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Sarbani Roy
Tocklai Tea Research Institute
Somnath Roy
Tocklai Tea Research Institute
Venkatesan Selvaraj
Tocklai Tea Research Institute
Chandra Ghosh
chandraghosh19@nbu.ac.in

University of North Bengal

Research Article

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Sarbani Roy[1], Somnath Roy[1], Venkatesan Selvaraj[1], Chandra Ghosh[2*]

1. Tocklai Tea Research Institute, Jorhat, Assam- 785008
2. Department of Tea Science, University of North Bengal, Darjeeling - 734013, West Bengal, India
* Corresponding Author: chandraghosh19@nbu.ac.in

Abstract

This study identifies weed species and assesses their frequency, abundance, dominance, and similarity index in selected tea estates on the South bank of Assam. A phytosociological survey of weeds using random quadrat technique of (1x1) m was carried out in tea gardens from 2022 to 2024 at regular intervals to compare the weed flora in organic and conventional tea gardens and identify the most prevalent weeds in the gardens of South Bank of Assam. The floristic diversity of weeds was evaluated for the most dominant weeds based on a higher value of important value index (IVI). 188 different weeds were collected that belonged to 41 dicot families, 6 monocot families, and 7 pteridophytic families which were predominantly therophytes. Native weed species accounted for 71% while exotic species represented 29% of total weeds. Asteraceae (11.53%) and Poaceae (10%) represented the highest number of species. Cluster analysis of weed flora highlighted the species like *Ageratum houstonianum, Ageratum conyzoides, Spermacoce alata, Axonopus compressus* and *Oxalis debilis* to be higher in organic gardens. Herbicide resistant weeds like *Polytrias indica, Eleusine indica, Paspalum conjugatum, Oplismenus compositus* and *Cyperus brevifolius* have shown higher frequency, density and abundance than other weeds in conventional gardens. The study also found the presence of *Ageratum conyzoides*, *Spermacoce alata, Eleusine indica, Mikania micrantha, Peperomia pellucida, Chrysopogon aicicularis, Clerodendrum infortunatum, Colocasia esculenta* and *Crassocephalum crepidiodes* in all selected gardens regardless of cultural practices.

Keywords: Assam, weeds, phytosociological survey, organic, conventional, invasive, tea field.

INTRODUCTION

Weeds impart a significant constraint in tea cultivation, leading to reduced productivity and financial losses for tea growers. Weeds are unwanted plants that compete with the tea bushes for nutrients, water, space, and light. The competitive ability of weeds is affected by various factors, such as growth form, density, and the time of weed emergence in relation to the crop [1, 2]. The primary elements influencing the intensity of weed infestation include agroclimatic conditions, cultivation practices followed and the weed management strategies involved [3]. The substantial weed infestation in tea plantations is attributable to the highly humid environment that is necessary for tea cultivation concurrently favouring weed proliferation as well [4, 5]. Weeds are a ubiquitous component in all agricultural settings [6]. In contrast to the random emergence of other pests, weeds can significantly reduce yields without apparent indicators of damage. Their deleterious impact on the growth and yield of tea bushes arises from their competition for nutrients, sunlight, space, and water. They participate in allelopathic interactions with crops, parasitise crop plants, and offer refuge to harmful pests and pathogens [7, 8]. Improper weed management may lead to a 10-50% decrease in tea yield [9, 3].

The patterns of weed succession and distribution in tea estates are inherently dynamic. The composition of weed flora may vary based on location [10]. Consequently, weeding is an inevitable task in tea gardens. Weed growth, population density, and dispersion are influenced by spatial changes driven by soil composition, climatic conditions and management practice [11, 6]. A thorough understanding of weed density, distribution, and species composition is crucial for formulating efficient weed management techniques. Weed survey determines the distribution, abundance, and diversity of weed species in an area. A survey conducted by Ghosh and Das [12] in nine different tea estates in the Darjeeling and Terai regions of West Bengal reported 219 species of beneficial plants and 40 species of toxic weeds. Similarly, in a recent study conducted by Ghosh et al. [13] showed phenological observations on 220 prominent weeds found in tea estates of Darjeeling and Terai area. This information offers a comprehensive

database of weed infestation in specific tea gardens and serves as a foundation for planning and decision-making in effective weed management. Weed management strategies should incorporate this information to effectively target the most prevalent, abundant, and dominant species in a specific region. Dutta [14] conducted an exhaustive floristic assessment of the weeds present in the tea gardens of North East India, helping the tea planters in identifying the common weed species. Moreover, the everchanging climate patterns over the past fifty years have resulted in weed shift in the North East which facilitated the proliferation of a diverse array of weed species. Nonetheless, there has been a lack of updated information regarding weed flora compositions, abundance, relative importance and ranking of weed species in the main tea growing areas of the South Bank of Assam over the past fifty years. Therefore, this research on the floristic survey of weeds is of paramount importance.

Out of the total losses due to various biotic factors, weeds are known to account for one third. The extent of damage depends upon the nature of weeds, their density, dominance, ecological success and the association with the crops and other biotic and edaphic factors. It is, therefore, necessary to make a detailed survey of weeds in crop fields, their distribution, and relative occurrence. Therefore, there is a great need of research aiming at prevention of loss of yield due to weeds in the tea gardens and management of weeds by most economic and feasible method. These objectives can be achieved through a better understanding of biology of different weeds infesting the tea fields.

MATERIALS AND METHODS

Study Area

The present work is based on the survey on weeds of tea gardens in South bank of Assam. Assam, is one of the most important states of North East India and is the major producer of tea in India, located in the farthest eastern corner of the Indian sub-continent, extending between 24°44/ N and 27°45/ N latitude and 89°41/ E to 96°02/ E longitude. The river Brahmaputra flows from

Tibet into Arunachal Pradesh and further down through the breadth of Assam, creating a very fertile soil. Assam has four main tea growing regions (Fig 1).

1. **Upper Assam** which makes up the districts of Dibrugarh and Tinsukia.
2. **Barak Valley,** which includes Cachar.
3. **North Bank**, comprising Sonitpur, Darrang, Kamrup
4. **South Bank** marks the districts to the south of the Brahmaputra which includes Jorhat, Golaghat and Sibsagar.

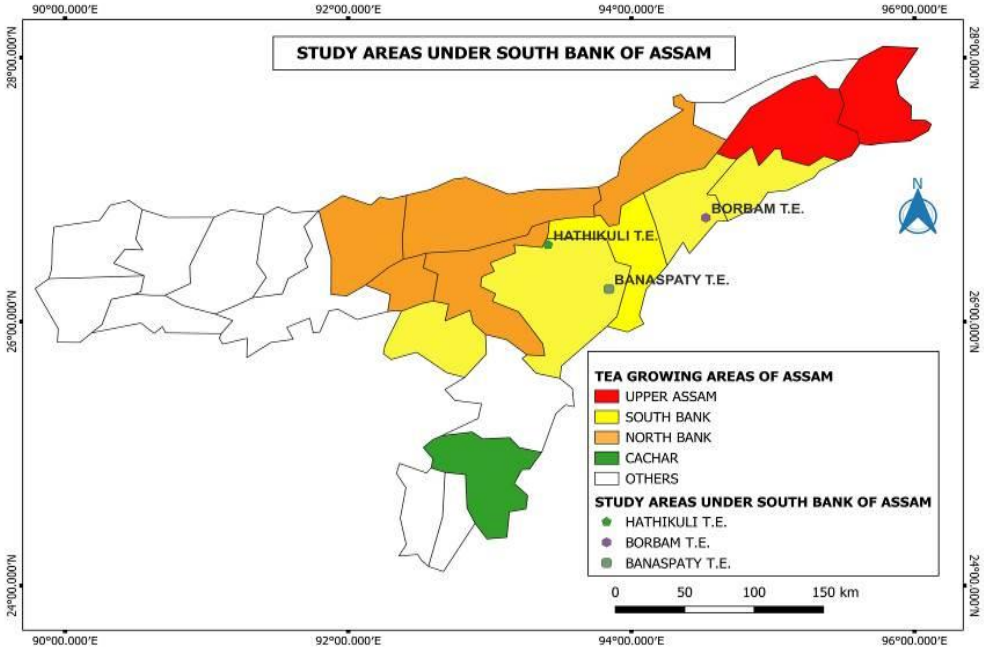


Fig 1: State map of Assam showing the tea growing regions with the study area (South Bank) highlighted in yellow

Gardens selected from South bank of Assam

The survey work was designed to be conducted within the boundary of South Bank of Assam which includes the districts of Jorhat, Shibsagar, Golaghat and Karbi Anglong. In the entire range of plains of South Bank of Assam, not only the tea cultivation is intense but also the growth of weeds and the natural vegetation are floristically very rich. A series of visits to multiple tea estates were made from 2022 to 2024 to record the life cycle stages of various plant species within the vegetation. From this region, following three tea gardens have been selected for the study (Table 1).

