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Research Article

Epiphytic vegetation on *Artocarpus heterophyllus* Lam. of road side area in Terai-Dooars and Northern Plain region of West Bengal, India

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Abstract

Epiphytic mode of nutrition is one of the important ecologically successful strategies of plants. In this study, we analyse the ecological and phytosociological distribution of epiphytic vegetation on *Artocarpus heterophyllus* Lam. plants of road side area in Terai-Dooars and Northern Plain region of West Bengal,India.To evaluate the ecological status of the epiphytic vegetation Density,Frequency,Abundance and Important Value Index were determined.To understand the status of epiphytic community several community indices were determined.

INTRODUCTION

Epiphytic plants include all the plants which live on a plants without drawing water or food from its living tissue (Barkman, 1958). Epiphytes are unique in taking advantage of an ecological niche which is completely different from the usual perception of a typical habitat. They lack direct connection with the ground and grow on tree bark surfaces with limited capacity to retain humidity. They grow on the bark surface of trees, taking advantage of the physical support provided by trunk,branches and twigs.Some of them are also living on dead outer tissue of of the host tree. Epiphytic plants do not accumulate humus and are completely dependent upon their host trees for physical support and the provision of elemental nutrients although some nutrients may be obtained directly from the atmosphere or atmospheric particulates (Benzing, 1990).Such ability to absorb and storage of water and nutrients represent their crucial adaptive character. Rather, epiphytes use trees as a scaffold, and this has proven to be an ingenious and ecologically successful strategy.

Epiphytes are of two types; vascular epiphytes and non vascular epiphytes. Epiphytic plants contribute up to 30% to the number of vascular plant species in certain global biodiversity regions (Benzing, 2000). The non vascular epiphytic plants like moss,ferns and lichens also exhibit a more widespread distribution around the glove.Epiphytes are known to play several important roles.

They provide habitats for a number of insects, birds and other animals.Inspite of these, their large scale diversity patterns are still discussed on the basis of analysis and evaluation from a few, local epiphyte inventories.Most of the explanatory models on epiphyte diversity focus on the impact of regional climate on small scale epiphyte species richness. However they are also contribute to large scale biodiversity through their interactions with other biota.They are comparatively poorly studied, probably due to their hardly accessible habitat (Kuper *et al.,* 2004). Most of the study about epiphytes has been done on the impact of habitat destruction for vertebrates, particularly birds and insects in forest areas. However they are also abundant in some other places including road side area. Assessment of phytosociological and ecological parameters serves a good index in providing particular status to any vegetation. Epiphytes are ecologically important as well as some of them are known to trap polluting substances and also produce many beneficial substances. Though the knowledge of epiphytic forms in road side trees in India is limited but recently such types of works have been carried out by several workers in India. The present investigation was carried out as an attempt to assess the diversity status of epiphytic vegetation on Jackfruit (*Artocarpus heterophyllus* Lam.) plants of road side area of Terai-Dooars and Northern plain region of West Bengal,India.

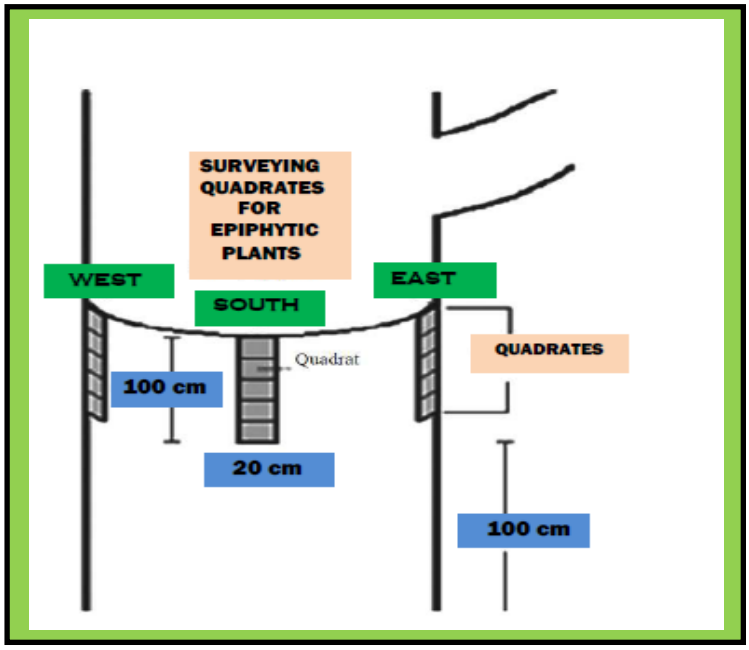
MATERIALS AND METHODS

Description of Study Area:

