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Exploration of Murophytes of Some Historical Buildings of Malda District of West Bengal, India

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ABSTRACT

The wall of the heritage sites are frequently colonized by the murophytic plants. Many species belonging to different families growing on these buildings incidentally and accidentally. Some plants acclimatized on walls often prove destructive to buildings and must be eradicated. The intensity of deterioration of wall depends on the distribution sites on which they occur.This study was carried out to identify the vascular plant flora growing on heritage buildings of Malda district, West Bengal, India. for this study, some heritage buildings of Malda were selected as the study area. In vascular flora, 5 species of Pteridophyte and 81 of the angiosperm were observed. A total 37 families of vascular flora were recorded. Most species were identified from the Asteraceae, Amranthaceae, Fabacea and Poaceae families. Among the distribution sites maximum diversity of species was noted in the Cavities at ground level.

Key words: *Murophyte, Deterioration, Colonization, Malda, Heritage Building, Prevalence.*

INTRODUCTION

Vascular plants are well adapted to a wide range of habitat. In addition with their natural habitat they use some other habitat either incidentally and accidentally. Certain vascular plants design their life processes for extraterrestrial survival on walls as an additional strategy to avoid completion and exclusion from the ecosystem. Walls are simply considered as manmade habitat representing a specific environment which quite similar to rocks and rock fissures[1]. The walls provide demanding conditions for plants because of natural calamities like exposure, drought and anthropogenic activities. Deposition of dust, Organic substance, suspended particle of air and atmospheric moisture lead to the formation of thin film of soil substratum on the walls and wall fissures; which leads to the development of a specialized flora.

This man-made habitat gradually influence a range of plant species to colonize on it. Though the man made walls represent extreme environments, with edaphic factors such as the low availability of water and nutrients, and exposure to wind and sun, but also some plants show the capacity to grow over the walls.

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Such type of flora is termed as Mural Flora and the plants are called as Murophytes. The murophytes usually have wide range of adaptations from mesic (moderate state of hydration) to xeric (dehydrated state) conditions[2].Among the buildings, ancient historical buildings are the most suitable habitat for the mural flora. The decoration and architecture of old buildings and the magnificent carvings for beautification provides more anchoring points for the settlement of seeds. Horizontal and vertical folds and joints in the carvings act as a capillary and facilitate the seed to settle with the movement of water[3].The uprooted or damaged plaster of a wall provides favorable sites for germination of seeds of murophytes. Abiotic natural agents such as fluctuating temperature, rain, hail, flood, earthquake etc. reduce the buildings to rubbles and implement the habitat for the mural plant. Damages caused by effects of Anthropogenic and Biotic factors also influence the rapid growth of mural flora.

Plant vegetation over historical building is one of the major problems faced by the conservator and authority of the heritage. Historical sites are especially important, because the structure and age of their walls provide a range of opportunities for plants such as weathered stonework and lime-rich mortar .The plants which are adapted to wall, are broadly classified into two categories, Ediphytes and Chasmophytes. The word Ediphyte is composed of two latin words *Edi*=Building, *Phytes* = Plants. Ediphytes are vascular plants growing out from the moist wall crevices and cracks caused by leaking sewage pipes of the neglected and dilapidated, multi storeyed buildings[4].Chasmophytes are crevices plants growing in abandoned places, cracked footpaths, and damaged foundations of buildings. They have developed several adjustments, such as strong roots, in order to survive. This supports them on the cliffs and also allows the maximum exploitation of the little water and nutrients contained in minimum soil (http[1]). Moreover, this habitat is susceptible to strong winds and full sunlight, as there is no tall vegetation to protect it from these climatic factors. It is noteworthy that most chasmophytic species are endemics. Most significant diference between them is that, Chasmophytes are unable to cause damage to the building but Ediphytes can cause damage to buildings and structures through direct or indirect root processes. When plants grow in fissures or cracks, the gap between these cracks and fissures may be increased further on account of the increase in the volume of the roots and root tip pressure. Walls have many primary seed traps, where the seeds are initially captured in building. After the growth of the plants, walls are further damaged and they provide secondary and tertiary seed traps too. This will result in the successive damage of buildings and makes them more vulnerable[5,6]. The present study focuses on identification of plants growing in the crevices and walls of historical buildings of Malda District and to determine the attributes of the different types of Mural communities of prevailing in the study area.

MATERIAL AND METHODS

Study Site:

Malda district is one of the reknowned historical place of West Bengal as well as India.The existence of this historic location can be traced back to long back, at least to the existence of Mouryan Empire. Archeological findings also figure out the existance of buildings of Gupta Empire (Pandua or Pundrabardhana and Gour) Palas dynasty , Senas dynasty, Muslim dynasty (Adina) and many Indian dynasty under British rule([3]http).In this investigation five heritage buildings were selected for the study of wall flora was carried out. These are Gour; Adina: Jami Masjid, Pandua: Eklakhi Mousoleum; Jagjibanpur-Nandadirghi Vihara; Chanchol and Harishchandrapur Rajbari.

Methodology

Extensive Field Surveys were conducted during December 2016 to January. 2018 to evaluate the status of Mural flora in the area and the impact of the flora on the studied area. The plant specimens were collected, mounted on herbarium sheets and identified through the available taxonomic literature, books and some relevant articles. The information regarding distribution are used to construct a model of distribution of mural flora[7].Some of these plants may grow on a substrate inside cavities in the wall (Fig.1, situations A, B, C, D, E, F,

G) or on a substrate formed on horizontal porous surfaces (Fig. 1, situations H, I). Different sites of the distribution of mural flora are categorized as

A. Cavities at ground level: Due to availability of heterogenous material this situation permits the growth of many species because in majority cases the plant root may penetrate the earth. In addition the rain water does not flow off. Thus the plants growing in this situation suffer less environmental stress[7].

B. Cavities in inclined surfaces: In this situation there are greater possibilities of receiving water and it is easier for seeds to lodge than on a vertical surface[7].

C. Cavities at the interface between two types of building material: The availability of nutrients is greater, the greater the chemical difference between the two materials[7].

D. Cavities in a vertical face of homogeneous material: This is the situation most hostile to plant growth since water availability is limited to wind-blown rain[7].

E. Cavities in horizontal surfaces: This is the situation with the greatest water availability but if the plant is not adapted to retain it, it has little chance of survival[7].

F. Cavities at the intersection of vertical and horizontal surfaces: This situation is similar to A as far as water is concerned, but there is less substrate[7].

