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Urban Greenery: Assessing the Diversity and Ecological Role of Wall-Adherent Flora in Aligarh, (Uttar Pradesh) India

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Abstract: This study assesses the diversity and ecological importance of vascular and non-vascular wall-adherent flora in Aligarh, Uttar Pradesh. Through a comprehensive survey, we identified and documented the plant species growing on walls across different locations within the district. A total of 116 vascular plant species were documented, among which 92 were dicotyledonous, 21 were monocotyledons, and 3 were pteridophytes. Only two plant species of non-vascular flora (bryophytes) were observed. Members of the Poaceae, Asteraceae, and Amaranthaceae families were in the highest number compared to others. The Aligarh district's most widespread wall flora among perennial woody trees belongs to the species *Ficus*. The study emphasises the value of vascular wall-adherent flora as a crucial component of Aligarh's urban vegetation. The presence of a wide range of plant species, particularly woody perennials, atop Aligarh's city walls demonstrates the city's age and low level of urbanisation.

Keywords: Wall flora, Urban ecosystems, Urban vegetation, Biodiversity, Urbanisation, Vascular plant

Walls are man-made ecosystems that are regionally and globally dispersed. The best way to describe a wall ecosystems through their environmental and physical qualities, which also influence habitats and support life forms. In ecosystems, many biotic and abiotic variables are interconnected, but nutrients, physical substrate, microclimate, and moisture are the four essential ecosystem elements that are particularly important for walls. The fact that walls can be found in both rural and urban areas means that the pressure exerted by the nearby ruderal and semi-natural vegetation types significantly impacts the composition of a wall's flora (Duchoslav 2002). Additionally, existing species are affected by the wall's distinct zones, consisting of the vertical surface with joints, the top, and the base. Various plant species that may colonise such environments are influenced by the artificial genesis of urban landscapes and wall-building technologies (Duchoslav 2002). There is a need to characterise the plant species distribution as well as their composition present in these areas in order to more effectively comprehend and handle the walls, protect them, and improve the environmental benefits of their associated habitats since it has been observed that numerous species of plants grow on the vertical surface of walls in urban areas. The analysis of the wall flora aids in developing an understanding of urban landscapes (Francis 2011) and is particularly crucial for maintaining historical sites.

Whether native or non-native, the plants that sprout out on their own in cities provide crucial ecological purposes. These activities are referred by ecologists as "environmental services," which involve additional absorption of nutrients in wetlands, food and medicine, soil erosion control, air, water, and soil pollution tolerance, and heat reduction in paved areas. Lichens and mosses are indicators of the water-nutrient component of the wall ecology. Plants, such as shrubs, herbs, and seedlings, depend on the effects of water-nutrient availability and habitat interaction. At the same time, the tree exhibits dependence on the larger-scale habitat components. Natural ecosystems that are spatially persistent ensure that there are always sufficient sources of seed, water, nutrients, a favourable microclimate, and clean air to support the establishment of wall vegetation (Jim et al 2010). The plant colonisation of walls is highly dependent on the presence of diaspores from the nearby semi-natural vegetation. Many studies have been done to investigate the wall flora in India, but there are few studies done in the humid tropical region. For instance, in India, some studies have been done, such as the vegetation of Bankura District (West Bengal) (Ghosh and Das 2002) and the vascular wall flora of Varanasi city (Uttar Pradesh) (Singh et al 2014). Studies on wall flora have existed since earlier times, but little is known about the vegetation that grows and inhabits Aligarh's urban walls. This research aims to survey and catalogue the diverse plant species naturally inhabiting these unique

habitats while also evaluating their distribution patterns in terms of frequency, diversity, and dominance. Furthermore, the study delves into the specific case of Aligarh District, one of India's ancient urban centres, to investigate how cracks and crevices in walls serve as nurturing grounds for plant growth. By observing the seasonal shifts in wall flora, the study seeks to shed light on the intricate interplay between urban environments and the natural world.

MATERIAL AND METHODS

Study area: The Aligarh District (latitudes 77°, 29°, and 78°, 38° east and 27°, 29° to 28°, 10° north) is situated in western Uttar Pradesh. It has a tropical monsoon climate with a wet season that includes two extreme weather events: bitterly cold winters and hot summers (Gulzar and Siddiqui 2015). In terms of geography, the district's low lying centre and uplands to the east and west give it the appearance of a shallow basin. Ninety-two percent (252.5 mm) of the total rainfall falls during the months of July, August, and September. Hence district is characterised by a monsoon-type climate. Mid-November marks the beginning of the winter season, which lasts until February. January is the coldest month of the year, with an average low of 15°C. October is regarded as a strictly transitional month. March marks the beginning of the summer season, which finishes in mid-June. In May and June, the average high temperature may reach 45 ℃. Aligarh's soil is primarily alluvial. Old alluvium (bangar/bhangar) is found above the flood levels of the rivers and their tributaries, whereas young alluvium (Khadar) is found in the river areas impaired by flooding (Khan et al 2018).