The present study has been carried out along several road side areas of Terai-Dooars and northern Plain region of West Bengal, India.The Terai and Dooars region politically constitute the plains of Darjeeling District, whole of Jalpaiguri and Alipurduar district and upper region of Cooch Behar District in West Bengal. The slope of the land is gentle, from north to south. The general height of the land is 80 to 100 m above sea level. The entire region is made up of sand, gravel and pebbles laid down by the rivers like the Teesta,Torsa, Raidak, Jaldhaka, Sankosh and several other small rivulets. The Teesta has divided the area into two parts- the western part is known as the Terai whereas the eastern part is known as the Dooars or Duars. The area Dooars is starting from the eastern bank of river Tista in the Jalpaiguri district and stretching up to the western bank of the river Sankosh in Alipurduar district and is spreading over a span of around 130 km of which 40 km area is running along with the Himalayan foothills. The Dooars region can be further subdivided into the Siliguri or Western Dooars, the middle or Jalpaiguri Dooars and the eastern or Alipur Dooars.Northern plain start from the south of Terai region and continues up to the left bank of the Ganges. The southern parts of the district Jalpaiguri, North Dinajpur baring some extreme northern regions, South Dinajpur, Malda, Alipurduar and southern part of Cooch Behar districts constitute this geographical region.

Field Investigation and Data Collection:

A thorough search of studies providing both species richness and abundance data yielded only 100 studies in the year 2013 to 2016.From each site ten non adjacent plants were randomly selected.As for the recording of epiphytes on the tree trunk, monitoring quadrates are used which consist of four independent segments with five squares 20 cm x 20 cm. With the aid of a compass or GPS (Global Positioning System) the four segments are attached to the sides of the tree trunk facing the East, West, North and South. The segments have to be attached in a way that the lower edge is one metre above the highest point of the ground. Then, to avoid areas on the tree trunk that are unsuitable for the survey, for instance wounds and knots, a shifting of a segment by a maximum of 20° clockwise is permitted.Another tree has to be selected if the placement of at least three segments is impossible. If conditions such as damaged or decorticated parts, knots, rain tracks and parts with lichen or bryophyte cover higher than 25% the attachment of segments is prohibited. Then the epiphytic plant species which occur in each segment are recorded, as well as the number of squares of each segment in which the species was found is counted. This is called frequency and it is the basis of the quantitative survey of the epiphyte vegetation (Phillips EA, 1959). The specimens were identified by studying the morphology, anatomy and using several taxonomic keys like Bengal Plants,The recent literature and books were also consulted for identification of the epiphytic species .



(a) Frequency (%): This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage. It is calculated by the equation:

$$\text{Frequency } (\%) = \frac{\text{No. of plot in which the species is present}}{\text{Total No. of plot sampled}} \times 100$$

(b) Relative Frequency (%): The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\text{Relative Frequency } (\%) = \frac{\text{Frequency of the species}}{\text{Frequency of all the species}} \times 100$$

(c) Density: Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. Density is calculated by the equation:

$$\text{Density} = \frac{\text{No. individuals of the species}}{\text{Total No. of plots sampled}}$$

(d) Relative Density (%): Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\text{Relative Density} = \frac{\text{Density}}{\text{Density of all the species}} \times 100$$

(e) Relative Dominance (%): Dominance of a species is determined by the value of the height. Relative dominance is the height value of a species with respect to the sum of coverage of the rest of the species in the area.

$$\text{Relative Dominance} = \frac{\text{Height Value of the species}}{\text{Height Value of all the species}} \times 100$$

