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CHANGING PATTERN OF THE FLORA VIS-À-VIS TEA CULTIVATION IN UTTARAKHAND HILLS

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ABSTRACT

This communication outlines the influence of tea cultivation on the change in vegetation through summer, winter and rainy season in tea gardens and adjoining non-tea areas in Uttarakhand hills. A total of 184 genera (57 families) grow in summer, 263 genera (73 families) in rainy season and 211 genera (57 families) in winter. Weed species such as Ageratum *conyzoides, Chrysanthellum americanum, Crassocephalum* crepidioides and others grow abundantly in tea gardens, which are otherwise uncommon in the native flora adjoining the tea gardens. These species may invade the adjacent areas and change the composition of native flora that could lead to ecological consequences such as alteration of natural habitat, elimination of native species and a change in pollinators' populations. Some of the habitats ideal for medicinal herbs have been brought under tea cultivation. The adverse impact on insect pollination and soil fauna is emphasized due to the use of pesticides in tea gardens.

Key words: Uttarakhand hills; tea gardens; habitats; influence of tea cultivation

INTRODUCTION

The history of tea gardens in the Uttarakhand is as old as the commencement of its commercial cultivation in India in 1834/35. There were a total of 63 tea gardens in Uttarakhand up to 1880 and were spread over an area of 4375 ha, registering a production of about 770270 kg by 1897 (Joshi, 1995). Tea industry collapsed over the years due to several reasons (Negi and Agrawal, 2005). In 1995-96, Government of India promoted this activity again in Uttarakhand hills. In a few places it has now become an important land management activity for income and employment-generation. Uncultivated wasteland is put under tea cultivation to solve the problem of ever-increasing wasteland and also, to help the locals to earn their livelihood from these otherwise unutilized/underutilized wastelands. So far, approximately 500 ha land has been put under tea cultivation in Uttarakhand hills and it is proposed to further increase tea plantations by 7000 ha (Uttarakhand Tea Development Board, Almora, 2006).

One of the major concerns in the biodiversity-rich tropical lands is the impact of large-scale intensive agriculture, such as tea farming. Tea necessitates the use of a lot of pesticides; it is, hence, likely to have a direct impact on one of the earth's important endemic biodiversity. For instance, introduction of tea in Sri Lanka in 1867 brought about large scale changes in the landscape of central mountain region of the country (Illukpitiya *et al.*, 2004). Tea is often singled out as the greatest threat to tropical montane ecosystems, especially to lower organisms including amphibians (Daniels, 1991). Since tea grows best in humid, biodiversity-rich parts of the world, it attracts a large number of pests; over 300 species of arthropods, 58 species of fungi and 130 species of plants infest tea fields in India, necessitating continuous application of heavy doses of pesticides (Muraleedharan and Selvasundaram, 1996). In the tea gardens of

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Western Ghats, Kumara *et al.* (2004) found exotic weeds such as *Eupatorium sp.*, *Lantana sp.*, *Macaranga pellata*, and others. It has been reported that some herbaceous and shrubby exotics like *Ageratum conyzoides*, *Erigeron* sp., *Lantana camara* and *Parthenium hysterophorum* have proved to be harmful to mankind; their invasion and multiplication caused ecological havoc to indigenous vegetation in and around Dehradun (Negi and Hajra, 2007).

There are some positive impacts also on the ecosystem due to tea cultivation. A study by Daniels (2003) in the Anamallais (Coimbatore District, Tamilnadu) pointed out that despite the possible environmental contamination, tea estates tend to support a fairly high diversity of ambhibians. The tree frog (*Rhacophorus pseudomalabaricus*) that was for the first time reported from the rainforests of the Indira Gandhi Wildlife Sanctuary (Anamallais) in 2000 (Vasudevan and Dutta, 2000) and not reported from elsewhere, occurred within the tea plantations of the Anamallis (Daniels, 2003). Tea gardens in the Western Ghats provide foraging grounds and movement corridors to wild mammals (Kumara *et al.*, 2004). A large group of tea estates in Anamallais has initiated the process of enriching sections of "fuel forests" that are maintained within the estates in the Anamallais with tropical tree species of rainforests; these are being protected as 'biodiversity plots'. There is also a coordinated effort guided by United Planters Association of Southern India (UPASI) to minimize the use of pesticides in tea cultivation and shift towards organic farming, though in much smaller scale (Daniels, 2003).

