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Phytosociology of Weeds in Tea Plantations of South India

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ABSTRACT

Phytosociological studies of the weed flora of tea plantations in south India were carried out to generate information that could assist in identifying important and recalcitrant weeds during different seasons and in various situations which in turn should help in formulating effective measures for their control. One hundred and twelve weed species were found to occur in the tea fields of south India during the rainy seasons (June to December). The weed flora during the rainy season was dominated by *Drymaria cordata, Bidens pilosa, Ageratum conyzoides, Crassocephalum crepidioides* and *Spermacoce ocymoides.* During the dry season (January to March) only 34 weed species were recorded and the dominant weed species were *Conyza leucantha, Conyza bonariensis, Ageratum conyzoides, Panicum repens* and *Paspalum conjugatum.* Tea fields adjacent to human habitats favoured the growth of *Drymaria cordata, Amaranthus viridis, A. spinosus, Rorippa dubia* and *Persicaria barbata. Panicum repens, Paspalum conjugatum, Axonopus compressus* and *Cyperus rotundus* were the dominant weeds in tea fields adjoining water sources. Tea fields bordering forest boundaries had *Persicaria chinensis, Chromolaena odorata, Pteridium aquilinum, Mikania cordata* and *Urena lobata.*

Key words : Soil type, weed flora, cultivation practices, weed survey

INTRODUCTION

Weed flora and its composition in a crop/ region is influenced by the type of cultivar, time or season of cultivation, spacing, soil type, soil pH, climatic conditions such as rainfall, temperature, cultivation practices like irrigation, tillage systems, application of fertilizers and weed management practices (Savedra *et al*., 1990; Kolar and Mehra, 1992). In south India, tea is grown in western ghats at elevations ranging between 600 and 2200 m, having typical tropical to sub-tropical climatic conditions with an annual precipitation of 1150 to 8000 mm and temperatures ranging between eight and 35^{0}C. The soil pH ranges between 4.0 and 6.0. These conditions also promote the growth of a wide array of weed species. A study was undertaken to categorise the weed species occurring in tea fields of south India based on their occurrence in different seasons, various habitats such as fields adjacent to human habitats, forest boundaries and water sources. Information on their abundance, density and frequency will help in assessing the changing importance of different species in different seasons and situations, which in turn, aid in identifying important species requiring concerted efforts for their control.

MATERIALS AND METHODS

The area under study lies between 8.0^O and 13.0^{O}N and 75.0^O and 78.0^O E, in the western ghats in south India. Tea plantation districts of Anamallais, Central Travancore, High Range, Nilgiris, Nilgiri-Wynaad and Wynaad falling in Tamil Nadu and Kerala were chosen for the study. Tea estates situated in these regions were surveyed for collection and documentation of the weeds.

The following regional floras were consulted for the identification of the weed species as a first step : 1. The Flora of the Presidency of Madras (Gamble and Fischer, 1915-1936), 2. The Flora of the Tamil Nadu Carnatic (Matthew, 1983), 3. The Flora of south Indian Hill Stations (Fyson, 1932) and 4. The Flora of the Nilgiri and Pulney Hill Tops (Fyson, 1915-1920). The following check lists were also consulted. 1. Flora of Tamil Nadu (Hendry *et al*., 1987), 2. The Survey of the Flora of the Anamallai Hills in the Coimbatore District, Madras Presidency (Fischer, 1921) and three studies on the Vascular Flora of the Anaimudi and the surrounding regions (Shetty and Vivekanandan, 1971). The identification of the weed specimens was confirmed by comparing them with the herbarium available at the Madras Herbarium, Botanical Survey of India, Southern Circle, Coimbatore, Tamil Nadu, India.

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Quadrates of the size of 10 m^2 were laid out at random, once in a month in different locations of the tea fields. The weed species occurring within the quadrates were recorded till the total number of weed species became constant and their abundance, density and frequency were calculated as per the following formulae (Sharma, 1995) :

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all the quadrates}}{\text{Number of quadrates in which the species occurred}}$$

$$\text{Density} = \frac{\text{Total number of individuals of the species in all the quadrates}}{\text{Total number of quadrates studied}}$$

$$\text{Frequency} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrates studied}} \times 100$$

The data obtained from all the estates surveyed were pooled and the mean was calculated.