(f) ***Abundance:*** It is the study of the number of individuals of different species in the community per unit area. By quadrats method, samplings are made at random at several places and the number of individuals of each species was summed up for all the quadrats divided by the total number of quadrats in which the species occurred. It is represented by the equation:

$$\text{Abundance} = \frac{\text{No. individuals of the species}}{\text{Total No. of plots in which the species is present}}$$

(g) ***Importance Value Index:*** This index is used to determine the overall importance of each species in the community structure.In calculating this index, the percentage values of the relative frequency, relative density and relative dominance(Relative Basala Area) are summed up together and this value is designated as the Importance Value Index or IVI of the species.

IVI= Relative Frequency + Relative Density + Relative dominance

3. Data processing and Phytosociological Analysis:

All the data both spatial and especial collected from different sources has been tabulated and analyzed separately. The data collected were used to compute community indices like –

(a) **Species diversity (H')**: Species diversity of different tree species; it was calculated using the Shannon- Weiner Index (Shannon and Weiner, 1963):$(H') = -\sum [(ni / N). \ln (ni / N)]$

Where 'ni' is the IVI of individual species and N is the total IVI of all the species.

(b) **Species dominance (Cd)**:Species dominance was calculated following Simpson (Simpson, 1949): $Cd = \Sigma (ni/N)^2$,

where, ni and N are the same as those for Shannon Weiner information function.

(c)**Equitability of evenness (e)**: Equitability of evenness refers to the degree of relative dominance of each species in that area. It was calculated according to Pielou (1966) as:

Evenness (e) = H'/log S

where, H'= Shannon index, S = number of species.

(d)**Species richness (D)** :Species richness was determined by Margalef index (1968) as:

D=(S-1)/ln N.

S = number of species. N= total number of individuals .

(e)**Menhinick's index (D_{mm})**: Menhinick's index (Whittaker 1977) is expressed as $D_{mm}=S/ N$, where N is the number of individuals in the sample and S is the species number.

(f) **Equitability Index:** The Shannon's equitability Index(Lloyd and Ghelard, 1964) is expressed as (EH)=H/Hmax = H/ln S

(g) **Berger-Parker Dominance Index:**The Berger-Parker Dominance Index is a simple measure of the numerical importance of the most abundant species and is expressed a d = Nmax/N.

N_{max} is the number of individuals in the most abundant species and N is the total number of individuals in the sample. The increase in the value of reciprocal of Berger-Parker Dominance Index reflects the increase in diversity and a reduction in dominance.

RESULT AND DISCUSSION

The survey of epiphytes growing on Jackfruit tree species in road side area of Terai-Dooars region of West Bengal, revealed the presence of 34 species of vascular plants belonging from 21 families.From the quadrate analysis by using ecological parameter it was clear that *Drynaria quercifolia* (L.) J. Sm.,*Pyrrosia confluens* (R. Br.)Ching, are the dominant epiphytes of jackfruit tree of this region. The IVI was recorded for these plants as 15.687 and 14.968 respectively. *Bulbophyllum sp., Cleome rutidosperma* DC.,*Ficus religiosa* L., *Ficus hispida* L.f. etc were also found as the common epiphytes of of jackfruit tree (Table 3.)

Graph1.Status of fern,monocot and dicot plant among the epiphytic community of Jackfruit plant

