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The Weed Flora of Turkish Tea Plantations

Türkiye'nin Çay Bahçelerindeki Yabancı Bitki Florası

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Abstract

This study was performed to find out the vascular weed taxa of tea (*Camellia sinensis* (L.) Kuntze) plantations in Turkey and determine the critical control periods of the taxa which are negatively affect both of crop quality and yield. These taxa were determined with the studies and observations of authors both in tea plantations and local herbarium (KATO). A total of 114 native and naturalized/cultivated vascular plant taxa were found out as weeds in tea plantations. The most noxious weed, which were unintentionaly added to harvested shoots and negatively affected the tea quality, were underlined. The most commonly growing taxa in tea plantations in the region were: *Pteridium aqulinum* (L.) Kuhn., *Smilax excelsa* L., *Alnus glutinosa* (L.) Gaertn. subsp. *barbata* (C.A. Mey.) Yalt., *Crassocephalum crepidioides* (Bentham) S. Moore, *Calystegia silvatica* (Kit.) Griseb, *Commelina communis* L., *Microstegium vimineum* (Trin.) A. Camus., *Oplismenus undulatifolius* (Ard.) P. Beauw. and *Rubus* spp. A high number of the observed weed species are ecologically tolerated taxa which are naturalized in the region. Furthermore, of these taxa 9 are climbers and 14 are woody plants. The critical periods of weed control in tea plantations were derived from both literature and our ecological/phenological observatins in tea plantations.

Keywords: Black Sea, *Camellia sinensis*, Tea, Turkey, Weed

Öz

Bu çalışma, Türkiye'deki çay (Camellia sinensis (L.) Kuntze) plantasyonlarının vasküler yabancı bitki taksalarını ve hem mahsul kalitesini hem de verimini olumsuz etkileyen bu taksonların kritik kontrol dönemlerini belirlemek için yapılmıştır. Bu taksonlar, çay plantasyonlarında ve lokal herbaryumda (KATO) yazarların çalışmaları ve gözlemleri ile belirlenmiştir. Çalışma kapsamında çay bahçelerinde yayılış gösteren toplam 114 adet doğal ve doğallaşmış damarlı bitki taksonu tespit edilmiştir. Hasat edilen sürgünlere kasıtsız olarak karıştırılan ve çay kalitesini olumsuz etkileyen en zararlı bitki taksonları vurgulanmıştır. Çay bahçelerinde en çok yayılan taksonlar; Pteridium aqulinum (L.) Kuhn., Smilax excelsa L., Alnus glutinosa (L.) Gaertn. subsp. barbata (C.A. Mey.) Yalt., Crassocephalum crepidioides (Bentham) S. Moore, Calystegia silvatica (Kit.) Griseb, Commelina communis L., Microstegium vimineum (Trin.) A. Camus., Oplismenus undulatifolius (Ard.) P. Beauw. ve Rubus spp.'dir. Bu taksonların çoğu ekolojik toleransı yüksek ve ülkemizde doğallaşmış taksonlardır. Taksonlardan dokuz adeti tırmanıcı, 14 adeti de odunsu bitkidir. Çay bahçelerindeki yabancı bitkilerin kontrollerindeki kritik periyotlar hem literatürden hem de arazideki fenolojik/ekolojik gözlemlerimizden elde edilmiştir.

***Anahtar kelimeler**: Karadeniz, Camellia sinensis, Çay, Türkiye, Yabancı Bitki*

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1. Introduction

The tea plant (*Camellia sinensis* (L.) Kuntze), originates from Southeast Asia and approximately three billion kilograms of tea is consumed yearly in the world and it is now being cultivated in more than 30 countries (Hayat et al., 2015) including Turkey. The eastern Black Sea Region of Turkey receives the highest rainfall throughout the year in the country and tea cultivation is the most important subsistence source of farmers in the region. Starting from the province of Artvin/Hopa, tea plantations are spread to Fatsa/Ordu province extending the plantation range to Rize, Trabzon, Artvin and Giresun (Taşkın et al., 2015). With slight fluctuations compared to long years in the region, tea farming is done on area of approximately 75,890 ha in Turkey (Anonymous, 2012). Many exotic plant taxa have been hosted by tea cultivation areas depending on the current climate conditions, intense commercial activities with Asian countries and other natural reasons (Terzioğlu and Anşin, 2001; Terzioğlu and Coşkunçelebi, 2017; Farooq et al., 2017; Önen et al., 2015; Özaslan et al., 2017). On the other hand, Black Sea Region is located on one of the major bird migration routes of Turkey, many non-native plants can also be migrated to the North Eastern Anatolia from far distances. Especially in 1990s, bur cucumber (*Sicyos angulatus* L.) for example, which has been determined from Artvin, Rize, Trabzon, Giresun and Ordu provinces (Duman and Güner, 1996; Terzioğlu and Anşin, 1999; Terzioğlu et al., 2015), has increased its detrimental effects on both agricultural crops and natural plant taxa.

