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A study on population dynamics of weeds in Rice fields of Brahmaputra River Beds located in Majuli District, Assam

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Abstract

Being the most important cereal crop in the developing countries, rice is the most essential staple food for at least 33 countries in all over the world. The objective of the study is to understand the composition of weed flora in the rice field area of the Brahmaputra river beds of Majuli district, Assam. A total of 26weed species were found in the studied area,out of which, 14 were broad leaves weeds, 8 were grasses and remaining 4 were sedges. The maximum density of 2.60 and abundance of 3.50 has been recorded in plot 2 with maximum IVI value of 14.26. But on the other hand the Plot 1 was recorded with maximum of Shanon Weiner's diversity index with 3.02, evenness index of 0.98, richness index of 1.79 and biodiversity index of 0.37. It has been noticed that, only 8 species among all were found common in all the three plots which indicated the similarity index of only 30% in average.Now from the analyses of the recorded data, the results indicate that there is vast area in this regards to study in-depth.

Key words : Majuli, Brahmaputra, Weeds, Rice, Grass.

Being the most important cereal crop in the developing countries, rice is the most essential staple food for at least 33 countries in all over the world[8]. Rice cultivation is thought to be the oldest form of intensive agriculture by man[9]. Grist[10] had stated that the rice isthe staple food and the first cultivated crop in Asia. As per an estimation India needs to produce 120 million tons of rice by 2030 to feed its one and a half billion plus population[2]. The growing demands of rice invokes for an enhanced productivity, but with limited land and water resources. Among various biotic stresses limiting rice yields, the major stress is imposed by weeds, particularly in direct-seeded rice (DSR) under aerobic situations[7]. The growth of weeds in paddy fields causes a major biological threat to higher rice productivity and quality[11]. It is fact that the total number of weed species in a field largely depends on the associated environment and cropping systems. So, phytosociological studies of weeds are necessary for understanding the relationship between the crops and their weed flora and also to use such knowledge as a tool for developing a sustainable long term weed management strategy[14]. Like other states of India, rice cultivation is the primary income source for the major portion of people of Assam also where Majuli district is not exceptional. Farmers of Majuli also face severe loss in rice production due to growing of weeds in large numbers in the field every year. The study was carried out to understand the population dynamics of weeds that grow in the rice fields of Dakhinpat Satraarea of Majuli district during the growing period of the rice crop (*i.e.* from August to October) when weather condition is of warm wet type. In this period the weeds were well established to the field, as most of them were in flowering or seed setting stage of their life. The rice fields of Dakhinpat Satra areaare permanent beds in the river banks of mighty river Brahmaputra.

Study site :

Three siteswere selected randomlyat three different locations inthe rice field area of Dakhinpat Satra of Majuli district of Assam for the study. The area is located between the latitude of 26°91 N and longitude of 94°26 E. The average annual rainfall receiving for Majuli district has been recorded as 300 mm per year.The soil of the area is alluvium with sandy loam and quite suitable for agriculture, especially in Assam, because of seasonal or annual deposition of organic matters (humus and potash) by the river[3]. Being a river island of the mighty Brahmaputra, Majuli district experienced heavy flood every year.

Data collection and statistical analysis :

The sizes of each Plot were approximately of 15 m^2 and are approximately 2 kms. apart from each other. Weed flora in the selected rice fields had been collected by following quadrate method, as adopted by ICAR and All India Coordinated Research Project on Weed Management. Quadrate of 1m × 1m size has been plotted randomly in each Location of each type of lands and all the weeds were collected (destructive method) for their quantitative analysis of population and biomass. Five quadrates had been plotted at each Location at a minimum distance of five meters, giving emphasis on proper representation of available weed flora diversity. Statistical analyses were done to find out the frequency, density,abundance along with their relative values from the primary data of the weed population that collected with the help of quadrate system by following the standard statistical procedure of [6]. The Importance Value Index (IVI)[12], Species Diversity Index[16], Species Evenness Index[13], Species Richness Index, Species Biodiversity Index[1] and Sorensen's Species Similarity Index[4] were also evaluated as per requirement from the collected data.