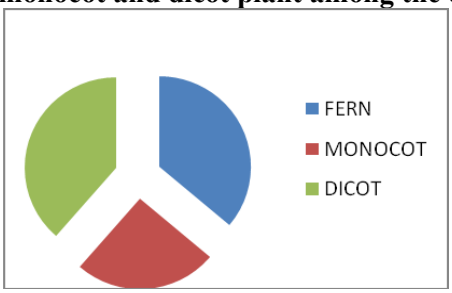


Table 1: Epiphytic community of Jackfruit plants and their nature

SL. No.	**Plant Name**	**Family**	**Habit**	**Type of epiphyte**
1	*Acalypha indica* L.	Euphorbiaceae	Herbaceous	Accidental epiphyte
2	*Leucas aspera* (Willd.) Link	Lamiaceae	Herbaceous	Accidental epiphyte
3	*Spermacoce alata* Aubl.	Rubiaceae	Herbaceous	Accidental epiphyte
4	*Ficus religiosa* L.	Moraceae	Deciduous tree	Facultative epiphyte
5	*Ficus benghalensis* L.	Moraceae	Deciduous tree	Facultative epiphyte
6	*Pilea microphylla* (L.) Liebm.	Urticaceae	Herbaceous	Lithophytic epiphyte
7	*Pouzolzia zeylanica* (L.) Benn.	Urticaceae	Herbaceous	Accidental epiphyte
8	*Drynaria quercifolia* (L.) J. Sm.	Polypodiaceae	Fern	Strictly epiphytic
9	*Trema orientalis* (L.) Blume	Cannabaceae	Tree	Facultative epiphyte
10	*Ficus hispida* L.f.	Moraceae	Tree	Facultative epiphyte
11	*Cymbidium sp.*	Orchidaceae	Herbaceous	Strictly epiphytic
12	*Lindenbergia indica* Vatke	Plantaginaceae	Herbaceous	Obligatory epiphyte
13	*Clerodendrum infortunatum* L.	Lamiaceae	Herbaceous	Accidental epiphyte
14	*Epipremnum aureum* (Linden & Andre) G.S.Bunting	Araceae	Herbaceous	Climbing epiphyte
15	*Microsorum punctatum* (L.) Copel.	Polypodiaceae	Fern	Strictly epiphytic
16	*Argyreia nervosa* (Burm. f.) Bojer	Convolvulaceae	Herbaceous	Climbing epiphyte
17	*Premna mollissima* Roth	Lamiaceae	Tree	Facultative epiphyte
18	*Papilionanthe teres* (Roxb.) Schltr.	Orchidaceae	Herbaceous	Strictly epiphytic
19	*Hoya parasitica var. citrina* (Ridl.) Rintz	Apocynaceae	Herbaceous	Climbing epiphyte
20	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Herbaceous	Climbing epiphyte
21	*Murdannia nudiflora* (L.) Brenan	Commelinaceae	Herbaceous	Accidental epiphyte
22	*Cyperus compressus* L.	Cyperaceae	Herbaceous	Accidental epiphyte
23	*Peperomia pellucida* (L.) Kunth.	Piperaceae	Herbaceous	Accidental epiphyte
24	*Pyrrosia confluens* (R. Br.) Ching	Polypodiaceae	Fern	Strictly epiphytic
25	*Portulaca oleracea* L.	Portulacaceae	Herbaceous	Accidental epiphyte
26	*Luffa cylindrica*(L.)M.Roem.	Cucurbitaceae	Herbaceous	Climbing epiphyte
27	*Cleome rutidosperma* DC.	Cleomaceae	Herbaceous	Accidental epiphyte
28	*Cuscuta reflexa* Roxb.	Convolvulaceae	Herbaceous	Parasitic epiphyte
29	*Cyanthillium cinereum* (L.) H.Roxb.	Asteraceae	Herbaceous	Accidental epiphyte
30	*Bulbophyllum Sp.*	Orchidaceae	Herbaceous	Strictly epiphytic
31	*Vanda tessellata (*Roxb.) Hook. ex G.Don	Orchidaceae	Herbaceous	Strictly epiphytic
32	*Scoparia dulcis* L.	Scrophulariaceae	Herbaceous	Accidental epiphyte
33	*Mikania micrantha* Kunth	Asteraceae	Herbaceous	Climbing epiphyte
34	*Lepisorus Sp.*	Polypodiaceae	Fern	Strictly epiphytic