G. Cavities where two vertical surfaces meet: This situation is similar to F but less water is available.

H. Substrate formed on a horizontal porous surface: The situation is constituted by a corbel which is a decorative element in roman buildings and baroque and renaissance churches. It usually consists of marble, travertine or sandstone[7].

I. Substrate formed on ruined stonework: This is a special situation results from the destruction of walls or pillars built with an outer layer of bricks or squared stones enclosing a space filled with irregular stones or broken bricks held together with lime mortar. Exposure of the central core by man or weathering provides the ideal situation for the collection of substrate which can host plants of different species even in a very limited area[7].

Study Sites

1-4 Different places of GOUR; 5-7. Different places of ADINA-JAMI MASJID;8. PANDUA-EKLAKHI MAUSOLEUM;9-10. Excavation of JAGJIBANPUR-NANDADIRGHI VIHARA; 11-12.CHANCHAL AND HARRISHCHANDRAPUR RAJBAR

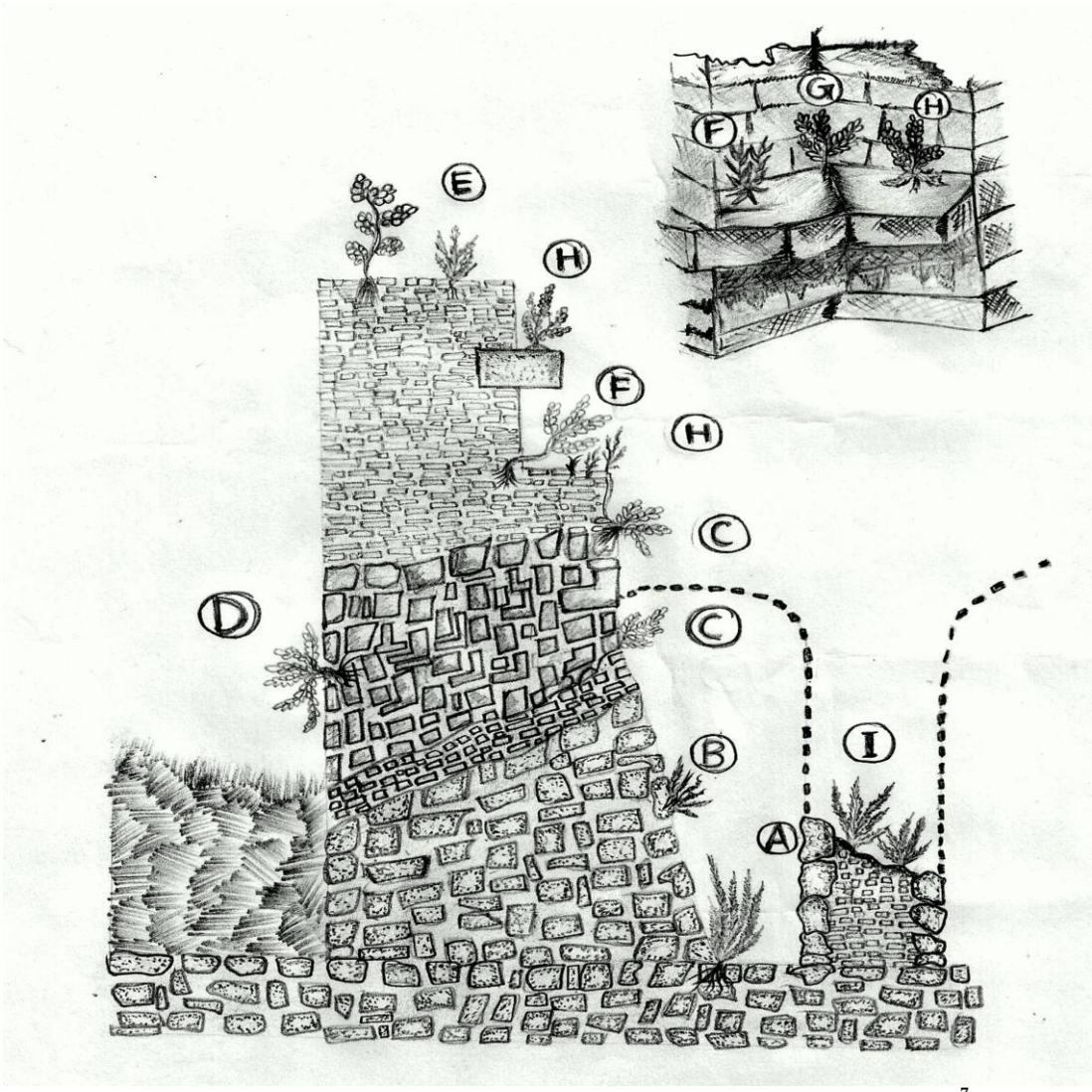


Fig. 1: Diagrammatic Representation of the main situations of Mural Flora[7]

