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Phytocoenology Study of Weeds of Rice Crop with Edaphic Variation: An Analysis from Jhargram, West Bengal, India

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Abstract

Under edaphic fluctuation, the current study explains the phytosociological characteristics and weed distribution patterns in transplanted rice crops. Present work was done in Jhargram block, West Bengal, during *kharif* season 2022 and 2023. For every weed species, analytical quantitative characters were determined, such as relative density, relative dominance and important value index. There were 15 (6 grassy, 6 BLWs, 3 sedge), 14 (4 grassy,6 BLWs, 4 sedge), 16 (5 grassy, 8 BLWs, 3 sedge) and 11 (3 grassy, 5 BLWs, 3 sedge) weeds species found in Jhargram, Binpur I and Binpur II and Nayagram block of Jhargram district, respectively. Observation showed that, the relative density of single plant species at Jhargram Block, *Cynodon dactylon* was the predominant grassy weed; however, relative density of BLWs (Broad Leaved Weeds) and sedges, more seen with *Euphorbia hirta*, *Amaranthus spinosus* and *Cyperus* sp., respectively. Importance Value Index (IVI) more reported with *Cynodon dactylon* for grasses, *Ludwigia parviflora* and *Euphorbia hirta* for BLWs and *Cyperus difformis* for sedges. In Binpur I, *Cynodon dactylon* for grasses, *Ludwigia parviflora* for BLWs and *Cyperus rotundus* for sedges, were the predominant weed species with highest IVI. In Binpur II, block, more IVI found with *Paspalum scorbiculatum* for grasses, *Euphorbia hirta* and *Ludwigia parviflora* for BLWs and *Cyperus rotundus* for sedges. In Nayagram, block, relative abundance was observed more with *Echinochloa colona*, *Hydrolea zeylanica* and *Cyperus rotundus* for grasses, BLWs and sedges, respectively. More number of BLWs was observed throughout the observation followed by grasses in case of Jhargram, Binpur I and sedges in Binpur II and Nayagram block. This baseline information become very imperative for future research as well as for farming community to choose right kind of competitive crops and cropping pattern in the red-latertic zone.

Keywords: Density, IVI, Phytocoenology, Rice, Weeds

Introduction

The area of botany known as phytocoenology or phytosociology depict the composition, growth and structure of plant communities as well as the interactions between different species that inhabit them. Many experts believe that phytosociology is a crucial field within plant science that focuses on the study of vegetation, including its composition, growth and distribution. It is a subset of plant ecology that examines how different plant species coexist within ecosystems (Ewald, 2003). Weeds are plants that grow in unwanted locations, such as agricultural fields and gardens. They can thrive in a variety of soil and climate conditions, making them a common nuisance worldwide. Certain plant families, such as Asteraceae, Brassicaceae, Solanaceae and Poaceae, are known to dominate weed populations in cultivated areas. With over 15,000 weed species identified globally, more than 41 of them are particularly harmful to crops (Mukherjee, 2021). Weeds are formidable adversaries to crops, as they compete for essential resources like space, water, nutrients, and light, ultimately reducing the yield and quality of agricultural produce (Kumar *et al*., 2023). Their

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rapid growth and early germination make it easy for weed seedlings to establish and spread quickly within crop fields.

Weeds in agriculture are known to be a significant problem as they compete with crop plants for essential resources and strong competitive nature with allelopathic effects can cause irreversible damage to the crops. The competition between economical plant and weeds is a major factor contributing to low crop production per unit area. Studies have shown that weed infestations can lead to significant yield losses in various crops. For example, in West Bengal, farmers have reported yield losses of approximately 18-36% in potatoes, 18-37% in wheat, 16-25% in mustard and 23-46% in Kharif rice due to weed interference (Mukherjee, 2020; Shah *et al*., 2023). Proper weed management practices are crucial to minimize these losses and improve overall crop yield. Managing weeds in an ecological manner requires a wealth of knowledge rather than simply relying on heavy inputs. However, it doesn't have to be overly laborious. By selecting the most effective strategy for each specific weed at the appropriate time, you can minimize the amount of labor needed while ensuring that weeds do not negatively impact crop yields. The presence of weed species in any agricultural system is influenced by various factors including the history of the planting area, the soil seed bank, tillage practices, crop selection, use of chemical fertilizers, irrigation and agronomic techniques (Saavedra *et al*., 1990). The environment is incredibly important to humanity, as our modern society is built on utilizing natural resources and human ingenuity. Biodiversity in different ecosystems is regulated by the theory of species richness, which considers factors such as resource availability and disturbance in shaping plant communities. Species diversity refers to the variety of species present in a community or geographical area, with a higher diversity indicating a greater number of species. At its core, species diversity is a measure of the richness of life in a given area. Further, climate change could threaten food security because it is a major deciding factor in the growth, development and survival of all organisms including different weed flora distribution (Teli *et al*., 2023).