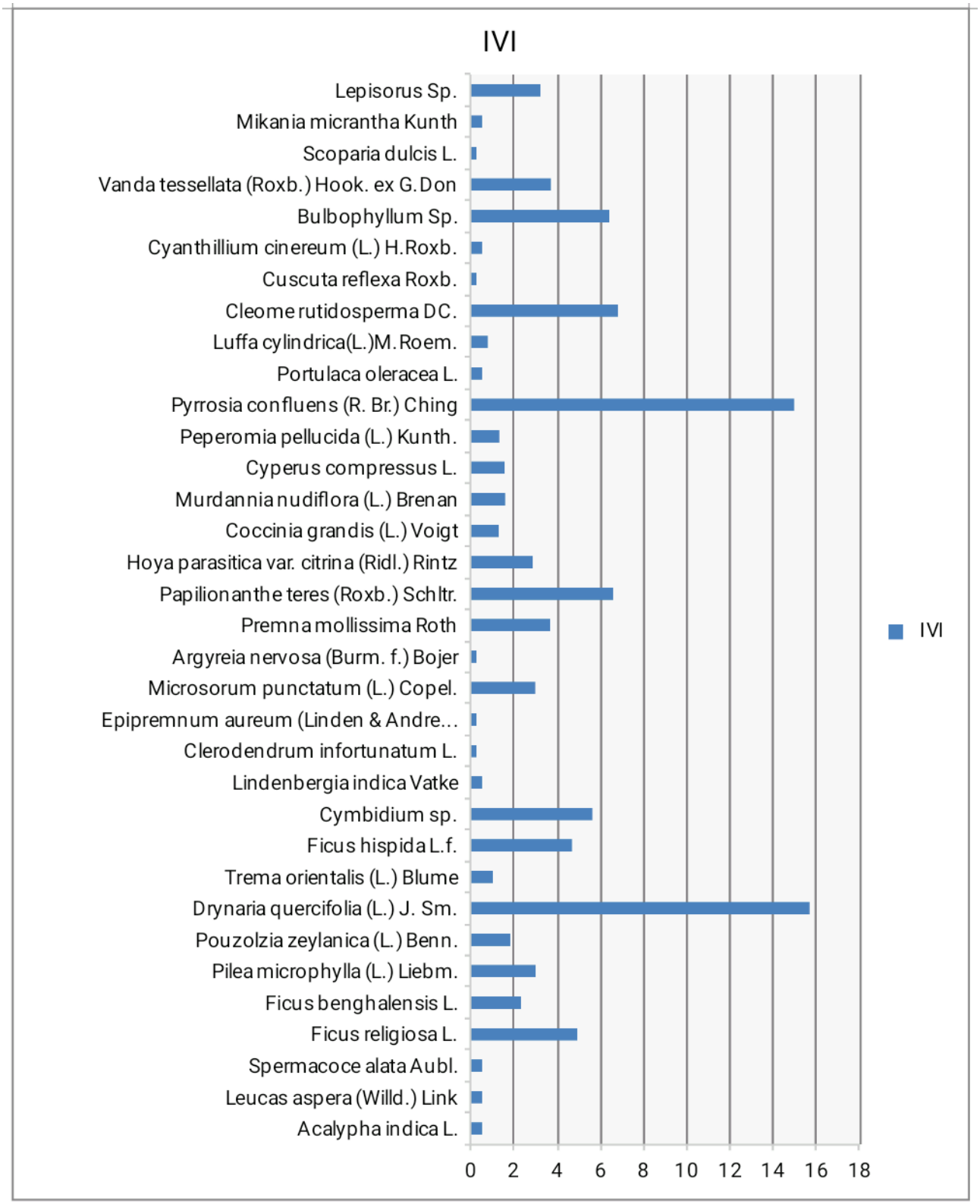
Table 2: Phytosociological status of Epiphytic community of Jackfruit plants .

