

Adaptability Of Some Climbing Plant Species From Different Habitats Of Amravati Urban Area

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Abstract

Present investigation is an entire investigation on climbing plants and their adaptive behaviour with respect to urban environmental circumstances. The study also focused on the ecological status of climbing plant species, along with their climbing modes. The investigation was carried out in most of the diversified segments of Amravati city urban as well as suburban area and observed the climbing species with respect to their biomechanical adaptations. In the present study 42 climbing species belonging to 17 angiospermic families were enumerated with respect to their climbing modes. The most dominant families having climber's richness are Convolvulaceae and Cucurbitaceae. The dominant liana species recorded from the investigated area were *Cryptostagia grandiflora*, *Antigonon leptopus* and *Ipomoea carica*. Whereas *Dregia volubilis*, and *Pergularia daemia* invading some habitats. The rich floristic of the Amravati urban area also shows diversity with respect to biomechanics of the climbers. About 23 climbers from the investigated area are twiners, where the plant develop long searching shoot and twines along possibly available host. Urban infrastructure like electric poles, hoardings and waste household tools act as a possible host for them. Besides, roadside trees and bushes becomes the long lasting host where the twiners survive satisfactorily. As far as climbing mode is concern the area composed of dominance of stem twiners (23/42) followed by tendril climbers (12/42). The study noted that, Vertical greening using climbing plants in urban areas not only expands urban garden space and increases the artistic beauty of urban architecture, but also increases urban green coverage.

Key Words: Urban environment, biodiversity, climbers, biomechanics, ecology.

Introduction:

Urbanization is a complex socio-economic process with numerous consequences for different levels of society, the environment, and biodiversity (United Nations, 2018). With rapidly growing urban populations, solving problems regarding efficiency and sustainability of cities are becoming relevant and pressing issues. Urbanization leads to primary (e.g., removal of existing vegetation and construction of urban infrastructure) and secondary (e.g., habitat loss, fragmentation and isolation, climatic changes, pollution of air, water, and soil) processes that represent many challenges to the persistence of non-human species (Parris, 2016). The more urban areas expand, the more natural environments become fragmented, as cities interrupt habitats and connectivity. Instead, urban "texture" results from a complex mosaic of built and vegetated patches. Urbanization filters species in communities depending on their adaptability to conditions in built-up areas, especially in semi-natural habitats. Roadside vegetation is widespread along urban-rural gradients and is

therefore a good place to study landscape-scale factors influencing plant community composition (Cochard, 2017).

Climbers are herbaceous or woody plants that germinate in the soil and remain rooted throughout their lives, needing other plants to support their development. Climbing plants offer significant sustainability benefits in urban environments by improving air quality, regulating building temperatures, and enhancing mental well-being. Their ability to absorb pollutants, reduce heat absorption, and create serene green spaces makes them valuable additions to urban landscapes (Borowaski, 2018). It has been reported that plant leaves with fuzzy, furrowed surfaces have a stronger dust retention capacity than leaves with smooth, thin, waxy layers. Climbing plants may respond to increased shade through plasticity in some leaf traits (e.g. specific leaf area, photosynthetic rate or leaf chlorophyll content). However, deciduous climbing plant species are likely to be more plastic than evergreen species as they have less conservative resource strategies. Most climbing plant species can maintain growth and physiological function when light conditions change from full-sun to heavy shade (Chung et.al. 2013). This adaptability is crucial for their survival and success in the often harsh and variable conditions of cities (Choi et, al. 2011). Climbing plants do not occupy space at the street level, but use existing building walls, or vertical greening methods on highways and slopes. Vertical greening using climbing plants in urban areas not only expands urban garden space and increases the artistic beauty of urban architecture, but also increases urban green coverage.

According to Schenck (1893) the stem and wood anatomy of climbing plants differs from that of self-supporting plants. Although vines and self-supporting plants differ physiologically, anatomically and phenologically, the primary differences are biomechanical. Because of lacking capacity to remain upright, climbing plants are forced to encounter suitable support and ascent efficiency. The majority of vine seedlings produce searcher shoots that grow up bend over a support and try to maintain upright posture. Putz, 1984).