Perennial cropping system such as tea plantation requires long term investment in activities such as infilling, replanting and soil fertility maintenance (Illukpitiya *et al.*, 2004). Aiming short term profits by extracting higher yields with indiscriminate use of inorganic fertilizers and other agrochemicals, is unmistakably not sustainable; current production practices and patterns of resource use in tea agro-ecosystems need course-correction (Illukpitiya et. al. 2003). Despite the desirable influence of tea cultivation, the adverse impacts should be envisaged by way of pollution of water sources, loss of habitats of native species of plants, animals and pollinators as tea cultivation involves the use of fertilizers and pesticides. It has been reported that use of pesticides containing sulphur, chlorine and phosphate based chemicals are likely to lead to residue problem, if used indiscriminately (Chaudhury, 1993). Negi *et. al.* (2003) found that the concentration of chlorine in the water draining from tea gardens was markedly high compared to control sites in Uttarakhand. UPASI has set out guidelines on the use of pesticides for reduction of adverse impacts of tea cultivation (Daniels, 2003).

Tea cultivation, therefore, could be considered as a unique agro-ecosystem due to intensive cultural practices and inputs and needs to be understood from the standpoint of ecological impacts, particularly, on flora, fauna, soil and water quality of the region. Tea being a monoculture, requires effective weed control measures, lest the estates provide a fertile focal point for proliferation of weeds that invade adjoining areas. Therefore, it will be of interest to investigate the composition of the vegetation in tea gardens of varying ages vis-à-vis the adjacent non-tea garden areas representing the native vegetation, to assess the changes in its composition, habitat loss of some of the important plants and preponderance of weed species, so as to suggest some corrective measures. Often, these landscapes are hot spots of biodiversity and serve as special ecological niches for several rare plant and animal species.

MATERIALS AND METHODS

Eleven tea gardens spread over an area of 116 ha in three districts of Uttarakhand (Almora, Bageshwar and Chamoli) were selected for detailed study (Table 1). These tea gardens (TG) of different ages, ranging from five to ten years, were surveyed for flora during summer, rainy and win-

ter seasons of the years, 2005 and 2006; adjoining non-tea areas were also surveyed, simultaneously. Transect walks were held to scale the entire length and width of these tea gardens. The plant specimens, with floral parts, collected during these field-trips were identified with the help of the herbarium kept at the Central Council for Research in Ayurveda and Siddha (CCRAS), Tarikhet (Uttarakhand). The nomenclature of the plants was confirmed further by consulting published records on local flora (Atkinson, 1989; Gaur, 1999; Naithani, 1990). Interactions with the owners of tea gardens and local people were held to verify the preponderance/disappearance of the plants in a given locality after the introduction of tea cultivation.

Fig. 1. Location of tea gardens in Uttarakhand (map not to scale)

RESULTS AND DISCUSSION

Number or plant species recorded through the three seasons in the 11 tea gardens and adjoining non-tea areas is presented in Table 2 (List of plant species recorded during summer, rainy and winter seasons is available on request). In summer, 51 species were recorded from the tea gardens and 180 species from adjoining non-tea areas (Fig. 2). Out of a total of 184 species, 49 species were common in both the areas. In rainy season, 105 species were recorded from tea fields and 253 species from the adjoining areas (Fig. 3). Out of a total of 263 species found in tea gardens and adjoining non-tea areas, 96 were

Table.1. Area and year planting of tea gardens

Name of tea garden	Area (ha)	Year of plantation
Chatiya	9.06	1998-1999
Dangoli	14.0	1999-2000
Gewar	7.72	1997-2002
Gwaldam	8.85	1998-99
Jarapani	17.0	1999
Kandhar	14.5	1997-98
Laubanj	5.0	1997
Main Division	21.0	1995
Reetha	5.0	2000-01
Saurdhar	8.66	1997
Sedu	5.0	1999
Total	115.79	

(Source: Uttarakhand Tea Development Board, 2006)

common in both the areas. In winter 107 species were recorded from tea fields and 203 from the non-tea areas (Fig. 4). Out of a total of 211 species found in both tea fields and non-tea areas, 100 were found common in both the areas. Categorization of flora under various growth forms(Table 2) revealed that as many as 270 species of herbs, 89 species of shrubs, 51 species of trees, 16 under-shrubs, ten pteridophytes, six climbing herbs, four bryophytes and four climbers were represented in the native flora. In the tea gardens this representation was very low: 147 herbs, 31 shrubs, 15 trees, eight under-shrubs, five pteridophytes, two climbing herbs and one bryophyte.

Table 2. Species belonging to different classes and habit, in tea (TG) and non-tea (NTG) areas.