Field observation: A two-year comprehensive field survey was conducted to document the plant species growing on the walls in the Aligarh district from January 2021 to December 2022. Identification of these wall-adherent species was done using standard monographs and with the help of a taxonomic expert. After identification, nomenclature was updated following 'The World Flora Online' (https://www.worldfloraonline.org/), 'Tropicos' (http://www.tropicos.org/) and 'International Plant Name Index' (https://www.ipni.org/) (Table 1). The collected plant specimens have been deposited in the herbarium of the Botany Department of Aligarh Muslim University, Aligarh. The wall flora was studied in the different areas of Aligarh district, like Barauli, Atrauli, Harduaganj, Gonda, and Jalali (Fig. 2). Besides this, the wall flora was studied near the old buildings of main Aligarh city, such as the walls of buildings represented by residences, hospitals, educational and administrative buildings, canteens, motor garages, health centres, gymnasiums, forts, playgrounds, and churches. Every two months, there was one visit. Consequently, twelve trips in total were made for the field survey throughout the two-year period. The attempts were undertaken to search each and every corner of the Aligarh district throughout the survey procedure for wall flora.

RESULTS AND DISCUSSION

The city walls have changed over the course of civilization into specialised areas. Following the survey, it was discovered that the walls of the Aligarh district were home to 118 different species of vascular and non-vascular plants. There were 113 angiosperms (Table 1), three pteridophytes (Table 2), and two bryophytes (Table 3). Additionally, the angiosperms were given by 81 genera from 42 families, out of which 92 plant species were dicotyledons that are dispersed across 36 families, compared to 21 plant species with monocotyledons dispersed in 6 families. The study demonstrates that dicotyledonous species predominate the angiosperm flora of Aligarh city walls, with a more significant proportion than monocotyledonous ones. Additionally, three species of pteridophytes and two species of bryophytes distributed among two families of each group (Tables 2, 3). These families were each assigned locations based on the Bentham & Hooker classification. The Aligarh wall flora was predominately made up of an angiosperm group of plants, and no known gymnosperm species were found. Poaceae (15) and Asteraceae (12) families had the greatest number of species of plants documented on the city walls of Aligarh, followed by the Amaranthaceae family, which has 7 plant species recorded, (Fig. 3). The previous research study also shows the dominance of the Asteraceae and Poaceae families on the wall ecosystem (Pavlov and Tonkov 2005, Nedelcheva 2011, Singh 2011, Singh et al 2014).

The walls were colonised by the representative members of these three dominant families throughout three distinct seasons. Members of the Asteraceae often colonise the walls in the winter. In contrast, those of the Poaceae typically do so during the rainy months, while the members of Amaranthaceae colonise the walls mainly throughout the summer. In accordance with the study, only 11 (9.4%) plant species were discovered to exist during the summer season, whereas 31 (26.4%) and 37 (31.6%) plant species only exist during the rainy and winter seasons, respectively. Additionally, 1.7% of plant species exist in both the rainy and summer seasons as well as the winter and summer seasons, compared to 11 (9.4%) species that were discovered to live in both. However, 25 (21.3%) habitats for plants on walls are ideal for their appearance and growth throughout the winter and rainy seasons. Furthermore, it is evident from the study that the rainy season supports many plant species connected to walls. The annual plants (41%) were greater in number among other life span forms, followed by perennials (40%).

