week
2.	May	2.5	3.5%	3 week
3.	June	3.835	5.3%	2 week
4.	July	7.75	10.86%	4 week
5.	August	16.835	23.6%	1 week
6.	September	27.795	38.9%	1 week
7.	October	11.39	15.97%	2 week
8.	November	0.835	1.17%	1 week
	Total:	**71.315**	**100%**	

An analysis of temperature dynamics from April to November 2025 showed that the highest weekly mean temperature reached 29°C in July. Elevated temperatures (24–27°C) were observed in June and August, representing the stable summer phase.

Moderate temperatures (15–23°C) occurred in April, May, September, and October, reflecting transitional spring and autumn conditions. In contrast, a sharp decline was observed in November (3–14°C), indicating late autumn cooling. Overall, the results demonstrate a clear seasonal temperature pattern typical of a continental climate (Figure 2a).

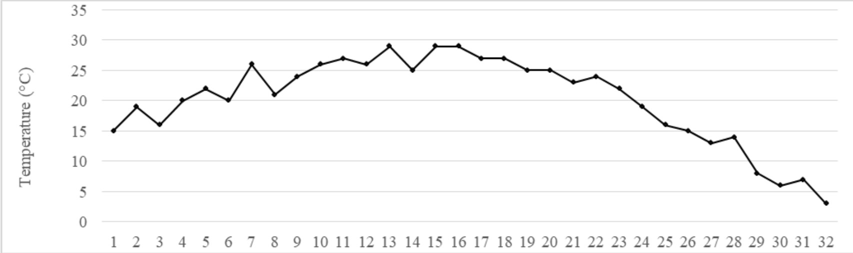

Figure 2a. Weekly variation in temperature (April – November 2025)

The analysis of relative humidity showed that the highest values (70–75%) occurred during spring and autumn, reflecting increased atmospheric moisture. High humidity (63–69%) was recorded in April, September, and October, likely associated with seasonal air mass changes and precipitation.

Moderate to low humidity (55–62%) was observed from May to September, corresponding to drier summer conditions. The lowest levels (50–54%) occurred in June and July, representing the driest period. Overall, relative humidity exhibited a clear seasonal pattern typical of a continental climate (Figure 2b).

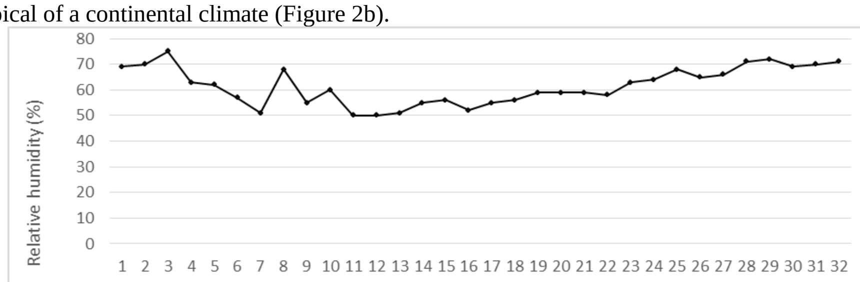

Figure 2b. Weekly variation in humidity (April – November 2025)

The analysis of wind speed showed that the highest values (7–8 km/h) occurred in May, indicating increased atmospheric circulation. High values (6 km/h) were also recorded in April–June, associated with active spring conditions.

During the rest of the study period, wind speeds were predominantly moderate (5 km/h) to low (3–4 km/h), reflecting relatively stable conditions. Overall, wind speed exhibited a seasonal pattern, with more active conditions in spring and greater stability in summer and autumn.