RESULTS AND DISCUSSION

Phytosociological Analysis of Weed Species Occurring in Rainy Seasons (June to December)

Abundance, density and frequency of the following species occurring in rainy seasons are presented in Table 1. *Drymaria cordata* is the dominant species followed by *Bidens pilosa*, *Ageratum conyzoides*, *Crassocephalum crepidioides*, *Spermacoce ocymoides*, *Mitracarpus villosus*, *Conyza bonariensis*, *Galinsoga parviflora*, *Spermacoce latifolia*, *Persicaria nepalensis* and *Mecardonia procumbens* in that order. Adequate soil moisture in conjunction with favourable relative humidity and temperature regimes from June to November favoured the growth of a wide variety of weed species in large numbers. Most of the annuals such as *Drymaria cordata, Bidens pilosa, Ageratum conyzoides*, *Crassocephalum crepidioides*, *Mitracarpus villosus, Spermacoce ocymoides* and *S. latifolia* occurring in rainy seasons complete their life cycle before the onset of drought.

Phytosociological Analysis of Weed Species Occurring in Dry Season (January to March)

During dry season, *Conyza leucantha* is dominant followed by *Spilanthes calva*, *Pteridium aquilinum*, *Panicum repens*, *Paspalum conjugatum*, *Axonopus compressus*, *Ipomoea nil*, *Bidens pilosa*, *Ageratum conyzoides* and *Justicia simplex* (Table 2). Reduced moisture availability, wide amplitude between mean minimum and maximum temperatures and low relative humidity prevailing during dry season led to a narrowing of weed species, as also, reduction in their numbers. Most of the species occurring in dry season were perennials, some of which were shrubby; many of these species like *Ageratum conyzoides, Axonopus compressus, Bidens pilosa, Conyza bonariensis, C. leucantha, Ipomoea nil, Justicia simplex, Lantana camara, Panicum repens, Pteridium aquilinum, Solanum surattense, S. torvum* and *Urena lobata* have some hairy growth called indumentum on their foliage as a protection against adverse climatic conditions. The perennial dicotyledons, rhizomatous monocotyledons and pteridophytes, namely, *Achyranthes aspera, Chromolaena odorata, Ipomoea nil, Mikania cordata, Persicaria chinensis, Sida acuta, Stephania japonica, Axonopus compressus, Cynodon dactylon, Panicum repens, Paspalum conjugatum, Dicranopteris linearis* and *Pteridium aquilinum* survived through drought season. Germination of *Conyza leucantha* and *Spilanthes calva* was found to be high in November/December than in any other months, resulting in the dominance of these two species during the following dry season. Grass species such as *Axonopus compressus, Cynodon dactylon, Panicum repens* and *Paspalum conjugatum* also survived during the dry season alongwith the fern *Pteridium aquilinum* because of their rhizomatous/ stoloniferous stems.

Phytosociological Analysis of Weed Species Occurring in Tea Fields Adjoining Human Habitats

Tea fields adjacent to human habitats supported the growth of *Drymaria cordata, Amaranthus viridis, A. spinosus, Rorippa dubia, Persicaria barbata, Ipomoea nil, Solanum torvum, S. nigrum, Sonchus oleraceus* and *S. surattense* exhibiting abundance, density and frequency in declining order (Table 3). *Drymaria cordata* with its sticky fruits was predominant in human habitations

Table 1. Phytosociological analysis of top 30 weed species occurring in rainy seasons (June to December)