Tea plants grown in Turkey have recently been significantly affected by both insects (*Ricania simulans* Walker) (Ak et al., 2015) and weeds. Weeds may significantly reduce yield and impair crop quality, resulting in financial losses to the farmers (Kavaliauskaitė and Bobinas, 2006). Globally, weeds have been estimated to be responsible for about 10% reduction in crop yield (Froud-Williams, 2002). However, it is reported that the uncontrolled weed growth can cause 50-70% loss of tea productivity. Weeds are regarded as one of he most important factors among the crtitical factors limiting optimum productivity of tea plantations, (Deka and Barua, 2015). In parallel, the presence of native and naturalized plants in tea plantations negatively affects the black tea processing quality and make harvest difficult. The management efforst to control these weeds also includes significant monetory costs. Determination of the important weed taxa in tea plantaions is the first step to increase the effectiveness of management practices by considering the biological/phenological characteristics of identified weedy taxa. Identification of taxa is the first step, and determining their density and frequency is the second step for weed control (Kaçan and Boz, 2015).

In the present study, native and naturalized vascular plant taxa in tea plantations of Black Sea Region, Turkey were identified and the most harmful ones were tried to underline. As well, it is aimed to determine the most effective time period for controlling depending both on literature and field observations.

For this purpose, the vascular plant taxa were determined with our long-term field studies and observations, and the data obtained from KATO (Herbarium of Faculty of Forestry, Karadeniz Technical University). Undefined vascular plant taxa, observed in tae plantations, were fistly collected and their identification made by the authors in the KATO herbarium. Correspondingly, the literature on the related studies carried out in this region (Terzioğlu, 1998; Terzioğlu and Anşin, 1999; Gökdemir, 1998; Anşin and Terzioğlu, 2000; Terzioğlu and Anşin, 2001; Coşkunçelebi et al., 2007; Terzioğlu and Coşkunçelebi, 2017; Ergül Bozkurt, 2017) were studied in detail. All taxa, belonging to fern and seed plants, were listed on the alphabetical order of their genera in order to enable easy evaluation. These taxa were listed with the following characteristics, which are important in their controlling, together with their families (Table 1):

- ✓ Name of taxon,
- ✓ Family,
- ✓ Life form,
- ✓ Phytogeographic region,
- ✓ Type of damage,
- ✓ Period of control.

2. Results and Discussion

As a result of the study, 41 families and 99 genera were found making 114 native or naturalized vascular weed taxa distributed in tea planttaions of Black Sea region, Turkey. Detailed information of these identified taxa are given in table 1 where the Turkish names were given according to Güner et al. (2012).

Table 1. Turkish names, Families, life form, phytogeographic region, type of damage and period of control of the determined taxa