Amravati is a divisional city of Maharashtra state having its own floral and faunal diversity. Beside that of the roadside plantation there is vast floral diversity along the empty spaces of city area. As Amravati is becoming a developing city, some constructive as well as developing steps to be undertaken by the city planning department of Municipal Corporation. Beside that of roadways, several buildings have been under construction as far as commercial as well as social demands are concern. For the constructive purpose there is lot of disturbances in natural habitat which not only survives the local flora but also maintain aesthetic health of the urban area. However, in such a fragmented urban system climbers are those plants who always in search of their space. The infrastructural tools and professional constructions from the urban area becomes the host of climbing species where they adaptively made their own assistance. According to earlier researches Dhore (1986) the climbing species which are dominantly survive in urban circumstances are from the following genera *Cryptostagia*, *Antigonan*, *Dregia*, *Pergularia*, *Coccinia*, *Passiflora*, *Basella*, *Tragia*, *Luffa*, *Trichosanthes* etc. Some were ornamental now becomes wild in the investigated area. Urban environment also support satisfactory growth of climbing plant species this area of research is not focused so far in India, which is why the investigation is undertaken.

Review of Literature:

The literature survey related to present study reveals the intermediate picture as under. Chung et.al. (2013) surveyed the plasticity of seven climbing species with emphasis on their leaf traits in urban circumstances of urban environment. This study suggests that all of the seven climbing plant species possessed traits that are plastic enough to reasonably maintain their ecosystem service function and performance as a nature-based solution whether in full-sun or heavy shade conditions. Gianoli (2015) studied the behavior ecology of climbing plants. His study stated that, vines that find a suitable support have greater performance and fitness than those that remain prostrate. Therefore, the location of a suitable support is a key process in the life history of climbing plants. The study also narrated, how host tree attributes may determine the probability of successful colonization for the different types of climbers, and examine the evidence of environmental and genetic control of circumnutation behavior and phenotypic responses to support availability. Borowski (2018) while investigating effects of climber on urban infrastructure suggested that, climbers in natural conditions cling to vertical supports, often beginning their growth in deep shadow, in forest understory, ending in tree canopies, in direct sunlight. For this very reason, climbing plants exhibit a large tolerance to habitat conditions, including unfavorable conditions prevalent in cities. And, more importantly, they occupy little space in built-up conditions.

Bullock, (1990). while working on the diversity and structure of climbing plants in an urban forest fragment stated that, lianas are indicators of disturbance in forest fragments, and it is necessary to guarantee the balance and functionality of the forest in this fragment to avoid liana infestation in the fragment's interior and to prevent greater impacts on the fragment's biodiversity of tree species. Lianas were abundant in both interior and edge environments Carlquist, (1988). carried out a comparative anatomical study of stems of climbing plants from the forest remnants of Moringa, Brazil. The study stated that the mechanical strategies among woody lianas are adapted to grow across gaps and reach host supports.

From the literature cited in the investigated area it was observed that the floristic survey of

Amravati district has been carried out by Dhore (1986) in "Flora of Amravati District". The flora described 70 species belonging to 34 families which exhibit variable climbing habits. Recently Bhogaonkar and Devarkar (1999) re-explored Melghat area and added about 67 new species including some climbers. All these works were purely taxonomical and not focused over any ecological aspects which is the adaptive image of climbers.

Materials and Method:

The investigation on ecological aspects of climbing plants from Amravati urban environmental circumstances carried out as following.

Actual field visits of floristic inventory along different possible habitats were extensively carried out during rainy seasons. Through continuous exploration the species were collected randomly from the field as herbarium specimens and identified with the help of standard floras and expertise. In the second phase of investigation the ecological aspects regarding to each identified climbing species along with its community

were thoroughly examined by continuous observations, measurements and close reports. The examination include, the habitat where the vine tend to grow, the juvenile characters of the seedlings, seedling growth, length of leader shoots and the way of approach towards the host were keenly measured. The rapid growth of vines over their host for survival, approach and establishment of vines and vine support to host during extreme circumstances was intensively evaluated.

