Ecology And Diversity Of Wall Flora Dwelling In Artificial Habitats With Special Reference To Various Successional Stages In Few Urban Sites Of Kamrup (Metro) District, Assam

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ABSTRACT

Wall vegetation includes an interesting group of plants growing on artificial habitats like walls which are not only tolerant to different types of abiotic stresses such as strong light, heat, wind, cold, drought etc. but also thrives in substrates very poor in nutrients. Human has started constructing mud, stone and brick walls for various purposes thereby creating a conducive environment for the invasion and establishment of different plants including medicinal plant species. Pioneer species after invasion on the bare wall are replaced by other species in some orderly sequence during the course of time. Species living on rocks, stones or walls are also found to occur in rock and wall crevices where little amount of detritus and humus have accumulated. After surveying of various walls like retaining walls, garden walls, churchyard walls, building walls, fencing wall etc., it was observed that wall flora consists of different species which are at different stages of development and it includes mainly crustaceous lichens, different bryophytes, few ferns species including *Adiantum* sp., *Pteris* sp., many flowering species such as *Ficus glomerata, Ficus religiosa, Eclipta alba, Portulaca oleracea, Ludwigia adscandans, Euphorbia hirta, Cleome sp., Ocimum sanctum, Sonchus sp. etc.* As the inclination of a mural site decreases, the number of species increases as the exposure of the sites is very important to invasion of different species in these artificial habitats. Species showing a marked preference for north-facing wall surfaces besides on South, West or East-facing walls because here the humidity and temperature ranges are usually small. There are pronounced and noticeable effects of atmospheric pollution on mural flora and is greatest on lichens followed by bryophytes. The pH values of the substrata which support mural vegetation usually lies between pH 7 and pH 9 in different stages of mural communities. Gradual decomposition of the wall by different agents and factors along with the accumulation of dust, soil particles and organic matter contributes minimum substrata for the development of a plant cover and thereby encourage the process of succession. In this regard, water, nutrient and light act as important limiting factor in development of mural communities in different sites and these dwelling communities possess special adaptations to tolerate fluctuations in the moisture content of the substratum and also to survive in habitats containing minimum nutrient content and sunlight availability. The anthropogenic influence on the communities is also strong which not only invites invasion of new species but may also gradually shift the direction of succession up to certain extent.

Key Words: Detritus, Pioneer species, Mural communities, Substrata, Crustaceous lichens, pH, Succession, Limiting factor, Artificial habitats, Invasion, Abiotic stresses

Introduction:

The North Eastern region has attracted the attention of many botanists from different corners of the world due to richness in flora produced as a result of its varied climatic, topographic and geographical features. Walls represent a unique habitat, which is partly similar to rocks and rock fissures (Anonymous, 2001).But their artificial origin, its location in the urban and rural landscape and technology/materials involved in the wall building influence a range of plant species that are able to colonize this habitat and thereby separates plant species found in rocks and stones over the period of time. In favorable environmental conditions, walls not only supports algae, fungi, lichens, ferns but is also colonized by flowering species. This colonization of plant communities depends on various factors such as nature of the substrate, availability of water, light conditions, nutrients etc. Plants growing on the walls have a specific ecology. Many of these plants play an important role in weathering process of walls due to growth of their roots, chemical and mechanical actions excreted by them (Ceneva & Rachardi,1989)

Study Site:

Kamrup district, a North Eastern State of India is an important area of Indian mega-diversity hotspot centre with diverse tribes and culture along with rich cultural heritage. It extends from 25°46 to 26°49 North latitude and from 90.4° to 91.5° East longitudes. Kamrup Metropolitan (M) is one of the 33 districts in Assam state in north-eastern India. It was carved out of the erstwhile undivided Kamrup district in 2003 and covers an area equivalent to the area of 627.18 sq. km but as per Census Report, the area is 1150.13sq.km. According to the 2011 census, Kamrup Metropolitan district has a population of 1,260,419. The district is bounded by Brahmaputra river and Darrang on the north, Meghalaya on the south, Meghalaya and Morigaon on the east and Kamrup (Rural) on the west. Climate of the district is sub-tropical with

semi dry summer and cold in winter. Ranges of annual rainfall are between 1500-2600 mm. The temperature ranges from 7°C-38.5°C.

The aim of the present work is to analyse the composition, diversity and succession pattern of the plants in different walls. The different ecological factors which influence colonization, growth and establishment were also investigated in the present study.

MATERIALS AND METHODS:

This study is based on collection and wall's field observations carried out from April, 2017 to Feb, 2019 covering selected sites of the Kamrup (Metro) district of Assam, a North Eastern State of India. Wall selected for the present study is dissimilar in construction and age. Plants growing on walls and fences of different temples, buildings, pavements etc. were collected, processed for herbarium preservation and finally identified following standard methods involving dissection, description and reference to literature. Each site was visited at least twice, at different seasons, though most of the walls were visited much more. Plants growing at the extreme base of a wall were normally ignored as the plants may be probably rooted in the ground. Wall-tops or vertical tops has little accumulation of soil or organic matter. The families and genera of different angiospermic plants are according to Bentham and Hooker's system of classification (1862-1883) with necessary modifications. Moreover, the families of Pteridophytic species are arranged after Pichi Sermolii (1977, 1982) with slight modifications.

