ГЛАСНИК Српског географског друштва 105(2) 575-588
BULLETIN OF THE SERBIAN GEOGRAPHICAL SOCIETY 2025

Original scientific paper
UDC 574:911.375.1(65)
https://doi.org/10.2298/GSGD2502575S

Received: August 27, 2025
Corrected: October 24, 2025
Accepted: November 7, 2025

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FLORISTIC AND ECOLOGICAL ANALYSIS OF URBAN CAMPUS GREEN SPACES: A CASE STUDY OF M'SILA UNIVERSITY, ALGERIA

Abstract: Urban university campuses provide critical green spaces that enhance urban ecology, support biodiversity, and offer significant social and recreational benefits. However, the floristic composition of many such spaces remains under-documented, limiting their potential for strategic ecological management. This study presents the first systematic floristic inventory of the Faculty of Law and Political Sciences campus at the University of M'sila, Algeria, a site situated within a semi-arid Mediterranean climate. Field surveys conducted between January and February 2024 identified 20 vascular plant species from 20 genera and 16 families. The results indicate a predominance of the Asteraceae family and a flora dominated by woody species (phanerophytes), reflecting both the natural Mediterranean ecosystem and anthropogenic influence through ornamental plantings. The plant assemblage displays diverse biogeographic origins, with Euro-Siberian as a prominent component, and shows clear adaptations to dry environments, including a dominance of mesophyllous leaves and drought-tolerant characteristics. This study provides a fundamental biodiversity assessment, supplying important data for future conservation initiatives, sustainable landscape management, and the improvement of ecological services within this urban green space.

Keywords: urban ecosystem, flora, Mediterranean, biodiversity, ecosystem services

Introduction

Urban and university green spaces play a crucial role in enhancing the ecological and social structure of cities. These spaces provide significant recreational opportunities for students, staff, and local residents, helping to address the lack of public green spaces in crowded urban areas (Aram et al., 2019; Zhang et al., 2024). Additionally, university green spaces promote urban sustainability by fostering biodiversity, providing food resources from fruit-bearing trees, and cultivating better links between persons and nature (Rangkuti et al.,

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2021; Semeraro et al., 2021). Campus green spaces provide a cooling impact that can decrease local temperatures and reduce energy consumption in neighbouring buildings, rendering them vital for climate adaptation (Aram et al., 2019; Feng et al., 2021).

Even with their importance, many urban campuses face challenges such as limited space and a need for more attractive, accessible, and versatile designs. Improving pathways and biophilic design can enhance these places for increased utilization and happiness (Li et al., 2019; Wurianturi et al., 2022). Student perceptions underline the importance of plant diversity, seasonal colouring, and accessible locations in boosting the attractiveness of campus green spaces (Saha & Haq, 2024; Tudorie et al., 2020). Consequently, well designed university green spaces are essential resources that promote well-being, social cohesiveness, and ecological sustainability (Zhang & Qian, 2024).

The University of M'sila stands out as a great example, with its Pole 2 campus showing a wide range of plant life, including 32 ornamental and 89 wild species (Rebbas et al., 2023). On the other hand, the plant diversity at the Faculty of Law and Political Sciences located at Pole 1 has not been thoroughly recorded. It is essential to create a detailed record to set a baseline for biodiversity and support sustainable practices, particularly considering the local semi-arid climate and rising water shortages. As a result, this research intends to carry out an initial plant inventory on the Faculty's campus to recognize the species present, categorize their families and life types, and provide a basic evaluation of this green urban space.

Materials and Methods

Study site description

The study was carried out in Algeria at the University of M'sila's Faculty of Law and Political Science campus (35°42'44. 4N, 4°31'25. 7E). The campus has a perimeter of 772. 58 meters and a total area of 28,786. 47 square meters (see Figure 1).