Table 1: Comprehensive details of the tea gardens under study area

Sl no	**Garden Name**	**District**	**Latitude & Longitude**	**Altitude**	**Mode of Cultivation**	**Total area** (Ha)
1	Hatikhuli Tea Estate	Golaghat	26°35'5"N 93°22'15"E	88 m amsl	Organic	157.00
					Conventional	298.15
2	Banaspaty Tea Estate	Karbi Anglong	26°14'50"N 93°50'34"E	100 m amsl	Organic	53.51
3	Borbam Tea Estate	Shibsagar	26°37'20"N 94°6'20"E	86.6 m amsl	Conventional	951.00

amsl- above mean sea level, Ha – Hectares

Methodology

The weed specimens were collected from these tea gardens was done using random selection method throughout the year from 2022 to 2024. The study focused on the three climatic seasons: summer, monsoon and winter. According to the climatic conditions of Assam, winter encompasses from end of October to February and summer includes the period between April to June while monsoon includes the months from July to September. Efforts were made to obtain a comprehensive understanding of the

weed flora, encompassing all categories of perennial and seasonal weeds that are present in these gardens. Regular visits were made to gardens in order to gather all pertinent field data covering the stages of life cycle of the weeds. For categorising life forms of the vegetation into Phanerophtes, Chamaephytes, Hemicryptophytes, Cryptophytes and Therophytes, Raunkiaer system of classification has been followed [15].

The random quadrat method was applied for the phytosociological studies. Fifty quadrats of 1m x1m were laid down in tea fields in a random manner. The phytosociological parameters were computed using list, count, and basal data of quadrats. GPS tagged photos were taken during the survey work in all the gardens (Fig. 1). For the phytosociological study frequency, density, abundance, relative frequency, relative density, relative dominance and Importance Value Index (IVI) were calculated, following methods by Curtis and McIntosh [16] and Misra [17].

(a) (b) (c)

Fig.1: GPS tagged photos during survey in different gardens (a) Hatikhuli TE (b) Borbam TE (c) Banaspaty TE

RESULTS AND DISCUSSION

Phytosociological study of weeds, provide knowledge of the dynamics and relative importance of a species in a particular vegetation and has enormous relevance in crop-weed ecosystem. It gives an appraisal of species through quantitative characters which allow effective weed management decision.

It was found that the tea gardens under study were infested with 188 different weeds belonging to 44 families (Acanthaceae, Amaranthaceae, Asteraceae, Commelinaceae Convolvulaceae, Cyperaceae, Euphorbiaceae, Fabaceae, Linderniaceae, Lythraceae, Malvaceae, Marsileaceae, Onagraceae, Oxalidaceae, Plantaginaceae, Poaceae, Portulacaceae, Solanaceae, Tiliaceae, and Verbenaceae etc) (Table 2, Table 3 & Table 4). Poaceae had the highest number of species 10.81% followed by Asteraceae 9.72% in the study area (Fig. 2). During the phytosociological study, in all the study sites, it was found that weed species varied in the level of frequency, abundance and dominance. Among the identified weed species, 76.75% broad leafed weeds were recorded. Based upon the morphological classification the infestation of sedges and grassy weed types were about 17.83% while the pteridophytic weeds represented 5.40% in the selected tea gardens (Fig. 3A) with the majority being indigenous species represented by 71% while exotic species accounted for 29% of the total weeds (Fig. 3B). Precipitation was also an influential factor in the emergence of weeds, which have favored the rapid growth of these weed species. The weeds in the study area primarily consisted of annual herbaceous plants or Therophytes (83%) (Fig. 4). The result revealed that *Ageratum conyzoides*, *Spermacoce alata*, *Eleusine indica, Mikania micrantha, Peperomia pellucida, Chrysopogon acicularis, Clerodendrum infortunatum, Colocasia esculenta, Crassocephalum crepidiodes* were some of the prominent weed species found in the selected gardens irrespective of the cultural practices followed (Fig. 5). The similarity index value of Organic gardens (Hatikhuli TE, Banaspaty TE) and Conventional tea gardens represented by Borbam TE, Hatikhuli TE (conventional part) was 82.70% which implies the weed species composition are similar in the two cultivation methods. This might be because of the similarity in soil, environmental conditions and cultural practices between the locations [20]. According to Deka and Baruah [3], prevalence of

several perennial grasses and bushy broadleaved weeds like *Urena lobata, Triumfetta rhomboidea, Solanum torvum*, perennial climbers like *Lygodium flexuosum, L. japonica* and sedges belonging to *Carex, Scleria* etc. are seen in organic tea plantations.

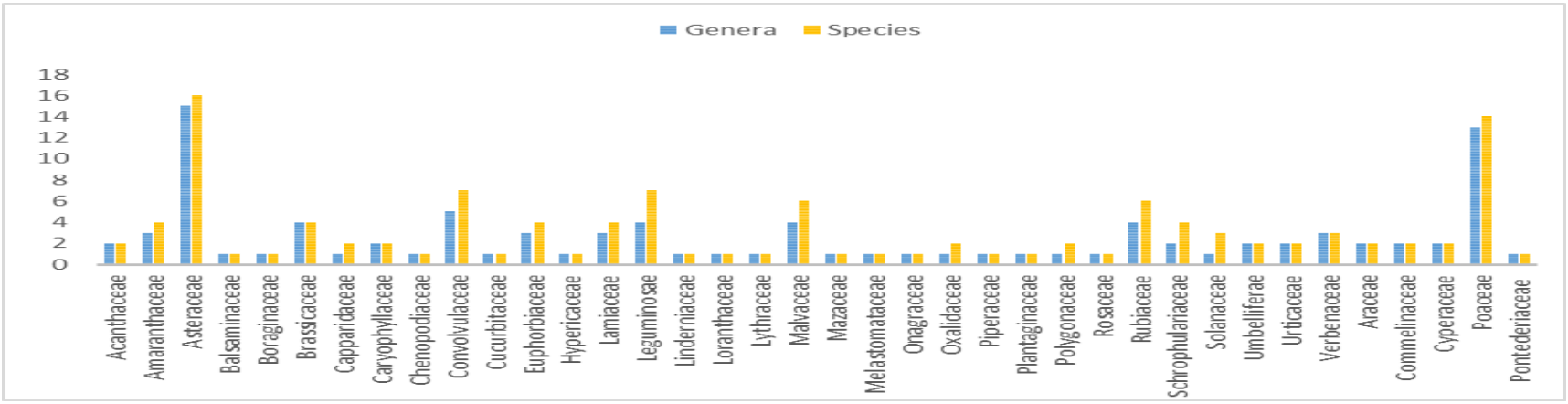
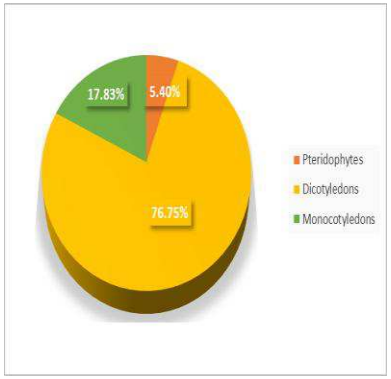
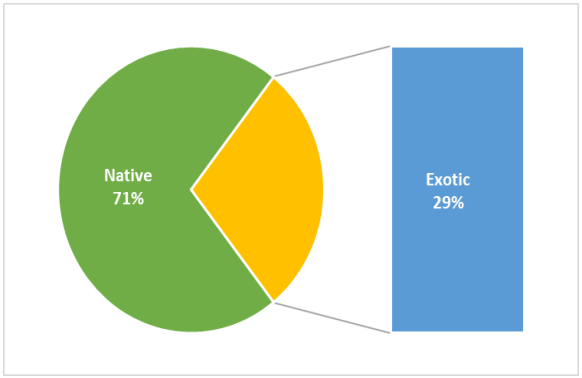


Fig. 2: Graphical representation of distribution of genera and species into different families of the weeds found at study sites.