Further efforts were made to analyze the vine interaction, their reproduction and dispersal mechanisms with respect to their community. Photographic data of each species regarding to their seedling, habit over host, climbing organs, biomechanics, floral display, fruits, propagatory methods and their significance were shoot out with the help of Nikon Coolpix Li20 digital camera.

Observations

The intensive exploration of different habitats from Amravati urban as well as suburban area including social and commercial infrastructure shows rich floristic diversity of climbers.

The study worked out about 42 climbing species belonging from 17 families of flowering plants. Out of the total, 42 species belongs to dicotyledons and the remaining 2 species belongs to monocotyledons. (Table).

As far as the distribution of climbers in the investigated area is concerned 3 species are strictly adapted to urban dusty habitat i, e. *Cryptostagia grandiflora*, *Antigonon leptopus* and *Ipomoea carica*. Whereas *Dregea volubilis*, and *Pergularia daemia*, becomes invasive along urban habitats in the recent past from the nearby wild area. The dominantly found rain-fed climbing specie along wastelands, sewer ins and roadside bushes of urban circumstances are *Mucuna prurita*, *Ctenolepis garcini*, *Diplocyclos palmatus*, *Cuculus hirsutus*, *Tinospora cordifolia*, *Cayratia trifolia*, *Cryptolepis buchmani*, and *Ipomoea pes-tigridis*. These species are commonly confined in the said environment. The Stream banks, thickets, bushes and open lands of urban as well as suburban area shows survival of *Cuculus hirsutus*, *Tinospora cordifolia*, *Cissus vitifolia*, *Cardiospermum helicacabum*, *Abrus precatorius*, *Clitoria ternatea*, *Rhynchosia minima*, *Coccinia grandis*, *Mukia maderaspatana*, *Trichosanthes cucumerina*, *Dregea volubilis*, *Pergularia daemia*, *Telosma pallida*, *Hemidesmus indicus*, *Ipomoea hederifolia*, *Ipomoea obscura*, and *Cuscuta reflexa*. It was remarkably noted that the conditions of the urban area is mostly suitable for lianas. *Ventilago denticulata*, *Combretum ovalifolium*, are the lines which are specifically confined along stream banks. *Capparis zeylanica* adapted to waste infrastructure such as damaged houses and waste factories.

Taxonomical composition of vines in the studied area also shows great diversity. The potentially rich families are Convolvulaceae (7 species), Cucurbitaceae (8 species), Papilionaceae (5 species), followed by Asclepiadaceae (3 species).

The rich floristic of the Amravati urban area also shows diversity with respect to biomechanics of the climbers. About 23 climbers from the investigated area are twiners, where the plant develop long searching shoot and twines along possibly available host. Urban infrastructure like electric poles, hoardings and waste household tools act as a possible host for them. Besides, roadside trees and bushes becomes the long lasting host where the twiners survive satisfactorily. Major families consisting twining species are Convolvulaceae,

Papilionaceae and Dioscoriaceae. About 12 species especially from Cucurbitaceae, and Vitaceae exhibit tendrillar climbing mechanism where the species develop single or branched tendrils. Tendrils are such flexible adventitious structure through which climbers can make them erect even if along walls and delicate hostile surfaces. Beside these, 3 species are armed stragglers, 1 species are unarmed stragglers, 1 species are root climbers and remaining 2 species are hook climbers (Table). The flexible-erect postures of climbing species prominently supported by distinct anatomical peculiarities provide great taxonomical significance.

Climbers normally associated with a well-balanced community because of lack of self-support among themselves. In various habitats of the city climbing species shows great diversity as far as their associating hosts and the tropic community is concerned. The herbaceous vines are normally associated with all the possible growth forms of the community. In the absence of host the vines may trail over the surface or adapt the situation by changing their habit (Lipiec et al., 2013). In the forest community liana develop competition with their tree partners which not only survive them but also perceive some significant characters among tree species. Liana network over host particularly over electric poles, along river banks and escapes always resist the adverse environmental conditions.