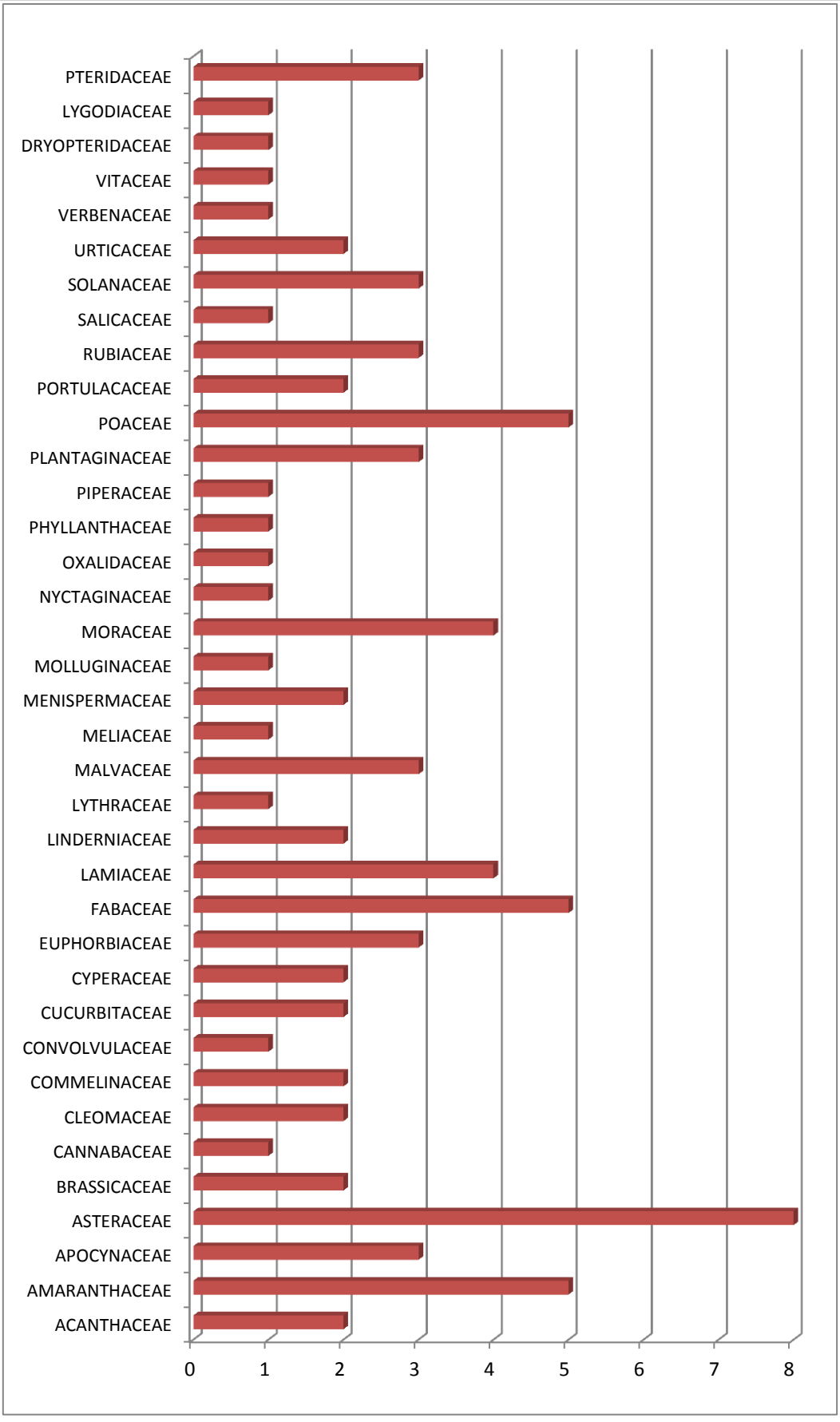
A. Cavities at ground level;
B. Cavities in inclined surfaces;
C. Cavities at the interface between two types of building material;
D. Cavities in a vertical face of homogeneous material;
E. Cavities in a horizontal surface;
F. Cavities at the intersection of vertical and horizontal surfaces;
G. Cavities where two vertical surfaces meet;
H. Substrate formed on a horizontal porous surface;
I. Substrate formed on ruined stonework.

The present work which covered the wall flora of five major heritage buildings of Malda district, *viz.* Gour, Adina:Jami Masjid, Pandua: Eklakhi Mousoleum, Jagjibanpur: Nandadirghi Vihara, Chanchol and Harishchandrapur Rajbari could record as many as 86 vascular plant species belonging to 37 families. Among the species 5.8139% are fern and 94.1860% are angiosperm. No any species of Gymnosperms was reported from the wall of the study sites. Habit analysis of wall plants shows the presence of 74.4186% herbs, 10.4651% shrubs, 8.1395%vines and 6.9767% trees. (Graph1.) Of the total 82 vascular plant were recorded the maximum number of species that is 8 (9.3023 %) belongs to Asteraceae family, 5 (5.8139%) to Poaceae , 5 (5.8139%) to Fabaceae and 5 (5.8139%) to Amaranthaceae (Table 2). Thus the study reveals that Asteraceae, Poaceae, Fabaceae,

and Amaranthaceae are the dominant murophytic family of the heritage sites of Malda district. The number of species was highest in walls of Jagjibanpur: Nandadirghi Vihara (67 species). The next to come in the list is Gour with 66 species. There were 52 species in Adina: Jami Masjid and 41 species in case of Harishchandrapur Rajbari. The number of species was lowest for Pandua: Eklakhi Mousoleum (23 species).

Table 1: Family wise status of Murophytes

Sl. No.	Family	No. of Plant Representatives
1	ACANTHACEAE	02
2	AMARANTHACEAE	05
3	APOCYNACEAE	03
4	ASTERACEAE	08
5	BRASSICACEAE	02
6	CANNABACEAE	01
7	CLEOMACEAE	02
8	COMMELINACEAE	02
9	CONVOLVULACEAE	01
10	CUCURBITACEAE	02
11	CYPERACEAE	02
12	EUPHORBIACEAE	03
13	FABACEAE	05
14	LAMIACEAE	04
15	LINDERNIACEAE	02
16	LYTHRACEAE	01
17	MALVACEAE	03
18	MELIACEAE	01
19	MENISPERMACEAE	02
20	MOLLUGINACEAE	01
21	MORACEAE	04
22	NYCTAGINACEAE	01
23	OXALIDACEAE	01
24	PHYLLANTHACEAE	01
25	PIPERACEAE	01
26	PLANTAGINACEAE	03
27	POACEAE	05
28	PORTULACACEAE	02
29	RUBIACEAE	03
30	SALICACEAE	01
31	SOLANACEAE	03
32	URTICACEAE	02
33	VERBENACEAE	01
34	VITACEAE	01
35	DRYOPTERIDACEAE	01
36	LYGODIACEAE	01
37	PTERIDACEAE	03



Graph 1: Family wise status of Murophytes

Table 2: Habit, Abundance of the murophytes and their prevalence of the plant Species in different walls