Biodiversity among plant species plays a crucial role in how communities are organized and allows for comparisons of their structural characteristics. It is closely tied to various aspects of community dynamics such as integration, evolution, stability, structure, competition and productivity. The concept of one species displacing another through competition is of utmost importance. In addition to this, the control of weeds and environmental factors play a significant role in influencing the distribution of weed species. Therefore, it is essential to have a thorough understanding of the phytosociology of weeds that compete with crops, as well as to analyze plant communities from both a floristic and structural perspective while identifying the species present in a specific area (Concenço *et al.*, 2013).

Material and Methods

Red-lateritic belt of West Bengal is situated between 22°38' N to 24°35' N latitude and 85°75' E to 88°1' E longitudes. Phytocoenological analysis of weed flora in *Kharif* 2022 and 2023 was conducted in 4 blocks *viz*., Jhargram, Binpur I and II and Nayagram under Jhargram district of West Bengal. The zone experiences an average annual rainfall of 1100 to 1300 mm, with 75% of the rainfall occurring between June and September. The temperature in this region ranges from 15 to 46 °C during the peak winter and summer months. The predominant soil types in this zone are red and lateritic, with variations in depth and sometimes shallow in nature. The undulating terrain of the area has led to significant erosion of the soil. The soils are characterized by a coarse texture, low water retention capacity and susceptibility to erosion, with a PH range of 4.7-6.4. During the observation of weed flora composition, stops were made every 3-4 km and recording sites were selected in 3 to 4 fields. Weeds associated with crops and other habitats were identified, with a quadrate size of 0.5 m × 0.5 m used for sampling. Five spots within each block were selected for each habitat. The ecological analysis of weed flora was conducted using quantitative methods based on relative frequency, relative density, relative dominance and the importance value index (IVI) following the methods outlined by Mueller-Dombois and Ellenberg (1974).

Results and Discussion

A study on the plant and weed communities, also known as phytocoenology, offers valuable insights into the behavior and significance of different species within specific ecological communities or across multiple communities. This information is crucial for understanding the interactions within crop-weed ecosystems (Mukherjee, 2023a). By analyzing quantitative data, researchers can make informed decisions regarding weed management strategies. The findings reveal that the abundance of individual weeds differs significantly across various blocks, as shown in table 1-4.

Weeds Distribution Pattern in Rice Field

The presence of weed species in rice fields was examined in different blocks of Jhargram district. A total of 15 weed species were identified in Jhargram, including 6 grasses, 6 broad-leaved plants and 3 sedges. In Binpur I, 14 weed species were found, consisting of 4 grasses, 6 broad-leaved plants and 4 sedges. Binpur II had 16 weed species, with 5 grasses, 8 broad-leaved plants and 3 sedges. Finally, Nayagram block had 11 weed species, including 3 grasses, 5 broad-leaved plants and 3 sedges. This information is summarized in table 1. Among grasses, *Echinochloa colona* and *Cynodon dactylon* become very dominant throughout the observed field. With different BLWs, density of *Commelina benghalensis*, *Ludwigia parviflora* and *Euphorbia hirta* become high compared to other observed species. Moreover, with sedges, highest distribution pattern observed with *Cyperus iria* and *Fimbristylis miliacea.* These weeds were the most frequently distributed in transplanted rice field in all the blocks. This kind of weed variation was also reported by Mukherjee (2023b). Based on the result revealed the relative density of individual weed species in 2022 and 2023 at Jhargram Block, the *Cynodon dactylon* was the predominant grassy weed species with highest relative dominance and was very close to *Paspalum scorbiculatum*. Relative density observed more with *Euphorbia hirta*, *Amaranthus spinosus among* all BLWs (Table 1). This confirm with the earlier finding of Sutradhar *et al.* (2018). Another important biodiversity

indicator is the relative (proportional) abundance or degree of dominance of individuals among different species. This usually referred to as evenness or equability and measures the extent to which species are equally represented in a community. Relative abundance percent observed more with *Oryza nivara*, *Ludwigia parviflora* and *Cyperus difformis* for grasses, BLWs and sedges, respectively. Important value index (IVI) more *reported with Cynodon dactylon* followed by *Oryza nivara* for grasses, *Ludwigia parviflora* and *Euphorbia hirta* for BLWs and *Cyperus difformis* for sedges. This clearly indicates importance of different species of weeds in particular location and help in different measure to control them on the basis of IVI figure.

