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Observations on the Woody Wall Flora of Varanasi City, India

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ABSTRACT

An observational study was conducted to explore the woody wall flora of the world's oldest city of Varanasi, India located at the bank of sacred Ganges River. Forty one woody plants of 35 genera belonging to 18 families were recorded on the walls of the city represented exclusively by the dicotyledonous angiospermic group of plants. Fabaceae, Moraceae and Apocynaceae were the dominant families of the woody wall flora of Varanasi city. Native woody species were greater in number compared to exotic woody species on the walls of Varanasi city.
Keywords: Varanasi City, Vertical Wall Surface, Woody Wall Flora

I. INTRODUCTION

Walls are manmade habitats representing a specific environment which is partly similar to rocks and rock fissures [1]. The artificial origin in urban landscape and technology of wall building influence a range of plant species which are able to colonize such habitats [2]. Walls as a specialized microenvironment conditioned by human beings are colonized only by plant species with specific adaptations for development and reproduction [3, 4]. Considering vertical division, walls usually consist of three different zones (i) the base, (ii) the vertical wall surface with joints (fissures); and (iii) the wall top.

The study of wall flora provides a better understanding of the urban environment [1, 5-7]. Several studies have been conducted to explore the wall flora in urban environment [1, 2, 5, 6-14]. However, till date no any information is available regarding the exploration of woody wall flora of a place from any part of the world. Therefore, the main objective of the present study was to explore the woody wall flora of Varanasi city (India), which is one of the oldest living cities of the world. Varanasi also known as Benares (or Banaras) and Kashi is the cultural capital of India. The city is a melting pot of religion and culture. Varanasi has a long continuous history since 1500 B.C. and finds a mention in *Atharvaveda* and in Indian Epics and most of the Indian *Puranas* [15].

STUDY AREA

Varanasi is situated on the left crescent bank of sacred Ganges (also called as Ganga) River (Fig. 1) (25^{o} $18^{'}$ N Latitude and 82^{o} $59^{'}$ E Longitude). It spreads over an area of about 1,550 km^2 with population of about 1.4 million according to 2011 census. The city area stands a height between 71-80 m above mean sea level.

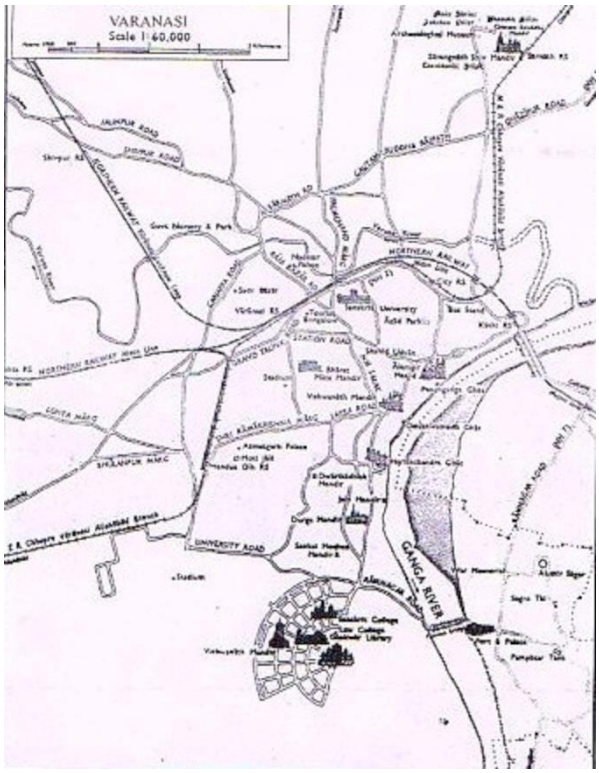

Figure 1: Map of the Study Area

The climate is Tropical monsoonal type with three distinct seasons; the cold (November to February), the hot (March to mid-June), and the rainy (mid-June to September) while October is regarded strictly as transitional month. The diurnal range of temperature ranges on average between 13 and 14.5^{o}C in the cold and hot months. The highest monthly temperature is recorded in May, varying between 32 and 42^{o}C. The annual rainfall is around 100 cm of which about 90% occurs in the rainy season [15].

II. METHODS AND MATERIAL

The present study is based on a yearlong intensive field survey and collection taken from July 2014 to June 2015. Regular field visits were made to record and collect the various woody plant species growing on the walls of Varanasi city. The walls surveyed to record and collect the woody plants included older walls surrounding residential compounds, parks, gardens, schools, colleges, universities, hospitals, temples, forts, monuments etc., and also the walls of all types of buildings, temples, forts and monuments as well. The collected specimens were identified through flora of Hooker (1875-1897) [16] and Duthie (1903-1922) [17].

Figure 2. *Ficus benghalensis* and *Ficus racemosa* growing on vertical wall surface in the street of world famous Sankatmochan temple in Varanasi city

III. RESULT AND DISCUSSION

Woody plants recorded on the walls of Varanasi city are presented in the Table 1. A total of 41 woody plants belonging to 35 genera and 18 families were recorded on the walls of Varanasi city. All the recorded species were represented by the dicotyledonous angiospermic group of plants. A previous study on the wall flora of Varanasi city reports the dominance of dicotyledonous plant species on the walls with greater degree of variety compared to monocotyledonous plant species [14]. In the present study *Ficus* with 6 species was the dominant genus of the woody wall flora of Varanasi city.