3A



3B

Fig. 3A: Distribution of dicots, monocots and pteridophytes
Fig. 3B: Distribution of native and exotic species

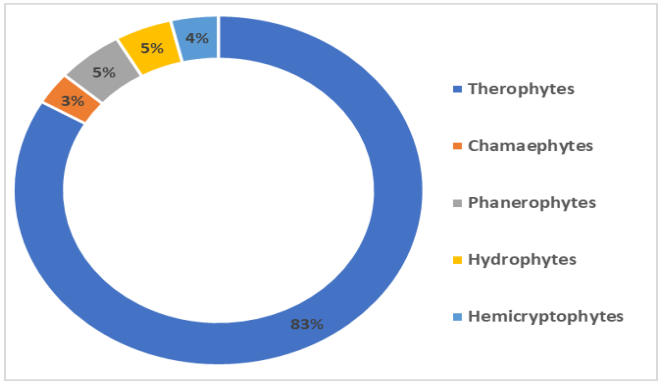


Fig. 4: Distribution of life form classes among the weeds in study area

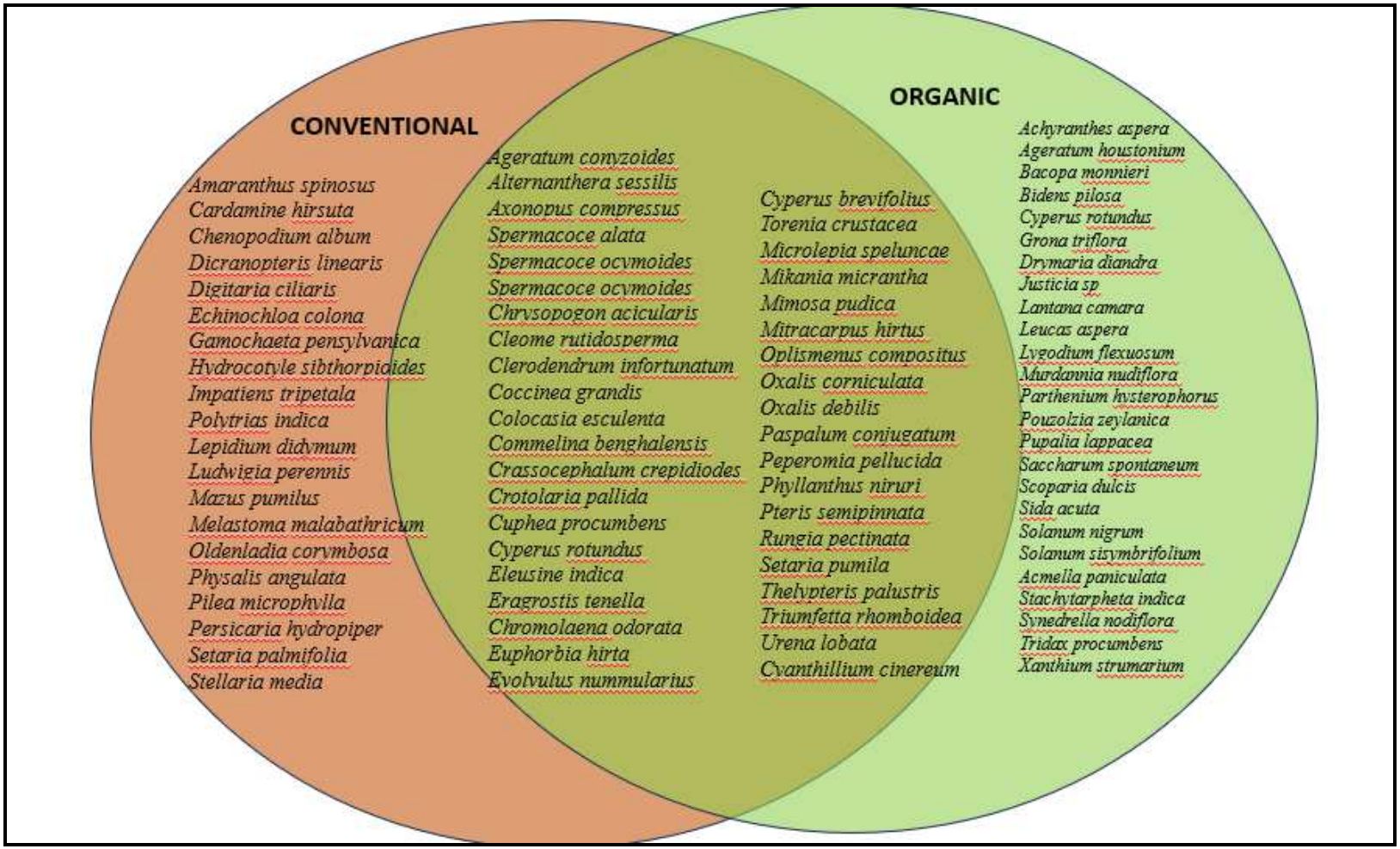


Fig 5: Venn diagram of weed species that are unique and shared by gardens practising Conventional and Organic cultivation

Based on the importance value index (IVI), it is inferred that the ten most dominant weeds in South bank of Assam are *Polytrias indica*, *Ageratum conyzoides, Spermacoce alata, Oxalis corymbosa, Eleusine indica, Axonopus compressus, Peperomia pellucida, Rungia, pectinata, Paspalum conjugatum, Evolvulus nummularius, Stellaria media* and *Eragrostis tenella*. The results of comparative analysis of weed species composition of organic gardens against those practising conventional methods during the monsoon and winter months displaying the impact of seasonal variation are presented in Table 5. It was seen that Hatikhuli TE (Organic Division) sharing the same ecological niche with that of Kaziranga National Park and have higher weed density and diversity than conventional gardens both in monsoon as well as winter months as they do not employ herbicides to control the weed growth rather they manage by removing them mechanically. 64 different weed species were recorded during monsoon season while 50 weed species were listed during the dry winter months followed by 53 weeds during summer season while recording the phytosociological data in the organic division of Hatikhuli TE (Fig.6A). Similarly, 43 different weed species were recorded in the monsoon season while only 32 different weed species were recorded during the winter months in Banaspaty TE which is also an organic garden located in South bank of Assam. The weed population is remarkably reduced to 25 during monsoon and only 19 species in the winter period in Borbam TE practicing conventional mode of cultivation. The diversity of weed species fluctuated with the seasons, influenced by temperature, rainfall and the timing of weeding operations.

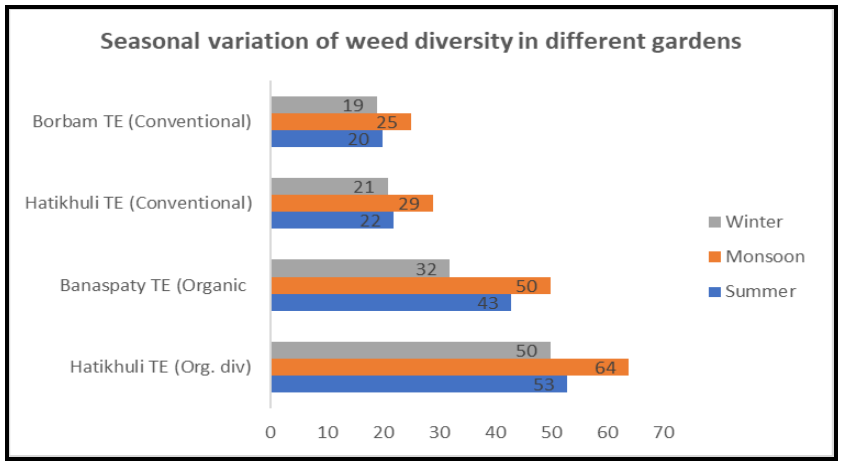


Fig 6A: Impact of seasonal variation on weed diversity in different gardens

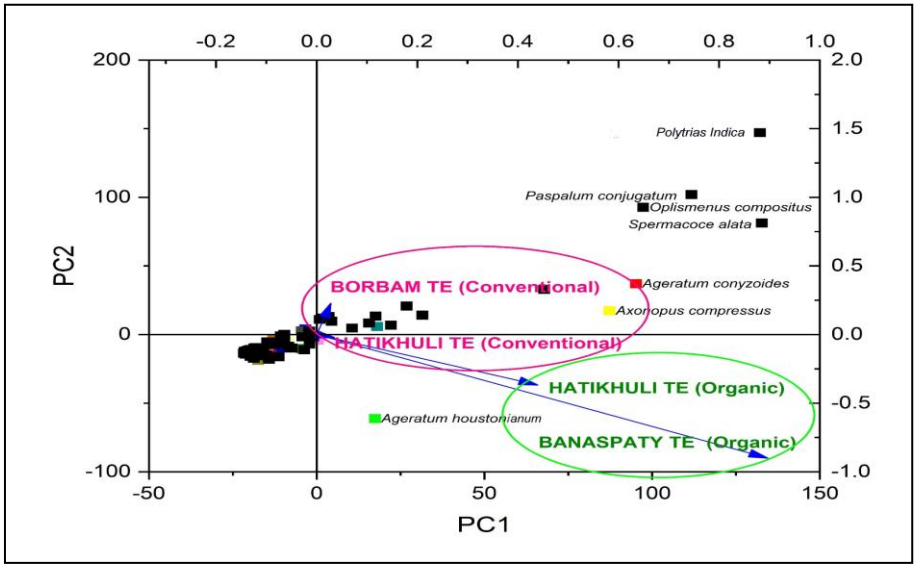


Fig. 6B: Principal Component Analysis (PCA) demonstrating the clustering of tea estates and the distribution of various plant species.