Table 1 : Details of climbing plants enumerated from Amravati District with respect to distribution, climbing modes and ecological status. (WV: Woody vines; HV: Herbaceous vines; ST: Stem twiners; Str-A: Stragglers-armed; Str-UR: Stragglers-unarmed; TC: Tendril climbers; RC: Root climbers; and HC: Hook climbers).

Sr. No.	Name of Species	Family	Distribution	Habit	Climbing mode	Status
1	<i>Cocculus hirsutus</i> L.	Menispermaceae	On Hedges and roadside bushes	WV	ST	Very common
2	<i>Tinospora cordifolia</i> Miers	Menispermaceae	On Hedges and roadside trees, bushes, fencings, wastelands, houses	WV	ST	Very common
3	<i>Capparis zeylanica</i> L.	Capparidaceae	On Hedges and roadside trees, bushes, fencings, wastelands, service lines	WV	Str-AR	Common
4	<i>Ventilago denticulata</i> Willd	Rhamnaceae	Along river and stream banks of suburban area	WV	Str-AR	Rare
5	<i>Cayratia trifolia</i> L.	Vitaceae	Along fencings and road side trees	WV	TC	Common
6	<i>Cissus vitiginea</i> L.	Vitaceae	Along stream banks of suburban area	WV	TC	Rare
7	<i>Cardiospermum helicacabum</i> L	Sapindaceae	On Hedges and roadside bushes	HV	TC	common
8	<i>Abrus precatorius</i> L.	Papilionaceae	Along field fencings, stream banks and open grazing lands	WV	ST	common

9	<i>Canavalia gladiata</i> Jacq.	Papilionaceae	On trees and thickest of suburban area	WV	ST	common
10	<i>Clitoria ternatea</i> L.	Papilionaceae	On thickets and escapes of wastelands	HV	ST	Frequent
11	<i>Clitoria ternatea</i> var <i>alba</i> L.	Papilionaceae	Rarely in thickets and escapes of wastelands	HV	ST	Rare
12	<i>Mucuna prurita</i> Hook	Papilionaceae	On trees and thickest of suburban area	WV	ST	Very common
13	<i>Rhynchosia minima</i> L.Dc.	Papilionaceae	On thickets and escapes of wastelands as well as gardens	HV	ST	Very common
14	<i>Combretum ovalifolium</i> Roxb	Combretaceae	Along stream banks of suburban area	WV	ST	Very common
15	<i>Passiflora foetida</i> L.	Passifloraceae	Along stream banks of suburban area	HV	TC	Rare
16	<i>Coccinia grandis</i> L.	Cucurbitaceae	On thickets and escapes of wastelands as well as gardens	HV	TC	Very common
17	<i>Ctenolepis garcini</i> L.	Cucurbitaceae	Rarely in thickets, fencings and escapes of wastelands	HV	TC	Rare
18	<i>Diplocyclos palmatus</i> L.	Cucurbitaceae	On fencing, bushes and hedges	HV	TC	Very common
19	<i>Lagenaria leucantha</i> , var. <i>vulgaris</i> Duch	Cucurbitaceae	On thickets and escapes of wastelands as well as gardens	HV	TC	Common
20	<i>Luffa cylindrica</i> L.	Cucurbitaceae	On road side trees, fencings and hedges	HV	TC	Rare
21	<i>Momordica charantia</i> L.	Cucurbitaceae	On thickets and escapes of wastelands as well as gardens	HV	TC	Common
22	<i>Mukia maderaspatena</i> L.	Cucurbitaceae	Rarely in thickets, fencings and escapes of wastelands	HV	TC	Rare
23	<i>Trichosanthes cucumerina</i> L.	Cucurbitaceae	On thickets and escapes of wastelands as well as gardens	HV	TC	Rare
24	<i>Vernonia elignifolia</i> DC.	Asteraceae	Frequently cultivated on fencing and porches becomes wild on wastelands	WV	Str-AR	Rare