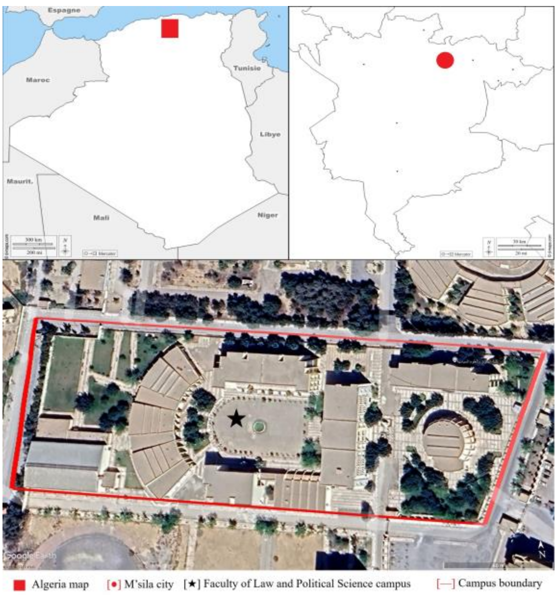

Fig. 1. Location of the Faculty of Law and Political Science campus, University of M'sila, M'sila city, Algeria. Source: Adapted from www.d-maps.com

The location is in a semiarid Mediterranean climatic zone, distinguished by moderate winters and hot, dry summers with highly variable precipitation. According to long-term meteorological records, M'Sila experiences an average annual temperature of approximately 18.6–20.3°C, with average relative humidity of around 45–48%, and annual precipitation ranging between 213–249 mm, which is highly variable and concentrated primarily in the winter months (Climate-data.org, 2024; Weatherandclimate.com, 2016; Bahlouli et al., 2012). Between 2017 and 2021, this climate caused significant water scarcity concerns, which contributed to a noticeable reduction in the amount of urban green space in M'sila from 7,732. 68 hectares to 3,802. 77 hectares (Graça et al., 2022; Hafsi et al., 2022; Seghiri et al., 2022).

The site exhibits minimal topographical variation (476.97–479.55 m above sea level), with a median elevation of 478.01 m, indicating level terrain suitable for diverse vegetation. Aerial imagery analysis revealed that green spaces comprise 27% of the total campus area. This is distributed as mature tree canopy (15.5%), lawn and grass areas (7%), and ornamental vegetation (4.5%). This distribution creates a heterogeneous mosaic of microhabitats, including managed ornamental beds, maintained lawns, roadside verges, and uncultivated patches that support both cultivated and spontaneous plant communities.

Floristic survey and data collection

Field surveys were conducted between January and February 2024, when cooler temperatures and residual winter moisture create optimal conditions for fieldwork and species identification in M'sila's semi-arid environment, capturing both perennial ornamentals and winter-active herbaceous taxa before the onset of summer dormancy. A systematic approach using repeated transect walks was employed to cover all accessible areas of the campus, ensuring comprehensive spatial coverage. Each encountered plant specimen was documented in situ through digital photography, assigned a unique collection number, and recorded in field notebooks. Corresponding data included the collection date, precise microhabitat location, and growth form classification (tree, shrub, or herb).

Data analysis

Data were organized and analysed using Microsoft Excel (version 2019). Descriptive statistics were applied to summarize species composition and related variables. Results were visualized through radar charts, pie charts, and histograms to illustrate structural and functional patterns in the recorded flora, enabling clear comparison of species distributions, trait prevalence, and family-level representation.

Results and Discussion

Floristic diversity and composition

The survey identified 20 vascular plant species belonging to 20 genera and 16 families, as detailed in Table 1. This documents the foundational floristic composition of the researched area. Among the identified families, Asteraceae was the most dominant, with four species. This was followed by Apiaceae, with two species. As illustrated in Figure 2. our localized survey quantitatively validates the Asteraceae dominance reported by Rebbas et al. (2023) in their campus inventory, but critically demonstrates that 70% of the species documented at our site- primarily ruderal flora - were unrecorded in their work. This distribution reflects the common prominence of Asteraceae in Mediterranean and semi-arid floras, where many species in this family are well-adapted to disturbed and sun-exposed environments typical of urban landscapes.