Table 1. Angiospermic wall flora of Aligarh district, India

Plant species	Family	Habit	Seasonal occurence	Origin status	Life forms	Accession No.
Tinospora cordifolia (Willd.) Miers	Menispermaceae	Herb	Rainy	Native	Therophyte	31337
Argemone mexicana L.	Papavaraceae	Herb	Winter	Exotic	Therophyte	31221
Fumaria indica (Hussk.) Puglesly	Fumaraceae	Herb	Winter	Native	Chamaephyte	31575
Brassica rapa L.	Brassicaceae	Herb	Winter	Exotic	Therophyte	31121
Lepidium didymum L.	Brassicaceae	Herb	Winter	Exotic	Chamaephyte	31135
Sisiumbrium irio L.	Brassicaceae	Herb	Winter	Native	Therophyte	31192
Portulaca oleracea L.	Portulacaceae	Herb	Winter	Exotic	Chamaephyte	31291
Portulaca grandiflora Hook.	Portulacaceae	Herb	Winter	Exotic	Therophyte	31928
Stellaria media (L.) Vill.	Caryophyllaceae	Herb	Winter	Native	Therophyte	3104
Bombax ceiba Burm. F.	Malvaceae	Tree	Rain, Winter & Summer	Native	Phanerophyte	31457
Malvastrum coromandelianum (L.) Garcke	Malvaceae	Undershrub	Rainy	Exotic	Therophyte	31303
Sida rhombifolia L.	Malvaceae	Undershrub	Rainy	Exotic	Therophyte	31438
Urena lobata L.	Malvaceae	Undershrub	Rainy	Exotic	Therophyte	31405
Ziziphus nummularia (Burm.f.) Wt. & Arn.	Rhamnaceae	Shrub	Rainy,Winter & Summer	Native	Phanerophyte	31463
Biophytum sensitivum DC.	Oxalidaceae	Herb	Winter	Native	Therophyte	31460
Oxalis corniculata L.	Oxalidaceae	Herb	Rainy	Exotic	Chamaephyte	31965
Azadirachta indica A. Juss.	Meliaceae	Tree	Rainy,Winter & Summer	Native	Phanerophyte	31994
Melia azedarach L.	Meliaceae	Tree	Rainy, Winter & Summer	Native	Phanerophyte	31453
Melilotus indicus (L.) All	Fabaceae	Herb	Winter	Native	Chamaephyte	31503
Melilotus officinaliss (L.) Pall.	Fabaceae	Herb	Winter	Exotic	Chamaephyte	31541
Trifolium alexandrium L.	Fabaceae	Herb	Winter	Exotic	Phanerophyte	31504
Cassia tora L.	Ceaslpiniaceae	Herb	Winter & Rainy	Exotic	Therophyte	31402
Leucaena leucocephala (Lam.) de Wit	Ceaslpiniaceae	Tree	Rainy, Winter & Summer	Exotic	Phanerophyte	31982
Lablab purpureus (L.) Sweet	Ceaslpiniaceae	Herb	Winter & Summer	Exotic	Phanerophyte	31912
Citrullus lanatus (Thunb.) Matsum. & Nakai	Cucurbitaceae	Herb	Rainy	Exotic	Therophyte	31924
Coccinia grandis (L.) Voigt.	Cucurbitaceae	Herb	Winter & Summer	Native	Therophyte	31506
Trianthema Portulacastrum L.	Aizoaceae	Herb	Summer	Exotic	Therophyte	31506
Eucalyptus hybrida Maiden	Myrtaceae	Tree	Rainy, Winter & Summer	Exotic	Phanerophyte	31493
Oldenlandia corymbosa L.	Rubiaceae	Herb	Winter	Native	Therophyte	31448
Ageratum conyzoides L.	Asteraceae	Herb	Summer	Exotic	Therophyte	31559
Bidens Pilosa L.	Asteraceae	Herb	Winter	Exotic	Therophyte	31529
Blumea eriantha DC.	Asteraceae	Herb	Summer	Native	Therophyte	31216
Blumea lacera DC.	Asteraceae	Herb	Rainy	Native	Therophyte	31342
Calandula officinalis L.	Asteraceae	Herb	Winter	Native	Therophyte	31273
Erigeron bonariensis L.	Asteraceae	Herb	Summer & Rainy	Exotic	Therophyte	31591
Eclipta alba Hassk.	Asteraceae	Herb	Rainy	Native	Therophyte	31369
Gnaphalium purpureum L.	Asteraceae	Herb	Winter	Exotic	Therophyte	31219
Parthenium hysterophorus L.	Asteraceae	Herb	Winter & Rainy	Exotic	Therophyte	31217
Sonchus arvensis L.	Asteraceae	Herb	Winter	Exotic	Therophyte	31197