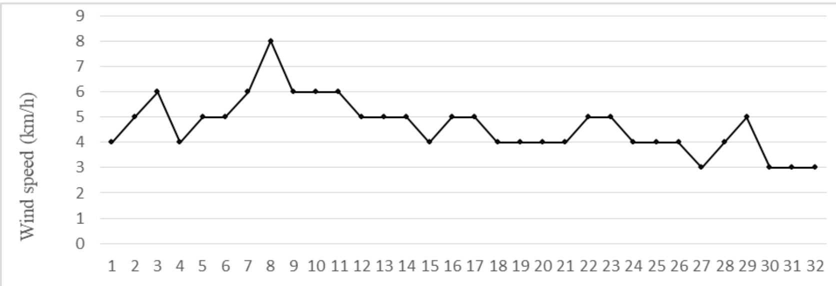

Figure 2c. Weekly variation in wind speed (April – November 2025)

The analysis of precipitation showed that the maximum rainfall (2–3 mm) occurred in April, associated with increased spring frontal activity. Higher values (1–1.5 mm) were also recorded in April–May.

Moderate precipitation (0.2–0.5 mm) was observed throughout the study period, while low or near-zero values (0–0.1 mm) predominated in summer and autumn, reflecting dry continental conditions. Overall, rainfall exhibited a clear seasonal pattern, with higher levels in spring and significantly lower values in summer and autumn.

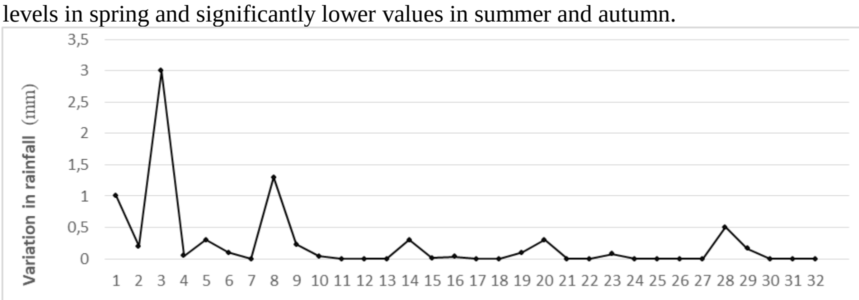

Figure 2d. Weekly variation in rainfall (April – November 2025)

The relationship between Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen concentration and meteorological parameters was assessed using Spearman’s rank correlation. Significant negative correlations were found with relative humidity

($\rho = -0.442$; $p < 0.05$) and rainfall ($\rho = -0.434$; $p < 0.05$). These results indicate that increased moisture and precipitation reduce airborne pollen levels, likely due to the washout effect and reduced suspension time under high humidity.

A very weak, non-significant positive correlation was observed with temperature ($\rho = 0.067$; $p > 0.05$), while no significant relationship was found with wind speed ($\rho = -0.055$; $p > 0.05$). Overall, humidity and rainfall were the main limiting factors affecting pollen concentration, whereas temperature and wind speed showed no significant influence.

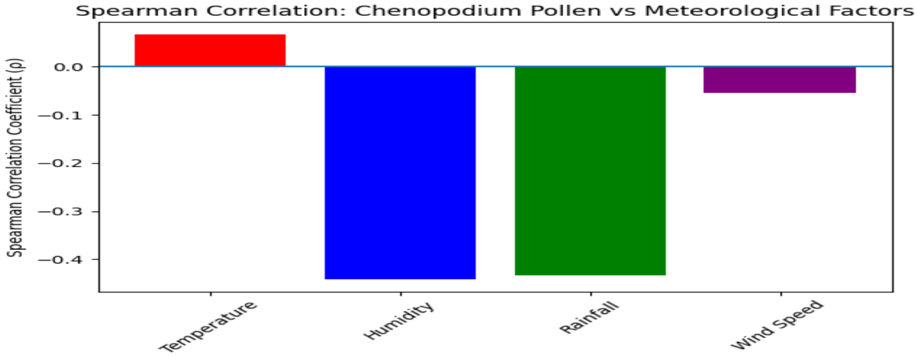

Figure 3. Spearman correlation between Amaranthaceae pollen concentration and meteorological factors

Conclusion. The seasonal dynamics of Amaranthaceae (*Amaranthus* and *Chenopodium*) pollen in the atmospheric air of the Andijan region were investigated during spring, summer, and autumn 2025. The results showed a clear seasonal pattern, with a total pollen concentration of 71.315 grains/m³. The highest levels were recorded in August and September, indicating that the main pollen season occurs in late summer and early autumn.