The PCA plot shows a clear separation between "Conventional" tea estates represented by Borbam TE and Hatikhuli TE enclosed in a magenta ellipse and "Organic" tea estates like Banaspaty TE and Hatikhuli TE (Organic Division), enclosed in a green ellipse. This clustering suggests that conventional and organic cultivation practices lead to distinct differences in the measured variables or environmental conditions associated with these tea estates, which are captured by the principal components.

As evident from the PCA plot various weed species like *Polytrias indica, Paspalum conjugatum, Oplismenus compositus, Spermacoce alata, Ageratum conyzoides, Axonopus compressus* are also plotted, indicating their closeness to the tea estates practicing conventional farming while *Ageratum houstonianum* is mostly present in the organic gardens. Therefore, we can say species closer to a particular cluster of tea estates are more likely to be associated with the conditions or characteristics of that cultivation system (Fig. 6B).

The heatmap with a hierarchical clustering dendrogram on the left (Fig.7) illustrating the distribution pattern of weed species found in the gardens of South Bank of Assam based on frequency, density and abundance between organic and conventional management gardens. The colour gradient represents the relative abundance of each species, with darker shades indicating higher abundance. Some species like *Ageratum houstonianum, Axonopus compressus, Eleusine indica, Drymaria diandra,* and *Oxalis debilis* show high abundance under organic management, while others, such as *Polytrias indica*, *Paspalum conjugatum*, *Oplismenus compositus, Spermacoce alata* are more abundant under conventional management system. One important finding in our study was that *Polytrias indica,* was one of the dominant grassy weeds recorded in high abundance in the conventional gardens but were sparsely found in the organic gardens which once again highlights the fact that overuse of herbicides, particularly glyphosate may result in the development of “superweeds” which later becomes difficult to manage thereby posing significant challenge to the tea gardens. On the contrary, *Ageratum houstonianum* one of the prominent weeds in the tea gardens practicing organic cultivation but was rarely found in the conventional gardens. This investigation offers substantial and pertinent information regarding the floristic diversity, composition, and distribution of the weed flora in the South bank of Assam.

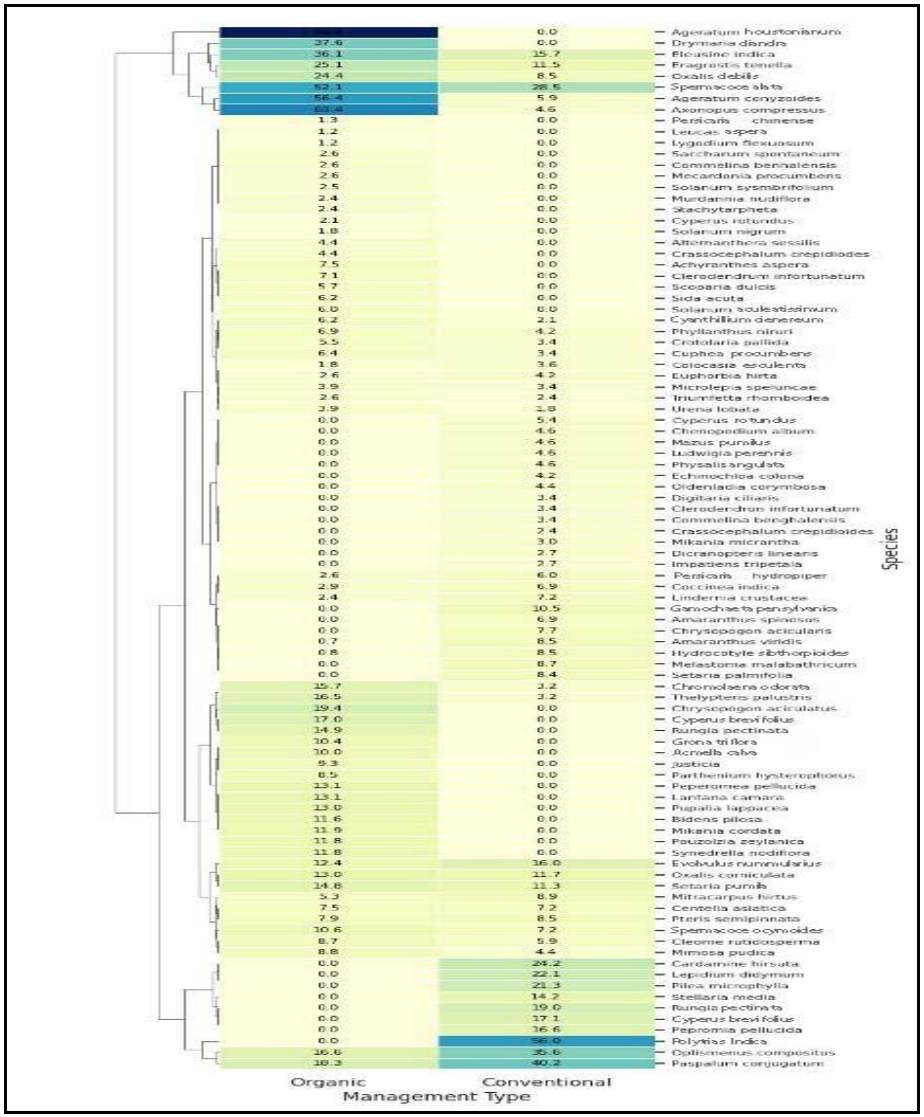


Fig 7: Heatmap with dendrogram illustrating the distribution pattern based on frequency, density and abundance among weed species between organic and conventional management types

Humans actively or mistakenly introduce exotic, foreign, non-indigenous, or non-native plants from one location to another. Naturalised species are foreign plants that escaped their habitat and reproduce in the local flora. Naturalised alien species that spread in the local flora and displace native biota or endanger valuable environmental and agricultural resources are invasive and can have catastrophic consequences. Invasive alien weed species can lead to biodiversity loss in the tea gardens and impact crop production, aquatic ecosystems and overall microclimate of the tea garden area. According to Mooney and Hobbs [18] rapid increase in invasive species are homogenising the world's vegetation. Some alien species can replace native plants and disturb nutrient cycles and affect plant succession once established. Invasive plant species have the ability to produce large number of easily dispersible seeds, develop vigorous root stems, shows short generation times, have high dispersal rates and prolonged flowering and fruiting periods. They also have the tendency to spread abundantly in a broad native area [19]. During the survey in these gardens, 50 invasive alien plant species are found. The most dangerous invasive aliens are *Mikania micrantha, Ageratum conyzoides, Parthenium hysterophorus, Lantana camara, Alternanthera philoxeroides, Chromolaena odorata and Eichhornia crassipes.* The invasive alien plants (IAS) found during the survey are highlighted in Table 2 and Table 3.

CONCLUSION

This study provides a comprehensive overview of the tea garden weeds in the South Bank of Assam, an area characterised by a wealth of biodiversity. Tribal indigenous groups employed as tea garden labourers rely significantly on tea garden weeds for the treatment of various disorders and diseases. They utilise many weeds in conjunction with fern species for medicinal, nutritional, fodder and other purposes. Despite the detrimental effects on crop yield, certain weeds can therefore have beneficial socioeconomic role [21]. In Assam and other parts of the world, the majority of the weeds found in tea gardens are used as vegetables or as medicine. Some weed species are used as folk medicine by the tea tribe people to treat a variety of illnesses [22,

23]. According to Saikia, 47 different species of weeds are used in traditional medicine by small tea growers in North Lakhimpur, Assam [24].

However, the extensive application of herbicides in tea gardens and other human activities severely depletes the number of tea weeds. Consequently, preserving the significant weed flora in fallow or marginal regions can facilitate the garden labourers during crises and support ethnobotanical practices among tribes in tea garden areas.

Numerous invasive weed species persist in tea gardens like *Mikania micrantha, Lantana camara, Parthenium hysterophorus, Ipomoea cairica* and *Sphagneticola trilobata.* If their weedy characteristics are not recognised or if eradication and prevention measures are neglected, they may proliferate and overrun extensive areas of the tea garden within a few years. Therefore, it is imperative to prioritise the eradication of the invasive weeds at the earliest opportunity. Some species remain non-invasive if proper attention is not given for a long period. Moreover, not all invasive plants show the same magnitude of invasiveness, some are restricted to a limited area and do not spread aggressively. Consequently, additional research is necessary to assess yield losses and describe the dynamics of weed flora and their potential effects on tea productivity using a large sample size.

All weed species documented during the study were examined on the IUCN Red List of Threatened Species to enhance the understanding of the biodiversity of the tea gardens. It was found that the weeds fall under Least Concern (LC) category. The key elements contributing loss of biodiversity comprises of habitat destruction, invasive species, climate change, pollution, overexploitation and spread of diseases. All assessments were based on data currently accessible for the taxon throughout its global distribution as per IUCN Red List of Threatened species.

