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Research Article

POLLEN MORPHOLOGY OF THE SELF-STERILE AND CRYPTIC SELF-FERTILE *Campsis radicans* (L.) Seem. (BIGNONIACEAE)

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ABSTRACT. This study, conducted in Eskişehir, aimed to identify the pollen of *Campsis radicans* (L.) Seem. (Bignoniaceae) found in city centers and parks and to examine its pollen morphology using light microscopy and scanning electron microscopy. Comparative analysis of the palynological data revealed differences and similarities in pollen measurements, sizes, and shapes compared to previously studied samples. Additionally, the study investigated the pollination season and allergic properties of *Campsis radicans* in Eskişehir. The primary objective is to contribute valuable data to plant systematics and to assist physicians and individuals affected by allergies in the diagnosis and treatment of allergic diseases.

Keywords: *Campsis radicans* (L.) Seem., *Bignoniaceae, Pollen Morphology, Allergy, Eskişehir, Turkey*

INTRODUCTION

Palynology is the scientific study of pollen grains and spores, encompassing their production, dispersion, and preservation in sediments and geological formations. Derived from the Greek words “paluno” (to sprinkle or scatter) and “logos” (study), palynology provides crucial insights into past climates, vegetation patterns, and evolutionary histories. By analyzing the morphology, distribution, and abundance of pollen and spores, palynologists reconstruct ancient environments, trace the evolution of plant species, and contribute to fields as diverse as archaeology, climatology, and forensic science. This interdisciplinary approach makes palynology a powerful tool for unraveling the mysteries of our planet's past.

Pollen morphology plays a pivotal role in taxonomic studies, serving as criteria for the classification of families, genera, or species. Similarities in pollen morphology exist among phylogenetically related groups, contributing to accurate classifications. Palynology significantly contributes to plant taxonomy, necessitating consideration alongside morphological, anatomical, and ecological features.

Modern systematic and phylogenetic research benefits from pollen morphology, with widely accepted classification systems incorporating it extensively. The classification of essential pollen in taxonomic studies is based on its shape, structure, and ornamentation of the exine layer.

Evolutionary methods in taxonomic research, particularly those employing phylogenetics, have revealed changes in plant pollen evolution. Electron microscopy aids in precise taxonomic differentiation, allowing examination at various levels, from variety to population.

Palynological studies contribute to new plant system establishment, aid in plant identification keys, assist in tree species classification, and differentiate natural and cultivated plant hybrids. Aeropalynological studies determine pollen and spore abundance, creating calendars on various time scales. Results are disseminated to the public through media in some countries. Numerous studies, both globally and in our country, have been conducted in the field [1-17]. Some of these studies have focused on identifying allergenic pollens in Europe, determining pollen and fungal allergies in South Sardinia (Italy). They have also involved the comparison of data obtained from skin tests and volumetric methods with samples collected from the air. Additionally, certain studies have measured variations in settling velocities of specific pollens and spores [18, 19].

Global and local studies in this field have identified allergenic pollens, measured settling velocities of certain pollens and spores, and compared data from skin tests with volumetric methods. In a study in Eskişehir, allergic *Campsis radicans* pollen was identified, providing data to illuminate plant systematics and aid physicians in diagnosing and treating allergic diseases.

MATERIALS AND METHODS

The research material comprises pollen grains of *Campsis radicans*, collected from parks and gardens in the city center of Eskişehir between 2022 and 2023. Plant collection occurred during the spring months of the 2022-2023 period. Pollen samples, extracted from newly opened flowers specifically for palynological studies, were carefully labeled and stored in paper envelopes.

Palynological studies utilized pollen grains from 10 to 15 different plants gathered across various regions for each sample. During plant collection, samples belonging to the same taxon were segregated into individual paper envelopes to avoid any cross-contamination with pollen exhibiting different characteristics. Our study examined the pollen morphologies of the taxon under a light microscope, employing the terminology of Faegri and Iversen for naming the exine layers.

Preparations for light microscopy followed the methods of Wodehouse (1935) and Erdtman (1969). The Wodehouse method involved adding a specified amount of basic fuchsin dye to the glycerin-gelatin prepared for pollen examination [20]. A Nikon Eclipse E100 light microscope equipped with an apochromatic oil immersion objective (x100) and a micrometric eyepiece (x10) was used for pollen examination. The micrometric ruler used had a one-range value calculated as 1 µ. Pollen measurements were conducted for each taxon until achieving a Gaussian curve for P and E.