The formulae for calculating the above mentioned various phytosociological attributes are described below:

Shanon-Weiner's Species Diversity Index (H) = -$\sum$ [Pi (ln Pi)]

Here, Pi=n/N (Where, n= Number of individuals of a species and N= Total number of all individuals of weed species)

Evenness Index (E) = H / Log S

Here, H = Shanon-Weiner's Species Diversity Index and S = Total number of species

Species Richness Index (D) = S/√ N

Here, S = Total number of species and N = Total number of all individuals of weed species

Species Biodiversity Index (SB) = A / T

Here, A= Total number of all weed species in one location

T= Total number of all weed species of the particular area

Sorensen's Species Similarity Index (S) = 2C / (A+B)

Here, A = Number of weed species in location-A

B = Number of weed species in location-B

C = Number of common weed species in both two locations

Soil composition :

The collected soil samples from the studied locations were found sandy and alluvial type where deposition of silts found to some extents. The average organic matter content for soil samples tested from the rice fields was recorded as 0.20% and average moisture content as 0.25%. The pH value of tested soil samples has been measured as 5.6.

Weed population composition and distribution :

This study recorded a total number of 26 different weed species in the selected rice field area of Dakhinpat Satra of Majuli district of Assam. The recorded species were comprise of grasses, sedges and broad leaved weeds (BLW) belongs to 10 different families, where BLW were more abundant which counts 14 out of 26, followed by the grasseswith 8 and then sedges with 4 weed species (Table-1). Poaceae was recorded as the major family as it comprised of 8 weed species followed by Amaranthaceae and Cyperaceae each with 4 different species. Other families like Compositae and Linderniaceae have 2 species each and remaining 5 families were comprised of 1 weed species only (Table-1).

In Plot 1 of the studied area total of 22 weed species were recorded out of which *Bonnaya reptans* (family Linderniaceae) was found in maximum no. with highest density of 2.20 and highest abundance of 2.75 and their relative values are 6.04 and 6.03 respectively. But in Plot 2 a total of 18 species were found where highest density of 2.60 has been shown by *Chenopodium album* of Amaranthaceae family and *Chrysopogon aciculatus* of Poaceae family with relative density of 5.51, whereas the highest abundance was recorded for *Fimbristylis miliaceae* of Cyperaceae which is of 3.50 and the relative value for it is 5.80. On the other hand in Plot 3 *Bonnaya reptans* of Linderniaceae and *Cynodon dactylon* and *Saccharum spontaneum* of Poaceae family have showed highest density of 2.00 with relative density of 3.97 among 16 numbers of total species recorded, whereas *Kyllinga brevifolia* of Cyperaceae family has showed highest abundance of 3.00 with highest relative value of 4.94 for the same (Table 2 & 3). The highest IVI value has been recorded as 16.08, 14.26 and 11.26 for *Bonnaya reptans, Chenopodium album* and *Saccharum spontaneum* in Plot-1, Plot-2 and Plot-3 respectively.

Table-1. List of weed species found in the study area

Sl. No.	Species Code	Scientific name of weed species	Family	Type
1.	RFW-1	*Ageratum houstonianum*	Asteraceae	Weeds (BLW) Broad Leave
2.	RFW-2	*Alternanthera philoxeroides*	Amaranthaceae	
3.	RFW-3	*Amaranthus spinosus*	Amaranthaceae	
4.	RFW-4	*Amaranthus viridis*	Amaranthaceae	
5.	RFW-5	*Lindernia ciliata*	Linderniaceae	
6.	RFW-6	*Bonnaya reptans*	Linderniaceae	
7.	RFW-7	*Capsella bursa-pastoris*	Cruciferae	
8.	RFW-8	*Spermacoce hispida*	Rubiaceae	
9.	RFW-9	*Centella asiatica*	Apiaceae	
10.	RFW-10	*Chenopodium album*	Amaranthaceae	
11.	RFW-11	*Drymaria cordata*	Caryophyllaceae	
12.	RFW-12	*Eclipta prostrata*	Compositae	
13.	RFW-13	*Elephantopus scaber*	Compositae	
14.	RFW-14	*Alternanthera sessilis*	Amaranthaceae	
15.	RFW-15	*Axonopus compressus*	Poaceae	Grasses
16.	RFW-16	*Chrysopogon aciculatus*	Poaceae	
17.	RFW-17	*Cynodon dactylon*	Poaceae	
18.	RFW-18	*Digitaria sanguinalis*	Poaceae	
19.	RFW-19	*Eleusine indica*	Poaceae	
20.	RFW-20	*Imperata cylindrica*	Poaceae	
21.	RFW-21	*Saccharum spontaneum*	Poaceae	
22.	RFW-22	*Setaria glauca*	Poaceae	
23.	RFW-23	*Cyperus pilosus*	Cyperaceae	Sedges
24.	RFW-24	*Cyperus rotundus*	Cyperaceae	
25.	RFW-25	*Fimbristylis miliacea*	Cyperaceae	
26.	RFW-26	*Kyllinga brevifolia*	Cyperaceae	