Results clearly indicate that *Ageratum conyzoides, Spermacoce alata* and *Eleusine indica* are the most frequently distributed weed species in all the study sites sampled. Density-wise also, these three species were found the most dominant species. Almost

the same picture is seen with abundance also. The study infers that diversity of dicot weeds in the study areas is more than the monocot weeds. According to Ghosh et al., despite the frequent application of chemical herbicides for controlling the weeds in the tea gardens, seeds from adjacent vegetation infiltrate the gardens shortly, restoring the weed flora [13]. The greater number of Therophytes (83%) in this study has been linked to significant anthropogenic disturbances and various biotic interferences which results in the subsequent introduction and proliferation of small weedy plants while regular weeding activities in the gardens prevent the spread of Phanerophytes (5%).

A high number of weeds identified in the organic gardens could be attributed to the presence of a large weed seed bank in the soil that must have been deposited from previous years. Weeds have higher seed production that is easily dispersed through different ways with variable dormancy resulting in germination by flushes over a long period. The persistent weed species give a severe competition to the tea crop and reduce the productivity. Most of the weed species with the highest density, frequency and abundance were of the grass family and sedges. These weeds have high fecundity producing thousands of seeds during single growing season and also reproduce through vegetative propagules. Weeds like *Ageratum conyzoides* belonging to the Asteraceae family produce a large number of seeds, which may remain in soil and serve as seed bank for the next season. It can be emphasized that major weeds should be controlled at proper time to check reduction in the tea gardens and they must be removed before flowering and fruiting to reduce the production of seeds that remain as soil seed bank for the following years. For proper management of weed one should remember that most of the weeds flower and fruit during June to November and hence weeding must be done before this period to avoid the gradual development of weed bank in the soil under dormant condition which in further time period would germinate and propagate at faster rate to reduce the agricultural output.

Table 2 : Composition of dicot weed species in the selected gardens under study

Sl. No	Scientific Name	Family	Assamese Name	Life form	IUCN status	Exotic/ Native	Garden Name
1	*Abutilon indicum* (L.) Sweet	Malvaceae	Jopa petari	T	-	Native	B
2	*Acanthus carduaceus* Griff.	Acanthaceae	-	T	-	Native	BB
3	*Achyranthes aspera* L.	Amaranthaceae	Ultihot	T	-	Native	H,B
4	*Acmella paniculata* (Wall. ex DC.) R.K.Jansen	Asteraceae	Sohoni bon	T	-	Native	H,B,BB
5	#*Ageratum conyzoides* L.	Asteraceae	Gondhwa bon	T	LC	Exotic:Tropical America	H,B,BB
6	#*Ageratum houstonianum* Mill.	Asteraceae	Gondhwa bon	T	-	Exotic:Tropical America	H,B
7	*Alternanthera brasiliana* (L.) Kuntze	Amaranthaceae	Bishalyakara ni	T	-	Exotic: Tropical America	H,B,BB
8	#*Alternanthera philoxeroides* (Mart.) Griseb.	Amaranthaceae	Matikanduri	T	-	Exotic:Tropical America	H,B,BB
9	*Alternanthera sessilis*(L.) DC	Amaranthaceae	Matikanduri	T	LC	Native	H,B,BB
10	*Amaranthus spinosus* L.	Amaranthaceae	Hati khutora	T	-	Native	H
11	*Amaranthus viridis* L.	Amaranthaceae	Khutora saak	T	-	Native	H,B,BB
12	*Anisomeles indica* (L.) Kuntze	Lamiaceae	Gopali	T	-	Native	B
13	*Argyreia nervosa* (Burm.f.) Bojer	Convolvulaceae	Tokria alu	Ch	-	Native	B
14	*Bacopa monnieri* (L.) Wettst.	Plantaginaceae	Brahmi saak	Ch	LC	Native	H,B
15	*Barleria cristata* L.	Acanthaceae	Jhinili	T	-	Native	H
16	#*Bidens pilosa* L.	Asteraceae	Kurro	T	-	Exotic:Tropical America	H,B
17	#*Blumea lacera* (Burm.f.) DC.	Asteraceae	Kakoranda	T	-	Exotic: Tropical America	BB
18	*Bonnaya antipoda* (L.) Druce	Linderniaceae	Kasidoria	T	LC	Native	H
19	*Bonnaya ciliata* (Colsm.) Spreng.	Linderniaceae	Kasidoria	T	LC	Native	H, B
20	*Capsella bursa- pastoris* (L.) Medik.	Brassicaceae	Ganga moola	T	LC	Native	H
21	#*Cardamine hirsuta* L.	Brassicaceae	Bon horioh	T	-	Exotic:Tropical America	H

22	*Centella asiatica* (L.) Urb.	Apiaceae	Bor Maanimuni	Ch	LC	Native	H,B,BB
23	*Chenopodium album* L.	Amaranthaceae	Jhilmil saak	T	-	Native	H
24	#*Chromolaena odorata* (L.) R.M.King & H.Rob.	Asteraceae	German habi	T	-	Exotic: Tropical America	H,B,BB
25	#*Cleome rutidosperma* DC.	Cleomaceae	Neel bon	Ch	-	Exotic:Tropical America	H,B
26	*Cleome spinosa* Jacq.	Cleomaceae	Hurhuriya	T	-	Exotic: Tropical America	H
27	*Clerodendrum chinense* (Osbeck) Mabb.	Lamiaceae	Nepaphu	T	LC	Native	H,B
28	*Clerodendrum colebrookeanum* Walp.	Lamiaceae	Nephafu	T	-	Native	B
29	*Clerodendrum infortunatum* L.	Lamiaceae	Dhopat tita	T	LC	Native	H,B,BB
30	*Coccinia grandis* (L.) Voigt	Cucurbitaceae	Kundoli	Ch	-	Native	H,B
31	*Coleus scutellarioides* (L.) Benth.	Lamiaceae	Pashanbhed	T	-	Native	H
32	#*Crassocephalum crepidioides* (Benth.) S.Moore	Asteraceae	Bonkapali	T	-	Exotic:Tropical America	H,B,BB
33	#*Crotalaria pallida* Aiton	Fabaceae	Jhunjhunia	T	-	Exotic:Tropical America	H,B,BB
34	#*Croton bonplandianus* Baill.	Euphorbiaceae	Bon tulsi	T	-	Exotic:Tropical South America	H
35	*Cuphea procumbens* Ortega	Lythraceae	Pani jetuka	T	-	Native	H,B,BB
36	#*Cuscuta reflexa* Roxb.	Convolvulaceae	Akashi lota	T	LC	Exotic: Mediterranean	B
37	*Cyanthillium cinereum* (L.) H.Rob.	Asteraceae	Sahadebi	T	-	Native	H,B,BB
38	*Dendrophthoe longiflorus* (Desr.) Ettingsh.	Loranthaceae	Raghu Mola	-	-	Native	B
39	*Dichrocephala integrifolia* (L.f.) Kuntze	Asteraceae	-	T	-	Native	H, B,BB
40	*Drymaria diandra* Blume	Caryophyllaceae	Lai jabori	Ch	-	Native	H,B,BB
41	#*Eclipta prostrata* (L.) L.	Asteraceae	Keheraj	T	LC	Exotic:Tropical America	H,B
42	*Elephantopus scaber* L.	Asteraceae	Hati khoje	T	-	Native	H
43	#*Emilia sonchifolia* (L.) DC.	Asteraceae	Bonkapahua	T	-	Exotic:Tropical America	H,B
44	*Enydra fluctuans* Lour.	Asteraceae	Helonchi	Hy	LC	Native	H,BB

45	*Eryngium foetidum* L.	Apiaceae	Man dhania	Ch	-	Native	H,B, BB
46	*Euphorbia hirta* L.	Euphorbiaceae	Dudh bon	T	-	Native	H,B
47	#*Evolvulus nummularius*(L.) L.	Convolvulaceae	Alosa bon	Ch	-	Exotic:Tropical America	H,B,BB
48	*Ficus pumila* L.	Moraceae	Lata dimaru	Ch	-	Native	H
49	*Gamochaeta pensylvanica* (Willd.) Cabrera	Asteraceae	Kapah gutia bon	T	-	Native	H
50	#*Grangea maderaspatana* (L.) Desf.	Asteraceae	Makhipotia	Ch	LC	Native	H,BB
51	*Grona triflora* (L.) H.Ohashi & K.Ohashi	Fabaceae	Tripodi	Ch	LC	Native	H
52	*Heliotropium indicum* L.	Boraginaceae	Hati sur	T	-	Native	H, B
53	*Houttuynia cordata* Thunb.	Sauraceae	Masundari	T	-	Native	H,B
54	*Hydrocotyle sibthorpioides* Lam.	Apiaceae	Soru manimuni	Ch	LC	Native	H,B,BB
55	*Hypericum japonicum* Thunb.	Hypericaceae	Asoibon	Ch	-	Native	H,B
56	*Hyptis brevipes* Poit.	Lamiaceae	-	T	-	Native	H,B
58	*Hyptis capitata* Jacq.	Lamiaceae	-	T	-	Native	H
59	#*Impatiens tripetala* Roxb. ex DC.	Balsaminaceae	Bijolkoria	T	-	Exotic: Tropical America	H
60	*Ipomoea cairica* (L.) Sweet.	Convolvulaceae	-	Ch	-	Native	H,B,BB
61	#*Ipomoea carnea* Jacq.	Convolvulaceae	Mati Kolmou	P	-	Exotic:Tropical America	H,B,BB
62	*Ipomoea purpurea* (L.) Roth	Convolvulaceae	-	Ch	-	Native	H,B,BB
63	*Ipomoea triloba* L.	Convolvulaceae	-	Ch	LC	Native	B
64	*Justicia adhatoda* L	Acanthaceae	Boga bahok	P	LC	Native	H
65	*Justicia gendarussa* Burm.f.	Acanthaceae	Tita bahek	P	-	Native	H, B,BB
66	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Pategoja	T	-	Native	H, B
67	#*Lantana camara* L.	Verbenaceae	Putush	P	-	Exotic:Tropical America	H,B,BB
68	*Leonurus sibiricus* L.	Lamiaceae	Ronga durun	T	-	Native	H, B, BB
69	*Lepidium didymum* L.	Brassicaceae	-	Ch	-	Native	H
70	*Leucas aspera* (Willd.) Link.	Lamiaceae	Doron bon	T	-	Native	H,B