Table 1. Floristic composition of Faculty of Law and Political Science campus, University of M'sila, M'sila city, Algeria

No	Scientific Name	Authority	Common Name	Family	Class
1	*Morus alba*	L., 1753	White Mulberry	Moraceae	Magnoliopsida
2	*Solanum villosum*	Mill., 1768	Hairy Nightshade	Solanaceae	Magnoliopsida
3	*Lactuca virosa*	L., 1753	Wild Lettuce	Asteraceae	Magnoliopsida
4	*Anthriscus cerefolium*	(L.) Hoffm., 1814	Common Chervil	Apiaceae	Magnoliopsida
5	*Conium maculatum*	L., 1753	Poison Hemlock	Apiaceae	Magnoliopsida
6	*Phoenix dactylifera*	L., 1753	Date Palm	Arecaceae	Liliopsida
7	*Malva sylvestris*	L., 1753	Common Mallow	Malvaceae	Magnoliopsida
8	*Echinops spinosissimus*	Turra, 1765	Spiny Globe Thistle	Asteraceae	Magnoliopsida
9	*Sonchus oleraceus*	L., 1753	Common Sowthistle	Asteraceae	Magnoliopsida
10	*Cynara humilis*	L., 1753	Wild Artichoke	Asteraceae	Magnoliopsida
11	*Oxalis pes-caprae*	L., 1753	Bermuda Buttercup	Oxalidaceae	Magnoliopsida
12	*Lantana camara*	L., 1753	Common Lantana	Verbenaceae	Magnoliopsida
13	*Ligustrum japonicum*	Thunb., 1780	Japanese Privet	Oleaceae	Magnoliopsida
14	*Eugenia uniflora*	L., 1753	Surinam Cherry	Myrtaceae	Magnoliopsida
15	*Cynodon dactylon*	(L.) Pers., 1805	Bermuda Grass	Poaceae	Liliopsida
16	*Schinus terebinthifolius*	Raddi, 1820	Brazilian Peppertree	Anacardiaceae	Magnoliopsida
17	*Jacaranda mimosifolia*	D.Don, 1822	Jacaranda	Bignoniaceae	Magnoliopsida
18	*Ceratonia siliqua*	L., 1753	Carob Tree	Fabaceae	Magnoliopsida
19	*Melia azedarach*	L., 1753	Chinaberry Tree	Meliaceae	Magnoliopsida
20	*Rosa rubiginosa*	L., 1771	Sweet Briar	Rosaceae	Magnoliopsida

Source: Species list from author's inventory. Taxonomy and authorities follow Plants of the World Online (powo.science.kew.org)

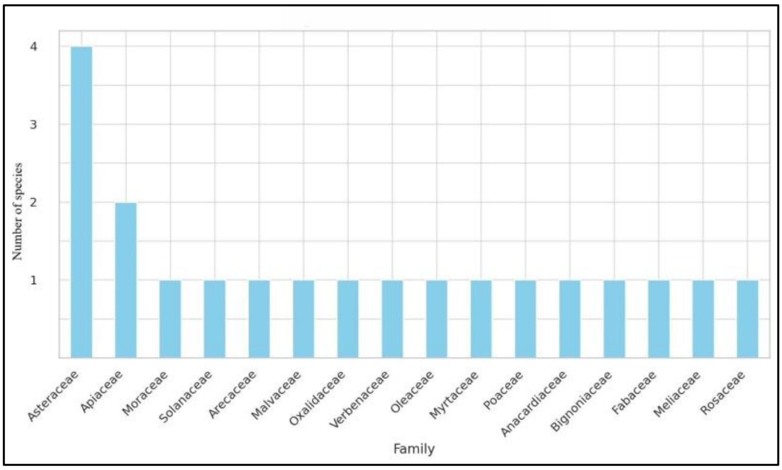

Fig. 2. Plants family in the study area

The exceptional adaptability of the Asteraceae family to challenging environments, such as Mediterranean and semi-arid regions, is a primary reason for their dominance. These plants have evolved a variety of strategies to thrive in conditions of aridity, variable soils, and human-caused disturbances, including tolerance to environmental stresses and rapid life cycles (therophytes) that allow them to flourish in habitats with scarce water and nutrients (Waheed & Arshad, 2024).