Table-2. Plot wise and species wise Frequency (F), Density (D) and Abundance (A)

Sl. No.	Species Code	Plot-1			Plot-2			Plot-3		
		F	D	A	F	D	A	F	D	A
1.	RFW-1	0.80	1.40	1.75	1.00	1.80	1.80	0.00	0.00	0.00
2.	RFW-2	0.80	1.40	1.75	1.00	2.40	2.40	0.00	0.00	0.00
3.	RFW-3	0.60	1.00	1.67	0.40	0.80	2.00	0.00	0.00	0.00
4.	RFW-4	0.80	1.40	1.75	0.80	1.80	2.25	0.00	0.00	0.00
5.	RFW-5	0.60	1.60	2.67	0.00	0.00	0.00	1.00	1.20	1.20
6.	RFW-6	0.80	2.20	2.75	0.00	0.00	0.00	1.00	2.00	2.00
7.	RFW-7	0.80	1.80	2.25	1.00	2.00	2.00	1.00	1.20	1.20
8.	RFW-8	0.00	0.00	0.00	0.80	1.40	1.75	0.00	0.00	0.00
9.	RFW-9	1.00	1.40	1.40	0.80	1.80	2.25	0.80	1.60	2.00
10.	RFW-10	0.00	0.00	0.00	0.80	2.60	3.25	1.00	1.60	1.60
11.	RFW-11	0.80	2.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00
12.	RFW-12	1.00	2.00	2.00	0.60	1.60	2.67	0.60	1.00	1.67
13.	RFW-13	0.80	1.60	2.00	0.00	0.00	0.00	0.60	1.00	1.67
14.	RFW-14	0.60	1.00	1.67	0.80	1.40	1.75	0.80	0.80	1.33
15.	RFW-15	1.00	1.60	1.60	1.00	1.80	1.80	0.20	0.40	1.00
16.	RFW-16	0.00	0.00	0.00	1.00	2.60	2.60	0.60	1.40	2.33
17.	RFW-17	0.80	1.60	2.00	0.80	1.60	2.00	1.00	2.00	2.00
18.	RFW-18	0.80	1.60	2.00	0.20	0.20	0.33	0.00	0.00	0.00
19.	RFW-19	0.80	1.40	1.75	0.00	0.00	0.00	0.00	0.00	0.00
20.	RFW-20	0.80	1.20	1.50	0.00	0.00	0.00	0.00	0.00	0.00
21.	RFW-21	0.60	0.80	1.33	0.00	0.00	0.00	0.80	2.00	2.50
22.	RFW-22	0.00	0.00	0.00	1.00	2.00	2.00	0.60	0.80	1.33
23.	RFW-23	1.00	0.20	0.20	0.60	0.80	1.33	0.00	0.00	0.00
24.	RFW-24	0.40	0.40	1.00	0.80	1.20	1.50	0.60	1.40	2.33
25.	RFW-25	0.80	1.20	1.50	0.40	1.40	3.50	0.80	1.20	1.50
26.	RFW-26	0.60	1.40	2.33	0.00	0.00	0.00	0.60	1.80	3.00

Table-3. Relative values of recorded Frequency (RF), Density (RD), Abundance (RA) and IVI

