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Documentation of several drought tolerance Angiosperms associated with walls in Purulia District, West Bengal

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ABSTRACT

This study was conducted to analyze the drought tolerance angiosperms associated with walls in Purulia District, West Bengal. A total of 40 vascular plants were recorded. The angiosperms were represented by 38 genera under 25 different families. Only two species were represented by Pteridophytes viz. Dryopteris filix-mas and Pteris vittata. Asteraceae, Amaranthaceae, and Euphorbiaceae were dominant families during the survey period associated with walls in Purulia District.

Keywords: *Documentation, Drought Tolerance, Angiosperms, Walls, Purulia District*

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1. INTRODUCTION

Wall, one of the most distinct man-made constructions, is an extreme environment in many respects, such as the available room for settlement, the hardness and the alkalinity of the substratum, the scarcity of soil and humus, the inclination, the temperature and the humidity (Segal, 1969). Thus, being a peculiar habitat, which is suitable for only a limited number of taxa, walls are the subject of an increasing number of publications. In the frame of a wider research concerning the urban and suburban flora of Purulia District, the old fortification walls of the city were studied (Lagiou et al., 1998). Several scientists also took part in describing the importance of walls as modified cliff-like habitats in urban and semi-urban localities in different countries (Gilbert, 1989; Gilbert, 1992; Larson et al., 2009; Crowe, 1979; Kent et al., 1999; Hill et al., 2002; Lundholm and Marlin, 2006; Francis, 2011; Singh, 2011; Singh and Singh, 2014; Shimwell, 2009; Altay et al., 2010). Different plant groups such as Angiosperms, some Bryophytes and Pteridophytes were frequently distributed on old walls with ecological importance in different environmental conditions like high temperature, hot climate, scarcity of water and humus, extreme pollution by vehicles on roadsides, etc.

Drought is a natural event arising due to extreme temperature, deficiency of precipitation, scarcity of water, global warming, etc (Sharafi et al., 2019; Mirzaee et al., 2018). Drought conditions make it unfavorable for plants and vegetation cover to survive (Fahri Saadi, 2019). Under drought conditions, the vascular plants have inherent dormancy mechanisms that protect their seeds, spores, etc. from germination into such adverse environments (Gul & Kausar, 2019). In this context, the present work was undertaken as research work for documentation of vascular plant species associated with walls in Purulia District.

2. MATERIALS AND METHODS

To carry out the work on drought tolerance Angiosperms associated with the stone and bricks wall in Purulia District, West Bengal, at first, the study area was selected and divided into different localities in different blocks for prevalence percentage of Angiospermic plants and their systematic study. To study the floristic diversity in different selected areas, the frequent visits were conducted to the study area in different localities, so that the taxonomic study of **"Documentation of several drought tolerance angiosperms associated with walls in Purulia District, West Bengal "** could be performed.

A general survey was carried out from January 2019 to May 2019 and different habits of plant vegetation such as herbs, shrubs, and trees were observed. During this period (at the end of Post- monsoon and Pre-monsoon) the temperature of study sites was very high. Because Purulia is a drought-prone district of West Bengal. During Pre-monsoon Season, some of the sources of water become dry in Purulia District. Purulia district is considered as dry as well as a backward region of West Bengal where rainfall is considered as a limiting factor for the successful growth of agriculture (Asutosh, 2019). The general associations of plants were observed in all the unprotected areas. Apart from the study of vegetation, plant species were collected, Herbarium sheets were prepared and identified with the help of pertaining literature (Prain, 1963; Roy and Mukherjee, 2011; Mandal and Mukherjee, 2016; Dey, and Das, 2017; Paul, 2018; Pal et al., 2000). During the survey period we visited different pally of Purulia Town such as Sufal pally, Bal Bharati Lane, Vivekananda Pally, BSNL office's Lane, Near IDBI

Bank Lane, Ashu Sahish Lane along with Adra Town such as South Eastern Railway Colony, Station Road, and Kashipur Rajbari in Purulia District and the vegetation of drought-tolerant species in walls were recorded. Herbarium specimens were preserved in the proposed Herbarium, Sidho Kanho Birsha University, Purulia for further studies.

3. STUDY SITES

Adra Town

A small rural settlement elevated to a town by the British setting up a large Railway Junction in 1903. Some colonies were built for the residential purpose of the Railway officers of the British. Adra Town includes Beniasole, Palashkola, Jhariadih, Panchudanga, Laldanga, Daulatpur, Arabinda Pally, and South Eastern Railway colonies.