Life forms and structural features

The study of plant life forms sheds light on the of the campus flora's structural composition. The distribution reveals that herbaceous forms collectively constitute a substantial portion of the flora, accounting for 50%. Trees represent the single largest woody life form at 25%, as shown in Figure 3. This structural diversity is essential for creating varied habitats and aesthetic appeal. Similar patterns have been observed in other university campuses as well, with some sites dominated by herbaceous species and others having a more equitable balance of woody and non-woody plants (Saini & Singh, 2016; Syamsiah et al., 2023).

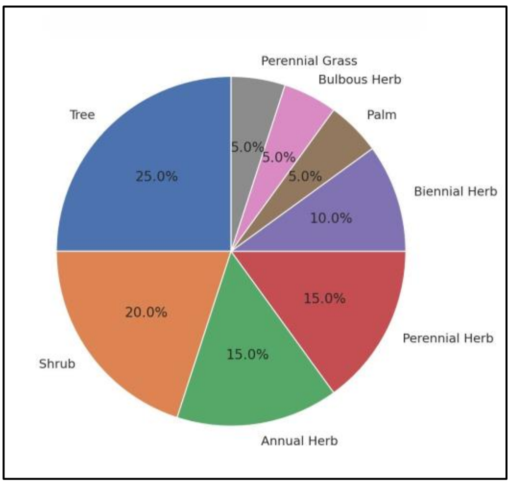

Fig. 3. Distribution of plants by biological type

A more precise classification using the Raunkiær system, presented in Figure 4, shows the dominance of phanerophytes (50%), including trees and other large shrubs. This pattern implies a landscape influenced by both the temperate-to-subtropical climate and the human introduction of ornamental plants. Additionally, the high proportion of hemicryptophytes (25%) and therophytes (15%) indicates an adaptation to seasonal climatic variability and sporadic stress occurrences, as these herbaceous plants survive unfavourable seasons as buds at the soil surface or as seeds, respectively.

Managed environments like university campuses and botanical gardens often have this arrangement, where phanerophytes shape vertical structure and aesthetic appeal while herbaceous forms offer resilience to regular climatic stresses (Midolo et al., 2024; Thoudam et al., 2024).

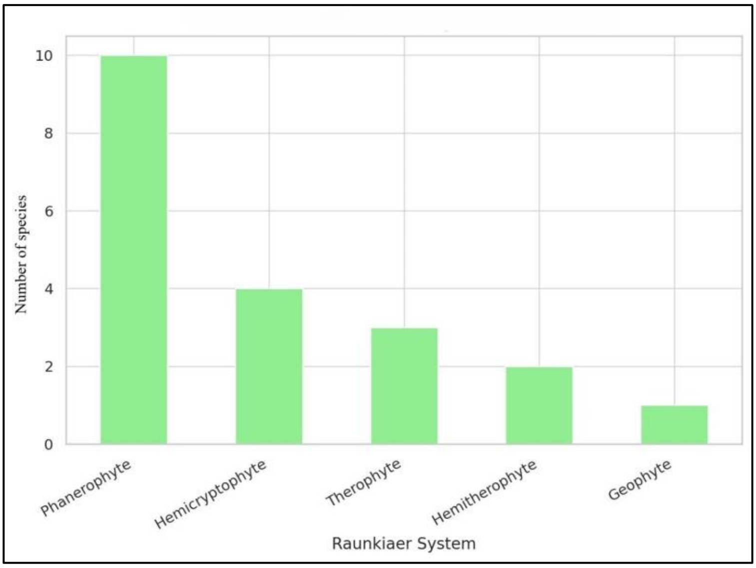

Fig. 4. Distribution of plants by biological Raunkiaer system

The campus flora's leaf size distribution shows a clear dominance of mesophyllous species account for 45% of the total, which is a common adaptation to managed landscapes where adequate water availability is maintained through irrigation practices (Wright et al., 2017; Yates et al., 2010). Furthermore, the significant proportions of microphyllous (35%) and macrophyllous (20%) plants indicate that the balance between natural resources supports both large and small-leaved taxa. Liu et al. (2008) discovered that Mediterranean climate and targeted irrigation of decorative plants improved performance. The variation in leaf size reflects the connection between environmental constraints and human management practices: microphyllous leaves help to reduce transpiration and heat stress in dry climates. Larger leaves take advantage of extra moisture to boost photosynthetic potential (Yates et al., 2010). The campus's leaf morphology patterns generally demonstrate a balance between water-conserving strategies and aesthetic variety, which is typical of maintained Mediterranean green areas where climate and cultivation practices influence plant form and function (Liu et al., 2017; Wright et al., 2017; Yates et al., 2010).