Taxa	Turkish name	Family	Life form	Phytogeographic region	Type of damage	Period of control
**Acalypha australis* L.	Burtam	Euphorbiaceae	Annual	Exotic	NP	Aug.-Oct.
**Ailanthus altissima* (Mill.) Swingle	Kokarağaç	Simaroubaceae	Tree	Exotic, invasive	NP,S	May-Jun.
Ajuga reptans L.	Meryemsaçı	Lamiaceace	Rhizomatous, Perennial	Euro-Sib. el.	NP	Mar.-Jun.
Alnus glutinosa (L.) Gaertn. subsp. *barbata* (C.A.Mey.) Yalt.	Yeykin	Betulaceae	Tree	Euxine el.	NP,S	Apr.
Amaranthus retroflexus L.	Tilkikuyruğu	Amaranthaceae	Annual	Invasive	NP,S	May.-Jul.
Ambrosia artemisifolia L.	Arsız zaylan	Asteraceae	Annual	-	NP,S	Jun.
**Artemisia verlotiorum* Lamotte	Laz yavşanı	Asteraceae	Perennial	Exotic, invasive	NP,S	Oct.
Athyrium filix-femina (L.) Roth	Yel eğreltisi	Athyriaceae	Rhizomatous perennial	-	NP	Jun.
**Bidens frondosa* L.	Yaprak suketeni	Asteraceae	Annual	Exotic, invasive	NP	Jul.-Sep.
Blechnum spicant (L.) Sm.	Tarak eğreltisi	Blechnaceae	Rhizomatous perennial	-	NP	Apr.-May.
Brachypodium sylvaticum (Huds.) P. Beauv.	Koru kılcanı	Poaceae	Perennial	Euro-Sib. el.	NP	Jun.-Sep.
Brassica oleracea L.	Lahana	Brassicaceae	Annual	-	NP	Mar.-May.
Calystegia silvatica (Kit.) Griseb.	Bürük	Convolvulaceae	Rhizomatous perennial	-	NP	Apr.-Aug.
Campanula lactiflora M. Bieb.	Kuspida	Campanulaceae	Perennial	Euxine el.	NP	Jul.-Sep.
Campanula rapunculoides L.	Elmacık	Campanulaceae	Perennial	Euro-Sib. el.	NP	Jul.-Sep.
Capsella bursa-pastoris (L.) Medik.	Çobançantası	Brassicaceae	Biannual	Cosmopolitan	NP	Jan.-Dec.
Castanea sativa Mill.	Kestane	Fagaceae	Tree	Euro-Sib. el.	NP,S	Jun.-Jul.
Chenopodium album L.	Aksirken	Amaranthaceae	Annual	-	NP	May.-Aug.
Cirsium arvense (L.) Scop.	Köygöçüren	Asteraceae	Perennial	-	NP	May.-Sep.
Clinopodium grandiflorum (L.) Kuntze	Kaba fesleğen	Lamiaceace	Perennial	Euro-Sib. el.	NP	Jun.-Oct.
Clinopodium vulgare L.	Yabani fesleğen	Lamiaceace	Perennial	-	NP	Jun.-Sep.
**Commelina communis* L.	Mahmuza	Commelinaceae	Perennial	Exotic, invasive	NP	Aug.-Sep.
Conyza albida Willd. ex Spreng.	Ak çakalotu	Asteraceae	Annual	-	NP	Jul.-Dec.
**Conyza canadensis* (L.) Cronquist	Selviotu	Asteraceae	Annual	Exotic, invasive	NP	Jul.-Dec.
**Crassocephalum crepidioides* (Benth.) S. Moore	Duduka	Asteraceae	Annual	Exotic, invasive	NP	Aug.-Nov.
Cucurbita maxima Duch.	Helvacı kabağı	Cucurbitaceae	Annual	Cultivation	NP	-

Table 1 (continued)