S. No.	Weed species	Abundance (No./10 m^2)	Density (No./10 m^2)	Frequency (%)
1.	*Drymaria cordata* (L.) Roemer ex Schultes	174.2	140.8	92.4
2.	*Bidens pilosa* L.	66.3	60.0	82.6
3.	*Ageratum conyzoides* L.	53.2	50.8	80.1
4.	*Crassocephalum crepidioides* (Benth.) S. Moore	42.3	40.0	78.3
5.	*Spermacoce ocymoides* Burm. f.	30.2	27.1	80.3
6.	*Conyza bonariensis* (L.) Cronq.	25.0	22.5	73.8
7.	*Mitracarpus villosus* (Sw.) DC.	22.1	19.4	75.7
8.	*Galinsoga parviflora* Cav.	17.5	16.9	75.1
9.	*Spermacoce latifolia* (Aublet) Schum.	14.4	13.5	62.2
10.	*Persicaria nepalensis* (Meissn.) Gross	12.6	11.4	60.5
11.	*Mecardonia procumbens* (Mill.) Small	11.3	10.1	55.3
12.	*Commelina clavata* C. B. Clarke	11.0	10.8	20.7
13.	*Justicia simplex* D. Don	10.4	9.2	50.7
14.	*Cyanotis cristata* (L.) D. Don	10.1	9.1	20.5
15.	*Oxalis latifolia* Kunth	9.8	8.4	35.1
16.	*Panicum repens* L.	9.6	8.2	23.6
17.	*Oxalis corniculata* L.	9.0	8.1	30.1
18.	*Paspalum conjugatum* Berg.	6.9	5.8	20.4
19.	*Digitaria ciliaris* (Retz.) Koeler	6.4	5.5	19.6
20.	*Emilia sonchifolia* (L.) DC.	6.0	5.3	20.5
21.	*Axonopus compressus* (Sw.) P. Beauv.	5.2	4.4	18.8
22.	*Centella asiatica* (L.) Urban	5.0	4.1	50.5
23.	*Eleusine indica* (L.) Gaertner	4.0	3.3	6.2
24.	*Gnaphalium polycaulon* Pers.	2.5	1.9	22.0
25.	*Conyza leucantha* (D. Don) Ludlow & Raven	2.4	1.8	56.5
26.	*Cynodon dactylon* (L.) Pers.	2.0	1.7	15.6
27.	*Pteridium aquilinum* (L.) Kuhn ex Decken	1.8	1.5	5.0
28.	*Indigofera spicata* Forsskal	1.5	1.2	14.8
29.	*Digitaria longiflora* (Retz.) Pers.	1.4	1.2	14.6
30.	*Persicaria chinensis* (L.) Gross	1.3	1.0	14.3

Table 2. Phytosociological analysis of top 20 weed species occurring in dry season (January to March)

S. No.	Weed species	Abundance (No./10 m^2)	Density (No./10 m^2)	Frequency (%)
1.	*Conyza leucantha*	49.0	47.3	90.0
2.	*Conyza bonariensis*	47.0	35.7	86.0
3.	*Ageratum conyzoides*	49.0	35.9	85.0
4.	*Panicum repens*	38.0	35.1	25.0
5.	*Paspalum conjugatum*	35.0	25.9	20.0
6.	*Axonopus compressus*	35.0	24.9	18.0
7.	*Ipomoea nil*	22.0	10.7	75.0
8.	*Bidens pilosa*	20.0	10.0	74.0
9.	*Pteridium aquilinum*	18.0	7.9	60.0
10.	*Justicia simplex*	10.0	6.8	59.0
11.	*Cynodon dactylon*	9.7	5.8	16.0
12.	*Sida acuta*	6.5	4.0	50.0
13.	*Stephania japonica*	5.4	3.8	45.0
14.	*Paspalum scrobiculatum*	5.1	3.8	15.0
15.	*Achyranthes aspera*	4.7	3.8	38.0
16.	*Mikania cordata*	4.5	3.3	25.0
17.	*Mitracarpus villosus*	4.1	3.1	25.0
18.	*Polygonum chinensis*	4.0	3.0	16.0
19.	*Phyllanthes debilis*	3.8	2.8	15.9
20.	*Eleusine indica*	3.4	2.7	13.8

Table 3. Phytosociological analysis of top 10 weed species occurring in tea fields adjoining human habitats