In regard to preparation and preservation of specimens, the herbarium techniques are followed as suggested by Jain and Rao (1977). The authentic specimens are preserved and maintained in the Department of Botany, Dakshin Kamrup College, Mirza.

The wall found and observed in different sites not only differs in ages and sizes but also differs in chemical composition and accordingly different types of walls are found. They are:

(a)Brick wall with cement as binding material (**BW**).
(b)Stone wall with cement as binding material (**SW**)
(c)Brick Mortar wall with mortar as cementing material (**BM**)

The microhabitat or the vegetational zones of wall are classified into the following types:

(i)Vertical top (**HT**) of the wall
(ii)Vertical face (**VF**) of the wall
(iii) Base (**B**) of the wall

Regarding the study of succession changes, a considerable longer period of observation is required which is not possible within a period of two year but instead wall of different ages and materials are so selected that recording of habit of plants gives some information in regard to their successional stages. Accordingly, plants are classified into:

(a) Early Successional (**ES**) species found on walls of maximum age 5years.
(b) Mid Successional (**MS**) species found on walls of age between 5-10years.
(c) Late Successional (**LS**) species found on walls of age greater than 10years.

Moreover, the facing side of the wall which shelters numerous plant species is also recorded and accordingly, four facing sides are considered. They are:

(a) East Facing (**ETF**) side of the wall.
(b) West Facing (**WF**) side of the wall.
(c) North Facing(**NF**) side of the wall.
(d) South Facing (**SF**) side of the wall.

Analysis of substrata found in different sites in regard to pH is also done after collecting samples (substrata) from different sites.

The range of sampling stands included in the present study are different types of walls from isolated walls in courtyard, fortification, city walls, walls of disintegrated buildings, temples, pavements etc. The study was mainly restricted to the vertical wall tops, wall bases (vertical surface up to 30 cm above ground) and vertical side walls. Data on flora and substrata were collected from different walls having varied chemical composition.

RESULT:

In the present investigations, a total of 90 plant specimens excluding crustose lichens and different moss species were collected during the study period 2017 to 2019. On walls, the highest number of vascular plant species which are recorded is angiospermic species followed by pteridiophytic species. Lichens and mosses occur at very low frequency in some selected sites. Of the total 90 species recorded, 35 of them attained frequencies below 20% and 7 species found in the present study attained frequencies of more than 40%. The most common mural species that flourished luxuriantly includes *Ficus religiosa*, *Ficus racemosa*, *Oldenlandia corymbosa, Pouzolzia zeylanica*, *Phyllanthus fraternus*, *Euphorbia hirta*, *Peperomia pellucida*, *Amaranthus spinosa*, *Eupatorium odoratum, Eclipta prostrate, Cleome rutidosperma, Pogonatherum crinitum* etc. all occurred on maximum percent of studied walls as shown in the **Table 1.** They were mostly found on both vertical surfaces and vertical wall tops due to optimum habitat conditions. Altogether 6 pteridophytic families and 35 angiospermic families were recorded on studied walls, the most common Angiospermae families which represent maximum number of species were Compositae, Gramineae, Euphorbiaceae, etc. as shown in **Figure 1**. Besides native species, some non-native alien species such as *Parthenium sp.*, *Eupatorium* sp., *Aegeratum* sp. etc makes their appearance and also forms an important component in wall flora.