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Plant species	Family	Habit	Seasonal occurence	Origin status	Life forms	Accession No.
Sonchus oleraceus L.	Asteraceae	Herb	Winter	Exotic	Therophyte	31198
Tagetes erecta L.	Asteraceae	Herb	Winter	Exotic	Therophyte	31219
Anagallis arvensis L.	Primulaceae	Herb	Winter	Exotic	Therophyte	31558
Catharanthus roseus G. Don	Apocynaceae	Herb	Rainy, Winter & Summer	Exotic	Therophyte	31414
Calotropis gigantea (L.) R. Br.	Asclepiadaceae	Shrub	Rainy, Winter & Summer	Native	Phanerophyte	31590
Calotropis procera (Ait.) R. Br.	Asclepiadaceae	Shrub	Rainy, Winter & Summer	Native	Phanerophyte	31311
Ipomea nil (L.) Roth.	Convolvulaceae	Herb	Summer	Exotic	Chamaephyte	31547
Evolvulus nummularius L.	Convolvulaceae	Herb	Rainy	Native	Chamaephyte	31591
Campsis grandiflora K.Schum.	Bignoniaceae	Tree	Summer	Exotic	Phanerophyte	31006
Datura metel L.	Solanaceae	Undershrub	Rainy & Winter	Exotic	Phanerophyte	31567
Datura stramonium L.	Solanaceae	Herb	Rainy	Exotic	Therophyte	31496
Nicotiana plumbaginifolia Viv.	Solanaceae	Herb	Winter	Exotic	Therophyte	31258
Solanum nigrum L.	Solanaceae	Herb	Winter	Native	Therophyte	31275
Solanum virginianum L.	Solanaceae	Herb	Rainy	Native	Therophyte	31427
Wethania somnifera (L.) Dunal	Solanaceae	Herb	Winter	Native	Therophyte	31319
Lindenbergia indica (L.) Kuntz	Scrophulariaceae	Herb	Rainy & Winter	Native	Therophyte	31276
Verbascum chinense (L.) Staut.	Scrophulariaceae	Herb	Winter	Exotic	Therophyte	31428
Veronica agrestis L.	Scrophulariaceae	Herb	Winter	Exotic	Therophyte	31568
Justicia japonica Thunb.	Acanthaceae	Herb	Winter	Exotic	Therophyte	31078
Ruellia tuberosa L.	Acanthaceae	Herb	Rainy & Summer	Exotic	Therophyte	31484
Rungia pectinata (L.) Nees	Acanthaceae	Herb	Winter	Native	Therophyte	31474
Lantana camara ((L.) R.W. Sanders	Verbenaceae	Shrub	Rainy,Winter & Summer	Exotic	Phanerophyte	31035
Hyptis suaveolens (L.) Poit.	Lamiaceae	Herb	Rainy	Native	Therophyte	31150
Ocimum amaricanum L.	Lamiaceae	Herb	Winter	Exotic	Therophyte	31138
Ocimum basilicum L.	Lamiaceae	Shrub	Rainy, Winter & Summer	Native	Therophyte	31550
Scoparia dulcis L.	Plantaginaceae	Herb	Summer	Native	Therophyte	31583
Rumex dentatus L.	Polygonaceae	Herb	Winter	Native	Therophyte	31066
Rumex crispus Linn.	Polygonaceae	Herb	Rainy	Native	Therophyte	31079
Peperomia pellucida (L.) Kunth.	Piperaceae	Herb	Rainy	Exotic	Therophyte	31250
Achyranthes aspera L.	Amaranthaceae	Herb	Rainy,Winter & Summer	Native	Therophyte	31031
Alternanthera sessilis (L.) DC.	Amaranthaceae	Herb	Rainy,Winter & Summer	Exotic	Chamaephyte	31249
Amaranthus polygamous L.	Amaranthaceae	Herb	Summer	Native	Therophyte	31062
Amaranthus spinosus L.	Amaranthaceae	Herb	Rainy,Winter & Summer	Exotic	Therophyte	31049
Amaranthus viridis L.	Amaranthaceae	Herb	Summer	Native	Therophyte	31011
Celosia argentea L.	Amaranthaceae	Herb	Winter	Native	Therophyte	31532
Gomphrena celosioides Mart.	Amaranthaceae	Herb	Rainy, Winter & Summer	Exotic	Therophyte	31551
Chenopodium album L.	Chenopodiaceae	Herb	Winter	Exotic	Therophyte	31036
Chenopodium murale L.	Chenopodiaceae	Herb	Winter	Exotic	Therophyte	31032
Boerhavia diffusa L.	Nyctaginaceae	Herb	Rainy & Winter	Native	Chamaephyte	30309

Cont...

Table 1. Angiospermic wall flora of Aligarh district, India

Plant species	Family	Habit	Seasonal occurence	Origin status	Life forms	Accession No.
Ficus benghalensis L.	Moraceae	Tree	Rainy,Winter & Summer	Native	Phanerophyte	31323
Ficus racemosa Roxb.	Moraceae	Tree	Rainy,Winter & Summer	Exotic	Phanerophyte	31365
Ficus hispida L. f.	Moraceae	Tree	Rainy,Winter &Summer	Native	Phanerophyte	31278
Ficus infectoria Roxb.	Moraceae	Tree	Rainy,Winter &Summ	Native	Phanerophyte	31349
Ficus religiosa L.	Moraceae	Tree	Rainy,Winter & Summer	Native	Phanerophyte	31322
Ficus carica L.	Moraceae	Tree	Rainy, Winter & Summer	Native	Phanerophyte	31515
Morus alba L.	Moraceae	Tree	Rainy,Winter & Summer	Exotic	Phanerophyte	31259
Holoptelea integrifolia Roxb.	Ulmaceae	Tree	Rainy,Winter & Summer	Native	Phanerophyte	31325
Cannabis sativa L.	Cannabaceae	Herb	Rainy	Exotic	Therophyte	31383
Acalypha indica L.	Euphorbiaceae	Herb	Rainy	Native	Therophyte	31564
Croton bonplandianum Baill.	Euphorbiaceae	Herb	Summer	Exotic	Therophyte	31364
Euphorbia hirta L.	Euphorbiaceae	Herb	Rainy & Winter	Exotic	Therophyte	31412
Euphorbia thymifolia L.	Euphorbiaceae	Herb	Rainy & Winter	Exotic	Therophyte	31001
Phyllanthus niruri Webst.	Euphorbiaceae	Herb	Rainy & Winter	Native	Therophyte	31535
MONOCTYLEDONS						
Zephyranthes sulphurea L.	Amaryllidaceae	Herb	Summer	Native	Therophyte	31150
Monstera gigantea Roxb.	Araceae	Shrub	Rainy,Winter & Summer	Native	Therophyte	31009
Sagittaria sagittifolia Linn.	Alismataceae	Herb	Rainy	Native	Therophyte	31017
Commelina benghalensis L.	Commelinaceae	Herb	Rainy	Native	Therophyte	31101
Cyperus rotendus L.	Cyperaceae	Herb	Rainy	Native	Therophyte	31168
Cyperus iria L.	Cyperaceae	Herb	Rainy	Native	Therophyte	31110
Brachiaria ramosa (L.) Stapf	Poaceae	Herb	Rainy	Exotic	Therophyte	31166
Chloris virgata Sw	Poaceae	Herb	Rainy & Winter	Exotic	Therophyte	31067
Cynodon dactylon (L.) Pers.	Poaceae	Herb	Rainy, Winter & Summer	Exotic	Hemicryptophyte	31002
Dactyloctenium aegyptium (L.) Willd	Poaceae	Herb	Rainy	Native	Hemicryptophyte	31155
Dichanthium annulatum Stapf.	Poaceae	Herb	Rainy	Native	Cryptophyte	31086
Digitaria ciliaris (Retz.) Koeler	Poaceae	Herb	Rainy	Native	Therophyte	31144
Digitaria setigera Roth	Poaceae	Herb	Rainy	Native	Therophyte	31071
Echinochloa colona (L.) Link	Poaceae	Herb	Rainy	Native	Therophyte	31103
Eleusine indica (L.) Gaertn.	Poaceae	Herb	Summer	Native	Chemaephyte	31141
Eragrostis amabilis ((L.) Wight & Arn.	Poaceae	Herb	Rainy	Exotic	Therophyte	31134
Eragrostis minor Host	Poaceae	Herb	Rainy	Native	Therophyte	31041
Oplismenus burmannii Beauv.	Poaceae	Herb	Rainy	Exotic	Chamaephyte	31028
Phalaris minor Retz.	Poaceae	Herb	Winter	Native	Therophyte	31162
Poa annua L.	Poaceae	Herb	Winter	Exotic	Therophyte	31037
Setaria verticillata (L.) P.Beauv.	Poaceae	Herb	Rainy	Exotic	Therophyte	31064