Table 1: Status of important weed flora of transplanted rice in Jhargram block (Pooled value of two years)

Weed species	Weed density (m^{-2})	Relative density (%)	Relative abundance (%)	Important value index (IVI)
Grasses				
Cynodon dactylon	10	24.4	20.9	62.0
Dactyloctenium aegyptium	6	14.6	16.7	48.1
Echinochloa colona	6	14.6	12.5	43.9
Paspalum scorbiculatum	9	22.0	18.8	57.5
Oryza nivara	8	19.5	22.3	58.6
Setaria glauca	2	4.9	8.4	29.9
Broad-leaved				
Amaranthus spinosus	18	21.7	20.1	58.5
Commelina benghalensis	10	12.0	14.9	43.6
Cyanotis axillaris	9	10.8	13.4	40.9
Euphorbia hirta	20	24.1	22.3	63.2
Hydrolea zeylanica	6	7.2	6.7	30.6
Ludwigia parviflora	20	24.1	22.4	63.2
Sedges				
Cyperus difformis	14	42.4	38.53	97.6
Cyperus iria	10	30.3	36.69	83.7
Fimbristylis miliacea	9	27.3	24.77	68.7

In Binpur I, block, the computed value of relative density for single weed flora indicated that among grasses more seen with *Cynodon dactylon* and was followed by *Setaria glauca*. However relative density of BLWs and sedges, much found with *Ludwigia parviflora* and *Cyperus difformis*, respectively (Table 2). This corroborate with the earlier finding of Duary *et al.* (2015), where they advocate more *Ludwigia parviflora* population with highest values of frequency, dominance and importance value index in rice field at Purulia, which was followed by *Eclipta alba*, *Cyperus iria*, *Marsilea quadrifolia*, *C. compressus* and *Commelina benghalensis*. Relative abundance percent observed more with *Cynodon dactylon*, *Ludwigia parviflora* and *Cyperus rotundus* for grasses, BLWs and sedges, respectively. Computed data of IVI for single weed species exhibited that *Cynodon dactylon* for grasses, *Ludwigia parviflora* for BLWs and *Cyperus rotundus* for sedges, were the prevailing weed taxon with maximum IVI.

In Binpur II, block, density of grasses observed more with *Paspalum scorbiculatum* and was followed by *Echinochloa colona*. However, relative density percent of BLWs and sedges was quite high with *Euphorbia hirta* and *Cyperus iria*, respectively (Table 3). Relative abundance percent observed more with *Paspalum scorbiculatum*, *Euphorbia hirta* and *Cyperus rotundus* for grasses, BLWs and sedges, respectively. Better IVI found with *Paspalum scorbiculatum* for grasses, *Euphorbia hirta* and *Ludwigia parviflora* for BLWs and *Cyperus rotundus* for sedges.

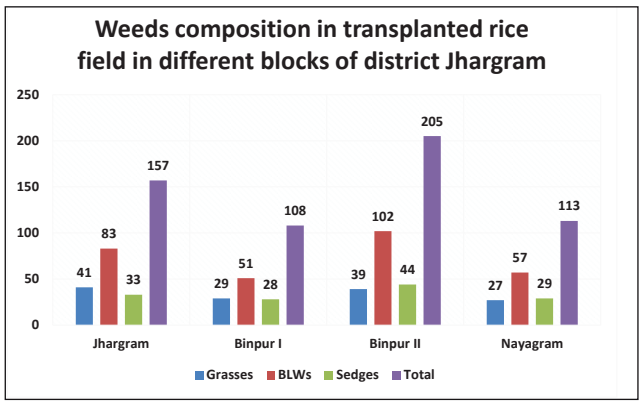

Figure 1: Weed flora composition in different blocks

In Nayagram, block, relative density of grasses observed more with *Echinochloa colona* and was close to *Oryza nivara*. More relative density observed with *Hydrolea zeylanica* among BLWs and with *Cyperus rotundus* in sedges (Table 4). Relative abundance percent observed more with *Echinochloa colona*, *Hydrolea zeylanica* and *Cyperus*

rotundus for grasses, BLWs and sedges, respectively. More IVI reported with *Echinochloa colona* for grasses, *Hydrolea zeylanica* and *Ludwigia parviflora* for BLWs and *Cyperus rotundus* for sedges.