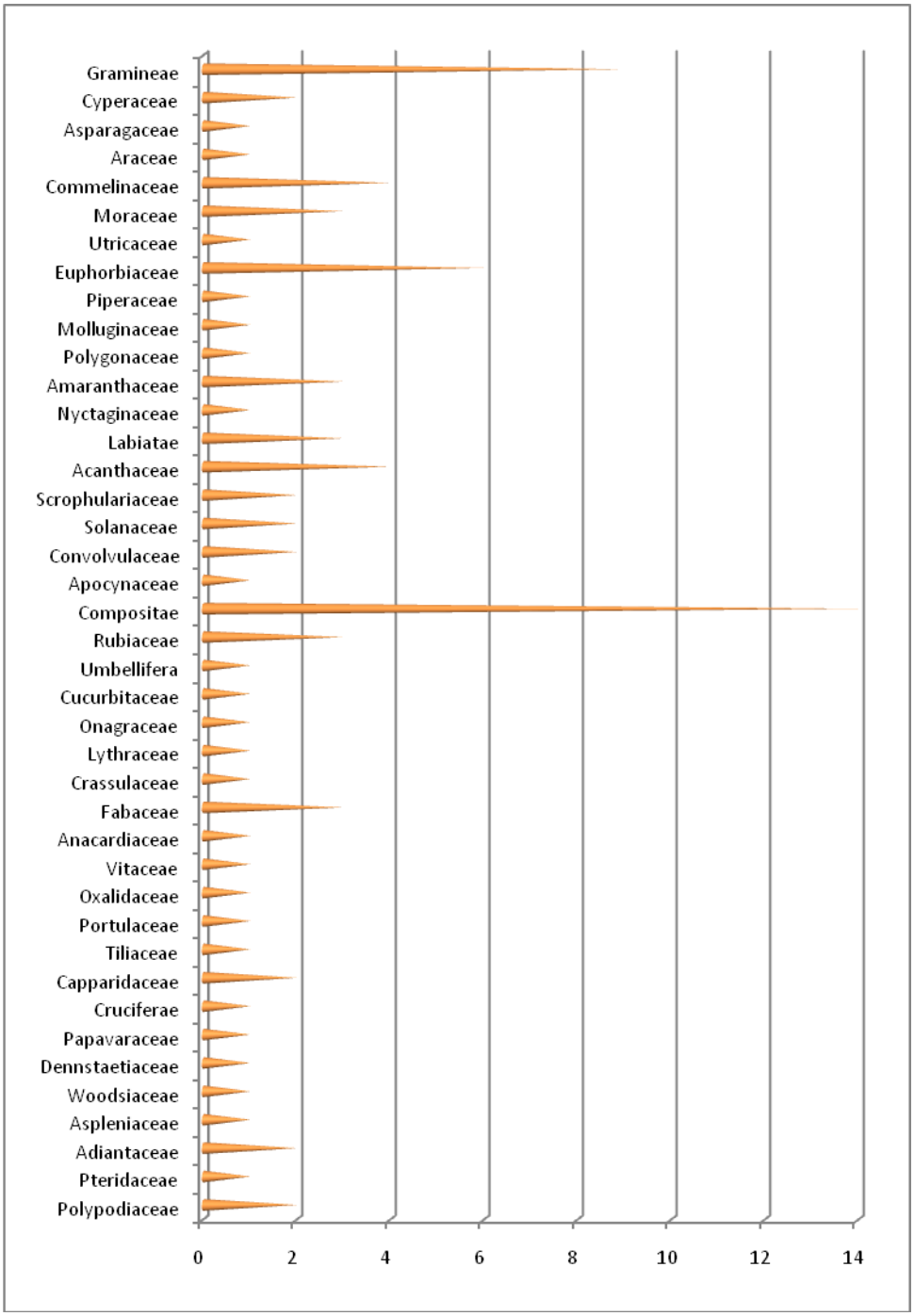

Fig 1: **Total Number of Species against respective family**

Anemochory and autochory were the two most common dispersal strategies adopted by the plants dwelling on walls**.** Moreover, the flora on the walls consists of predominately both heliophytic as well as sciophytic plants, which indicate mesic to warm habitats and semi-dry to freshly moist soils. No clear pattern in regard to soil reaction variability is observed in available substrate of the wall in different sites and the soil or existing substrata mainly shows neutral pH or basic pH.

Lower number of species was recorded on vertical top, the number of species recorded on vertical face is slightly more which may be due to favorable light conditions and optimum substrates along with available moisture over a period of time due to disintegration of binding material. Plants dwelling on both vertical sides and vertical wall tops represented only few numbers of species. Plant which requires little more moisture for growth and survival are found in the base. The wall tops exhibited a lower number of families in comparison with the vertical face. Therophytes were very common on the vertical wall tops whereas hemicryptophytes and phanerophytes are mainly prevalent on vertical side surfaces. The two microhabitats did not differ in the proportions of alien and native species.

Plants such as lichens mainly crustose moss, annual herbs such as *Argemone mexicana, Rorippa indica, Cleome rutidosperma, Portulaca oleraceae, Oxalis corniculata, Hedyotis coronaria* and also few grasses such as *Dactyloctenium aegyptium* etc. all constitute early successional species. The mid succession species mainly consist of

ferns of perennial nature such as *Drynaria quercifolia, Pyrossia adnascens, Pteris vitata, Adiantum caudatum,* perennial herbs and shrubs such as *Cyperus brevifolius, Pogonatherum crinitum, Tradescantia spathacea, Desmodium triflorum, Triumfetta rhomboidea*, *Crotolaria juncea, Ludwigia octovalvis, Phyllanthus reticulates, Imperata cylindrica, Lawsonia inermis* etc. Moreover, it is observed that various tree species such as *Mangifera indica, Ficus religiosa, Ficus hispida* etc. makes their appearance in later period through seed as propagules are carried by various agents and thereby categorized as the late successional species as shown in **Figure 2**.