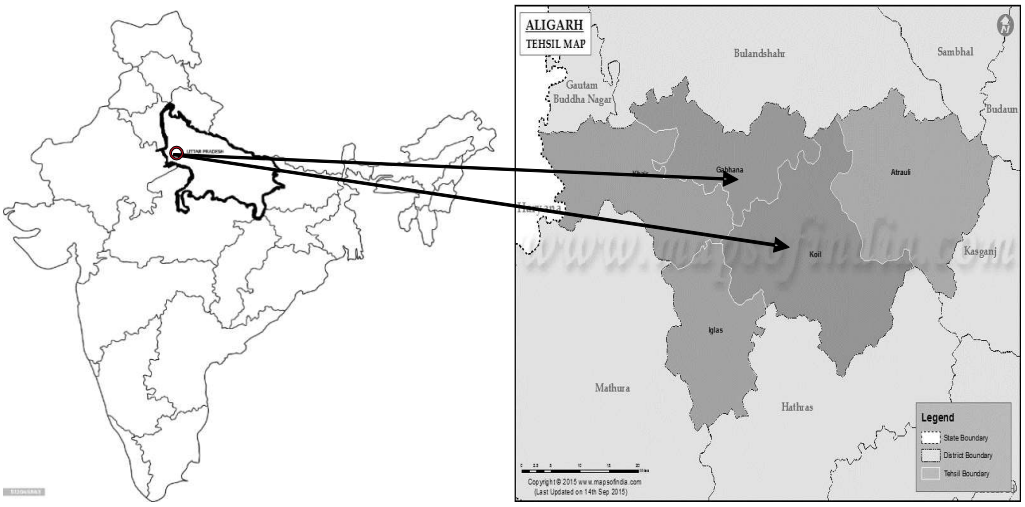


Fig. 1. Map of India showing Aligarh District (Uttar Pradesh)