Table 2: Status of important weed flora of transplanted rice in Binpur I block (Pooled value of two years)

Weed species	Weed density (m^{-2})	Relative density (%)	Relative abundance (%)	Important value index (IVI)
Grasses				
Cynodon dactylon	13	44.8	42.8	112.7
Dactyloctenium aegyptium	4	13.8	17.5	56.4
Echinochloa colona	6	20.7	19.7	65.5
Setaria glauca	6	20.7	19.7	65.5
Broad-leaved				
Amaranthus spinosus	8	15.7	13.3	45.7
Commelina benghalensis	7	13.7	15.5	45.9
Cyanotis axillaris	6	11.8	13.3	41.8
Euphorbia hirta	8	15.7	17.8	50.1
Ludwigia parviflora	16	31.4	26.6	74.7
Malvastrum coromandelianum	6	11.8	13.3	41.8
Sedges				
Cyperus rotundus	10	35.7	30.3	80.3
Cyperus iria	3	10.7	18.1	43.2
Cyperus difformis	9	32.1	27.2	73.7
Fimbristylis miliacea	6	21.4	24.2	60.0

Table 3: Status of important weed flora of transplanted rice in Binpur II block (Pooled value of two years)

Weed species	Weed density (m^{-2})	Relative density (%)	Relative abundance (%)	Important value index (IVI)
Grasses				
Cynodon dactylon	12	20.3	19.6	56.7
Dactyloctenium aegyptium	6	10.2	13.1	40.0
Echinochloa colona	16	27.1	26.2	70.0
Paspalum scorbiculatum	20	33.9	32.7	83.4
Oryza nivara	5	8.5	8.2	33.3
Broad-leaved				
Monochoria vaginalis	12	11.8	10.6	36.7
Commelina benghalensis	8	7.8	9.4	31.6
Phyllanthus niruri	7	6.9	8.3	29.5
Euphorbia hirta	25	24.5	22.2	61.1
Tridax procumbens	9	8.8	8.0	31.1
Hydrolea zeylanica	9	8.8	8.2	31.1
Ludwigia parviflora	16	15.7	14.3	44.2
Sphenoclea zeylanica	16	15.7	18.9	34.7
Sedges				
Cyperus iria	14	31.8	31.8	80.3
Cyperus rotundus	17	38.6	38.6	93.9
Fimbristylis miliacea	13	29.5	29.5	75.8

Distribution patterns of different dominant weed flora in four different blocks of Jhargram district, revealed that, more number of BLWs observed throughout the observation and was followed by grasses in case of Jhargram, Binpur I and for sedges in Binpur II and Nayagram block (Figure 1).

Table 4: Status of important weed flora of transplanted rice in Nayagram block (Pooled value of two years)

Weed species	Weed density (m^{-2})	Relative density (%)	Relative abundance (%)	Important value index (IVI)
Grasses				
Echinochloa colona	13	48.1	43.3	111.5
Paspalum scorbiculatum	5	18.5	16.6	55.2
Oryza nivara		33.3	40	93.3
Broad-leaved				
Commelina benghalensis	8	14.0	17.4	56.4
Euphorbia hirta	7	12.3	11.4	48.7
Hydrolea zeylanica	22	38.6	35.82	99.5
Ludwigia parviflora	15	26.3	24.4	75.8
Malvastrum sp.	5	8.8	10.8	19.6
Sedges				
Cyperus iria	7	24.1	26.4	67.2
Cyperus rotundus	12	41.4	45.3	103.3
Fimbristylis miliacea	10	34.5	28.3	79.5

Conclusion

The findings revealed the significant presence of various types of broad-leaved weeds, sedges and grasses in the environment surrounding transplanted rice. A higher Importance Value Index (IVI) was calculated for specific weed species during the years 2022 and 2023 in Jhargram district, across different blocks. It was observed that *Cynodon dactylon* and *Echinochloa colona* were the dominant grass species, while *Cyperus* species represented the majority of sedges. *Ludwigia parviflora*, *Euphorbia hirta* and *Hydrolea zeylanica* were the primary broad-leaved weed species in the lowland rice ecosystem. Weed management strategies in the area need to focus on effectively controlling these weeds in lowland rice fields. The results of this study can be used to develop efficient weed management programs for rice cultivation in the red-lateritic belt of West Bengal, India.