Kashipur Rajbari

The structure of Kashipur Raj Bari is in the colonial style and design incorporating the use of materials like red brick, stone slabs, concrete, and wood. This is familiar as a heritage site of Purulia District. It is situated along a similar line between 23° 26' 2.84 " N latitude and 86 40' 4.34 " E longitude at Kashipur town. The distance is about 25 km from Purulia and seven kilometers from Adra. Maharaja Neelmoni Singh Deo was the owner of this property. Maharaja Bhuvaneswari Prasad Singh Deo was the last owner of Kashipur Rajbari (**Fig. 1**).

Fig. 1: A view of Kashipur Rajbari

Purulia Town

Purulia is located between 22.60 ° and 23.50 ° north latitudes and 85.75 ° and 86.65° east longitudes. The area of the district is about 6259 Sq. km. This district is bordered on the east by Bankura, Paschim Medinipur districts, on the north by Burdwan district of West Bengal and Dhanbad district of Jharkhand, on the west by Bokaro and Ranchi districts of Jharkhand and on the south by West Singhbhum and East Singhbhum districts of Jharkhand (Mandal and Mukherjee, 2016) **(Fig. 2).**

Fig. 2: A political map of Purulia District, West Bengal.

Purulia is characterized by high evaporation and low precipitation. It is also an undulating part of Chota Nagpur Plateau. Temperature is average in summer and low in winter, which ranges from 2 ℃ in winter to 35 ℃ in summer. Average annual rainfall varies from 1100 to 1500 mm.

4. RESULTS

Table 1: An account of the prevalence of plant Species in different walls.

Sl. No.	Name of the plant	Family	Attendance in study sites			Prevalence (%)	Availability
			AT	KR	PT		
1	*Acalypha indica* L.	Euphorbiaceae			+	33.33	Less common
2	*Aerva lanata* (L.) Juss ex.Schult.	Amaranthaceae			+	33.33	Less common
3	*Alternanthera sessilis* (L.) R. Br. ex Dc.	Amaranthaceae			+	33.33	Less common
4	*Amaranthus viridis* L.	Amaranthaceae		+	+	66.66	Common
5	*Ammannia baccifera* L.	Lythraceae			+	33.33	Less common
6	*Anisomeles indica* (L.) Kuntze	Lamiaceae	+			33.33	Less common
7	*Antigonon leptopus* Hook & Arn.	Polygonaceae	+			33.33	Less common

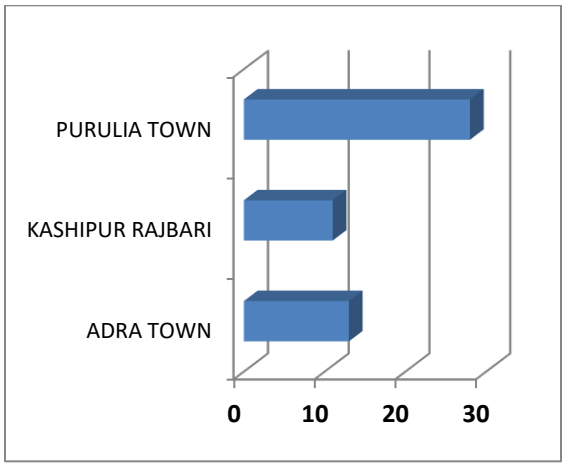
8	*Blumea lacera* Dc.	Asteraceae			+	33.33	Less common
9	*Boerhaavia repens* L.	Nyctaginaceae		+		33.33	Less common
10	*Calotropis procera* (Ait) R. Br.	Asclepiadaceae		+		33.33	Less common
11	*Catharanthus roseus* (L.) G. Don	Apocynaceae		+		33.33	Less common
12	*Cleome rutidosperma* Dc.	Cleomaceae			+	33.33	Less common
13	*Cleome viscosa* L.	Cleomaceae			+	33.33	Less common
14	*Commelina benghalensis* L.	Commelinaceae	+			33.33	Less common
15	*Croton bonplandianus* Baill.	Euphobiaceae	+	+	+	100	Common
16	*Dryopteris filix-mas* (L.) Scholt.	Dryopteridaceae	+			33.33	Less common
17	*Eclipta prostrata* (L.) L.	Asteraceae	+	+	+	100	Common
18	*Eragrostis tenella* (L.) P. Beauv.	Poaceae		+		33.33	Less common
19	*Euphorbia hirta* L.	Euphorbiaceae	+		+	66.66	Common
20	*Evolvulus nummularius* (L.) L.	Convolvulaceae			+	33.33	Less common
21	*Glinus oppositifolius* (L.) Aug.	Molluginaceae	+		+	66.66	Common
22	*Gomphrena celosioides* Mart.	Amaranthaceae	+			33.33	Less common
23	*Kyllinga monocephala* Rott.	Cyperaceae			+	33.33	Less common
24	*Lantana camara* L.	Verbenaceae		+		33.33	Less common
25	*Lindenbergia indica (*L.) Vatke	Scrophulariaceae			+	33.33	Less common
26	*Nicotiana plumbaginifolia* Viv.	Solanaceae			+	33.33	Less common
27	*Oldenlandia corymbosa* L.	Rubiaceae	+		+	66.66	Common
28	*Oxalis corniculata* L.	Oxalidaceae			+	33.33	Less common
29	*Phyllanthus fraternus* G. L. webster	Euphorbiaceae	+		+	66.66	Common
30	*Portulaca oleracea* L.	Portulacaceae			+	33.33	Less common
31	*Pteris vittata* L.	Pteridaceae	+			33.33	Less common
32	*Ranunculus sceleratus L.*	Ranunculaceae			+	33.33	Less common
33	*Ruellia tuberosa* L.	Acanthaceae			+	33.33	Less common
34	*Scoparia dulcis* L.	Scrophulariaceae			+	33.33	Less common
35	*Solanum nigrum* L.	Solanaceae			+	33.33	Less common
36	*Solanum sisymbriifolium* Lam.	Solanaceae		+	+	66.66	Common
37	*Sonchus arvensis* L.	Asteraceae			+	33.33	Less common
38	*Tridax procumbens* L.	Asteraceae	+	+		66.66	Common
39	*Verbascum chinense* (L.) Santapau	Scrophulariaceae			+	33.33	Less common
40	*Vernonia cinerea* (L.) Less.	Asteraceae		+	+	66.66	Common