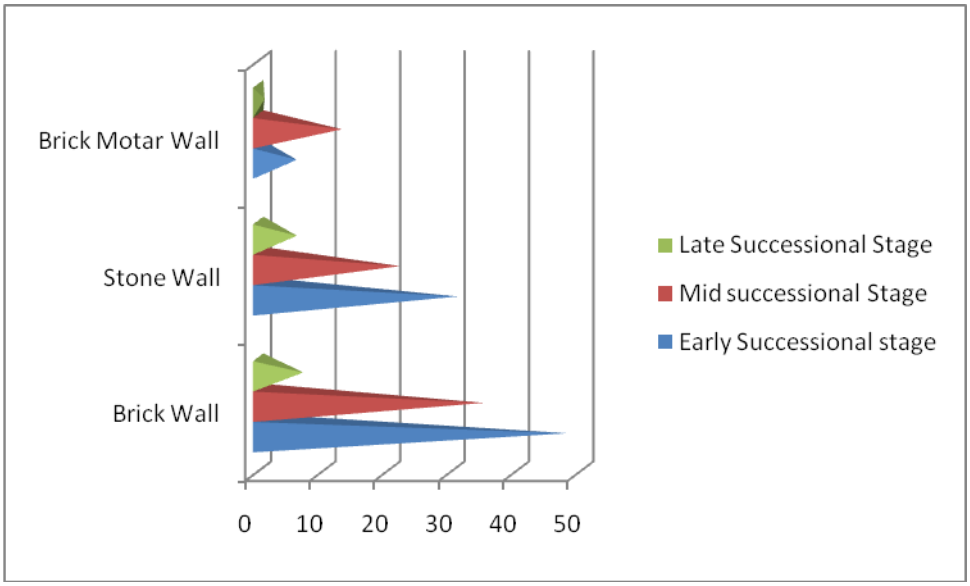

Fig 2: Total no. of species in different successional stages in different walls

The number of species on the North facing wall is comparatively high when compared to East, West and South facing wall. This may be due to higher solar irradiation that invites mainly the heliophytic species for its proper establishment. The wall tops did not differ from the vertical surfaces in values for temperature, soil reaction and pH. Significant differences between vertical wall tops and vertical sides were found for light and moisture. Higher shade tolerance is shown by species growing on vertical faces compared to those occurring on wall tops. Similarly, more species with high moisture indicator values were found on vertical faces as shown in **Figure 3.**

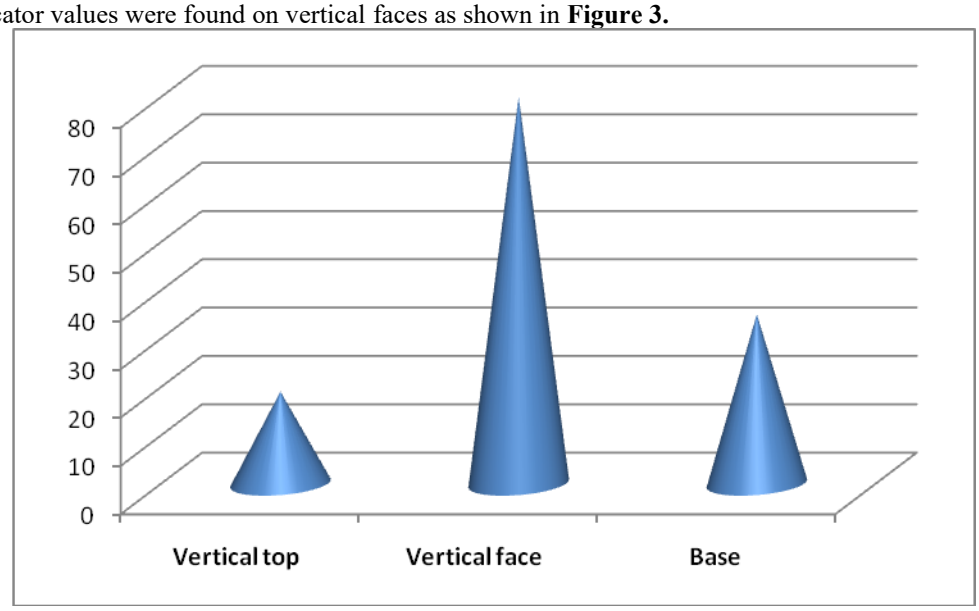

Fig **3: Total No. of species in different microhabitats within wall**

Most of the species which colonized and successfully thrive in the wall are in fact generalist species as they are found to occur in the surrounding habitats and are not adapted to thrive in such artificial habitats. Lichens and mosses are initially the dominant life forms observed in wall due to their ability to survive in harsh conditions like desiccation, temperature extremes and nutritionally deficient substrates. Along with their longevity and slow growth rates, they have the inherent capacity to release mineral nutrients from rock surface slowly and this paves the way for invasion, colonization and establishment of new species during the process of succession. Bryophytes like *Marchantia* sp., *Riccia* sp. are found to

grow in the crevices and joints of the mortar wall and thereafter vascular plants like ferns and flowering plants make their appearance.

Many tree species namely *Mangifera indica, Ficus religiosa, Ficus hispida* are found to attached to walls with brick and stones which are slightly to moderately weathered showing an increased affinity for old walls. The process of gradual weathering of wall substrata invites colonization of trees. Various ecological factors that include wall aspect, shade, adjacent vegetation, availability of moisture, solar irradiation, nature of substrata etc. all determine composition of wall flora which changes over a period of time leading to various successional stages. Besides this, geographical location, material, brick and stone dimensions, surface smoothness, weathering status, joint type and condition, inclination and exposure, wall environs, surrounding vegetation cover etc. all determine the wall flora in particular site.