Class of species & habit	Summer			Rainy			Winter		
	TG	NTG	Common Spp.	TG	NTG	Common Spp.	TG	NTG	Common Spp.
Bryophyte	1	3	1	1	4	1	1	2	1
Climber	0	3	0	0	3	0	0	3	0
Fern	2	3	2	4	8	4	3	7	3
Herb	22	78	21	81	150	72	76	117	71
Herb climber	1	1	0	0	3	0	1	3	1
Shrub	13	41	13	12	44	11	17	38	17
Under shrub	1	12	1	1	2	1	6	6	5
Tree	11	39	11	6	39	6	8	32	8
Total	51	180	49	105	253	95	112	208	106

During summer herbaceous family Asteraceae dominated (nine species) in the non-tea area; inside tea fields (Table 3) only four species of family Poaceae were present. Surprisingly, all these three species were weeds and they were

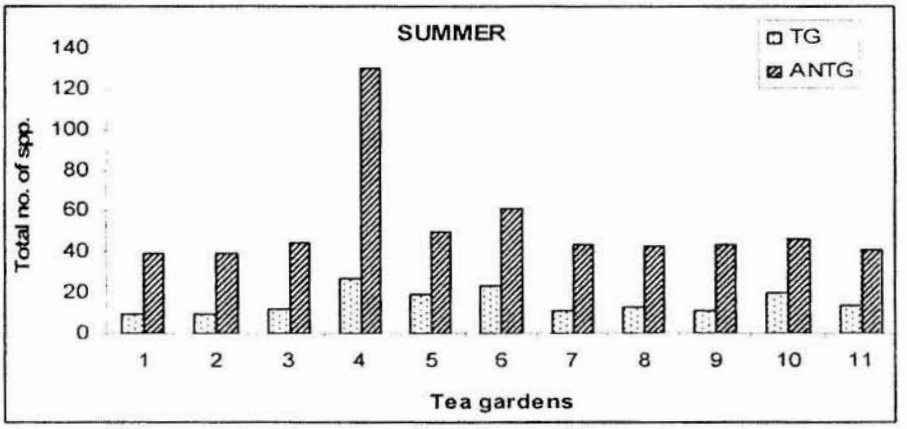

Fig. 2. No. of species present in tea garden (TG) and adjoining non-tea area (ANTG) in summer

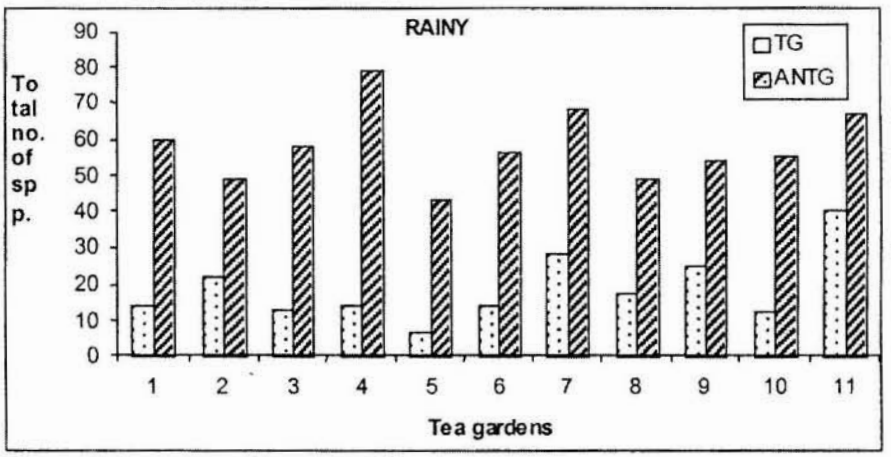

Fig. 3. No. of species present in tea garden (TG) and adjoining non-tea area (ANTG) in rainy season

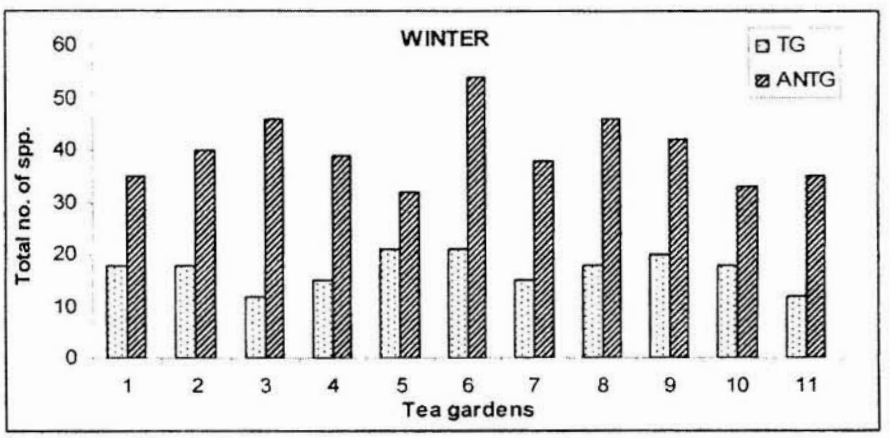

Fig. 4. No. of species present in tea garden (TG) and adjoining non-tea area (ANTG) in winter

Table 3. Weed species occurring in tea fields during summer, rainy and winter seasons.