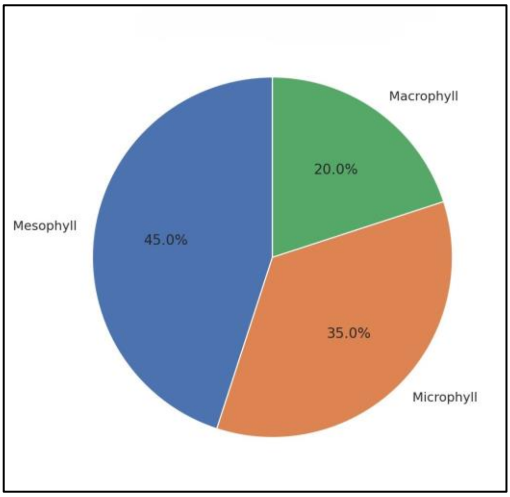

Fig. 5. Leaf size distribution

Biogeographic origins and distribution patterns

The campus plant community is a microcosm of global plant migration patterns influenced by the deliberate introduction of horticultural practices and natural distribution. Figure 6 illustrates the presence of Euro-Siberian (30 %) highlighting the historical biogeographic connectivity between European and Asian temperate floras, consistent with patterns observed in other managed landscapes (Liu et al., 2017). Moreover, the significant representation of Neotropical species (20 %) indicates successful cross continental cultivation, often facilitated by climatic analogues and selective horticultural practices (Liu et al., 2017). Similarly, Mediterranean species (20 %), known for their phenotypic plasticity, flourish in local xeric conditions through adaptive radiation (Liu et al., 2017).

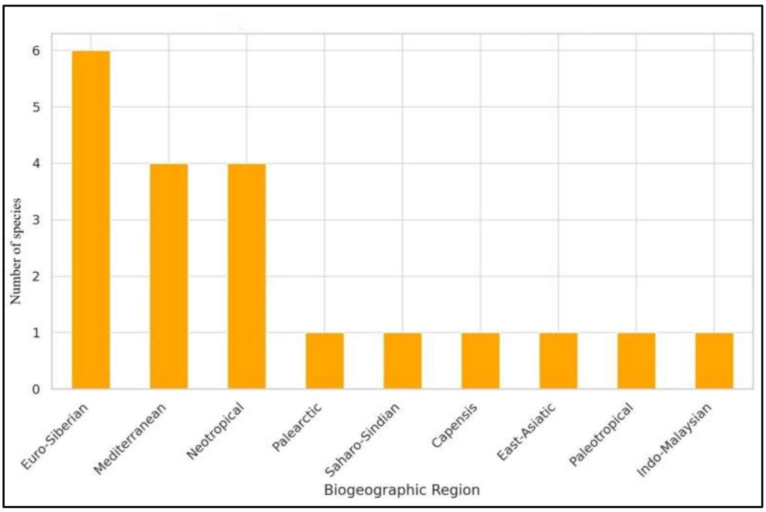

Fig. 6. Plant distribution by biogeographic regions

Furthermore, analysis of dispersion patterns reveals that the grown varieties dispersed primarily through human activity. Cosmopolitan species are common (40%), indicating successful human-induced spread and adaptive plasticity in several climatic zones. In contrast to the persistent presence of regional endemic species (35%) indicates human-mediated range extensions, reinforcing the need for horticultural management in introducing plants to researched area. Overall, these trends suggest that campus flora reflects larger migration and invasion patterns caused by deliberate cultivation and environmental constraints (Liu et al., 2017).