In preparations based on Wodehouse (1935) and Erdtman (1969) methods, the thicknesses of the exine and intine layers of *Campsis radicans* pollen grains were measured 20 to 50 times, and the direct mathematical averages of these measurements were computed.

Pollen grain diagnosis and counting were executed using a Prior binocular microscope, employing x 10 eyepiece, x 10, and x 40 plan objectives for counts, and x 100 plan oil-immersion objective for diagnosis. Each interval on the eyepiece micrometer equated to 1 µm.

Various fundamental palynological references and studies were consulted for pollen grain diagnosis [21-31].

For scanning electron microscope (SEM) examinations, non-acetolyzed pollen grains were affixed to an adhesive plate, gold-coated, and scrutinized using a Jeol 5600 LV scanning electron microscope [32, 33].

RESULTS AND DISCUSSION

Campsis radicans (Acem borusu) is a species from the Bignoniaceae family. It shows its natural distribution only in the Çatalca-Kocaeli sub-region in Turkey. While commonly referred to as Acemborusu in Turkish literature, in some regions, it is known as borazan çiçeği (trumpet flower) or trompet çiçeği (trumpet-like flower). The stem can develop in a climbing form, reaching up to 9 meters. The leaves are arranged oppositely, with a compound, feathery structure; leaflets are 5-13 in number, elliptical-lanceolate, and short-stalked. Flowering occurs between May and September; flower clusters are 10-20-flowered and arranged in racemes; there are 5 sepals; the corolla is dark orange, bell-shaped, and 5-lobed; stamens are usually 4, with two short and two long, occasionally with an additional sterile stamen; the ovary is superior, 2-carpelled, and unilocular. The fruit is capsule-shaped, 5-15 cm long, two-chambered, initially green, turning brown when mature; it ripens in autumn and persists on branches until winter, containing numerous seeds.

The palynomorphological data obtained in this study are as follows (Fig. 1 and Table 1):

Pollen type: Tricolpatae

Pollen shape: Subprolatae P/E= 1,28 µm (W); 1,14 µm (E)

Exine: Average thickness 1,02 µm (W); 0,88 µm (E)

Apertures: The colpi are long and slender, with rounded tips, distinct and smooth boundaries. The polar triangle is of moderate size and regular

Structure: Tectatae

Sculpture: Reticulatae

Table 1. *Pollen Morphology Measurement Values of Campsis radicans*

Wodehouse Method			**Erdtman Method**		
	M	**S**	**M**	**S**	
P	32,28	± 2,24	34,18	± 5,04	µm
E	26,44	± 2,62	30,06	± 2,66	µm
clg	24,28	± 1,66	16,12	± 2,33	µm
clt	8,48	± 2,56	11,35	± 2,54	µm
L	21,28	± 2,72	34, 98	± 3,42	µm
t	8,04	± 0,78	8,26	± 0,80	µm
i	0,90	± 0,08	-	-	µm
Ex	1,02	± 0,12	0,88	± 0,10	µm