Sl. No.	Name of the Plant	Family	Habit	Frequency of Occurrence	Attendance in study site					Prevalence (%)
					Go	Ad	Pa	Ja	Ch	
1	*Hemigraphis hirta* (Vahl) T. Anderson	Acanthaceae	Herb	Less	√	√		√		60
2	*Nelsonia canescens* (Lam.) Spreng.	Acanthaceae	Herb	Medium	√			√		40
3	*Amaranthus spinosus* L.	Amaranthaceae	Herb	Medium	√	√		√	√	80
4	*Achyranthes aspera* L.	Amaranthaceae	Herb	Less	√	√		√		60
5	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Herb	High	√	√		√	√	80
6	*Aerva lanata* (L.) Juss.	Amaranthaceae	Herb	Medium	√			√		40
7	*Amaranthus viridis* L.	Amaranthaceae	Herb	Medium	√	√		√		60
8	*Dregea volubilis* (L.f.) Benth. Ex Hook.f.	Apocynaceae	Vining Shrub	Less	√			√		40
9	*Cascabela thevetia* (L.) Lippold	Apocynaceae	Shrub	Less				√		20
10	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Shrub	Less	√			√	√	60
11	*Emilia sonchifolia* (L.) DC. ex DC.	Asteraceae	Herb	High	√	√	√	√	√	100
12	*Eclipta prostrata* (L.) L.	Asteraceae	Herb	High	√	√	√	√	√	100
13	*Laphangium luteoalbum* (L.) Tzvelev	Asteraceae	Herb	Less	√	√		√		60
14	*Blumea lacera* (Burm.f.) DC.	Asteraceae	Herb	High	√	√	√	√	√	100
15	*Cyanthillium cinereum* (L.) H. Rob.	Asteraceae	Herb	High	√	√	√	√	√	100
16	*Crassocephalum crepidioides* (Benth.) S. Moore	Asteraceae	Herb	Less	√	√		√	√	80
17	*Bidens pilosa* L.	Asteraceae	Herb	Medium	√			√		40
18	*Mikania micrantha* Kunth	Asteraceae	Vines	Less	√					20
19	*Rorippa indica* (L.) Hiern	Brassicaceae	Herb	Medium				√	√	40
20	*Cardamine hirsuta* L.	Brassicaceae	Herb	Less	√	√	√	√		80
21	*Trema orientalis* (L.) Blume	Cannabaceae	Tree	Medium	√	√	√	√		80
22	*Cleome rutidosperma* DC.	Cleomaceae	Herb	High	√	√		√	√	80
23	*Cleome viscosa* L.	Cleomaceae	Herb	Rare				√		20
24	*Commelina benghalensis* L.	Commelinaceae	Herb	Rare				√		20
25	*Murdannia nudiflora* (L.) Brenan	Commelinaceae	Herb	Medium	√	√		√		60
26	*Evolvulus nummularius* (L.) L.	Convolvulaceae	Herb	High	√	√	√	√	√	100
27	*Trichosanthes tricuspidata* Laur.	Cucurbitaceae	Vines	Rare	√					20
28	*Coccinia grandiflora* Cogn. ex Engl.	Cucurbitaceae	Vines	Rare	√			√		40
29	*Kyllinga brevifolia* Rottb.	Cyperaceae	Herb	Less	√	√	√	√	√	100
30	*Cyperus rotundus* L.	Cyperaceae	Herb	Medium	√	√		√		60
31	*Euphorbia hirta* L.	Euphorbiaceae	Herb	High	√	√	√	√	√	100
32	*Euphorbia thymifolia* L.	Euphorbiaceae	Herb	High	√	√	√	√	√	100
33	*Acalypha indica* L.	Euphorbiaceae	Herb	Less	√				√	40
34	*Sennatora* (L.) Roxb.	Fabaceae	Herb	Rare				√		20
35	*Desmodium triflorum* (L.) DC.	Fabaceae	Herb	Medium	√	√		√		60
36	*Sennasophera* (L.) Roxb.	Fabaceae	Shrub	Rare	√			√		40
37	*Desmodium gangeticum* (L.) DC.	Fabaceae	Shrub	Rare				√		20
38	*Desmodium heterophyllum* (Willd.)DC.	Fabaceae	Herb	Medium	√	√				40
39	*Leucasaspera* (Willd.)Link	Lamiaceae	Herb	Less	√			√	√	60
40	*Clerodendrum infortunatum* L.	Lamiaceae	Herb	Rare				√		20
41	*Ocimum tenuiflorum* L.	Lamiaceae	Herb	Rare				√		20
42	*Anisomelesindica* (L.) Kuntze	Lamiaceae	Shrub	Rare				√		20
43	*Linderniacrustacea* (L.) F.Muell.	Linderniaceae	Herb	High	√	√	√	√	√	100
44	*Lindernia ciliata* (Colsm.) Pennell	Linderniaceae	Herb	Less	√			√		40

45	*Cuphea hyssopifolia* Kunth	Lythraceae	Shrub	Rare				√		20
46	*Abutilon indicum* (L.) Sweet	Malvaceae	Shrub	Rare				√		20
47	*Triumfetta rhomboidea* Jacq.	Malvaceae	Shrub	Rare				√		20
48	*Sida cordata* (Burm.f.) Borss.Waalk.	Malvaceae	Shrub	Medium	√			√		40
49	*Azadirachta indica*A.Juss.	Meliaceae	Tree	Rare		√				20
50	*Cocculus hirsutus*(L.) W.Theob.	Menispermaceae	Vining Shrub	Less		√				20
51	*Stephania japonica* (Thunb.) Miers	Menispermaceae	Vining Shrub	Medium	√	√		√		60
52	*Glinus oppositifolius* (L.) Aug.DC.	Molluginaceae	Herb	Medium	√	√	√	√		80
53	*Ficus benghalensis* L.	Moraceae	Tree	High	√	√	√	√	√	100
54	*Ficus religiosa*L.	Moraceae	Tree	High	√	√			√	60
55	*Ficus racemosa* L.	Moraceae	Tree	Medium	√					20
56	*Ficus hispida*L.f.	Moraceae	Woody Shrub	High				√	√	40
57	*Boerhavia diffusa* L.	Nyctaginaceae	Herb	High	√	√	√	√	√	100
58	*Oxalis corniculata* L.	Oxalidaceae	Herb	High	√	√	√	√	√	100
59	*Phyllanthus urinaria* L.	Phyllanthaceae	Herb	Less		√	√		√	60
60	*Peperomia pellucida* (L.) Kunth	Piperaceae	Herb	Less				√	√	40
61	*Mecardonia procumbens*(Mill.)Small	Plantaginaceae	Herb	Medium	√	√	√	√		80
62	*Lindenbergia indica*Vatke	Plantaginaceae	Herb	High	√	√		√	√	80
63	*Scoparia dulcis* L.	Plantaginaceae	Herb	Medium	√	√		√	√	80
64	*Eragrostis amabilis* (L.) Wight &Arn.	Poaceae	Herb	High	√	√		√	√	80
65	*Sacciolepis indica* (L.) Chase	Poaceae	Herb	High	√	√		√		60
66	*Oplismenus burmanni* (Retz.) P.Beauv.	Poaceae	Herb	Medium	√	√		√		60
67	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb	Medium	√	√	√	√	√	100
68	*Axonopus compressus* (Sw.) P.Beauv.	Poaceae	Herb	Less	√	√		√		60
69	*Portulaca oleracea* L.	Portulacaceae	Herb	High	√	√	√	√	√	100
70	*Portulaca quadrifida* L.	Portulacaceae	Herb	Rare		√				20
71	*Dentella repens* (L.) J.R.Forst. &G.Forst.	Rubiaceae	Herb	Medium	√	√	√	√	√	100
72	*Oldenlandia corymbosa* L.	Rubiaceae	Herb	High	√	√	√	√	√	100
73	*Oldenlandia diffusa* (Willd.) Roxb.	Rubiaceae	Herb	Medium	√				√	40
74	*Flacourtia indica* (Burm.f.) Merr.	Salicaceae	Tree	Rare		√				20
75	*Solanum sisymbriifolium* Lam.	Solanaceae	Herb	Rare				√		20
76	*Nicotiana plumbaginifolia*Viv.	Solanaceae	Herb	Less	√	√		√	√	80
77	*Physalis peruviana*L.	Solanaceae	Herb	Rare	√					20
78	*Pouzolzia zeylenica* (L.)Benn.	Urticaceae	Herb	Medium	√	√		√		60
79	*Pilea microphylla* (L.) Liebm.	Urticaceae	Herb	High	√	√	√	√	√	100
80	*Phyla nodiflora* (L.) Greene	Verbenaceae	Herb	Less	√	√	√	√		80
81	*Ampelocissus latifolia*(Roxb.) Planch.	Vitaceae	Vines	Less	√					20
82	*Dryopteris filix-mas* (L.) Schott	Dryopteridaceae	Herb	Less	√	√			√	60
83	*Lygodium flexuosum* (L.) Sw.	Lygodiaceae	Herb	Rare	√			√		40
84	*Pteris vittata* L.	Pteridaceae	Herb	High	√	√		√	√	80
85	*Adiantum caudatum* L.	Pteridaceae	Herb	High	√	√		√	√	80
86	*Adiantum lunulatum*Burm. f.	Pteridaceae	Herb	Medium	√			√		40