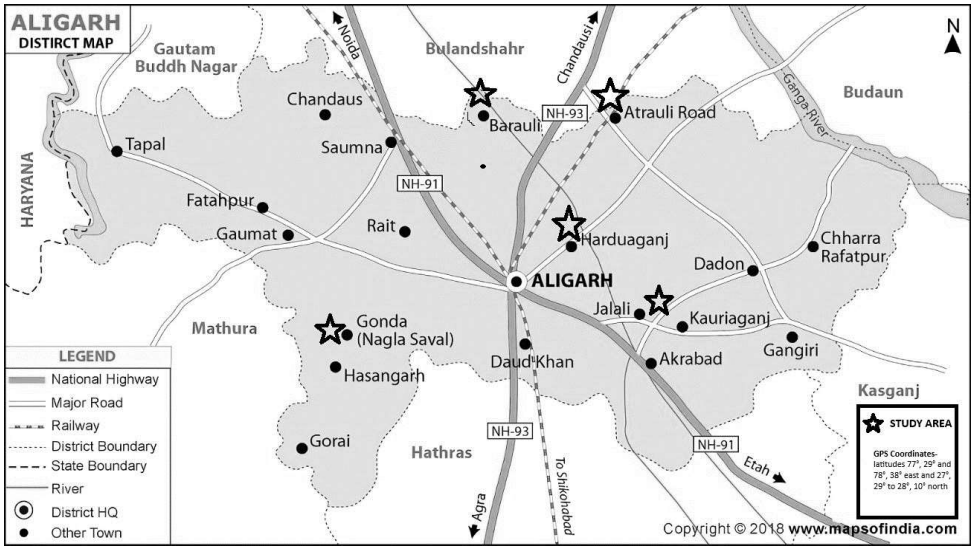


Fig. 2. Site location in relation to important landmarks

Table 2. Pteridophytic wall flora of Aligarh district, India

Plant species	Family	Habit	Seasonal occurrence	Origin status	Life forms	Accession No.
Adiantum philippense L.	Pteridaceae	Herb	Rainy & Winter	Native	Cryptophyte	316
Pteris vittata L.	Pteridaceae	Herb	Rainy & Winter	Exotic	Cryptophyte	317
Nephrolepis biserrata (Sw.) Schott.	Nephrolepidaceae	Herb	Rainy & Winter	Native	Cryptophyte	318

Table 3. Bryophytes wall flora of Aligarh district, India

Plant species	Family	Habit	Seasonal occurrence	Origin status	Life form
Marchantia polymorpha L.	Marchantiaceae	Herb	Rainy	Native	Cryptophyte
Funaria hygrometrica Hedw.	Funariaceae	Herb	Rainy	Native	Cryptophyte

Based on the research on origin status, out of the total documented species, 59 (50.4%) were native and 58 (49.5%) were exotic; there were just as many native species as exotic species. On the base and vertical wall surfaces, native species are more prevalent, although alien plants can easily occupy the roofs and tops of the walls. The studies on invasion ecology showed that disturbed habitats were populated by a small number of species, including *L. camara, M. micrantha*, *C. odorata*, and *A. conyzoides,* which led to a reduction in the richness of species (Sakachep et al 2021). The herbaceous 93 (79.4%) life forms were dominant in the total plant species recorded, followed by 14 (11.9%) trees, 6 (5.1%) shrubs, and 4 (3.4%) undershrubs.

The wall flora of Aligarh city is mainly populated by herbaceous plants. The wall flora also indicates that herbaceous plants predominate over other habit patterns (Pavlova and Tonkov 2005, Dos Reis et al 2006, Nedelcheva 2011, Singh 2011, Singh et al 2014). Additionally, herbaceous plants are better adapted to grow on walls in comparison with shrubs and trees. The study on life forms suggests the dominance of therophytes (66%) followed by phanerophytes (18%) and chameophytes (10%) in the wall flora of Aligarh District (Fig. 4), both cryptophytes and hemicryptophytes were also found. The plant species grow in different seasons, such as winter, summer, rainy, and all seasons. The maximum number of plant species were during the rainy (30.7%), season followed by winter (28.2%) (Fig. 5).