Sl. No.	Species Code	Plot-1				Plot-2				Plot-3			
		RF	RD	RA	IVI	RF	RD	RA	IVI	RF	RD	RA	IVI
1.	RFW-1	4.00	3.85	3.84	11.69	4.20	3.81	2.98	11.00	0.00	0.00	0.00	0.00
2.	RFW-2	4.00	3.85	3.84	11.69	4.20	5.08	3.98	13.27	0.00	0.00	0.00	0.00
3.	RFW-3	3.00	2.75	3.66	9.40	1.68	1.69	3.32	6.69	0.00	0.00	0.00	0.00
4.	RFW-4	4.00	3.85	3.84	11.69	3.36	3.81	3.73	10.91	0.00	0.00	0.00	0.00
5.	RFW-5	3.00	4.40	5.85	13.25	0.00	0.00	0.00	0.00	3.97	2.38	1.98	8.32
6.	RFW-6	4.00	6.04	6.03	16.08	0.00	0.00	0.00	0.00	3.97	3.97	3.29	11.23
7.	RFW-7	4.00	4.95	4.94	13.88	4.20	4.24	3.32	11.75	3.97	2.38	1.98	8.32
8.	RFW-8	0.00	0.00	0.00	0.00	3.36	2.97	2.90	9.23	0.00	0.00	0.00	0.00
9.	RFW-9	5.00	3.85	3.07	11.92	3.36	3.81	3.73	10.91	3.17	3.17	3.29	9.64
10.	RFW-10	0.00	0.00	0.00	0.00	3.36	5.51	5.39	14.26	3.97	3.17	2.63	9.78
11.	RFW-11	4.00	5.49	5.49	14.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.	RFW-12	5.00	5.49	4.39	14.88	2.52	3.39	4.42	10.33	2.38	1.98	2.74	7.11
13.	RFW-13	4.00	4.40	4.39	12.78	0.00	0.00	0.00	0.00	2.38	1.98	2.74	7.11
14.	RFW-14	3.00	2.75	3.66	9.40	3.36	2.97	2.90	9.23	3.17	1.59	2.19	6.96
15.	RFW-15	5.00	4.40	3.51	12.91	4.20	3.81	2.98	11.00	0.79	0.79	1.65	3.23
16.	RFW-16	0.00	0.00	0.00	0.00	4.20	5.51	4.31	14.02	2.38	2.78	3.84	9.00
17.	RFW-17	4.00	4.40	4.39	12.78	3.36	3.39	3.32	10.07	3.97	3.97	3.29	11.23
18.	RFW-18	4.00	4.40	4.39	12.78	0.84	0.42	0.55	1.82	0.00	0.00	0.00	0.00
19.	RFW-19	4.00	3.85	3.84	11.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.	RFW-20	4.00	3.30	3.29	10.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21.	RFW-21	3.00	2.20	2.93	8.12	0.00	0.00	0.00	0.00	3.17	3.97	4.12	11.26
22.	RFW-22	0.00	0.00	0.00	0.00	4.20	4.24	3.32	11.75	2.38	1.59	2.19	6.16
23.	RFW-23	5.00	0.55	0.44	5.99	2.52	1.69	2.21	6.43	0.00	0.00	0.00	0.00
24.	RFW-24	2.00	1.10	2.19	5.29	3.36	2.54	2.49	8.39	2.38	2.78	3.84	9.00
25.	RFW-25	4.00	3.30	3.29	10.59	1.68	2.97	5.80	10.45	3.17	2.38	2.47	8.02
26.	RFW-26	3.00	3.85	5.12	11.97	0.00	0.00	0.00	0.00	2.38	3.57	4.94	10.89

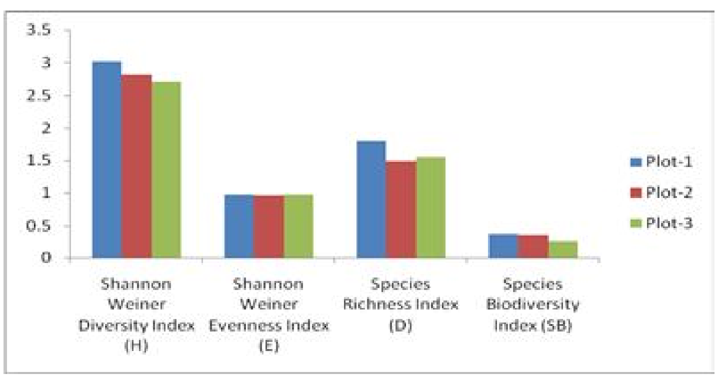

Figure 1: Plot wise Index values for diversity (H), evenness (E), richness (D) and diversity (SB)

Further analyses were done to evaluate the Shannon's diversity index (H) for weed flora of the studied area, which was recorded as 3.02 for Plot 1, 2.82 for Plot 2 and 2.71 for Plot 3. (Figure 1). Plot 1 also showed maximum value for Species richness Index (D) and Species Biodiversity Index (SB) which are of 1.79 and 0.37 respectively as maximum number of weed species recorded in this plot. From the Sorensen's Species Similarity Index (S) it is cleared that Plot 2 showed maximum similarity of 35% with plot 1 and 32% with Plot 3, whereas only 21% of similarity was recorded between Plot 1 and Plot 3 which is the lowest (Table-4).