71	*Limnophila sp*	Plantaginaceae	Aamsokola saak	T	LC	Native	H
72	#*Ludwigia adscendens* (L.) H.Hara	Onagraceae	Pani khutura	Hy	LC	Exotic: Tropical America	H
73	#*Ludwigia octovalvis* (Jacq.) P.H.Raven	Onagraceae	Bonoria long	T	LC	Exotic: Tropical Africa	BB
74	#*Ludwigia perennis* L.	Onagraceae	Pani Jolokia	T	-	Exotic:Tropical Africa	BB
75	*Mazus pumilus* (Burm.f.) Steenis	Mazaceae	Jhinuk phul	T	-	Native	H,B,BB
76	#*Mecardonia procumbens* (Mill.) Small	Plantaginaceae	-	T	-	Exotic:Tropical North America	H,B,BB
77	*Melastoma malabathricum* L.	Melastomataceae	Phutuka	P	-	Native	H,B,BB
78	#*Melochia corchorifolia* L.	Malvaceae	-	T	LC	Native	H, B
79	*Merremia hirta* (L.) Merr.	Convolvulaceae	Kolia lota	T	-	Native	H,B
80	#*Mesosphaerum suaveolens* (L.) Kuntze	Lamiaceae	Bilati Tulshi	T	-	Exotic:Tropical America	H,B
81	#*Mikania micrantha* Kunth	Asteraceae	Japani lota	Ch	-	Exotic:Tropical America	H,B,BB
82	# *Mimosa invisa* Mart. ex Colla	Fabaceae	Lajuki bon	T	-	Exotic: Brazil	H,B,BB
83	*Mimosa pudica* L.	Fabaceae	Lajuki bon	T	LC	Introduced	H,B,BB
84	*Mitracarpus hirtus* (L.) DC.	Rubiaceae	-	T	-	Native	H,B,BB
85	*Nelsonia canescens* (Lam.) Spreng.	Acanthaceae	-	Ch	LC	Native	B
86	#*Nicotiana plumbaginifolia* Viv.	Solanaceae	-	T	-	Exotic:Tropical America	H
87	#*Ocimum americanum* L.	Lamiaceae	Bon tulsi	T	-	Exotic: Tropical America	H, BB
88	*Oenanthe javanica* (Blume) DC.	Apiaceae	-	T	LC	Native	BB
89	*Oldenlandia corymbosa* L.	Rubiaceae	Bon jaluk	T	LC	Native	H,B,BB
90	#*Oxalis corniculata* L.	Oxalidaceae	Soru tengesi	T	-	Exotic:Europe	H,B,BB
91	*Oxalis debilis* Kunth	Oxalidaceae	Bor tengesi	T	-	Native	H,B,BB
92	*Paederia foetida* L.	Rubiaceae	Bhedailota	Ch	-	Native	H,B
93	#*Parthenium hysterophorus* L.	Asteraceae	Gajor ghaan	T	-	Exotic: Tropical North America	B
94	#*Peperomia pellucida* (L.) Kunth	Piperaceae	Ponownoa	Ch	-	Exotic: Tropical South	H,B,BB

						America	
95	*Persicaria chinensis* (L.) H.Gross	Polygonaceae	Modhusoleng	Ch	-	Native	H
96	*Persicaria hydropiper (L.)* Delarbre	Polygonaceae	Pothorua bihlongoni	T	LC	Native	H
97	*Persicaria lapathifolia* (L.) Delarbre	Polygonaceae	-	T	LC	Native	H, B, BB
98	*Persicaria perfoliata* (L.) H.Gross	Polygonaceae	Bagh asora	Ch	-	Native	H, B, BB
99	*Phaulopsis imbricata* (Forssk.) Sweet	Acanthaceae	-	T	-	Native	H,B
100	*Phlogacanthus thyrsiformis* (Roxb. ex Hardw.) Mabb.	Acanthaceae	Ronga bahek	P	-	Native	H,B
101	*Phyllanthus niruri* L.	Phyllanthaceae	Bon amlokhi	T	-	Native	H,B,BB
102	*Phyllanthus urinaria L.*	Phyllanthaceae	Bhui amlokhi	T	-	Native	H
103	*Physalis angulata* L.	Solanaceae	Pokmou	T	LC	Native	BB
104	#*Pilea microphylla* (L.) Liebm.	Urticaceae	-	T	-	Exotic: Tropical South America	H,B
105	*Piper sarmentosum* Roxb.	Piperaceae	-	Ch	-	Native	H
106	*Pogostemon auricularius* (L.) Hassk.	Lamiaceae	-	T	-	Native	H
107	*Pouzolzia zeylanica* (L.) Benn.	Urticaceae	Borali bokua	Ch	-	Native	H,B
108	*Pupalia lappacea* (L.) Juss.	Amaranthaceae	Bonxoth	T	LC	Native	H,B
109	*Ranunculus sceleratus* L.	Ranunculaceae	Saalkuori	T	LC	Native	BB
110	*Ricinus communis* L.	Euphorbiaceae	Era goch	P	LC	Native	H, B, BB
111	*Rorippa indica* (L.) Hiern	Brassicaceae	Bon horioh	T	-	Native	H, B, BB
112	*Rostellularia procumbens* (L.) Nees	Acanthaceae	Juron	Ch	-	Native	B,BB,H
113	*Rumex palustris* Sm.	Polygonaceae	Bon suka saak	T	LC	Exotic: Europe	BB
114	*Rungia pectinata* (L.) Nees.	Acanthaceae	Jokhini Bon	T	-	Native	H,B,BB
115	#*Scoparia dulcis* L.	Schrophulariaceae	Bon dhonia	Ch	-	Exotic: Tropical America	H,B,BB
116	#*Senna alata* (L.) Roxb.	Fabaceae	Khorpat	T	LC	Exotic: West Indies	H,B
117	#*Senna occidentalis* (L.) Link	Fabaceae	Medeluwa	T	LC	Exotic:Tropical South America	H,B,BB
118	#*Senna tora* (L.) Roxb.	Fabaceae	Bon	T	-	Inroduced	H,B

			medeluwa				
119	#*Sida acuta* Burm.f.	Malvaceae	Son borial	T	-	Exotic: Trop. America	BB
120	*Sida cordifolia* L.	Malvaceae	Son borial	T	-	Native	BB
121	*Sida rhombifolia* L.	Malvaceae	Soru sonborial	T	-	Native	H,B,BB
122	*Solanum aculeatissimum* Jacq.	Solanaceae	Kotahi bengena	T	-	Native	H,B,BB
123	*Solanum lasiocarpum* Dunal	Solanaceae	Bhot begena	T	LC	Native	H, BB, B
124	*Solanum nigrum* L.	Solanaceae	Latkochu	T	-	Native	H,B,BB
125	*Solanum sisymbriifolium* Lam.	Solanaceae	Birkuli Tita	T	-	Native	H,B,BB
126	#*Solanum torvum* Sw.	Solanaceae	Hati bhekuri	T	-	Exotic: West Indies	B, BB
127	*Spermacoce alata* Aubl.	Rubiaceae	Gahori bon	Ch	-	Native	H,B,BB
128	*Spermacoce hispida* L.	Rubiaceae	Gahori bon	Ch	-	Native	H, B,BB
129	*Spermacoce ocymoides* Burm.f.	Rubiaceae	Gahori bon	Ch	-	Native	H,B,BB
130	*Sphagneticola trilobata* (L.) Pruski	Asteraceae	Maha bhringaraj	Ch	-	Native	H, B, BB
131	*Stachytarpheta indica* (L.) Vahl	Verbenaceae	-	T	LC	Exotic: Trop. America	H
132	*Stellaria media* (L.) Vill.	Caryophyllaceae	Morolia sak	T	-	Native	H
133	#*Synedrella nodiflora* (L.) Gaertn	Asteraceae	-	T	-	Exotic: West Indies	H
134	*Thunbergia alata* Bojer ex Sims	Acanthaceae	-	Ch	-	Exotic: East Africa	B
135	*Thunbergia fragrans* Roxb.	Acanthaceae	-	Ch	-	Native	H,B
136	*Torenia bicolor* Dalzell	Linderniaceae	Toroni bon	T	LC	Native	H,B
137	*Torenia crustacea* (L.) Cham. & Schltdl.	Linderniaceae	Kasidoria	T	LC	Native	H,B
138	#*Tridax procumbens* L.	Asteraceae	Kurkuri bon	T	-	Inroduced	H
139	#*Triumfetta rhomboidea* Jacq.	Malvaceae	Bon Agora	T	-	Exotic: Trop. America	H,B
140	#*Urena lobata* L.	Malvaceae	Son boroluwa	T	LC	Exotic: Trop. Africa	H,B,BB
141	*Urena lobata subsp. sinuata* (L.) Borss.Waalk.	Malvaceae	Bon bhendi	T	-	Native	H
142	*Viola sp*	Violaceae	-	T	-	Native	BB