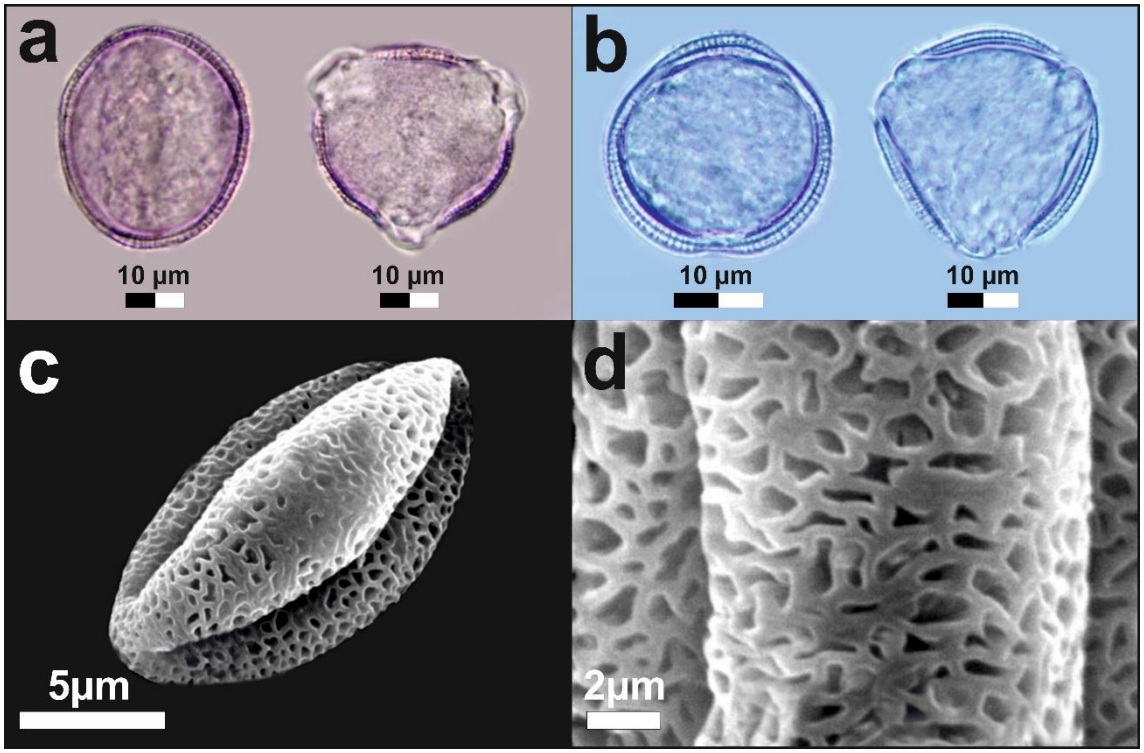


Fig. 1. *LM (**a**: Equatorial (W)-Polar (W), **b**: Equatorial (E)-Polar (E)) and SEM (**c**: Equatorial view, **d**: Exine ornamentation) microphotographs of investigated taxon*

In this investigation, the pollen morphology of *Campsis radicans*, a member of the Bignoniaceae family, was scrutinized in the parks and gardens of Eskişehir, employing both light and scanning electron microscopes. Alongside the pollen morphology examination, insights into the pollination period and prevalence in the studied area were unveiled. The airborne presence of *C. radicans*. pollen was observed to peak from May to September in the Eskişehir atmosphere, aligning with previous studies [14]. Discrepancies among studies, including those in Eskişehir and other locations, can be attributed to regional, seasonal, and climatic variations, as well as shifts in plant flora.

When examining the atmospheric pollen measurements conducted in Eskişehir in 2022 and 2023, it is evident that the pollen count of *Campsis radicans* increases particularly during the spring and summer months. In 2022, the pollen count was 4 per cm² in March, 8 per cm² in April, and 18 per cm² in May. During the summer months, it was recorded as 10 per cm² in June and 6 per cm² in July. A similar increase was observed in 2023; the pollen count was 9 per cm² in March, 15 per cm² in April, 26 per cm² in May, and 16 per cm² in June. It was recorded as 8 per cm² in July. These data indicate that Campsis radicans pollen is highly dispersed into the atmosphere, particularly in spring and summer, and that individuals with pollen allergies may experience increased symptoms during these periods. Therefore, it is important for individuals with pollen allergies in Eskişehir to take precautions and consider treatment measures during these times (Fig. 2).