The vegetation that grows on city walls is an area of urban

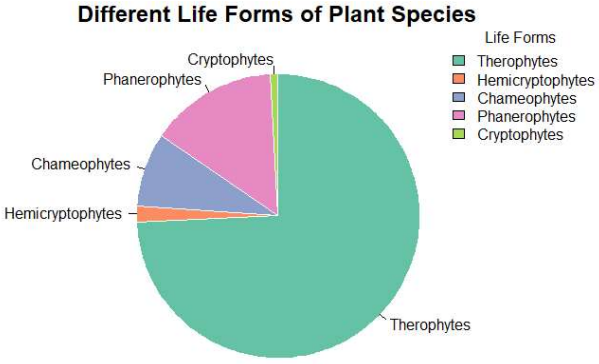


Fig. 4. Contribution by different life forms in wall flora

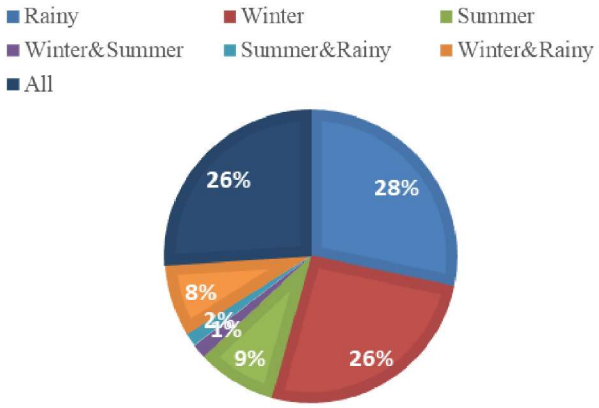


Fig. 5. Percent contribution by plant species growing in different seasons

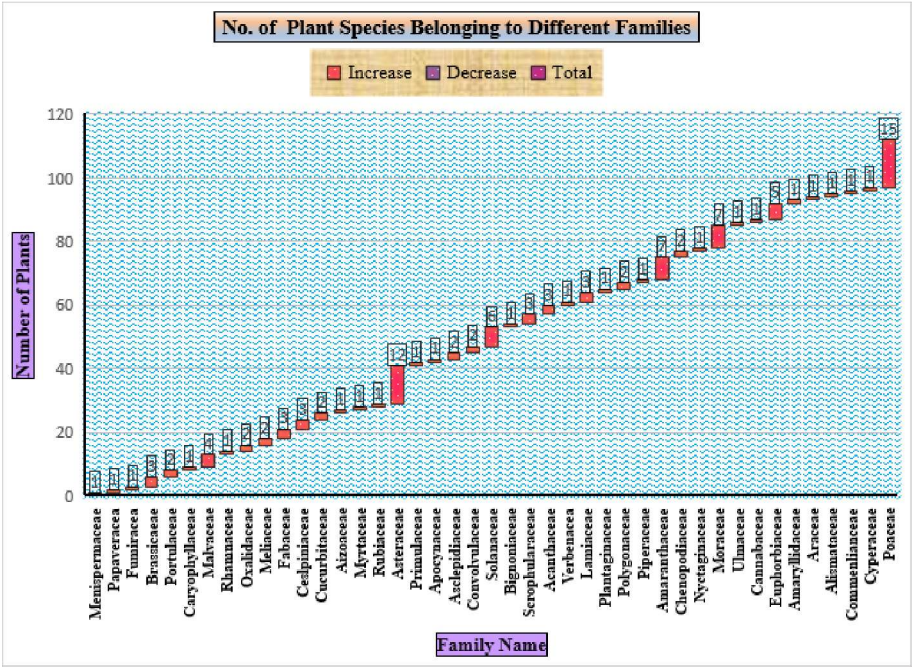
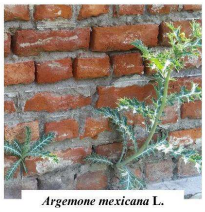
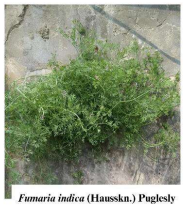


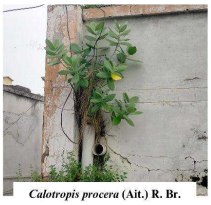
Fig. 3. Number of plants belonging to different families

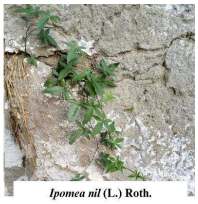

Tinospora cordifolia (Willd.) Miers


Argemone mexicana L.


Fumaria indica (Hausskn.) Puglesly


Catharanthus roseus G. Don

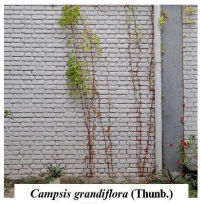

Calotropis procera (Ait.) R. Br.


Ipomea nil (L.) Roth.

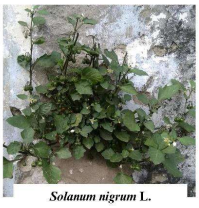

Brassica rapa L.

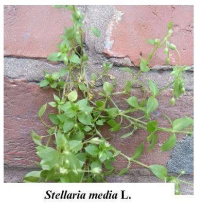

Lepidiun didymum L.

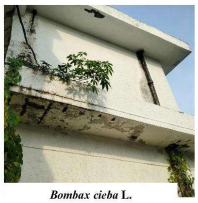

Portulaca oleracea L.

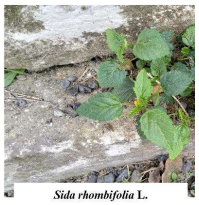

Campsis grandiflora (Thunb.) K.Schum

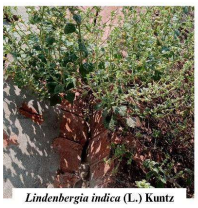

Nicotiana plumbaginifolia Viv.


Solanum nigrum L.

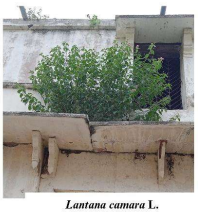

Stellaria media L.

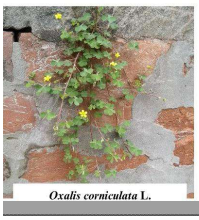

Bombax ceiba L.

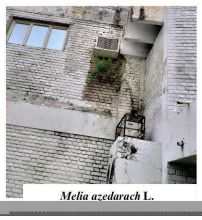

Sida rhombifolia L.

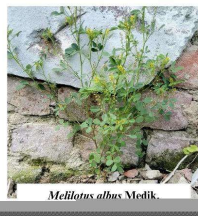

Lindenbergia indica (L.) Kuntz

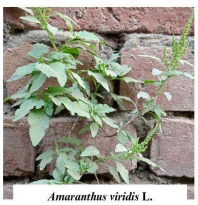

Veronica agrestis L.

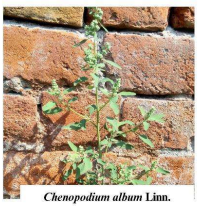

Lantana camara L.

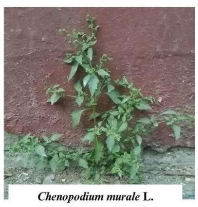

Oxalis corniculata L.