Taxa	Turkish name	Family	Life form	Phytogeographic region	Type of damage	Period of control
Cyclamen coum Mill.	Yer somunu	Primulaceae	Tuberous, perennial	-	NP	Feb.-May.
Cynodon dactylon (L.) Pers.	Köpekdişi	Poaceae	Rhizomatous, perennial	-	NP	Apr.Sep.
Cyperus longus L.	Karatopalak	Cyperaceae	Rhizomatous, perennial	-	NP	May.-Sep.
Dactylis glomerata L. subsp. *glomerata*	Domuzayrığı	Poaceae	Rhizomatous, perennial	Euro-Sib. el.	NP	May.-Jul.
Daucus carota L.	Yabani havuç	Apiaceae	Biannual	-	NP	Jun.-Sep.
**Dichrocephala integrifolia* (L.f.) Kuntze	Kırtıkotu	Asteraceae	Annual	Exotic	NP	Jun.-Sep.
Digitaria sanguinalis (L.) Scop.	Kızıl çatalotu	Poaceae	Annual	-	NP	Jun.-Oct.
Dioscorea communis (L.) Caddick & Wilkin	Dolanbaç	Dioscoreaceae	Tuberous, perennial	-	NP,S	Apr.-Jun.
**Duchesnea indica* (Andrews) Focke	Sabunçileği	Rosaceae	Stoloniferous, perennial	Exotic	NP	Jul.
Echinochloa crus-galli (L.) Beauv.	Darıcan	Poaceae	Annual	-	NP	Jun.-Oct.
**Eleusine indica* (L.) Gaertn.	Kazotu	Poaceae	Annual	Exotic	NP	Aug.-Oct.
**Elsholtzia ciliata* (Thunb.) Hyl.	Köriyaprağı	Lamiaceace	Annual	Exotic	NP	May.-Jul.
Erigeron annuus (L.) Pers.	Hemşin şifaotu	Asteraceae	Biannual	Exotic, invasive	NP	Jun.-Sep.
Fragaria vesca L.	Dağ çileği	Rosaceae	Perennial	-	NP	Apr.-Jun.
Frangula dodonei Ard. subsp. *dodonei*	Barutağacı	Rhamnaceae	Shrub	Euro-Sib. el.	NP,S	Jun.-Jul.
Galanthus rizehensis Stern	Rize kardeleni	Amaryllidaceae	Bulbous	Euxine el.	NP	Jan.-Apr.
**Galinsoga parviflora* Cav.	Kıllı beşpatçiçeği	Asteraceae	Annual	-	NP	Jun.-Aug.
Geum urbanum L.	Meryemotu	Rosaceae	Perennial	-	NP	May.-Jul.
Hypericum calycinum L.	Koyunkıran	Hypericaceae	Shrub	Euxine el.	NP	May.-Oct.
Hypericum perforatum L.	Binbirdelik otu	Hypericaceae	Perennial	-	NP	Apr.-Sep.
**Ipomoea purpurea* (L.) Roth	Kahkaha çiçeği	Convolvulaceae	Perennial	Exotic	NP,S	Jul.-Sep.
Iris lazica Albov	Laz süseni	Iridaceae	Rhizomatous	Euxine el.	NP	Feb.-Apr.
Lactuca racemosa Willd.	Çayır marulu	Asteraceae	Perennial	Euxine el.	NP	Jun.-Sep.
Lamium album L.	Balıcak	Lamiaceace	Stoloniferous, perennial	Euro-Sib. el.	NP	May.-Aug.
Lamium galeobdolon (L.) L.	Sarı balıcak	Lamiaceae	Perennial	-	NP	May.-Jun.
Lapsana communis L.	Şebrek	Asteraceae	Perennial	-	NP,S	May.-Oct.
Lolium perenne L.	Çim	Poaceae	Perennial	Euro-Sib. el.	NP	Apr.-Aug.
Luzula forsteri (Sm.) DC.	Gevşek luzul	Juncaceae	Stoloniferous, perennial	Euro-Sib. el.	NP	Mar.-Jul.
Lycopus europaeus L.	Kurtayağı	Lamiaceace	Perennial	Euro-Sib. el.	NP	Jun.-Oct.
Mercurialis annua L.	Parşen	Euphorbiaceae	Annual	-	NP	Feb.-Jul.

Table 1 (continued)