When the flora was analyzed on the basis of distribution of supporting wall very interesting results were obtained. Nine different types of distribution were studied of which maximum

diversity of species were recorded at site A (Cavities at ground level) and site H(Substrate formed on a horizontal porous surface). Minimum diversity of species were recorded at site G (Cavities where two vertical surfaces meet). (Table 3).

Among the species *Euphorbia thymifolia* L., *Ficus benghalensis* L., *Portulaca oleracea* L. and *Pilea microphylla* (L.) Liebm. were found at eight distribution sites. On the other hand *Trichosanthes tricuspidata* Laur., *Desmodium heterophyllum* (Willd.) DC, *Cuphea hyssopifolia* Kunth, *Mecardonia procumbens* (Mill.) Small, *Flacourtia indica* (Burm.f.) Merr. *Solanum sisymbriifolium* Lam. and *Phyla nodiflora* (L.) Greene were found to present at one site only. (Table 3. and Table 4.)

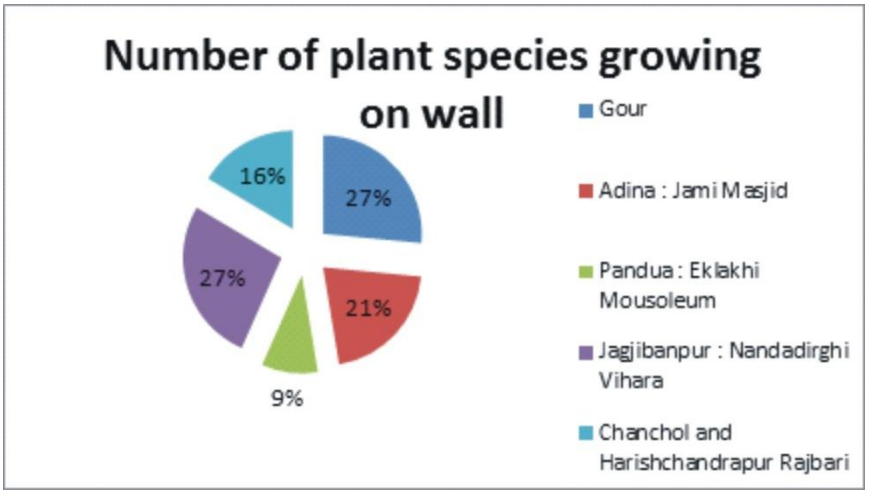
Table 3: Distribution sites and Diversity of species in different sites

Sl. No.	DIFFERENT POSITION OF SUBSTRATE CAVITIES OF GROWING MURAL PLANTS	POSITIONS DENOTES AS	No. OF PLANTS OCCURANCE AT THE POSITION	PERENTAGE OF DIVERSITY
1	Cavities at ground level	**A**	**58**	67.44186047
2	Cavities in inclined surface	**B**	**48**	55.81395349
3	Cavities at the interface between two types of building material	**C**	**39**	45.34883721
4	Cavities in a vertical face of homogenous material	**D**	**33**	38.37209302
5	Cavities in a horizontal surface	**E**	**16**	18.60465116
6	Cavities at the intersection of vertical and horizontal surfaces	**F**	**36**	41.86046512
7	Cavities where two vertical surfaces meet	**G**	**10**	11.62790698
8	Substrate formed on a horizontal porous surface	**H**	**54**	62.79069767
9	Substrate formed on ruined stonework	**I**	**40**	46.51162791