Functional characteristics and horticultural significance

Campus flora has a wide range of diverse functional and ornamental characteristics, which determine its ecological function and aesthetic worth. Figure 7 shows the prevalence of highly ornamental species (45%), indicating purposeful selection for aesthetic improvement, with diverse flower colours, shapes, and phonologies that attract different pollinators and enhance landscape beauty (Erickson et al., 2022; Ilyas et al., 2021). Similarly, the presence of toxic or otherwise undesirable species (20%) necessitates careful public safety considerations and management strategies. Architectural specimens (15%) serve important structural functions in landscape design, creating vertical stratification and spatial organization. Moreover, substantial variation in functional traits such as leaf thickness, specific leaf area, and plant height affects species' resilience to urban stressors and their capacity to regulate microclimates and support habitat provision (Ilyas et al., 2021; Matos et al., 2024). Consequently, the plant community reflects a carefully managed equilibrium between ornamental value, ecological performance, and safety imperatives, with strategic selection and placement serving as decisive factors in its overall composition (Erickson et al., 2022; Ilyas et al., 2021; Matos et al., 2024).

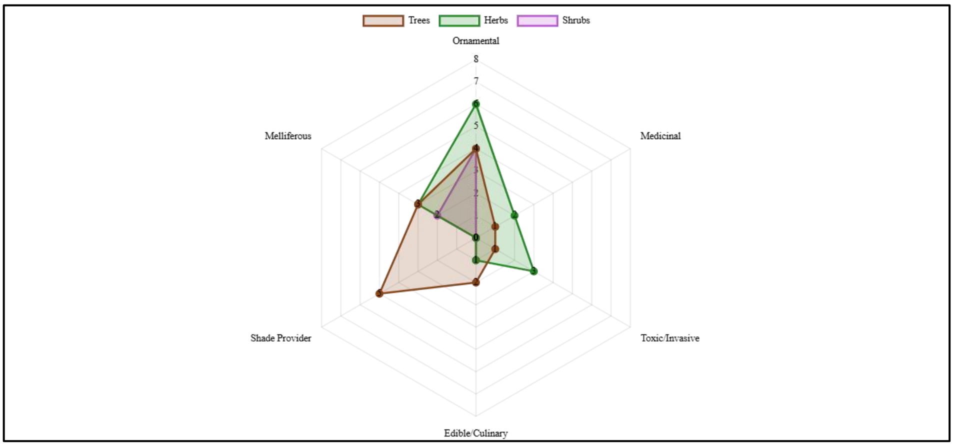

Fig. 7. Functional and ornamental traits of flora

The ecological functions of the campus flora are closely linked to its chemical and reproductive traits, with 43 % of species producing pleasant aromatics (43%) that likely reflect evolutionary optimization for pollinator attraction and defensive signalling. Peak flowering occurs in spring-early summer (April-June), aligning with Mediterranean optimal growing conditions and pollinator availability as depicted in the flowering calendar in Figure 8, reinforcing the predominance of entomophilous pollination (76%) and underscoring the importance of the campus flora for supporting local pollinator populations and maintaining ecosystem services. Moreover, the predominance of white and cream (30%), along with notable proportion of yellow (20%) flowers, reflects well documented pollinator attraction strategies, as detailed in Figure 9. While detailed quantitative data on aromatic prevalence and floral colour are lacking in broader research, existing studies affirm that campus plant communities consistently support pollinators, particularly through the prevalence of insect-pollinated species and the synchrony of flowering with peak pollinator activity and favourable local conditions (Charan et al., 2025; Lombah et al., 2025). This temporal and functional alignment strengthens key ecosystem services, notably pollination and biodiversity maintenance.