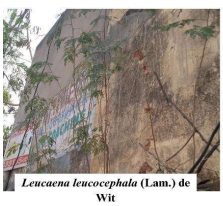

Melia azedarach L.


Melilotus albus Medik.


Amaranthus viridis L.


Chenopodium album Linn.

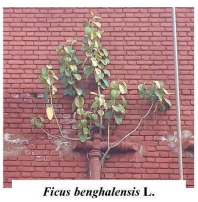

Chenopodium murale L.


Leucaena leucocephala (Lam.) de Wit

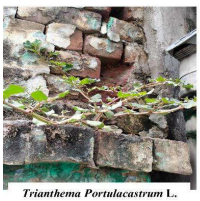

Citrullus lanatus (Thunb.) Matsum. & Nakai

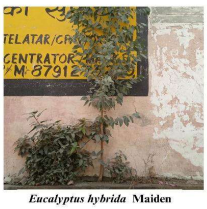

Coccinia grandis (L.) Voigt.

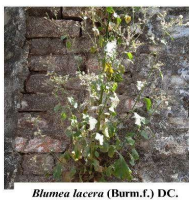

Boerhavia diffusa L.


Ficus benghalensis L.


Ficus virens Aiton


Trianthema Portulacastrum L.

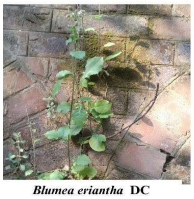

Eucalyptus hybrida Maiden


Blumea lacera (Burm.f.) DC.


Ficus carica L.

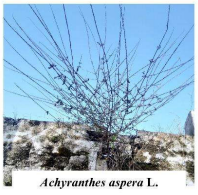

Ficus religiosa L.


Ficus racemosa Roxb.


Blumea eriantha DC


Calandula officinalis L.


Conyza bonariensis L.


Achyranthes aspera L.

Acalypha indica L.

Euphorbia hirta L.

Eclipta alba Hassk.

Gnaphalium purpureum L.

Sonchus oleraceus L.

Phyllanthus niruri Webst.

Achyranthes aspera L.

Holoptelea integrifolia *Roxb.*

Fig. 6. Selected photographs of the wall flora of Aligarh district

greenery that has received little attention but is crucial to the environment. Wall-adherent flora is a distinctive and overlooked urban plant that can survive in harsh conditions like soil and water scarcity, extreme heat, and pollution exposure. These plant communities have exhibited fantastic adaptability to the urban environment, which has allowed them to endure and add to the urban greenery. On a local, regional, and global level, the exponential rise of the human population and the ensuing rapid urbanisation in emerging nations like India promote natural and ecological system change processes (Roy et al 2020). Singh (2015) observed that prevalent woody plants found colonising the vertical wall surfaces of Varanasi city were *Ficus benghalensis, Ficus hispida, Ficus racemosa, Ficus religiosa, and Ficus virens*. Because of its rich biodiversity, it plays an important role in ecological services. A healthy and resilient urban environment requires understanding and commitment to preserving urban greenery, including the frequently ignored vegetation that adheres to walls. Studying the wall flora also essential for managing urban biodiversity and conservation efforts since it helps to manage natural resources in an ecologically sound manner while also providing habitat for wildlife (Roy et al 2020). Significant discoveries included the ecological importance of wall-adherent plants in maintaining urban wildlife, serving as pollinator pathways, and improving air quality. Thirteen significant ecosystem services, including managing urban temperature, air purification, and waste disposal, were identified in a study by Gómez-Baggethun (2013). The importance of the wall-adherent vegetation of Aligarh's urban greenery cannot be overstated. By offering crucial ecological niches for numerous organisms in the city, these green spaces contribute to the total urban biodiversity. The studied area was highly rich in biodiversity. Vegetation's ecological roles are essential for enhancing human welfare, protecting the environment, and reducing global warming. Studies on the ecological role of vegetation is highly valuable scientifically for managing vegetation in the future since land use and climate change are two major factors that affect how ecosystem services are provided (Yang et al 2019).

CONCLUSION

Aligarh district is made up of robust, adaptive, and well-equipped taxa that survive in harsh conditions as compared to other plants. Poaceae and Asteraceae family members were dominant during the rainy and winter seasons, respectively. The herbaceous life forms were dominant of the total plant species recorded; the most frequent woody plants are *Ficus benghalensis, Ficus racemosa, Ficus religiosa, Ficus virens, Bombax cieba, Lucaena lucocephala, Zizyphus numularis, Holoptelea intigrifolia, Lantana camara,* and *Calotropis procera* colonises the vertical wall surfaces of Aligarh District. The presence of a wide range of plant species, particularly woody perennials, atop Aligarh city walls demonstrates the city's age and low level of urbanization.

AUTHORS CONTRIBUTION

Mo Shadab, Nazish Akhtar, and Quratul Ain conducted the survey and wrote the manuscript. Mo Shadab, Mumayyza Khan and Nazish Akhtar performed statistical analysis. Mo Shadab and Uzma Parveen reviewed and edited the manuscript. M.B. Siddiqui designed and supervised the work.

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