Abbreviations: AT=Adra Town; KR=Kashipur Rajbari; PT=Purulia Town.

5. DISCUSSION

The present study enclosed drought tolerance species associated with the wall of three major areas of Purulia District, viz. Adra Town, Kashipur Rajbari, and Purulia Town could record about 40 species belonging to 38 genera under 25 different families. The number of species was very low in association with the wall flora studied. There was a lack of awareness among people about the importance of plant vegetation on the wall in Purulia District. The grasses appeared in large numbers during monsoon but at the end of post-monsoon and pre-monsoon, only *Eragrostis tenella* was enlisted.

The highest number of species took shelter in the walls of Purulia Town i.e. **28** species. The second position is occupied by Adra Town with **13** species. There were only **11** species in Kashipur Rajbari during the survey period (**Table 1).**

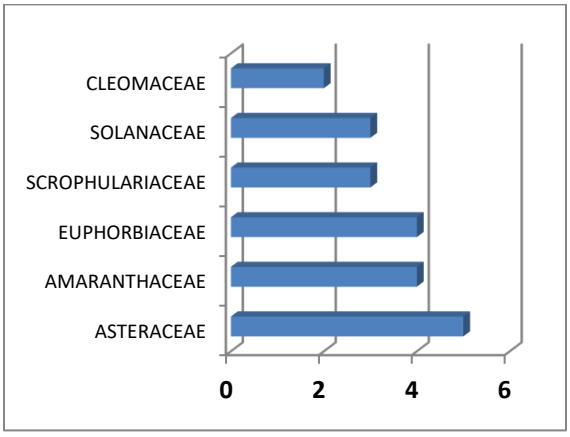


Graph 1: Graphical representation of the number of Plants in the Study Sites

In Kashipur Rajbari, a large number of dry grasses were observed due to high temperatures and hot climate. Two different types of walls were studied in Purulia District viz. cemented brick wall and the other type of wall was constructed by brick, mud, and lime. The cemented brick walls tolerate the highest number of species i.e. **28** and **13** in Purulia Town and Adra Town respectively. The walls made of brick, mud, and lime could accommodate **11** species in the case of Kashipur Rajbari.

Only the highly xeric species like *Anisomeles indica, Antigonon leptopus, Blumea lacera, Cleome viscosa, Croton bonplandianus, Gomphrena celosioides, Lantana camara, Ruellia tuberosa,* etc. were capable of enduring under such stressful habitats. The cemented brick walls were mostly old with cracks and porosity due to sand mixed with cement. The conditions were suitable for accommodation in the case of **28** and **13 species** in procuring retained water and moisture and aeration in walls (**Table 1**).