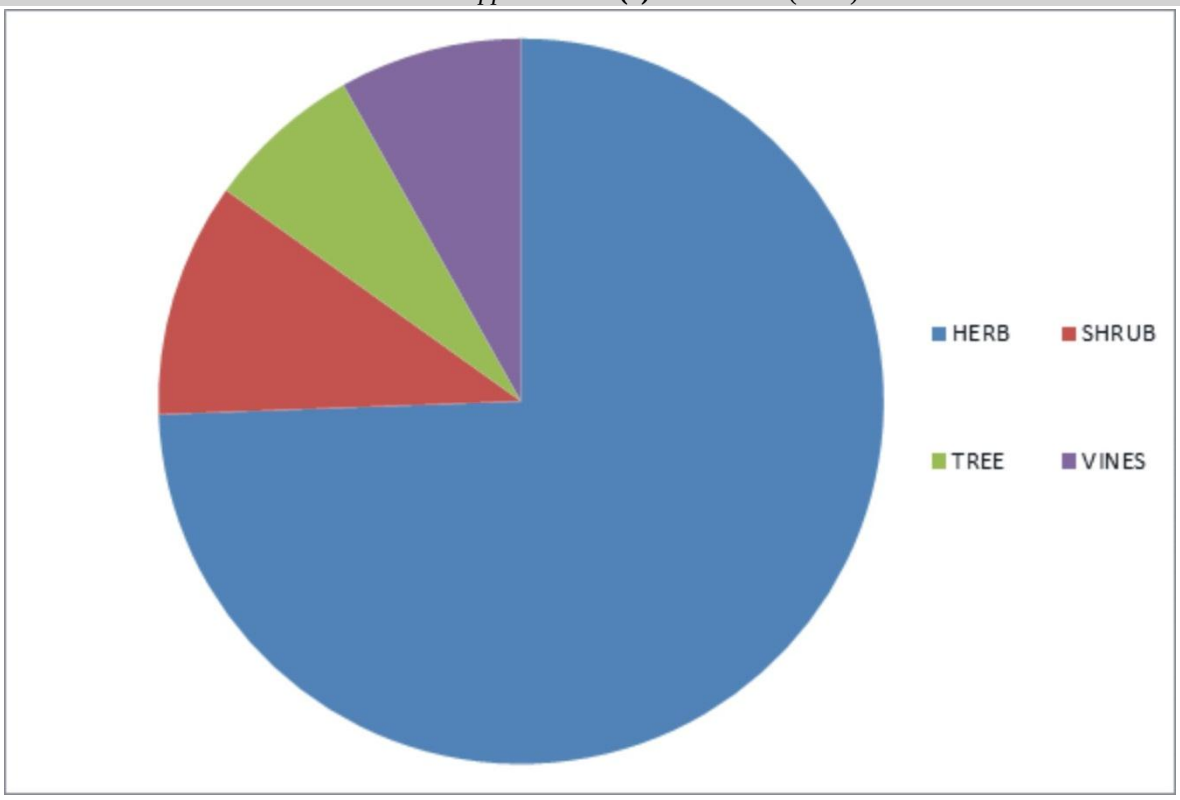
Table 4: Distribution sites of Murophytes and prevalence of the Plant Species based on distribution site

SL. No.	NAME OF THE PLANT	Distribution of mural flora in five heritage sites of Malda,India									Prevalence on the basis of distribution
		A ***	B **	C *	D **	E **	F ***	G *	H ***	I ***	
1	*Hemigraphis hirta* (Vahl) T.Anderson	+								+	22.22
2	*Nelsonia canescens*(Lam.) Spreng.	+					+		+		33.33
3	*Amaranthus spinosus* L.	+	+		+					+	44.44
4	*Achyranthes aspera* L.	+	+							+	33.33
5	*Alternanthera sessilis* (L.) R.Br. ex DC.	+	+	+			+			+	55.55
6	*Aerva lanata* (L.) Juss.	+							+	+	33.33
7	*Amaranthus viridis* L.	+					+		+		33.33
8	*Dregea volubilis* (L.f.) Benth. exHook.f.		+				+		+		33.33
9	*Cascabela thevetia* (L.) Lippold					+	+		+		33.33
10	*Calotropis procera* (Aiton) Dryand.					+	+		+	+	44.44
11	*Emilia sonchifolia* (L.) DC. ex DC.	+	+	+							33.33
12	*Eclipta prostrata* (L.) L.		+	+	+			+	+	+	66.66
13	*Laphangium luteoalbum* (L.) Tzvelev	+					+		+	+	44.44
14	*Blumea lacera* (Burm.f.) DC.	+	+	+	+			+	+		66.66
15	*Cyanthillium cinereum* (L.) H.Rob.	+	+	+	+	+	+		+		77.77
16	*Crassocephalum crepidioides*(Benth.)S.Moore	+				+	+		+	+	55.55
17	*Bidens pilosa* L.	+					+		+	+	44.44
18	*Mikania micrantha*Kunth			+	+				+		33.33
19	*Rorippa indica* (L.) Hiern	+					+		+	+	44.44
20	*Cardamine hirsuta* L.	+							+		22.22
21	*Trema orientalis* (L.) Blume			+	+	+	+	+	+		66.66
22	*Cleome rutidosperma* DC.	+	+	+			+		+	+	66.66
23	*Cleome viscosa* L.								+	+	22.22
24	*Commelina benghalensis* L.		+						+		22.22
25	*Murdannianudiflora* (L.) Brenan		+	+	+	+	+		+		66.66
26	*Evolvulusnummularius* (L.) L.	+					+		+		33.33
27	*Trichosanthes tricuspidata*Laur.						+				11.11
28	*Cocciniagrandiflora*Cogn. ex Engl.	+	+				+			+	44.44
29	*Kyllingabrevifolia*Rottb.	+	+								22.22
30	*Cyperusrotundus*L.		+	+	+				+	+	55.55