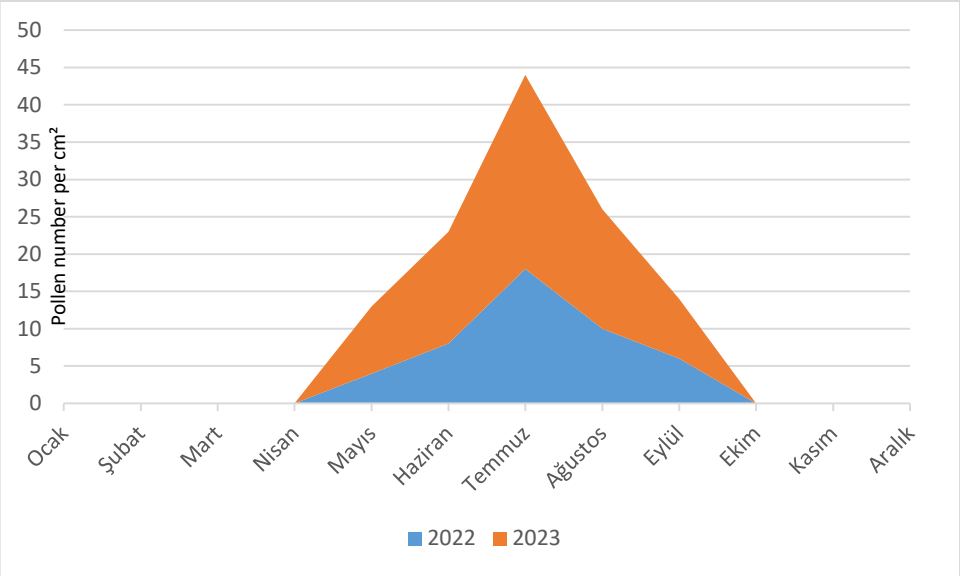


Fig. 2. *Distribution of Campsis radicans pollen in the atmosphere of Eskişehir by month for the years 2022-2023*

The temperature rise from January to August displayed a correlation with increased pollen quantities between January and May. Positive correlations between rising temperatures and pollen concentration in the atmosphere were consistent with studies in Istanbul, Ankara, Sivas, Bozüyük, and Zonguldak [6, 14-17, 21, 34]. Factors such as relative humidity, rainfall, and wind speed also played crucial roles. Consistent wind patterns during the study period facilitated optimal pollen dispersion conditions. The most intense flowering months being April and May contributed to the peak in pollination during May. Dry seasons exhibited slower and shorter flowering, while rainy days increased pollen counts, aligning with previous findings [6, 16, 17]. Post-rain temperature increases and humidity decreases further augmented pollen quantities in the atmosphere [34, 35].

Comparing palynological findings from previous examinations with our study revealed variations and similarities in pollen measurements and ornamentation. These differences may stem from different researchers, climate disparities, and the prevalence of cultivated plants. Routine studies considering meteorological conditions, plant cover richness, and cultivation area changes are crucial for accurate regional assessments.

The identified *Campsis radicans* pollen in Eskişehir's parks and gardens exhibited high allergenicity, being recognized as a significant contributor to hay fever [36]. In certain countries, especially in Czechoslovakia, this pollen has been reported to possess the highest allergic effects [37], underscoring its importance for allergic diseases in the Eskişehir region. Pollen, in general, is known to cause hay fever, emphasizing the role of pollen pollution as a dominant factor in cities [38]. Studies worldwide have highlighted the connection between high concentrations of airborne pollen and fungal spores with heightened allergenicity, where allergy tests aid symptom determination [18]. Regions like Serik (Antalya) have recommended precautionary measures for individuals sensitive to pollen during certain times based on the relationship between pollen and meteorological factors [5]. Similar initiatives in Russia and other countries have revealed pollen dispersion periods, guiding precautions for sensitive individuals [39]. Diagnosis

and treatment of pollen-related seasonal conditions such as rhinoconjunctivitis and asthma have been facilitated by such studies [40].

This study contributes to the understanding of the pollen morphology and allergic properties of *Campsis radicans*, shedding light on both plant systematics and public health concerns. The seasonal pollen quantities identified aim to assist individuals with pollen sensitivities and healthcare professionals in the region.

CONCLUSION

This study emphasizes the need for electronic pollen atlas databases in Turkey, highlighting the significance of understanding *Campsis radicans* pollen morphology and allergenic properties. Unlike other countries, Turkey lacks a continuously updated pollen atlas. The research serves as a guide for park and garden enthusiasts, contributing to Eskişehir's biological diversity and laying the foundation for a comprehensive national pollen atlas. The allergenicity of Campsis radicans, known to cause hay fever and allergic rhinitis, underscores its public health importance. The study aids in identifying allergenic species distribution, offering guidance for those sensitive to pollen. It also enhances the field of Plant Systematics in Turkey, suggesting the ornamental use of *Campsis* species and encouraging further exploration in nurseries. Overall, this research reveals the pollen morphology and allergenic properties of Campsis radicans in Eskişehir, setting the groundwork for future studies across Turkey and promoting its use in landscaping practices.

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