SL. No.	Plant Name	A	D	F	A/F	RD	RF	RA
1	*Acalypha indica* L.	1.00	0.02	02	0.50	0.0003	0.5195	0.0032
2	*Leucas aspera* (Willd.) Link	1.50	0.03	02	0.75	0.0004	0.5195	0.0048
3	*Spermacoce alata* Aubl.	1.50	0.03	02	0.75	0.0004	0.5195	0.0048
4	*Ficus religiosa* L.	1.11	0.21	19	0.06	0.0027	4.9351	0.0035
5	*Ficus benghalensis* L.	1.00	0.09	09	0.11	0.0016	2.3377	0.0032
6	*Pilea microphylla* (L.) Liebm.	34.00	3.74	11	3.09	0.0479	2.8571	0.1084
7	*Pouzolzia zeylanica* (L.) Benn.	7.00	0.49	07	1.00	0.0063	1.8182	0.0223
8	*Drynaria quercifolia* (L.) J. Sm.	33.76	19.92	59	0.57	0.2554	15.324	0.1076
9	*Trema orientalis* (L.) Blume	1.00	0.04	04	0.25	0.0005	1.0390	0.0032
10	*Ficus hispida* L.f.	1.11	0.20	18	0.06	0.0026	4.6753	0.0035
11	*Cymbidium sp.*	29.24	6.14	21	1.39	0.0787	5.4545	0.0932
12	*Lindenbergia indica* Vatke	1.00	0.02	02	0.50	0.0003	0.5195	0.0032
13	*Clerodendrum infortunatum* L.	1.00	0.01	01	1.00	0.0001	0.2597	0.0032
14	*Epipremnum aureum* (Linden & Andre) G.S.Bunting	1.00	0.01	01	1.00	0.0001	0.2597	0.0032
15	*Microsorum punctatum* (L.) Copel.	27.09	2.98	11	2.46	0.0382	2.8571	0.0863
16	*Argyreia nervosa* (Burm. f.) Bojer	1.00	0.01	01	1.00	0.0001	0.2597	0.0032
17	*Premna mollissima* Roth	8.64	1.21	14	0.62	0.0155	3.6364	0.0275
18	*Papilionanthe teres* (Roxb.) Schltr.	16.96	4.24	25	0.68	0.0543	6.4935	0.0541
19	*Hoya parasitica var. citrina* (Ridl.) Rintz	1.82	0.20	11	0.17	0.0026	2.8571	0.0058
20	*Coccinia grandis* (L.) Voigt	1.00	0.05	05	0.20	0.0006	1.2987	0.0032
21	*Murdannia nudiflora* (L.) Brenan	7.50	0.45	06	1.25	0.0058	1.5584	0.0239
22	*Cyperus compressus* L.	5.00	0.30	06	0.83	0.0038	1.5584	0.0159
23	*Peperomia pellucida* (L.) Kunth.	5.80	0.29	05	1.16	0.0037	1.2987	0.0185
24	*Pyrrosia confluens* (R. Br.) Ching	40.84	22.87	56	0.73	0.2932	14.545	0.1302
25	*Portulaca oleracea* L.	1.50	0.03	02	0.75	0.0004	0.5195	0.0048
26	*Luffa cylindrica*(L.)M.Roem.	1.00	0.03	03	0.33	0.0004	0.7792	0.0032
27	*Cleome rutidosperma* DC.	9.85	2.56	26	0.38	0.0328	6.7532	0.0314
28	*Cuscuta reflexa* Roxb.	1.00	0.01	01	1.00	0.0001	0.2597	0.0032
29	*Cyanthillium cinereum* (L.) H.Roxb.	1.50	0.03	02	0.75	0.0004	0.5195	0.0048
30	*Bulbophyllum Sp.*	29.75	7.14	24	1.24	0.0915	6.2338	0.0948
31	*Vanda tessellata (*Roxb.) Hook. ex G.Don	13.71	1.92	14	0.98	0.0246	3.6364	0.0437
32	*Scoparia dulcis* L.	1.00	0.01	01	1.00	0.0001	0.2597	0.0032
33	*Mikania micrantha* Kunth	1.00	0.02	02	0.50	0.0003	0.5195	0.0032
34	*Lepisorus Sp.*	22.58	2.71	12	1.88	0.0347	3.1169	0.0720

A=Abundance, D=Density, Fr=Frequency, RD=Relative Density, RF=Relative Frequency

Table 3: Community indices of epiphytic community on Jackfruit plants .