Taxa	Turkish name	Family	Life form	Phytogeographic region	Type of damage	Period of control
Microstegium vimineum (Trin.) A. Camus	Çin sakalotu	Poaceae	Annual	Invasive	NP	Aug.-Nov.
Muscari armeniacum Leichtlin ex Baker	Gâvurbaşı	Asparagaceae	Bulbous	-	NP	Mar.-Jul.
Omphalodes cappadocica (Willd.) DC.	Gök süreyre	Boraginaceae	Perennial	Euxine el.	NP	Mar.-May.
Oplismenus undulatifolius (Ard.) P.Beauv.	Fırfırlıot	Poaceae	Perennial	-	NP	Jul.-Oct.
Oxalis corniculata L.	Sarı ekşiyonca	Oxalidaceae	Perennial	Cosmopolitan	NP	Mar.-Aug.
**Paspalum dilatatum* Poir.	Kürdan darısı	Poaceae	Rhizomatous, perennail	Exotic	NP	Aug.-Oct.
**Paspalum distichum* L.	Yalan darısı	Poaceae	Rhizomatous-stoloniferous, perennial	Exotic	NP	Jun.-Oct.
Phaseolus vulgaris L.	Fasülye	Fabaceae	Annual	Cultivation	NP,S	-
**Phytolacca americana* L.	Şekerciboyası	Phytolaccaceae	Perennial	Exotic, invasive	NP,S	Jun.-Sep.
Plantago major L.	Sinirotu	Plantaginaceae	Perennial	-	NP	Apr.-Sep.
Polygonum aviculare L.	Köyotu	Polygonaceae	Perennial	Cosmopolitan	NP	Jul.-Nov.
Polygonum hydropiper L.	Su biberi	Polygonaceae	Annual	-	NP	Aug.
**Polygonum nepalense* Meissn.	Oğlakotu	Polygonaceae	Annual	Exotic	NP	May.-Sep.
**Polygonum perfoliatum* L.	Kapliçotu	Polygonaceae	Annual	Exotic, invasive	NP,S	Apr.-Jul.
Polygonum persicaria L.	Söğütotu	Polygonaceae	Annual	-	NP	Aug.-Dec.
Polygonum thunbergii Siebold & Zucc.	Gül madımak	Polygonaceae	Annual	Euxine el.	NP	Oct.
Polystichum aculeatum (L.) Roth	Sivri pilunç	Dryopteridaceae	Rhizomatous, perennial	-	NP,S	May.
Primula acaulis (L.) L.	Çuhaçiçeği	Primulaceae	Perennial	Euro-Sib. el.	NP	Mar.-Jun.
Prunella vulgaris L.	Gelincikleme otu	Lamiaceace	Perennial	Euro-Sib. el.	NP	May.-Sep.
Pteridium aquilinum (L.) Kuhn.	Eğrelti	Dennstaedtiaceae	Rhizomatous, perennial	-	NP,S	Jun.
Ranunculus ficaria L. subsp. *bulbifera* (Marsden-Janchen) Lawalreé	Buğdaycık	Ranunculaceae	Perennial	-	NP	Mar.-Apr.
**Rhus chinensis* Mill. var. *chinensis*	Çin sumağı	Anacardiaceae	Shrub	Exotic	NP,S	Jun.-Jul.
Rhododendron luteum Sweet	Zifin	Ericaceae	Shrub	Euxine el.	NP,S	Apr.-Sep.
Rhododendron ponticum L.	Kumar	Ericaceae	Shrub	Euxine el.	NP,S	Mar.-Aug.
**Robinia pseudoacacia* L.	Yalancı akasya	Fabaceae	Tree	Exotic, invasive	NP,S	Apr.-Jun.
Rubus canescens DC.	Çoban kösteği	Rosaceae	Shrub	-	NP,S	May.-Aug.
Rubus hirtus Waldst. & Kit.	Tüntürük	Rosaceae	Shrub	-	NP,S	Jun.-Jul.

Table 1 (continued)

Taxa	Turkish name	Family	Life form	Phytogeographic region	Type of damage	Period of control
Rubus ibericus Juz.	Malina	Rosaceae	Shrub	-	NP,S	Jun.-Aug.
Rumex pulcher L.	Ekşilik	Polygonaceae	Perennial	Cosmopolitan	NP	May.-Aug.
Salvia forskahlei L.	Dolma yaprağı	Lamiaceace	Perennial	Euxine el.	NP	Jun.-Sep.
Salvia glutinosa L.	Oklu şalba	Lamiaceace	Perennial	Hyrcano-Euxine el.	NP	Jul.-Oct.
Sambucus ebulus L.	Mürver otu	Adoxaceae	Rhizomatous, perennial	Euro-Sib. el.	NP,S	Jul.-Aug.
Sanicula europaea L.	Sanikel	Apiaceae	Perennial	Euro-Sib. el.	NP	May.-Aug.
Seneco vernalis Waldst. & Kit.	Kanaryaotu	Asteraceae	Annual	-	NP	Mar.-Aug.
Senecio vulgaris L.	Taşakcılotu	Asteraceae	Annual	-	NP	Mar.-Aug.
Setaria glauca (L.) P.Beauv.	Sıçansaçı	Poaceae	Annual	-	NP	Jul.-Oct.
**Sicyos angulatus* L.	İtdolanbacı	Cucurbitaceae	Annual	Exotic, invasive	NP,S	Jul.-Oct.
Sigesbeckia orientalis L.	Saruteçan	Asteraceae	Annual	-	NP	Aug.
Smilax excelsa L.	Dikenucu	Smilacaceae	Climber	Euxine. el.	NP,S	May.
Solanum americanum Mill.	İtüzümü	Solanaceae	Annual	Cosmopolitan	NP	Jun.-Nov.
Solanum dulcamara L.	Sofur	Solanaceae	Perennial	Euro-Sib. el.	NP,S	May.-Sep.
Sonchus asper (L.) Hill	Eşekgevreği	Asteraceae	Biannual	-	NP	Mar.-Aug.
Stachys sylvatica L.	Hamısırgan	Lamiaceace	Perennial	Euro-Sib. el.	NP	Jun.-Sep.
Stellaria media (L.) Vill.	Kuşotu	Caryophyllaceae	Annual	-	NP	Mar.-Jun.
Symphytum ibericum Steven ex M.Bieb.	Orman kafesotu	Boraginaceae	Stoloniferous, perennial	Euxine el.	NP	Mar.-Jul.
Tanacetum parthenium (L.) Schultz-Bip.	Beyaz papatya	Asteraceae	Perennial	-	NP	May.-Sep.
Teucrium chamaedrys L.	Kısamahmut	Lamiaceace	Rhizomatous, perennial	Euro-Sib. el.	NP	Jun.-Sep.
**Tradescantia fluminensis* Vell.	Ak telgrafçiçeği	Commelinaceae	Perennial	Exotic, invasive	NP	May
Trifolium pratense L.	Çayır üçgülü	Fabaceae	Perennial	Cosmopolitan	NP	May.-Sep.
Trifolium repens L.	Ak üçgül	Fabaceae	Perennial	-	NP	Mar.-Sep.
Tussilago farfara L.	Öksürükotu	Asteraceae	Perennial	Euro-Sib. el.	NP	Mar.-Apr.
Urtica dioica L.	Isırgan	Urticaceae	Perennial	Euro-Sib. el.	NP,S	Jun.-Sep.
Vaccinium arctostaphylos L.	Likarpa	Ericaceae	Shrub	Euxine el.	NP,S	May.-Jul.
Veronica anagallis-aquatica L.	Sugedemesi	Plantaginaceae	Perennial	-	NP	Mar.-Nov.
Veronica beccabunga L.	At teresi	Plantaginaceae	Rhizomatous, perennial	-	NP	May.-Oct.
Veronica persica Poiret	Cırcamuk	Plantaginaceae	Perennial	Cosmopolitan	NP	Mar.-Nov.
Vicia cracca L.	Kuş fiği	Fabaceae	Perennial	Euro-Sib. el.	NP	Apr.-Aug.
**Zea mays* L.	Mısır	Poaceae	Annual	Cultivation	NP,S	-