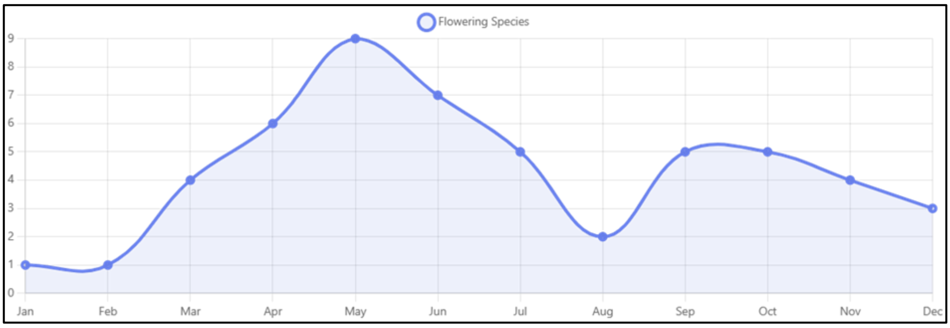

Fig. 8. Monthly flowering phenology of campus species

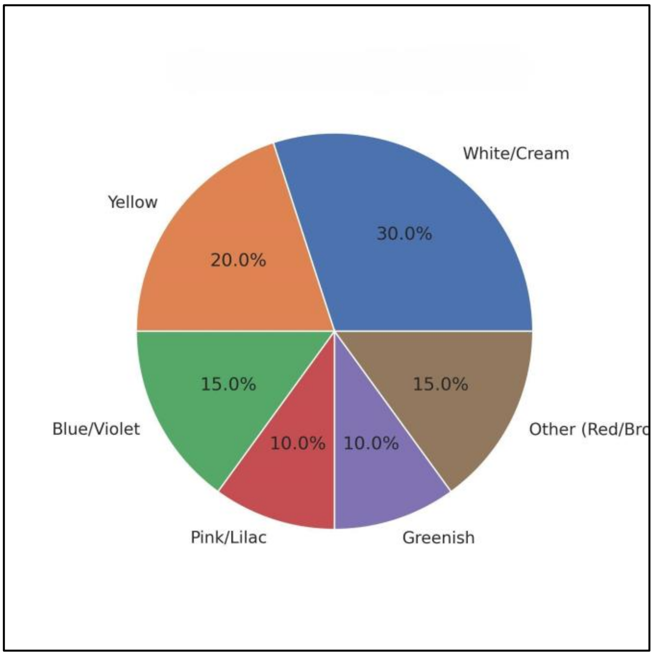

Fig. 9. Proportional distribution of flower colors

Additionally, campus flora contributes to ecosystem health by supporting diverse faunal communities, including pollinators like bees and birds, and by providing habitat complexity and resources throughout the year. These ecological roles underscore the importance of strategic plant selection and management in sustaining both biodiversity and essential ecosystem services on university campuses (Charan et al., 2025; Lombah et al., 2025).

Adaptations to the semi-arid campus environment

The campus flora demonstrates clear adaptations to the environmental constraints of the semi-arid Mediterranean climate, particularly water scarcity, as demonstrated in Figure 10. The predominance of drought-adapted taxa (30%) and species with full sun requirements (25%) reflects a sophisticated selection for high-irradiance and water-limited environments. This is further supported by the ecophysiological analysis presented in Figure 11, which shows an exceptional prevalence of high drought tolerance (55%) and a dominance of species with low-to-medium water requirements (85%), reflecting both convergent evolution towards xeromorphic characteristics, such as enhanced cuticular wax production and other water-use efficiency mechanisms.

These features, together with deep rooting, small or thick leaves, and high water-use efficiency, confer resilience under limited water availability and intense sunlight (Fahn, 1986; Kayabaş, 2021; Mircea et al., 2024; Nardini et al., 2014; Ramírez-Valiente et al., 2021). Population genetic studies confirm significant differentiation in drought tolerance across Mediterranean species, shaped by adaptation to local temperature and precipitation gradients, while phenotypic plasticity enables adjustment to increasingly arid conditions (Blanco-Sánchez et al., 2024; Nardini et al., 2014; Ramírez-Valiente et al., 2021).