SL. NO.	PLANT NAME	Importance Value Index	Shannon Index(H)	Species dominance	Evenness
1	*Acalypha indica* L.	0.523	0.02149	0.000021	0.014035
2	*Leucas aspera* (Willd.) Link	0.524	0.02710	0.000020	0.017700
3	*Spermacoce alata* Aubl.	0.524	0.02710	0.000020	0.017700
4	*Ficus religiosa* L.	4.941	0.14665	0.002342	0.095761
5	*Ficus benghalensis* L.	2.342	0.08666	0.005244	0.056590
6	*Pilea microphylla* (L.) Liebm.	3.013	0.10404	0.000870	0.067939
7	*Pouzolzia zeylanica* (L.) Benn.	1.846	0.07263	0.000327	0.047425
8	*Drynaria quercifolia* (L.) J. Sm.	15.687	0.28792	0.002365	0.188007
9	*Trema orientalis* (L.) Blume	1.042	0.46851	0.000104	0.305935
10	*Ficus hispida* L.f.	4.681	0.14142	0.002097	0.092343
11	*Cymbidium sp.*	5.626	0.15982	0.030360	0.104361
12	*Lindenbergia indica* Vatke	0.523	0.02703	0.000025	0.017654
13	*Clerodendrum infortunatum* L.	0.263	0.01536	0.000004	0.010035
14	*Epipremnum aureum* (Linden & Andre) G.S.Bunting	0.263	0.01536	0.000004	0.010035
15	*Microsorum punctatum* (L.) Copel.	2.981	0.10325	0.067424	0.059086
16	*Argyreia nervosa* (Burm. f.) Bojer	0.263	0.01536	0.000004	0.010035
17	*Premna mollissima* Roth	3.679	0.11984	0.001296	0.007825
18	*Papilionanthe teres* (Roxb.) Schltr.	6.601	0.17719	0.004186	0.115698
19	*Hoya parasitica var. citrina* (Ridl.) Rintz	2.865	0.10035	0.000789	0.065528
20	*Coccinia grandis* (L.) Voigt	1.302	0.05568	0.016129	0.036359
21	*Murdannia nudiflora* (L.) Brenan	1.588	0.06480	0.000242	0.042316
22	*Cyperus compressus* L.	1.578	0.02887	0.000239	0.018852
23	*Peperomia pellucida* (L.) Kunth.	1.320	0.05628	0.000167	0.036754
24	*Pyrrosia confluens* (R. Br.) Ching	14.968	0.28161	0.021536	0.183887
25	*Portulaca oleracea* L.	0.524	0.02710	0.000026	0.017701
26	*Luffa cylindrica* (L.) M.Roem.	0.782	0.03737	0.000057	0.024403
27	*Cleome rutidosperma* DC.	6.817	0.18082	0.004466	0.118073
28	*Cuscuta reflexa* Roxb.	0.263	0.01536	0.000004	0.010035
29	*Cyanthillium cinereum* (L.) Roxb.	0.524	0.02710	0.000026	0.017701
30	*Bulbophyllum* sp.	6.420	0.17406	0.003956	0.113660
31	*Vanda tessellata (*Roxb.) Hook. ex G.Don	3.704	0.12041	0.001317	0.113660
32	*Scoparia dulcis* L.	0.263	0.01536	0.000004	0.010035
33	*Mikania micrantha* Kunth	0.523	0.00387	0.000020	0.014035
34	*Lepisorus* sp.	3.223	0.10917	0.000998	0.071287



Graph 2. Status of IVI of different epiphytic genera on jackfruit plant

The paper reflects the phytosociological characters of epiphytic vegetation of Jackfruit plants in Terai-Dooars and Northern Plain region of West Bengal, India. This study implies the variety of epiphytic species, their ecological and phytosociological status.The epiphytic vegetation of the plant is composed of mosses, ferns, native grasses, climbers, shrubs and trees. Here Diversity index of epiphytic species was found as 3.31494,where as dominance index (Cd) was observed as 0.16668.The present investigation also revealed some interesting phytosociological findings about the epiphytic vegetation on the plants.The findings have also illustrated that road side jackfruit plants contain huge epiphytic vegetation than the gardens or other places.Therefore, the study recommends further research to be carried out to study the actual impact and interrelationship patterns of jackfruit plant and its epiphytic vegetation.