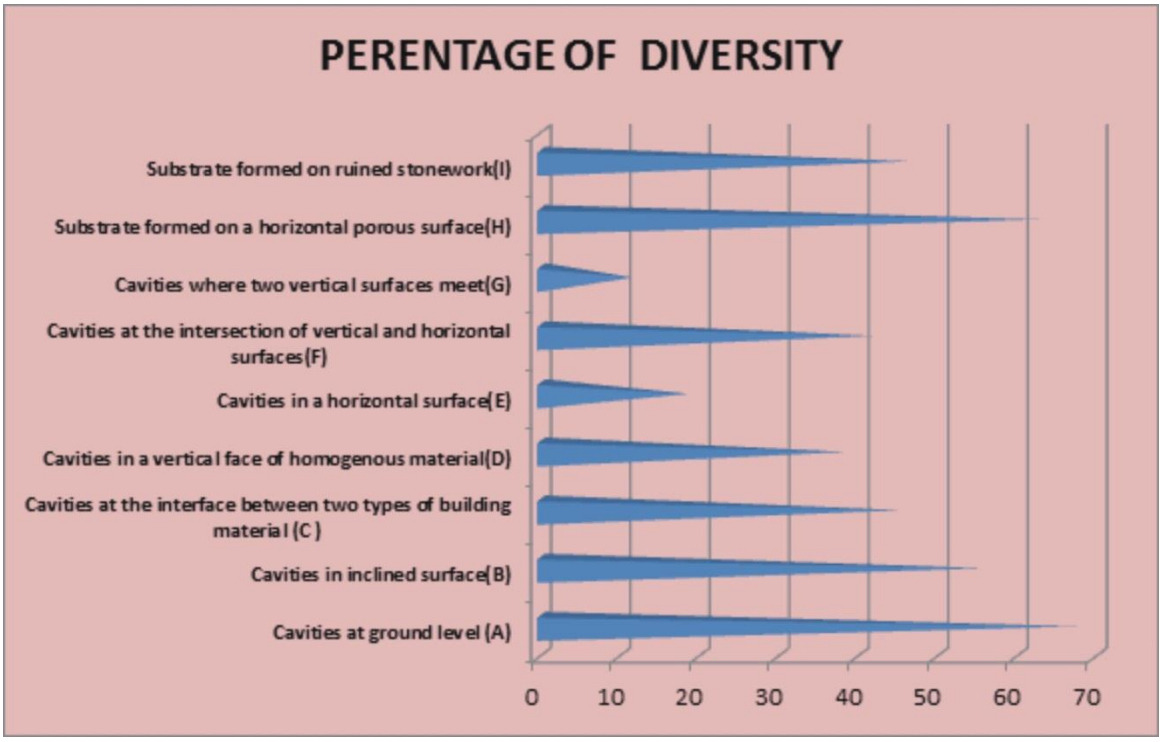
31	*Euphorbia hirta* L.	+	+	+	+		+		+		66.66
32	*Euphorbia thymifolia* L.	+	+	+	+	+	+		+	+	88.88
33	*Acalypha indica* L.	+		+			+		+	+	55.55
34	*Senna tora* (L.) Roxb.	+	+								22.22
35	*Desmodium triflorum* (L.) DC.	+	+								22.22
36	*Senna sophera* (L.) Roxb.	+							+	+	33.33
37	*Desmodium gangeticum* (L.) DC.		+	+							22.22
38	*Desmodium heterophyllum*(Willd.)DC.	+									11.11
39	*Leucasaspera* (Willd.)Link		+	+	+		+		+		55.55
40	*Clerodendrum infortunatum* L.	+	+	+	+						44.44
41	*Ocimum tenuiflorum* L.								+	+	22.22
42	*Anisomelesindica* (L.) Kuntze	+	+							+	33.33
43	*Linderniacrustacea* (L.) F.Muell.	+	+	+	+			+	+		66.66
44	*Lindernia ciliata* (Colsm.) Pennell	+	+				+		+	+	55.55
45	*Cuphea hyssopifolia* Kunth	+									11.11
46	*Abutilon indicum* (L.) Sweet				+				+		22.22
47	*Triumfetta rhomboidea* Jacq.	+		+	+				+		44.44
48	*Sida cordata* (Burm.f.) Borss.Waalk.	+	+				+		+		44.44
49	*Azadirachta indica*A.Juss.								+	+	22.22
50	*Cocculus hirsutus*(L.) W.Theob.	+		+	+						33.33
51	*Stephania japonica* (Thunb.) Miers	+	+	+	+		+		+	+	77.77
52	*Glinus oppositifolius* (L.) Aug.DC.	+	+				+		+		44.44
53	*Ficus benghalensis* L.		+	+	+	+	+	+	+	+	88.88
54	*Ficus religiosa*L.		+	+	+		+	+		+	66.66
55	*Ficus racemosa* L.	+		+			+		+		44.44
56	*Ficus hispida*L.f.	+	+			+			+		44.44
57	*Boerhavia diffusa* L.	+		+	+		+		+	+	66.66
58	*Oxalis corniculata* L.	+	+	+	+				+	+	66.66
59	*Phyllanthus urinaria* L.	+	+						+	+	44.44
60	*Peperomia pellucida* (L.) Kunth	+	+					+	+	+	55.55
61	*Mecardonia procumbens*(Mill.)Small	+									11.11
62	*Lindenbergia indica*Vatke		+	+	+	+	+	+	+		77.77
63	*Scoparia dulcis* L.	+	+						+	+	44.44
64	*Eragrostis amabilis* (L.) Wight &Arn.		+	+	+		+		+	+	66.66
65	*Sacciolepis indica* (L.) Chase	+		+	+				+		44.44
66	*Oplismenus burmanni* (Retz.) P.Beauv.	+	+								22.22
67	*Cynodon dactylon* (L.) Pers.	+	+							+	33.33
68	*Axonopus compressus* (Sw.) P.Beauv.	+								+	22.22
69	*Portulaca oleracea* L.	+		+	+	+	+	+	+	+	88.88
70	*Portulaca quadrifida* L.					+	+		+		33.33
71	*Dentella repens* (L.) J.R.Forst. &G.Forst.	+	+	+	+						44.44
72	*Oldenlandia corymbosa* L.		+	+	+	+			+	+	66.66
73	*Oldenlandia diffusa* (Willd.) Roxb.		+	+	+	+					44.44
74	*Flacourtia indica* (Burm.f.) Merr.									+	11.11
75	*Solanum sisymbriifolium* Lam.	+									11.11
76	*Nicotiana plumbaginifolia*Viv.	+		+						+	33.33
77	*Physalis peruviana*L.	+		+					+		33.33
78	*Pouzolzia zeylenica* (L.)Benn.	+	+								22.22
79	*Pilea microphylla* (L.) Liebm.	+	+	+	+	+		+	+	+	88.88
80	*Phyla nodiflora* (L.) Greene	+									11.11
81	*Ampelocissus latifolia*(Roxb.) Planch.			+	+				+		33.33
82	*Dryopteris filix-mas* (L.) Schott	+	+				+			+	44.44
83	*Lygodium flexuosum* (L.) Sw.	+	+			+				+	44.44
84	*Pteris vittata* L.		+	+	+						33.33
85	*Adiantum caudatum* L.		+	+	+		+				44.44
86	*Adiantum lunulatum* Burm. f.		+	+	+		+		+		66.66



Graph 2. Murophytic species of different study sites



Graph 3. Habits of Mural flora of study sites



Graph 4: Diversity of Mural species in different distribution sites.