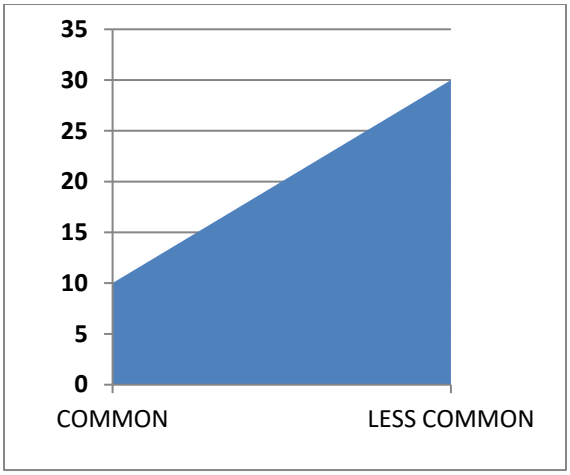
The taxonomic account of the wall flora reveals that Asteraceae was the most dominant family with five species followed by Amaranthaceae and Euphorbiaceae having four species each. The family of Scrophulariaceae and Solanaceae had three species each. Cleomaceae had only two species. The rest of the nineteen families had only single species each **(Graph 2).**



Graph 2: Graphical representation of Dominant Families in Walls of Purulia District

Only two species viz. *Croton bonplandianus* and *Eclipta prostrata* occupy **100** % of the prevalence value of the wall types. Only **8** species viz. *Amaranthus viridis, Euphorbia hirta, Glinus oppositifolius, Oldenlandia corymbosa, Phyllanthus fraternus, Solanum sisymbriifolium, Tridax procumbens,* and *Vernonia cinerea* showed their efficiency to use **66.66 %** and remaining **30** species viz. *Acalypha indica, Anisomeles indica , Oxalis corniculata , Pteris vittata, Verbascum chinense,* etc. **33.33**% of wall flora in drought-prone District of Purulia**.**

On the other hand, oniy **10** species viz, *Amaranthus viridis, Croton bonplandianus, Eclipta prostrata, Euphorbia hirta, Glinus oppositifolius, Oldenlandia corymbosa, Phyllanthus fraternus, Solanum sisymbriifolium, Tridax procumbens,* and *Vernonia cinerea* were common and the remaining **30** species viz. *Cleome rutidosperma*, *Pteris vittata, Solanum nigrum, Verbascum chinense,* etc. were less common in wall flora of Purulia District (**Graph 3**).



Graph 3: Graphical representation of the availability of species composing Wall Flora in Purulia District

Although, *Ranunculus sceleratus* grows on aquatic and semi-aquatic habitats, it was frequently observed on the wall of Vivekananda pally and Bal Bharati Lane with dense vegetation. Because the wall is moistured by the drainage water. Drought is a condition of reduced or very low availability of water to plants for a prolonged period of time, hence, distressing for plant growth, development, water relations, and efficiency of many terrestrial plants. Plants acclimatize themselves to different sophisticated biochemical, physiological, and morphological changes to conquer drought conditions (Butt et al., 2017). The occurrence of desiccation tolerance in the seed plants is overwhelmingly in the aerial reproductive parts, the pollen, and seed embryos (Gaff and Oliver, 2013).

6. CONCLUSION

Dey *et al.* (2017) in their contribution to the wall of Burdwan District also reported several species such as *Acalypha indica, Amaranthus viridis, Eclipta prostrata, Glinus oppositifolius, Oxalis corniculata,* and *Vernonia cinerea* (Dey and Das, 2017). Paul (2018) observed the seasonal distribution in the wall of Bishnupur Town and reported *Alternanthera sessilis, Cleome viscosa, Acalypha indica, Croton bonplandianus, Euphorbia hirta,*

Lindenbergia indica, Oxalis corniculata, Calotropis procera, Lantana camara, and *Scoparia dulcis* particulary in pre-monsoon season (Paul, 2018).

But in the present study, we have reported several unique drought-tolerant vegetation like *Aerva lanata, Anisomeles indica, Cleome rutidosperma, Dryopteris filix-mas, Eragrostis tenella, Portulaca oleracea, Ranunculus sceleratus,* and *Solanum sisymbriifolium* on the cemented brick wall and the wall was made of bricks, mud, and lime, which were not reported in the district of Burdwan and Bankura. We concluded that the cemented brick wall is more suitable for accommodation than the wall composed of bricks, mud, and lime due to cracks and porosity during this climatic condition.

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