Table 4. Status of community indices of epiphytic community on Jackfruit plant.

Community indices	Value
Species diversity (H')	**3.31494**
Species dominance (Cd)	**0.16668**
Equitability of evenness (e)	**0.10883**
Species richness (d)	**8.47860**
Menhinick's index (D_{mm})	**0.00435**
Equitability Index	**0.94004**
Berger-Parker Dominance Index	**0.29201**

Graph3. Status of community indices of epiphytic community on Jackfruit plant.

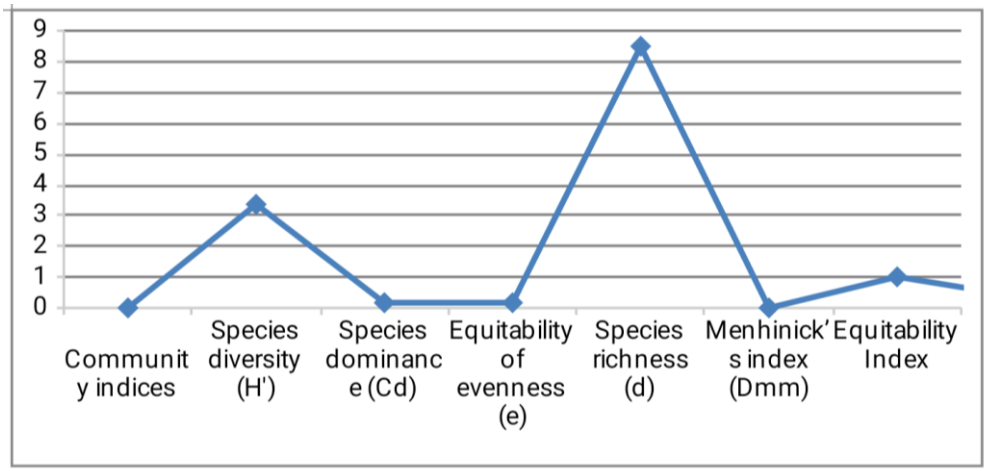


PLATE-I

1. *Acalypha indica* L.
2. *Trema orientalis* (L.) Blume
3. *Cymbidium sp.*
4. *Coccinia grandis* (L.) Voigt
5. *Murdannia nudiflora* (L.) Brenan
6. *Vanda tessellata* (Roxb.) Hook. ex G.Don
7. *Cleome rutidosperma* DC.
8. *Cyperus compressus* L.
9. *Hoya parasitica var. citrina* (Ridl.) Rintz
10. *Ficus religiosa* L.
11. *Pyrrosia confluens* (R. Br.) Ching
12. *Bulbophyllum Sp*

PLATE-II

13. *Ficus religiosa* L. and *Coccinia grandis* (L.) Voigt
14. *Argyreia nervosa* (Burm. f.) Bojer
15. *Drynaria quercifolia* (L.) J. Sm.
16. *Leucas aspera* (Willd.) Link
17. *Cleome rutidosperma* DC. and *Coccinia grandis* (L.) Voigt
18. *Epipremnum aureum* (Linden & Andre) G.S.Bunting
19. *Pilea microphylla* (L.) Liebm.
20. *Papilionanthe teres* (Roxb.) Schltr.
21. *Microsorum punctatum* (L.) Copel.
22. *Mikania micrantha* Kunth
23. *Ficus religiosa* L.
24. *Luffa cylindrica* (L.) M.Roem.

PLATE-III

25 *Ficus religiosa* L., *Cleome rutidosperma* DC. and *Spermacoce alata* Aubl.
26. *Pouzolzia zeylanica* (L.) Benn., *Cleome rutidosperma* DC. and *Peperomia pellucida* (L.) Kunth.
27. *Pyrrosia confluens* (R. Br.) Ching
28. *Premna mollissima* Roth
29. *Lepisorus* sp.
30. *Pouzolzia zeylanica* (L.) Benn. and *Spermacoce alata* Aubl.

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