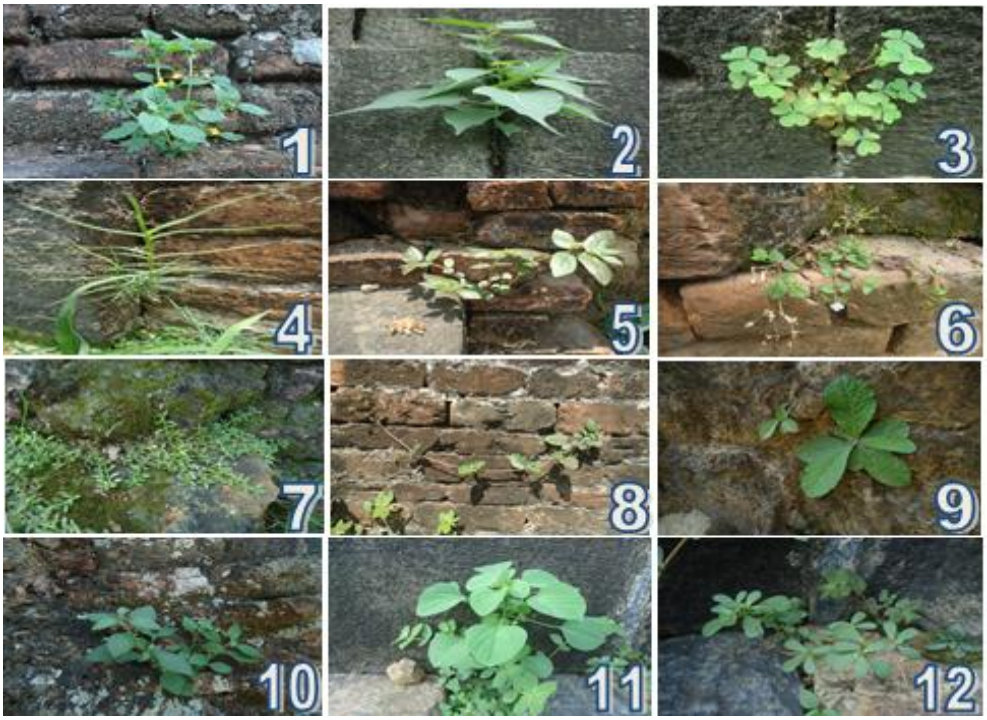
Weblinks;

1 http://www.parnitha-np.gr/chasmophytes.htm

2 http://www.urbanitewebzine.com/homepage-2/contact-me/

3 http://www.bharatonline.com/west-bengal/travel/malda/history.html

PLATE-I



1.*Lindenbergia indica* Vatke ; 2. *Ficus religiosa* L.; 3. *Oxalis corniculata* L.; 4. *Cynodon dactylon* (L.) Pers.; 5. *Euphorbia hirta* L.; 6. *Lindernia crustacea* (L.) F.Muell.; 7. *Dentella repens* (L.) J.R.Forst. &G.Forst.; 8. *Boerhavia diffusa* L.; 9. *Blumea lacera* (Burm.f.) DC.; 10. *Cyanthillium cinereum* (L.) H.Rob.; 11. *Acalypha indica* L.; 12. *Portulaca oleracea* L.

PLATE-II

13. *Portulaca quadrifida* L.; 14. *Adiantum caudatum* L.; 15. *Euphorbia thymifolia* L.; 16. *Phyllanthus urinaria* L.; 17. *Mecardonia procumbens* (Mill.)Small; 18. *Desmodium triflorum* (L.) DC.; 19. *Cyperus rotundus* L.; 20. *Amaranthus spinosus* L.; 21. *Leucas aspera* (Willd.)Link; 22. *Calotropis procera* (Aiton) Dryand.; 23. *Ficus benghalensis* L.; 24. *Pteris vittata* L.; 25. *Ficus hispida* L.f.

PLATE-III

26. *Flacourtia indica* (Burm.f.) Merr.; 27. *Solanum sisymbriifolium* Lam.; 28. *Aerva lanata* (L.) Juss.; 29. *Azadirachta indica* A.Juss.; 30. *Anisomeles indica* (L.) Kuntze; 31. *Lygodium flexuosum* (L.) Sw.; 32. *Triumfetta rhomboidea* Jacq.; 33. *Evolvulus nummularius* (L.) L.; 34. *Commelina benghalensis* L.; 35. *Sida cordata* (Burm.f.) Borss.Waalk.; 36. *Ocimum tenuiflorum* L.; 37. *Scoparia dulcis* L.; 38. Seedling of *Coccinia grandiflora* Cogn. ex Engl.; 39. *Ampelocissus latifolia* (Roxb.) Planch.

PLATE-IV

40. *Senna tora* (L.) Roxb.; 41. *Bidens pilosa* L.; 42. *Eclipta prostrata* (L.) L.; 43. Juvenile stage of *Ficus benghalensis* L.; 44. *Clerodendrum infortunatum* L.; 45. *Ficus religiosa* L. at the cap of Chanchal Rajbari Temple; 46. *Lindernia ciliata* (Colsm.) Pennell; 47. *Amaranthus viridis* L.; 48. *Cocculus hirsutus* (L.) W.Theob.; 49. *Trema orientalis* (L.) Blume; 50. *Murdannia nudiflora* (L.) Brenan; 51. *Oldenlandia corymbosa* L.; 52. *Ficus religiosa* L. at the top of a temple of Harischandrapur

CONCLUSION

The present study of wall flora provides a better understanding of dynamics of species diversity on the walls of some famous historical heritage buildings of Malda district. It can be concluded from the study that murophyte on the wall is dominated by Angiosperms. The study provides that the Asteraceae, Fabaceae, Amaranthaceae and Poaceae families represented exclusively by the most dominant murophytes. Because most of the plants belonging to these families are able to reach these habitats by wind (anemochorous), animals (zoochorous), mostly by birds and by stolon fragments (autochorous).At the same time the investigation of those artificial habitats reveals that the vertical wall surfaces especially porous surfaces and cavities at ground level are frequently colonized by the murophytes. Because the natural and ecological factors (topographic, temporal, access, edaphic, climatic etc) of these sites are influencial for the establishment of murophytes. The establishment and aggregation of the individual plant population depends on the capacity of adaptation of the plant and the efficiency of their seed dispersal. Most of the dominating plants of the study sites are anemochorous in nature. The capacity of deterioration of the plants depends on the physical action of their roots. These deteriorating murophytes have not only occupied the crevices and cracks of neglected parts of buildings but they even deteriorate the crevices or even a major parts of the buildings. Thus proper chemical and physical methods of eradication can be used to control such murophytes. The study recommended further extensive studies for a better understanding of the ecological stress and its impact on physiology of such murophytes.

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