References

Concenço, G., Ceccon, G., Correia, I., Leite, L., Alves, V., 2013. Occurrence of weed species under crop succession. *Planta daninha* 31(2), 359-368. DOI: https://doi.org/10.1590/S0100-83582013000200013.

Duary, B., Mukherjee, A., Bhowmick, M.K., 2015. Phyto-sociological attributes of weed flora in major crops of red and lateritic belt of West Bengal. *Indian Journal of Weed Science* 47(1), 89-92.

Ewald, J., 2003. A critique for phytosociology. *Journal of Vegetation Science* 14(2), 291-296. DOI: https://doi.org/10.1111/j.1654-1103.2003.tb02154.x.

Kumar, S., Rana, S.S., Sharma, N., Iqbal, R.K., Qureshi, H., Anwar, T., Syed, A., Elgorban, A.M., Eswaramoorthy, R., 2023. Weed phyto-sociology and diversity in relation to conservation agriculture and weed management strategies in Northwestern Himalayas of India. *Journal of King Saud University - Science* 35(6), 102728. DOI: https://doi.org/10.1016/j.jksus.2023.102728.

Mukherjee, D., 2020. Effect of different crop establishment and weed control options on yield and nutrient uptake in rice. *Annals of Agricultural Research* 41(3), 266-275.

Mukherjee, D., 2021. Weeds biodiversity: Challenges and opportunity in current context. Chapter 3. In: *Biological Diversity: Current Status and Conservation Policies* (Volume 1). (Eds.) Kumar, V., Kumar, S., Kamboj, N., Payum, T., Kumar, P. and Kumari, S. Agro Environ Media Publishers, Agriculture and Environmental Academy, Haridwar, Uttarakhand, India. pp. 46-66. DOI: https://doi.org/10.26832/aesa-2021-bdcp-03.

Mukherjee, D., 2023a. A case study: Weed identification and control measure in moisture stress conditions under Red-Lateritic Belt of West Bengal. *Agri Tech Today* 1(9), 6-8.

Mukherjee, D., 2023b. Modern Approaches of Organic Weed Prevention Measures in Crop Fields. In: *Recent Advancement in Organic Farming*. (Eds.) Bhakta, J.N. and Rana, S. Nova Science Publisher. pp. 65-91. DOI: https://doi.org/10.52305/KDXB1757.

Mueller-Dombois, D., Ellenberg, H., 1974. Community sampling: The releve method. In: *Aims and Methods of Vegetation Ecology*. John Wiley & Sons, New York. pp. 95-133.

Saavedra, M., Garcia-Torres, L., Hernandez-Bermejo, E., Hildago, B., 1990. Influence of environmental factors

on the weed flora in crops in the Guadalquivir Valley. *Weed Research* 30(5), 363-374. DOI: https://doi.org/10.1111/j.1365-3180.1990.tb01723.x.

Shah, M.H., Mandal, B., Mukherjee, D., Kundu, S., 2023. Effect of weed management in transplanted rice under New Alluvial Zone of West Bengal. *The Pharma Innovation Journal* 12(8), 1834-1838.

Sutradhar, J., Lokho, A., Das, A.P., 2018. Survey of weed flora of rice fields in Lateritic Belt and Alluvial Zone (Bindhya and Gangetic Alluvium) of Bardhaman District, West Bengal, India. Chapter 21. In: *Angiosperm Systematics: Recent Trends and Emerging Issues*, Volume 1. (Eds.) Agnihotri, P. and Khuraijam, J.S. M/S Bishen Singh Mahendra Pal Singh, Uttarakhand, India. pp. 391-404.

Teli, S., Saha, A., Debbarma, B., 2023. Climate smart weed management practices. *Plant Health Archives* 1(1), 03-04. DOI: https://doi.org/10.54083/PHA/1.1.2023/03-04.