Spearman's correlation analysis revealed significant negative relationships between pollen concentration and relative humidity and precipitation ($p < 0.05$), indicating that increased moisture reduces airborne pollen levels. No significant correlations were found with temperature or wind speed.

These findings help identify the main pollen season and key meteorological factors influencing pollen distribution, and are important for aeroallergen monitoring, allergy risk assessment, and preventive planning.

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REFERENCES

1. Candau, P. (1987). Chenopodiaceae. In: B. Valdés, M. J. Díez & I. Fernández (Eds.), Atlas polínico de Andalucía Occidental (pp. 103-105). Sevilla, Spain: Instituto de Desarrollo regional nº43, Universidad de Sevilla. Excma. Diputación de Cádiz.
2. https://powo.science.kew.org
3. The Angiosperm Phylogeny Group (APG IV). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Bot J Linn Soc. 2016; 181: 1-20. http://doi.org/10.1111/boj.12385.
4. Lombardero, M., Duffort, O. & Carreira, J.(1991). Allergenic significance of chenop pollen. In G. D'Amato, F.Th. M. Spieksma & S. Bonini (Eds.), Allergenic pollen and pollinosis in Europe (128-131). Oxford, United Kingdom: Blackwell Scientific Publications.
5. Smith EG. Sampling and Identifying Allergenic Pollens and Molds. Blewstone Press, San Antonio, Texas 1990.
6. Ruiz-Valenzuela L, Aguilera F. Trends in airborne pollen and pollen-season-related features of anemophilous species in Jaen (south Spain): A 23-year perspective. Atmos Environ. 2018; 180: 234-43. http://doi.org/10.1016/j.atmosenv.2018.03.012.
7. Erdtman, G. (1969). Handbook of Palynology: Morphology, Taxonomy, Ecology. Copenhagen: Munksgaard.
8. Moore, P. D., Webb, J. A., & Collinson, M. E. (1991). *Pollen Analysis.* 2nd ed. Oxford: Blackwell Scientific Publications.
9. A.B.Sin, N.M. Pınar, Z. Mısırlıgil, T. Ceter, A. Yıldız and S. Alan, Polen Allerjisi (Türkiye Allerjik Bitkilerine Genel Bir Bakış). Engin Yayınevi, Ankara (2007).
10. D'Amato, L. Cecchi, S. Bonini, C. Nunes, I. Annesi-Maesano, H. Behrendt, G. Liccardi, T. Popov and P. Van Cauwenberge, Allergenic pollen and pollen allergy in Europe. Allergy, 62 (9), (2007) 976–990.
11. Chuine, I., & Belmonte, J. (2004). Improving prophylaxis for pollen allergies: Predicting the time course of the pollen load of the atmosphere of major allergenic plants in France and Spain. Grana, 43(2), 65–80. https://doi.org/10.1080/00173130410019163
12. García-Mozo, H., Galán, C., Gomez-Casero, M. T., & Dominguez, E. (2000). A comparative study of different temperature accumulation methods for predicting the start of the Quercus pollen season in Córdoba (south West Spain). Grana, 39(4), 194–199. https://doi.org/10.1080/00173130051084322
13. Erdtman, G., The Asetolysis Method. A Deviseded Description, Svensk Bot. Tidskr. 54, 561-564 (1960).
14. Wodehouse, R.P., Pollen Grains, Mc Grew Hill Press. New York (1935).
15. Ulaş Uğuz, Aykut Güvensen. Olea europaea L. Polenlerinin Aydın, Manisa ve Muğla Atmosferindeki Dağılımları. Süleyman Demirel University Journal of Natural and Applied Sciences. Volume 23, Issue 3, 936-942, 2019 DOI: 10.19113/sdufenbed.565330