The maximum number of woody plants in the study were represented by the Fabaceae (10 species) family followed by the Moraceae (7 species) and Apocynaceae (4 species) families. Therefore, the study suggests that Fabaceae, Moraceae and Apocynaceae are the dominant families of the woody wall flora of the Varanasi city. However, a study on the vascular wall flora of Varanasi city reports the dominance of Asteraceae, Poaceae and Amaranthaceae families [14]. Several other studies conducted on the wall flora suggests the dominance of Asteraceae and Poaceae families [7, 11, 18-20]. In present study the Fabaceae, Moraceae and Apocynaceae families together constituted more than half of the woody plant species of the walls of Varanasi city.

Analysis of the origin status of the woody wall plants reveals that of total woody plants recorded on the walls of the Varanasi city, 23 (56.10%) were represented by the native species while 18 (43.90%) were represented by the exotic species. Thus the number of indigenous woody species was greater compared to non-indigenous species on the walls of Varanasi city. Several studies on the wall flora reports adequate representation by the exotic species [7, 13, 21]. Furthermore, Singh (2014) [14] reported greater number of exotic species compared to native species on the walls of Varanasi city.

Woody plants frequently colonizing the wall base of Varanasi city were represented by *Calotropis gigantea, Calotropis procera, Ficus hispida, Lantana camara, Senna occidentalis, Ziziphus nummularia* and *Ziziphus oenoplia*. These woody species are the component species of the surrounding vegetation. Species composition of the base of walls consists of plant species of nearby vegetation [2].

It was observed during the study that *Ficus benghalensis, Ficus hispida, Ficus racemosa, Ficus religiosa* and *Ficus virens* var. *sublanceolata* were the most common woody plants colonizing the vertical wall surfaces of the Varanasi city. Colonization of plants on vertical wall

surfaces depends on the level of disintegration of mortar, concrete or any other type of binding material [2].

Woody plants colonizing the wall tops of the Varanasi city were represented by *Albizia lebbeck, Azadirachta indica, Alstonia scholaris, Bombax ceiba, Dalbergia sissoo, Ficus religiosa* and *Leucaena leucocephala*. The colonization of plant species is determined by the disintegration of material on the wall tops [2].

IV. CONCLUSION

It can be concluded from the study that walls of Varanasi city hosts variety of woody plants dominated chiefly by the Fabaceae, Moraceae and Apocynaceae families which clearly indicates that the city is old with low level of urbanization.

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Table 1. List of woody plants recorded on the walls of Varanasi city

S. No.	Plant species	Family	Origin status
1.	*Abutilon indicum* (L.) Sweet	Malvaceae	Native
2.	*Aegle marmelos* (L.) Corr.	Rutaceae	Native
3.	*Albizia lebbeck* (L.) Willd.	Fabaceae	Native
4.	*Alstonia scholaris* R. Br.	Apocynaceae	Native
5.	*Anona squamosa* L.	Annonaceae	Exotic
6.	*Azadirachta indica* A. Juss.	Meliaceae	Native
7.	*Bombax ceiba* L.	Malvaceae	Native
8.	*Calliandra haematocephala* Hassk	Fabaceae	Exotic
9.	*Calotropis gigantea* (L.) R. Br.	Apocynaceae	Native
10.	*Calotropis procera* (Ait.) R. Br.	Apocynaceae	Native
11.	*Cestrum nocturnum* L.	Solanaceae	Exotic
12.	*Dalbergia sissoo* Roxb.	Fabaceae	Native
13.	*Dichrostachys cinera* (L.) Wt. & Arn.	Fabaceae	Native
14.	*Ficus benghalensis* L.	Moraceae	Native
15.	*Ficus hispida* L. f.	Moraceae	Native
16.	*Ficus mollis* Vahl	Moraceae	Native
17.	*Ficus racemosa* L.	Moraceae	Exotic
18.	*Ficus religiosa* L.	Moraceae	Native
19.	*Ficus virens* var. *sublanceolata* Miq. Corner	Moraceae	Native
20.	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae	Native
21.	*Jatropha integerrima* Jacq.	Euphorbiaceae	Exotic

22.	*Lantana camara* L.	Verbenaceae	Exotic
23.	*Lawsonia inermis* L.	Lythraceae	Exotic
24.	*Leucaena leucocephela* Willd.	Fabaceae	Exotic
25.	*Moringa oleifera* Lam.	Moringaceae	Exotic
26.	*Morus alba* L.	Moraceae	Exotic
27.	*Murrya paniculata* (L.) Jacq.	Rutaceae	Native
28.	*Nyctanthes arbor-tristis* L.	Oleaceae	Native
29.	*Ocimum sanctum* L.	Lamiaceae	Native
30.	*Psidium guajava* L.	Myrtaceae	Exotic
31.	*Punica granatum* L.	Lythraceae	Exotic
32.	*Ricinus communis* L.	Euphorbiaceae	Exotic
33.	*Senegalia polyacantha* (Willd.) Seigler & Ebinger	Fabaceae	Native
34.	*Senna alata* (L.) Roxb.	Fabaceae	Exotic
35.	*Senna occidentalis* (L.) Link.	Fabaceae	Exotic
36.	*Sesbania sesban* (L.) Merr.	Fabaceae	Exotic
37.	*Tecoma stans* (L.) H.B. & K	Bignoniaceae	Exotic
38.	*Thevetia peruviana* Schum	Apocynaceae	Exotic
39.	*Vachellia nilotica* (L.) P.J.H. Hurter & Mabb.	Fabaceae	Native
40.	*Ziziphus nummularia* (Burm f.) Wt. & Arn.	Rhamnaceae	Native
41.	*Ziziphus oenoplia* Mill.	Rhamnaceae	Native