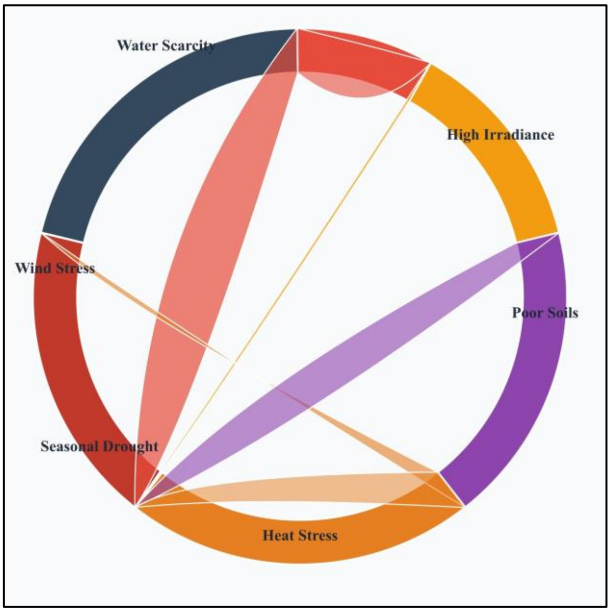

Fig. 10. Chord diagram of cultivation requirements and environmental tolerances

The cultivation matrix, emphasizing drainage (15%) and specialized care (20%), aligns with sustainable horticultural practices and supports hydraulic function in urban landscapes with limited water supply. Consequently, this curried and naturally selected assemblage functions as a robust model for examining plant hydraulic strategies and climate-change adaptation in Mediterranean urban settings (Kayabaş, 2021).

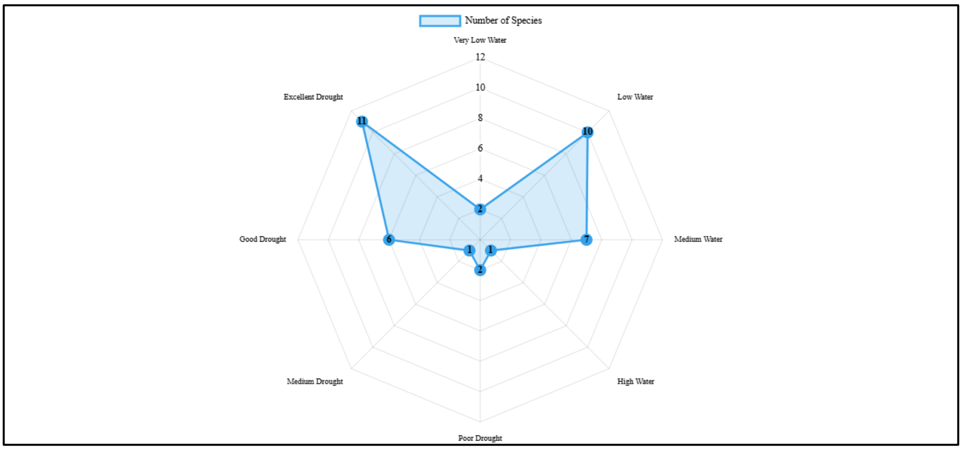

Fig. 11. Ecophysiological profile of campus flora based on drought tolerance and water needs

Conclusion

This study presents the first documented checklist of plant species for the Faculty of Law and Political Sciences campus at the University of M'sila, Algeria, revealing that even within a small, urban setting, the site supports a diverse flora comprising 20 species, including both native and introduced ornamental species. Structurally and functionally, the assemblage is well adapted to the semi-arid climate, exhibiting traits such as drought tolerance and water-use efficiency that enhance survival under local environmental constraints.

These findings provide a critical biodiversity baseline for guiding future ecological management and landscape planning, underscoring the importance of maintaining and protecting this green space to safeguard its role as a refuge for urban biodiversity. Moreover, prioritizing research on seasonal variation in plant diversity, plant–pollinator interactions, and species' ecological functions within the urban matrix will be essential to maximizing the environmental and social benefits this university green space can offer.

Future research should clearly evaluate the ecosystem services provided by this campus flora, such as microclimate regulation, carbon sequestration, improved air quality, and contributions to human well-being through psychological and educational advantages. Understanding these service flows will help to increase the evidentiary base for investing in university green infrastructure, as well as inform design strategies that prioritize both ecological integrity and the provisioning of various ecosystem services in semi-arid urban contexts.

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