S. No.	Weed species	Abundance (No./10m^2)	Density (No./10m^2)	Frequency (%)
1.	*Drymaria cordata*	121.5	115.0	80.1
2.	*Amaranthus viridis*	50.2	48.5	78.0
3.	*A. spinosus*	42.5	40.0	72.0
4.	*Rorippa dubia*	35.5	31.0	58.4
5.	*Persicaria barbata*	32.0	26.5	57.8
6.	*Ipomoea nil*	23.0	19.5	42.3
7.	*Solanum torvum*	14.3	11.5	24.8
8.	*S. nigrum*	11.4	8.4	22.4
9.	*Sonchus oleraceus*	10.1	7.2	10.3
10.	*Solanum surratense*	9.6	6.6	9.1

because of its nature of dissemination. The species like *Amaranthus viridis, Solanum torvum* and *S. nigrum* which were once cultivated as useful food species have now occupied ranking position in the weed flora of tea fields adjoining human habitations. *Ipomoea nil* which was earlier cultivated as an ornamental now grows wild adjoining the labour lines; others like *Amaranthus spinosus, Rorippa dubia, Persicaria barbata* and *Sonchus oleraceus* were known common garden weeds.

Phytosociological Analysis of Weed Species Occurring in Tea Fields Adjoining Water Sources

Tea fields contiguous to waterlogged areas, swamps, reservoirs, streams and rivers sustained the growth of *Panicum repens* as the dominant species followed by *Paspalum conjugatum, Axonopus compressus, Cyperus rotundus, Drymaria cordata, Kyllinga nemoralis, Hydrocotyl sibthorpioides, H. javanica* and *Plantago major* (Table 4). Different rhizomatous/stoloniferous grasses like *Panicum repens, Paspalum conjugatum,* sedges like *Cyperus rotundus* and *Kyllinga nemoralis* and runners like *Hydrocotyl sibthorpioides* and *H. javanica* generally known to be tolerant to water stagnation hence were found to be predominant in the fields adjoining water sources. A similar pattern was reported in tea fields of Assam (Chakravartee, 1994).

Phytosociological Analysis of Weed Species Occurring in Tea Fields Adjoining Forest Boundaries

Tea fields bordering forests have been found to be predominantly infested with *Persicaria chinensis, Chromolaena odorata, Pteridium aquilinum, Mikania cordata, Urena lobata, Lantana camara, Solanum torvum, Sida acuta, Ageratum conyzoides* and *Shutaria involucrata* in declining order (Table 5). The species that normally occur as undergrowth in tropical forests invade tea fields adjoining forests and become dominant

Table 4. Phytosociological analysis of top 10 weed species occurring in tea fields adjoining water sources

S. No.	Weed species	Abundance (No./10 m^2)	Density (No./10 m^2)	Frequency (%)
1.	*Panicum repens*	161.5	162.0	94.0
2.	*Paspalum conjugatum*	76.5	70.6	91.3
3.	*Axonopus compressus*	65.4	51.0	88.4
4.	*Paspalum scobiculatum*	52.3	45.4	75.2
5.	*Cyperus rotundus*	50.0	37.3	84.2
6.	*Drymaria cordata*	43.1	33.5	63.8
7.	*Kyllinga nemoralis*	32.6	21.2	80.6
8.	*Hydrocotyl sibthorpioides*	27.2	20.0	38.1
9.	*H. javanica*	16.3	12.7	30.8
10.	*Plantago major*	15.0	10.6	35.0

Table 5. Phytosociological analysis of top 10 weed species occurring in tea fields adjoining forest boundaries

S. No.	Weed species	Abundance (No./10 m^2)	Density (No./10 m^2)	Frequency (%)
1.	*Persicaria chinensis*	115.5	110.0	76.2
2.	*Chromolaena odorata*	112.0	109.0	72.5
3.	*Pteridium aquilinum*	94.5	98.0	60.8
4.	*Mikania cordata*	81.5	87.5	55.3
5.	*Urena lobata*	78.5	81.5	52.4
6.	*Lantana camara*	51.0	47.5	47.3
7.	*Solanum torvum*	46.5	44.0	26.2
8.	*Sida acuta*	37.0	25.5	18.4
9.	*Ageratum conyzoides*	33.5	20.0	12.2
10.	*Shuteria involucrata*	25.0	19.0	9.8

there (Shetty and Vivekanandan, 1971). Most of the dominant weed species in tea fields along the forest boundaries were found to be perennial shrubs except *Ageratum conyzoides, Chromolaena odorata* and *Mikania cordata;* the spread of other species far into the tea fields was rather restricted because of the less efficient dissemination of their propagules.

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