Table-4. Similarity index between the plots

	Plot-1	Plot-2	Plot-3
Plot-1	—	—	—
Plot -2	0.35	—	—
Plot -3	0.21	0.32	—

From the data it has been clear that broad leaved weeds cover the major portion of the studied area. But, on the other hand by comprising sedges and grasses maximum weeds are of monocot type. If we take count of family, then *Poaceae* stands first with comprising of 8 weed species in this area. It has been found that in Plot 1 total of 22 species recorded, whereas in Plot 2 and Plot 3 the recorded number of weed species are only 18 and 16 respectively and as a consequence, only 8 species *viz. Capsella bursa-pastoris, Centella asiatica, Eclipta prostrata, Alternanthera sessilis, Axonopus compressus, Fimbristylis miliacea, Cyperus rotundus and Cynodon dactylon* were found common in all the locations. Out of these common 8 species *Fimbristylis miliaceae*has showed highest abundance of 3.50 in Location 2 with highest relative value of 5.80. It was already reported that *Fimbristylis miliaceae*is a very widely distributed weed species in the rice fields of the country[5]. The index values of Species diversity, Species evenness, Species richness and Species biodiversity indicates the uniform distribution pattern of the listed weed species in the rice fields of this area as the values are almost in the same range with plot wise slight differences.

Even though the index values indicated uniform distribution of the weed species in the studied area, but, it has been noticed that only 8 number of weed species were found common in all the three plots of the studied rice field area out of 26 total species, which is only around 30%. On the other hand it was also mentioned above that only 21% of similarity was recorded between Plot 1 and Plot 3 which is the lowest. So, from this study it can be assume that such significant difference in floral composition within such small radius may be due to difference in soil composition or irrigation process or cropping pattern or may be use of other different inputs for cultivation. Hence it can be concluded that there is huge scope for in-depth study about the floral composition of weed in the rice fields or in nearby river bank area of mighty Brahmaputra. Now, it is also become important to understand the interaction between crop and weeds in the fields from the perspective of effect of weed in crop yield in such river areas.

References :

1. A.M.N.H. (2022). How to calculate a biodiversity index.American Museum of Natural History. New York (https://www.

amnh.org/plant-ecology).

2. Adhya, T.K. (2011). Vision-2030:Central Rice Research Institute, Indian Council of Agricultural Research, Bhubaneswar, India.
3. Anon (2016). Land Resources of Assam. ENVIS Centre, ASTEC, GoI. (www.asmenvis.nic.in). (last update on 08-01-2016).
4. Azizi, E. (2016). *International Journal of Life Science and Engineering. 2*(2): 8-20.
5. Baki, B.B. (1993). *Malayasian Agricultural Research and Development Institute Research Journal. 21*(2): 121-128.
6. Curtis, J.T. (1959). The vegetation of Wisconsin: an ordination of plant community. University of Winconsin press, Madison.
7. Dass, A., K. Shekhawat, A.K. Choudhary, S. Sepat, S.S. Rathore, G. Mahajan, and B.S. Chauhan, (2017). *Crop protection. 95:* 45-52. Elsevier Ltd, https://doi.org/10.1016/j.crepro.2016.08.003
8. FAO (1999). The state of food security in the world.Food and agricultural organization of the United Nations, Rome, Italy.
9. Fernando, C.H. (1977). *Geo. Eco. Trop.; 3:* 169-188.
10. Grist, D.H (1965). Rice (4^{th} Edition). London: Longmans; Green & Co. Ltd.
11. Paiman S.N.F.I. and A.S. Abdullah (2020). *Reviews Agril. Sci. 8:* https://doi.org/10.7831/ras.8.0_343.
12. Philips, E.A. (1959). Methods of vegetation study. Henry Holt and company, New York.
13. Pielou, E.C. (1977). Mathematical Ecology. A Wiley interscience publication, New York. Pp. 364-375.
14. Sah, D., G.S. Panwar, A.H. Kalhapure, and N. Singh, (2020). *Int. J. of Curr. Micro. and Applied Sc. 9*(11): 1285-1294.
15. Sarmah, R. (2019). *Ind. J Weed Sc. 51*(2)*:* 139-144.
16. Shannon, C.E. and W. Wiener (1963). The mathematical theory of communication. University of Juionis Press, Urbana. Pp. 117.