25	<i>Cryptostegia grandiflora</i> R.Br.	Asclepiadaceae (Periplocaceae)	Common on urban infrastructure, wasteland, roadsides and walls	WV	ST	Common
26	<i>Dregea volubilis</i> L.f.	Asclepiadaceae	Common on urban infrastructure, wasteland, roadsides and walls	WV	ST	Common
27	<i>Hemidesmus indicus</i> L.	Asclepiadaceae (Periplocaceae)	Along stream banks of suburban area	HV	ST	common
28	<i>Pergularia daemia</i> Foesk.	Asclepiadaceae	On thickets and escapes of wastelands as well as gardens	HV	ST	Very common
29	<i>Argyreia nervosa</i> Burm.f.	Convolvulaceae	Along stream banks of suburban area	WV	ST	Rare
30	<i>Argyreia sericea</i> Dalz.	Convolvulaceae	Along stream banks of suburban area	WV	ST	Rare
31	<i>Ipomoea cairica</i> L.	Convolvulaceae	Common ornamental becomes wild along stream banks and sewer lines	HV	ST	Common
32	<i>Ipomoea hederifolia</i> L.	Convolvulaceae	on small trees, fencing and bushes	HV	ST	Very common
33	<i>Ipomoea obscura</i> L.	Convolvulaceae	on small trees, fencing and bushes	HV	ST	Common
34	<i>Ipomoea pes-tigridis</i> L.	Convolvulaceae	on, fencing hedges and bushes of sub-urban area	HV	ST	Rare
35	<i>Operculina turpethum</i> L.	Convolvulaceae	Waste infrastructure of MIDC area	HV	ST	Very Rare
36	<i>Cuscuta reflexa</i> Roxb.	Cuscutaceae	On roadside hedges and bushes roadside	HV	ST	Common
37	<i>Basella rubra</i> , L.	Basellaceae	On fencings electric poles and bushes	HV	ST	Rare
38	<i>Antigonon leptopus</i> Lendl.	Polygonaceae	On fencings, small trees and bushes	HV	TC	Very common
39	<i>Antigonon leptopus</i> var. <i>alba</i> Lendl.	Polygonaceae	On fencings, small trees and bushes	HV	TC	Common
40	<i>Tragia hildebrandtii</i> Muell.	Euphorbiaceae	On fencings and bushes	HV	Str-UR	Rare
41	<i>Dioscoria belophyla</i> Haines.	Dioscoriaceae	On hedges and small trees along stream and river	HV	ST	Common

			banks of suburban area			
42	<i>Dioscoria bulbifera</i> L.	Dioscoriaceae	On hedges and small trees along stream and river banks of suburban area	HV	ST	Common



Photographic evidences of some Climbers and their adaptive hosts

Conclusion:

Present study tried to emphasize some ecological aspects of climbing plants from urban environmental circumstances of Amravati city. The study revealed that the city has ecologically diver's habitat which not only supports liana distribution but also got significant benefit. According to present investigation there might be more than 42 wild climbing species which are more or less adapted to present circumstances. The study also noted that from the total enumerated climbing species 20 wild species are well dominant, 5 species are rare and 3 species are endemically confined along specific parts of the city (Table). Similarly 3 species (*Cryptostagia grandiflora*, *Antigonon leptopus*, *Basella rubra*) are strictly adapted to urban habitat and most

of the times considered as weeds. Most of the explored wild species are associated with thickets, hedges, bushes, field fencings and roadside trees and shrubs (Dangwal and Singh 2012).

The study revealed that the biomechanical adaptations among vines internally well supported by adaptive anatomy. In most of the anatomically enumerated climbing species stem possesses alternation of soft and hard tissue which provide flexible strength during twining ascend. Large and wide vessels along xylem tissue provide extra nutritional support during vigorous growth. Assimilatory cortex and secretory cells make them tolerant during leafless posture and adverse circumstances respectively (Chettri, 2010). As far as the reproduction and dispersal is concerned it was realized that many forest climbers confined along urban area uses wind agency for their reproductive success. During the study period it was seriously observed that human interference through development as well as management practices destroying climber's populations at great extent. As said earlier field fencings, roadside bushes and hedges, foot hill thickets and stream banks are the favorable habitats of climbers particularly in plain areas.

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