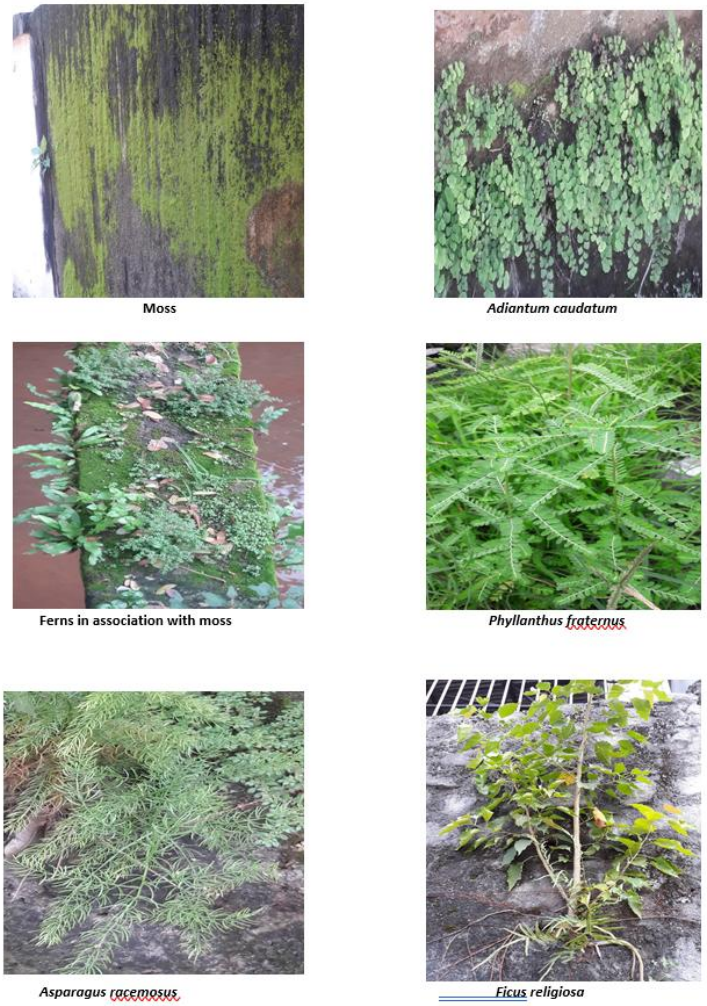

Fig 4: Non-flowering and flowering plants as a part of mural vegetation

DISCUSSION:

Walls when viewed from vertical plane generally show three distinct zones: the base, the vertical wall surface with joints and the vertical wall top with joints. Species composition in basal zone resembles with plants growing on vertical top. This may be due to the favourable environmental conditions in the form of sufficient moisture and nutrients which supports flora of adjoining areas also. *Drynaria quercifolia* and *Pyrossia adnascens* are two most common predominant fern species that are found on vertical tops of most walls. Development of plant communities and pattern of their succession mainly depends on the level of disintegration of different types of binding material.

The emergence of lichens on brick wall is very rare but it is clearly observed that in the most cases, the moss makes it first appearance on the studied walls at various sites. Mosses easily gets acclimatized and established in walls leading to formation of the first substrata over which other species makes its emergence. There are many moss species which can survive in xeric habitat and upon their death, adds more biomass and moisture to the existing thin layer of substrata. The formation of thick soil layer invites and supports the growth of herbaceous species that includes ferns, grasses etc. Plants with perennial habit make it appearance once the substrata develop the capacity to retain more moisture, accumulate more minerals as well as organic matter. Grasses and herbaceous vegetation were gradually replaced by tree species in many walls.

Species diversity and distribution in a plant community are affected by numerous variables, biotic and abiotic variables. It includes the size of the area sampled, age and nature of wall substrates, heterogeneity of the environment as well as distance from a source of diversity. Within a given habitat like wall, there are microhabitat variability that includes the differences in moisture regime, substrate quality, and light intensity as water and light can create specific vertical

patterns of plant distribution on walls and as such, the abundance and distribution of animals particularly arthropods are affected as they depend on these plants for food and shelter.
The direction of pattern of succession in wall cannot be exactly ascertained within a short period as the process of succession is very long process which require enough time for observations. Only the general trends of succession is observed in different walls which is highlighted in the present study as direction of succession is guided by many factors including climatic and anthropogenic factors which differs from place to place.