143	#*Xanthium strumarium* L.	Asteraceae	Ogora	T	-	Exotic:Trop. America	H,B,BB
144	#*Youngia japonica* (L.) DC.	Asteraceae	-	T	-	Exotic: Trop. South America	H

Table 3 : Composition of monocot weed species in the selected gardens under study

Sl No.	Scientific Name	Family	Life form	Assamese Name	IUCN status	Exotic/ Native	Garden Name
1	*Axonopus compressus* (Sw.) P. Beauv.	Poaceae	Ch	Jangli ghila	LC	Native	H,B,BB
2	*Caladium bicolor* (Aiton) Vent.	Araceae	T	Kosu	-	Native	H,B,BB
3	*Calla palustris* L.	Araceae	Hy	-	LC	Exotic:North America, Europe	H,B, BB
4	# *Cenchrus purpureus* (Schumach.) Morrone	Poaceae	T	Haatikutha	LC	Exotic : Tropical America	H
5	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Ch	Bonguti	-	Native	H,B,BB
6	*Coix lacryma-jobi* L.	Poaceae	T	Kauramoni	-	Native	H, B
7	*Colocasia esculenta* (L.) Schott	Araceae	T	Kosu	-	Native	H,B,BB
8	*Commelina benghalensis* L.	Commelinaceae	Ch	Kona simolu	LC	Native	H,B,BB
9	*Cymbopogon nardus* (L.) Rendle	Poaceae	H	Chitronella	-	Native	H,B,BB
10	*Cynodon dactylon* (L) Pers.	Poaceae	Ch	Dubori bon	-	Native	H,B,BB
11	*Cyperus brevifolius* (Rottb.) Hassk.	Cyperaceae	T	Keya bon	LC	Native	H,B,BB
12	*Cyperus rotundus* L.	Cyperaceae	T	Mutha bon	LC	Native	H,B,BB
13	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	T	Kakpod ghaan	-	Native	H,B,BB
14	*Digitaria ciliaris* (Retz.) Koeler	Poaceae	T	Aarala ghan	-	Native	H,B,BB
15	#*Echinochloa colona* (L.) Link	Poaceae	T	Binoi bon	LC	Exotic : Tropical South America	H, BB
16	*Echinochloa crus-galli* (L.) P.Beauv.	Poaceae	T	-	LC	Native	B
17	*Eleusine indica* (L.) Gaertn.	Poaceae	T	Bobosa bon	-	Native	H,B,BB

18	*Eragrostis tenella* (L.) P.Beauv. ex Roem. & Schult.	Poaceae	T	-	-	Native	H,B,BB
19	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Poaceae	T	-	LC	Native	B, BB
20	*Floscopa scandens* Lour.	Commelinaceae	T	Kona shimolu	LC	Native	H
21	*Hellenia speciosa* (J.Koenig) S.R.Dutta	Costaceae	H	Jom lakhuti	LC	Native	B
22	#*Imperata cylindrica* (L.) Raeusch.	Poaceae	H	Ulu, kher	-	Exotic: Tropical America	H,B,BB
23	*Murdannia nudiflora*(L.) Brenan	Commelinaceae	T	Kandoli	-	Native	H,B,BB
24	*Oplismenus compositus* (L.) P.Beauv.	Poaceae	T	Sor ghaan	LC	Native	H,B,BB
25	*Paspalum conjugatum* P.J.Bergius	Poaceae	T	Sor bon	LC	Native	H,B,BB
26	*Paspalum scrobiculatum* L.	Poaceae	T	Kodo bajra	LC	Native	BB
27	#*Pistia stratiotes* L.	Aracaeae	Hy	Borpuni	LC	Native	H,B,BB
28	*Polytrias indica* (Houtt.) Veldkamp	Poaceae	T	Korakol ghan	LC	Native	BB
29	#*Pontederia crassipes* Mart.	Pontederiaceae	Hy	Bih meteka	-	Exotic: Tropical America	H,B,BB
30	#*Saccharum spontaneum* L.	Poaceae	H	Kohua	LC	Exotic: Tropical West Asia	H,B,BB
31	*Sagittaria latifolia* Willd.	Alismataceae	Hy	Pani kochu	LC	Exotic: Tropical North America	B
32	*Setaria palmifolia* (J.Koenig) Stapf	Poaceae	T	Bisa Bon	-	Native	H,B
33	*Setaria pumila* (Poir.) Roem. & Schult.	Poaceae	T	Shial nejia bon	-	Native	H,B,BB
34	*Tripsacum laxum* Nash	Poaceae	H	-	LC	Exotic: South America	H,B,BB

Table 4: Composition of pteridophytic weed species in the selected gardens under study

Sl No	Scientific Name	Family	IUCN status	Exotic/ Native	Garden Name
1	*Adiantum philippense* L.	Pteridaceae	-	Native	H,BB
2	*Dicranopteris linearis* (Burm.f.) Underw.	Gleicheniaceae	Least concern (LC)	Native	H,B,BB
3	*Diplazium esculentum* (Retz.) Sw.	Aspleniaceae	Least concern (LC)	Native	H,B,BB
4	*Lygodium flexuosum* (L.) Sw.	Schizaeaceae	-	Native	H,B,BB
5	*Marsilea quadrifolia* L.	Marsiliaceae	Least concern (LC)	Exotic: Europe	H
6	*Microlepia speluncae* (L.)T.Moore	Dennstaedtiaceae	-	Native	H,B,BB
7	*Pityrogramma calomelanos* (L.) Link.	Pteridaceae	-	Exotic: South America	BB
8	*Pteris semipinnata* L.	Pteridaceae	-	Native	H,B,BB
9	*Pteris vittata* L.	Pteridaceae	Least concern (LC)	Native	H,B,BB
10	*Thelypteris palustris* Schott	Aspleniaceae	Least concern (LC)	Exotic: Europe	H,B,BB

Abbreviations used: Garden Names:H-Hatikhuli Tea Estate, B- Banaspaty Tea Estate, BB-Borbam Tea Estate
Life forms: P- Phanerophytes,T- Therophytes, Ch- Chamaerophytes, H- Hemicryptophytes, Hy- Hydrophytes
IUCN status : LC- Least Concern
 # - Invasive alien species

Table 5: A comparative analysis of the weed species found in organic and conventional gardens during quadrate study.