Weed species	Summer	Rainy	Winter
Ageratum conyzoides	+	-	-
Ageratum houstonianum	-	-	+
Agrostis nardoides	-	+	-
Bidens pilosa	-	+	-
Chrysanthellum americanum	+	+	-
Chrysocephalum crepedioides	+	+	-
Commelina oblique	-	+	-
Crepis japonica	-	+	-
Crotalaria juncea	-	-	+
Eclipta alba	-	+	-
Eragrostis spp.	-	-	+
Festuca gigantea	-	-	+
Fragaria vesca	-	+	-
Galinsoga parviflora	-	+	-
Geranium collinum	-	+	-
Geranium wallichii	-	+	-
Gnaphalium leuteo-album	-	+	-
Gypsophila spp.	-	-	+
Impatiens scabrida	-	+	-
Lapididum sativum	-	+	-
Mariscus paniceus	-	+	-
Oxalis corniculata	-	+	-
Parthenium hysterophorum	-	-	+
Phyllanthus amarus	-	-	+
Phyllanthus fraternus	-	+	-
Poa annua	-	+	-
Polygala crotalarioides	-	+	-
Polygonum caspa	-	+	-
Polygonum hydropiper	-	+	-
Stellaria media	-	-	+

the adjoining non-tea areas. These weed species were *Ageratum conyzoides, Chrysanthellum americanum* and *Crassocephalum crepidioides*. Lamiaceae had no representation inside the tea gardens. In rainy season, the family Asteraceae with 27 species dominated the flora followed by Poaceae with 15 species and Fabaceae with 12 species. Out of the 27 species of Asteraceae found in the non-tea areas only 17 species were growing in the tea gardens. Similarly, out of the 15 species of Poaceae found in the native flora, only nine species were found within the tea gardens. Fabaceae was represented by 12 species in the native flora and only seven species in the tea gardens. Similar trends were observed in other families like Lamiaceae, Cyperaceae, Euphorbiaceae, Geraniaeae and Polygonaceae. The list of weeds is presented in Table 3. In the winter season Asteraceae was represented by 25 species, out of which 20 were found growing in the tea gardens. Of the family Poaceae seven species were found inside tea gardens. The family Fabaceae was represented by only three species in tea gardens out of ten species in adjoining non-tea areas. Weed species such as *Ageratum houstonianum*, *Parthenium hysterophorum*, *Gypsophila* sp., *Stellaria media*, *Phyllanthus amarus*, *Crotalaria juncea*, *Eragrostis* spp. and *Festuca gigantea* were found growing abundantly in the tea gardens (Table 4). This investigation revealed that a few weed species, viz., *A. conyzoides, C. crepidioides, C. americanum, Galinsoga parviflora, Lepidium sativum* and others were growing in all the tea gardens but were uncom-

mon in the native flora of the region. Local people told that they noticed a few species such as *A. houstonianum*, *P. hysterophorum* and *Gypsophila* spp. only after tea plantations came up in the area. Some people noticed increased dominance of plants such as *Ageratum* spp. *C. crepidioides, C. americanum, G. parviflora* and others following tea cultivation. It can be safely presumed that availability of seed of these weeds of invasive nature may result in their spread to the adjoining non-tea areas and change the composition of native flora. Negi and Hajra (2007) reported that the rapid colonization of *Galinsoga parviflora, Argemone mexicana* and *Ageratum conyzoides* especially in agricultural fields, along footpaths, road sides and in gardens of heavy peat content have created socio-ecological problems and health hazards. *Parthenium hysterophorum*, *L. camara* and *Eupatorium odoratum* are also found to cause allergic problems. In the Annamalai Hills, Coimbatore District, the exotic weeds and shrubs dominated the vegetation of tea gardens (Kumara ital. 2004). They are non-palatable and therefore their spatial coverage reduces the carrying capacity of graziers (Sawarkar, 1984). These exotics are naturalized and are distinguishable from local flora only by their known history.

During the survey, *Gloriosa superba,* a rare species of climbing herb and *Satyrium nepalense,* a rare orchid, were found growing in the non-tea areas. These areas are also natural habitats of certain medicinal herbs, such as, *Centella asiatica, Mentha piperita, Valeriana wallichii* and others. The habitats of rare species and medicinal plants are under pressure from the weeds associated with tea cultivation. The habitat and ecology of these important species may change gradually. Aspects of pollination biology need to be investigated due to the preponderance of a few weed species in the tea gardens. Further, the use of pesticides and its impact on the soil fauna and insect populations and resultant loss in productivity of agricultural/ horticultural crops growing adjacent to these tea gardens also makes a potential area for future research.

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