CONCLUSION:
The different attributes related to habitat principally differentiate succession pattern in walls from the rocks. The artificial walls consist of building materials that piled up using various binding materials of low quality and of less durability. The binding material used in different walls is not only different in chemical composition but also the amounts of components used in the material may also varies that may also contribute to difference in floristic composition. The crumbling of the binding materials due to the influence of various biotic and abiotic factors contributes for accumulation of fine particles of rubbles and dust in rocks/ bricks crevices. This minimal buildup provides a substrate of variable nutrients content which generally invites early successional species. If the soil itself forms the major binding or covering material, then the rate of succession is hastened to a large extent.
Repeated anthropogenic interference in the form of cleaning operation by humans and grazing by grazers in wall vegetation provides a sort of temporary habitat for plant invasion. These frequent disturbances in mural flora thereby contribute to richness in species composition and exclude many species found typically in rocks and rock crevices. It is also observed that compared to rocks, walls are usually isolated objects of smaller dimensions and its microclimate is strongly influenced by fluctuation of ecological factors including temperature, precipitation, irradiation, substrate composition and its pH, degree and length of slope. Walls possess limited number of microhabitats, the sidewalls are of uniform slope and microtopography but there is slight difference in habitat conditions when we compare different faces of the wall. In spite of this, the wall vegetation supports diverse group of plants ranging from lichens, algae, fungi, bryophytes, ferns to angiosperms. The invasion, establishment and composition of wall flora are strongly governed from the surrounding ruderal and semi-natural vegetation types besides the composition of the substrate available in wall, exposure to prevailing winds as well as proximity to roads, forests, and cities.
Thus, walls offer good opportunities to study some basic ecological and evolutionary principles in respect to time scale including the concepts of community structure, diversity, adaptation and succession of various organisms like algae, lichens and mosses, along with flowering plants which are found to grow on the walls.

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Table-1: List of mural species found in some selected sites of Kamrup (Metro) district.

Sl. No.	Plant species	Family	Nature of Wall									Vegetation zones (Microhabitat)			Facing Side	Location
			Brick Wall (BW)			Stone Wall (SW)			Brick Mortar Wall (BM)			VT	VF	B		
			ESS	MSS	LSS	ESS	MSS	LSS	ESS	MSS	LSS					
1.	*Drynaria quercifolia* (L.)J.Smith	Polypodiaceae	−	+	−	−	+	−	−	+	−	+	+	−	**WF**	Six Mile
2.	*Pyrossia adnascens* (Swartz)Ching		−	+	−	−	+	−	−	+	−	+	+	−	**SF**	Basistha
3.	*Pteris vitata* Linn.	Pteridaceae	−	+	−	−	+	−	−	+	−	−	+	−	**ESF**	Six Mile
4.	*Adiantum philippense* L.	Adiantaceae	−	+	−	−	+	−	−	+	−	−	+	−	**SF**	Basistha
5.	*Adiantum caudatum* Linn.		−	+	−	−	+	−	−	+	−	−	+	−	**SF**	Sonapur
6	*Asplenium nidus* L.	Aspleniaceae	−	+	−	−	−	−	−	−	−	+	−	−	**NF**	Beltola
7.	*Diplazium esculentum Bl.*	Woodsiaceae	−	+	−	−	+	−	−	−	−	+	+	−	**WF**	Sonapur
8.	*Microlepia speluncae* (Linn.)	Dennstaetiaceae	+	−	−	+	−	−	−	+	−	−	+	−	**NF**	Six Mile
9.	*Argemone mexicana* L.	Papavaraceae	+	−	−	+	−	−	−	−	−	−	+	−	**NF**	Sonapur
10.	*Rorippa indica*(Linn.) Hiern	Cruciferae	−	+	−	−	+	−	−	−	−	−	+	−	**WF**	Six Mile
11.	*Cleome rutidosperma DC Prodr.*	Capparidaceae	+	−	−	+	−	−	−	+	−	+	+	−	**WF**	Beltola
12.	*Cleome viscosa* L.		+	−	−	−	−	−	−	−	−	−	+	−	**NF**	Sonapur
13	*Triumfetta r*homboidea Jacq.	Tiliaceae	−	+	−	−	−	−	−	−	−	−	+	−	**SF**	Chandmari
14.	*Portulaca oleraceae* Linn.	Portulaceae	+	−	−	+	−	−	−	−	−	−	+	+	**NF**	Basistha
15	*Oxalis corniculata* Linn.	Oxalidaceae	+	−	−	+	−	−	−	+	−	−	+	+	**SF**	Sonapur
16	*Caryatia trifolia* (L.)Domin	Vitaceae	−	+	−	−	+	−	−	+	−	−	−	+	**WF**	Chandmari
17.	*Mangifera indica* L.	Anacardiaceae	−	−	+	−	−	−	−	−	−	−	+	−	**SF**	Basistha
18	*Desmodium triflorum* (L.) DC	Fabaceae	+	−	−	+	−	−	−	−	−	+	+	−	**WF**	Sonapur
19.	*Crotolaria juncea* L.		−	−	+	−	−	+	−	−	−	+	−	−	**NF**	Sonapur
20	*Mimosa pudica* L.		+	−	−	−	−	−	−	−	−	−	−	+	**SF**	Chandmari
21.	*Kalanchoe pinnatum* (Lamk.)Pers.	Crassulaceae	−	+	−	−	−	−	−	−	−	+	−	−	**NF**	Chandrapur
22.	*Lawsonia inermis* L.	Lythraceae	−	+	−	−	−	−	−	−	−	+	+	−	**NF**	Chandrapur
23	*Ludwigia octovalvis (Jacq) Pers.*	Onagraceae	−	+	−	−	−	−	−	−	−	−	+	+	**SF**	Chandrapur
24	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	+	−	−	+	−	−	−	−	−	−	−	+	**SF**	Chandmari
25	*Centella asiatica* (Linn.) Urb.	Umbellifera	+	−	−	−	−	−	−	−	−	−	+	+	**NF**	Sonapur
26	*Hedyotis corymbosa (Linn.)Lam*	Rubiaceae	+	−	−	+	−	−	−	−	−	−	+	+	**NF**	Sonapur
27	*Hedyotis coronaria* Craib		+	−	−	−	−	−	−	−	−	−	+	−	**ESF**	Chandrapur
28	*Oldenlandia corymbosa* L		+	−	−	+	−	−	+	−	−	−	+	+	**NF**	Beltola
29	*Acmella paniculata* (Wall. ex DC.) R.K.Jansen	Compositae	+	−	−	+	−	−	−	−	−	−	+	+	**NF**	Sonapur
30	*Eclipta prostrate* (L.) Linn.		+	−	−	+	−	−	−	−	−	−	+	+	**ESF**	Kamakhya
31	*Mikania micrantha H.B.K.*		+	−	−	−	−	−	−	−	−	−	−	+	**SF**	Sonapur
32	*Tridax procumbens* Linn.		+	−	−	−	−	−	−	−	−	−	+	+	**SF**	Chandrapur
33	*Synedrella nodiflora (L.)*		+	−	−	−	−	−	−	−	−	−	+	−	**NF**	Chandrapur
34	*Aegeratum conyzoidess* L.		−	+	−	−	+	−	−	−	−	−	+	+	**NF**	Basistha
35	*Conyza bonariensis(L.) Cron.*		−	+	−	−	−	−	−	−	−	−	+	−	**ESF**	Sonapur
36	*Emila sonchifolia*(L.) DC		−	+	−	−	−	−	−	−	−	−	+	+	**SF**	Basistha
37	*Eupatorium odoratum* L.		−	−	+	−	−	+	−	−	−	−	+	−	**ESF**	Chandrapur