ORGANIC GARDENS							
		HATIKHULITE (Organic Division)			BANASPATYTE		
Sl no	Scientific Name	S*	M*	W*	S*	M*	W*
1	*Achyranthes aspera*	+	+	+	+	+	-
2	*Acmella paniculata*	-	+	+	-	-	-
3	*Ageratum conyzoides*	+	+	+	+	+	+
4	*Ageratum houstonianum*	+	+	+	+	+	+
5	*Alternanthera philoxeroides*	+	+	+	-	-	+
6	*Alternanthera sessilis*	+	+	-	-	-	-
7	*Amaranthus spinosus*	+	+	-	-	-	+
8	*Amaranthus viridis*	+	+	-	-	-	+
9	*Axonopus compressus*	+	+	+	+	+	+
10	*Bidens pilosa*	+	-	-	+	+	+
11	*Cardamine hirsuta*	-	+	-	-	-	-
12	*Centella asaiatica*	+	-	-	+	+	+
13	*Chromolaena odorata*	+	-	+	+	+	-
14	*Chrysopogon aciculatus*	+	+	-	+	+	+
15	*Cleome rutidosperma*	+	+	+	+	+	-
16	*Clerodendrum infortunatum*	+	+	+	+	+	+
17	*Coccinea grandis*	+	+	-	-	-	-
18	*Colocasia esculenta*	+	+	+	+	+	+
19	*Commelina benghalensis*	+	+	-	+	+	-
20	*Crassocephalum crepidiodes*	+	+	-	-	-	-

CONVENTIONAL GARDENS							
		HATIKHULITE (Rangajan Division)			BORBAMTE		
Sl no	Scientific Name	S*	M*	W*	S*	M*	W*
1	*Ageratum conyzoides*	+	+	+	+	+	+
2	*Alternanthera philoxeroides*	+	-	-	-	-	-
3	*Alternanthera sessilis*	-	-	+	-	+	-
4	*Amaranthus spinosus*	-	-	+	-	-	-
5	*Amaranthus viridis*	-	-	+	-	-	+
6	*Axonopus compressus*	-	+	-	+	+	+
7	*Cardamine hirsuta*	+	+	-	-	-	-
8	*Centella asiatica*	+	+	+	-	-	-
9	*Chromolaena odorata*	+	+	-	+	+	-
10	*Chrysopogon acicularis*	-	-	-	+	+	-
11	*Cleome rutidosperma*	+	+	+	-	-	-
12	*Clerodendrum infortunatum*	-	-	+	-	-	-
13	*Coccinea grandis*	-	-	+	-	-	-
14	*Colocasia esculenta*	-	-	-	+	+	+
15	*Commelina benghalensis*	-	-	+	-	-	-
16	*Crassocephalum crepidioides*	-	-	-	+	+	+
17	*Cuphea procumbens*	-	-	-	+	+	+
18	*Cyanthillium cinereum*	-	-	-	+	+	+
19	*Cyperus brevifolius*	-	+	+	-	-	-
20	*Cyperus rotundus*	-	-	-	+	+	-
21	*Dicranopteris linearis*	-	-	-	+	+	-

21	*Crotolaria pallida*	+	+	-	+	+	-
22	*Cuphea procumbens*	+	+	+	+	+	-
23	*Cyanthillium cinereum*	+	+	+	+	+	+
24	*Cynodon dactylon*	+	+	-	+	+	-
25	*Cyperus brevifolius*	+	+	-	+	+	-
26	*Cyperus rotundus*	+	+	+	+	+	+
27	*Diplazium esculentum*	+	+	+	+	+	+
28	*Drymaria diandra*	+	+	+	+	+	-
29	*Eleusine indica*	+	+	+	+	+	+
30	*Emilia sonchifolia*	-	-	+	-	-	-
31	*Eragrostis tenella*	-	-	+	-	-	-
32	*Euphorbia hirta*	+	+	+	+	+	+
33	*Evolvulus nummularius*	-	+	+	-	+	+
34	*Grona triflora*	+	+	+	+	+	-
35	*Hydrocotyle sibthorpioides*	-	-	+	-	-	-
36	*Lantana camara*	+	+	-	+	+	+
37	*Leucas aspera*	-	-	+	-	-	+
38	*Lygodium flexuosum*	-	+	+	-	-	-
39	*Mecardonia procumbens*	-	+	+	-	+	+
40	*Mesosphaerum suaveolens*	-	-	+	-	-	-
41	*Microlepia speluncae*	+	+	-	+	+	-
42	*Mikania micrantha*	+	+	+	+	+	-
43	*Mimosa pudica*	+	+	+	+	+	+
44	*Mitracarpus hirtus*	-	+	+	+	+	+
45	*Murdannia nudiflora*	-	+	-	-	-	-
46	*Oplismenus compositus*	+	+	-	+	+	-
47	*Oxalis corniculata*	+	+	+	+	+	+
48	*Oxalis debilis*	+	+	+	+	+	+
49	*Parthenium hysterophorus*	+	+	+	+	+	+

22	*Digitaria ciliaris*	-	-	-	+	+	+
23	*Echinochloa colona*	-	-	-	-	+	-
24	*Eleusine indica*	+	+	+	+	+	+
25	*Eragrostis tenella*	+	+	-	-	+	-
26	*Euphorbia hirta*	-	+	-	-	-	-
27	*Evolvulus nummularius*	+	+	+	-	-	-
28	*Gamochaeta pensylvanica*	-	+	-	-	-	-
29	*Hydrocotyle sibthorpioides*	-	+	+	-	-	+
30	*Impatiens tripetala*	-	-	-	+	+	+
32	*Leucas aspera*	-	+	-	-	-	-
33	*Ludwigia perennis*	-	-	-	-	+	-
34	*Mazus pumilus*	+	+	-	-	-	-
35	*Mecardonia procumbens*	+	+	-	-	-	-
36	*Melastoma malabathricum*	-	-	-	-	-	+
37	*Microlepia speluncae*	-	+	+	-	-	-
38	*Mikania micrantha*	+	-	-	+	+	+
39	*Mimosa pudica*	+	-	-	+	+	+
40	*Mitracarpus hirtus*	+	-	-	-	-	-
41	*Oldenladia corymbosa*	+	-	-	-	-	-
42	*Oplismenus compositus*	-	-	-	+	+	-
43	*Oxalis corniculata*	+	+	-	-	+	+
44	*Oxalis debilis*	+	+	+	-	-	-
45	*Paspalum conjugatum*	-	-	-	-	-	+
46	*Peperomia pellucida*	-	+	+	-	-	-
47	*Phyllanthus niruri*	-	-	-	-	-	-
48	*Pilea microphylla*	-	+	-	-	-	-
31	*Polytrias indica*	-	-	-	+	+	+
49	*Pteris semipinnata*	-	+	+	-	-	-
50	*Rungia pectinata*	-	+	+	-	-	-
51	*Scoparia dulcis*	+	+	-	-	-	-

50	*Paspalum conjugatum*	+	+	-	+	+	-
51	*Peperomia pellucida*	+	+	-	+	+	-
52	*Persicaria hydropiper*	+	-	+	+	-	-
53	*Phyllanthus niruri*	+	+	+	+	-	-
54	*Pouzolzia zeylanica*	+	+	+	+	+	-
55	*Pteris semipinnata*	+	+	+	+	+	+
56	*Pupalia lappacea*	+	+	+	-	+	-
57	*Rostellularia procumbens*	-	+	+	-	-	-
58	*Rungia pectinata*	-	+	+	-	-	-
59	*Saccharum spontaneum*	-	+	+	-	+	+
60	*Scoparia dulcis*	+	+	+	+	+	-
61	*Senna alata*	-	+	+	-	-	-
62	*Senna occidentalis*	+	+	+	-	-	-
63	*Setaria pumila*	-	+	-	+	+	-
64	*Sida acuta*	+	+	+	-	+	+
65	*Solanum aculeatissimum*	+	+	+	+	+	+
66	*Solanum nigrum*	+	+	-	+	+	-
67	*Spermacoce alata*	-	+	+	-	+	+
68	*Spermacoce ocymoides*	-	+	+	-	-	-
69	*Stachytarpheta indica*	+	+	-	-	-	-
70	*Synedrella nodiflora*	-	+	+	-	+	+
71	*Thelypteris palustris*	+	+	+	+	+	+
72	*Torenia crustacea*	-	+	-	-	-	-
73	*Tridax procumbens*	+	-	-	-	+	-
74	*Triumfetta rhomboidea*	-	-	-	-	+	-
75	*Urena lobata*	+	+	+	-	-	-
	Total no of species	53	64	50	43	50	32

52	*Setaria palmifolia*	-	-	-	+	+	-
53	*Setaria pumila*	+	-	-	-	-	+
54	*Solanum aculeatissimum*	+	+	-	-	-	-
55	*Spermacoce alata*	-	-	+	+	+	-
56	*Spermacoce ocymoides*	+	+	+	-	-	-
57	*Stellaria media*	-	+	-	-	-	-
58	*Thelypteris palustris*	-	+	-	-	-	-
59	*Torenia crustacea*	+	+	+	-	-	-
60	*Triumfetta rhomboidea*	-	-	-	-	-	+
61	*Urena lobata*	-	-	-	+	+	-
		22	29	21	20	25	19

S*- Summer , M*- Monsoon , W*- Winter

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DECLARATION

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PLANT REPRODUCIBILITY: All plant specimens were collected from different tea gardens of Assam and were identified by Dr Chandra Ghosh (Taxonomist), Associate Professor, Department of Tea Science, University of North Bengal, West Bengal and the specimens were submitted in the Index Herbarium of Tea Science Department at University of North Bengal (NBUTSH). A separate table containing the details of all plant specimens, herbarium and accession number are provided in a supplementary file.

ORCID

Chandra Ghosh https://orcid.org/0000-0001-6120-1963
Sarbani Roy https://orcid.org/0000-0002-6691-0125
Somnath Roy https://orcid.org/0000-0003-2454-0178
Venkatesan Selvaraj https://orcid.org/0009-0001-2379-9703

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