38	*Gnaphalium luteo-album* L		−	+	−	−	−	−	−	−	−	−	+	−	**SF**	Chandrapur
39	*Parthenium hysterphorus* L.		−	+	−	−	+	−	−	−	−	−	+	−	**WF**	Chandmari
40	*Spilanthes panicuata DC.*		+	−	−	−	+	−	−	−	−	−	+	+	**WF**	Chandmari
41	*Sonchus oleraceus* L.		−	+	−	−	−	−	−	−	−	−	+	−	**ESF**	Sonapur
42	*Vernonia cinera* (L.) Less.		−	+	−	−	+	−	−	+	−	−	+	+	**ESF**	Noonmati
43	*Catharanthus roseus* (Linn.) G.Don	Apocynaceae	+	−	−	−	−	−	−	−	−	+	+	−	**NF**	Sonapur
44	*Evolvulus nummularius* (Linn.) Linn.	Convolvulaceae	+	−	−	+	−	−	−	−	−	+	−	−	**NF**	Six Mile
45	*Merremia vitifolia* (Burm.f.) Hallier.f		+	−	−	+	−	−	−	−	−	−	+	+	**ESF**	Noonmati
46	*Solanum nigrum* Linn.		+	−	−	+	−	−	−	−	−	−	+	−	**SF**	Chandmari
47	*Nicotiana plumbaginfolia* L.	Solanaceae	+	−	−	+	−	−	−	−	−	−	+	+	**SF**	Kamakhya
48	*Scoparia dulcis* Linn.		+	−	−	+	−	−	−	−	−	−	+	−	**WF**	Basistha
49	*Lindernia crustacea* (Linn.) F.V.Muell	Scrophulariaceae	+	−	−	−	−	−	−	+	−	−	+	−	**ESF**	Six Mile
50	*Andrgraphis paniculata* (Burm.f.)Wall		+	−	−	−	−	−	−	−	−	−	+	−	**NF**	Six Mile
51	*Justicia simplex* D.Don		+	−	−	+	−	−	−	−	−	−	+	−	**WF**	Panikheti
52	*Justicia parviflora Retz.*	Acanthaceae	+	−	−	−	−	−	−	−	−	−	+	−	**ESF**	Chandrapur
53	*Lepidogathis incurve* Buch-Ham ex D. Don		−	+	−	−	+	−	−	−	−	−	+	−	**ESF**	Basistha
54	*Leucas plukenetii (Roth.) Spreng*		+	−	−	+	−	−	−	−	−	−	+	−	**SF**	Chandrapur
55	*Ocimum tenuiflorum* L.	Labiatae	−	+	−	−	+	−	−	−	−	−	+	−	**WF**	Sonapur
56	*Ocimum americanum* L		−	+	−	−	−	−	−	−	−	−	+	+	**WF**	Sonapur
57	*Boerhavia diffusa* Linn.	Nyctaginaceae	+	−	−	+	−	−	−	−	−	+	+	−	**SF**	Six Mile
58	*Amaranthus spinosa* Linn.		+	−	−	+	−	−	−	−	−	−	+	+	**SF**	Six Mile
59	*Amaranthus viridis* Linn.	Amaranthaceae	+	−	−	+	−	−	−	−	−	−	+	+	**NF**	Sonapur
60	*Alternathera sessilis* (Linn.) D.C.		+	−	−	−	−	−	−	−	−	−	+	+	**ESF**	Kamakhya
61	*Polygonum sp.*	Polygonaceae	+	−	−	−	−	−	−	−	−	−	+	−	**SF**	Chandrapur
62	*Mollugo oppositifolia* Linn.	Molluginaceae	−	+	−	−	−	−	−	−	−	−	+	−	**NF**	Kamakhya
63	*Peperomia pellucida* (Linn.).H.B.K.	Piperaceae	+	−	−	+	−	−	−	+	−	−	+	+	**SF**	Chandrapur
64	*Acalypha indica* Linn.		−	+	−	−	+	−	−	−	−	−	+	+	**NF**	Chandrapur
65	*Euphorbia hirta* Linn.		+	−	−	+	−	−	−	+	−	−	+	+	**NF**	Kamakhya
66	*Euphorbia thymifolia L.*		+	−	−	+	−	−	−	−	−	+	+	−	**NF**	Six Mile
67	*Phyllanthus amarus* Schumach & Thonn.	Euphorbiaceae	+	−	−	+	−	−	−	−	−	+	+	−	**SF**	Beltola
68	*Phyllanthus fraternus Webster*		+	−	−	−	−	−	−	−	−	−	+	−	**WF**	Six Mile
69	*Phyllanthus reticulatus* Poir.		−	−	+	−	−	+	−	−	−	−	+	+	**SF**	Chandmari
70	*Pouzolzia zeylanica* (L.)Benn	Utricaceae	+	−	−	+	−	−	−	−	−	−	+	+	**SF**	Basistha
71	*Ficus religiosa* Linn.		−	−	+	−	−	+	−	−	+	−	+	+	**NF**	Panikheti
72	*Ficus racemosa* Linn.	Moraceae	−	−	+	−	−	+	−	−	−	−	+	−	**ESF**	Chandrapur
73	*Ficus hispida* L.		−	−	+	−	−	+	−	−	−	−	+	−	**NF**	Chandrapur
74	*Commelina benghalensis* L.		+	−	−	+	−	−	−	−	−	−	−	+	**NF**	Panikheti
75	*Commelina paludosa* Blume		+	−	−	+	−	−	−	−	−	−	−	+	**SF**	Chandrapur
76	*Murdannia japonica* (Thunb.) Faden	Commelinaceae	−	+	−	−	+	−	−	−	−	−	+	−	**WF**	Beltola
77	*Tradescantia spathacea* Sw.		−	+	−	−	−	−	−	−	−	−	+	−	**NF**	Chandrapur

78	*Colocasia esculenta (Linn.)*Schott	Araceae	+	−	−	−	−	−	−	−	−	−	+	+	**NF**	Six Mile
79	*Asparagus racemosa* Willd.	Asparagaceae	−	+	−	−	+	−	−	−	−	−	+	−	**WF**	Beltola
80	*Cyperus brevifolius* (Rottb.) Hassk		+	−	−	+	−	−	−	−	−	−	+	+	**NF**	Six Mile
81	*Cyperus pilosa* Vahl	Cyperaceae	+	−	−	+	−	−	−	−	−	−	+	+	**WF**	Basistha
82	*Arthraxon hispidus* (Thunb.) Makino		−	+	−	−	−	−	−	−	−	−	+	−	**NF**	Chandmari
83	*Axonopus compressus* (Sw.) P.Beauv.		−	+	−	−	−	−	−	−	−	−	+	−	**SF**	Beltola
84	*Cynodon dactylon* (L.) Pers.	Gramineae	−	+	−	−	+	−	−	−	−	−	+	−	**NF**	Chandmari
85	*Dactyloctenium aegyptium* (L.) P. Beauv.		+	−	−	−	−	−	−	−	−	+	+	−	**NF**	Panikheti
86	*Eragrostis tenella(L.) P.Beauv. ex R & S.*		−	+	−	−	+	−	−	−	−	+	+	−	**ESF**	Chandrapur
87	*Microstegium vimineum* (Trin.) A. Camus		−	+	−	−	+	−	−	−	−	−	+	+	**WF**	Chandrapur
88	*Pogonatherum crinitum (Thumb.) Kunth,*		−	+	−	−	+	−	−	−	−	+	+	−	**WF**	Panikheti
89	*Imperata cylindrica (L.)P.BW*		−	+	−	−	+	−	−	−	−	+	+	−	**ESF**	Chandmari
90	*Oplismenus burmanni* (Retz) P.Beauv		+	−	−	+	−	−	−	−	−	+	+	−	**WF**	Chandrapur

BW-Brick Wall; **ST**-Stone Wall; **BM**-Brick Mortar;
VT-Vertical Top, **VF**-Vertical Face; **B**-Base;
ESS-Early Successional Stage; **MSS**-Mid Successioal Stage; **LSS**-Late Successional Stage
ESF- East Facing; **WF-**West Facing**; NF-**North Facing**; SF-**South facing
+ = Presence; ─ = Absence