**Naturalized/cultivated; Euro-Sib. el. : Euro-Siberian element; NP: Nutrient partnership; S: Shadow; Jan. : January; Feb. : February; Mar. : March; Apr. : April; Jun. : June; Jul. : July; Aug. : August; Sep. : September; Oct. : October; Nov. : November; Dec. : December.*

The richest families (with the total number of taxa) were ; Asteraceae 18 taxa (15.78%), Poaceae 13 (11.40%), Lamiaceace 12 (10.52%), Polygonaceae 7 (6.14%), Fabaceae and Rosaceae 6 (5.35%) (Figure 1). Asteracea and Poaceae are the largest families and have the members with easily distributed diaspores. So, this result is not surprise. According to Flora of Turkey and the East Aegean Islands (Davis, 1965-1985), the phytogeographic regions of 43 plant taxa were determined. 21 taxa (18.42%) are Euro-Siberian element, 14 taxa (12.28%) are Euxine element, 1 taxon (0.87%) is Hircano- Euxine element, 7 taxa (6.14%) are cosmopolitan, 5 taxa (4.38%) are exotic, 2 taxa (1.75%) are invasive and 11 taxa (9.64%) are invasive-exotic. Pyhtogeographic regions of these taxa are shown in Figure 2.

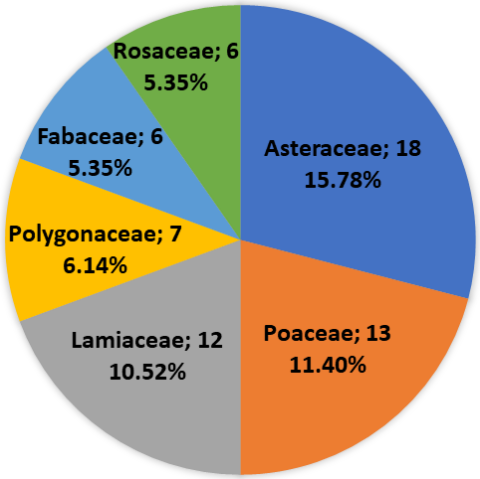

Figure 1. Families that have the most amount of taxa

The entire plantation areas are located in the NE Anatolian Region. Therefore, Euro-Siberian elements (18.42 %) have the highest percentage (Figure 2).

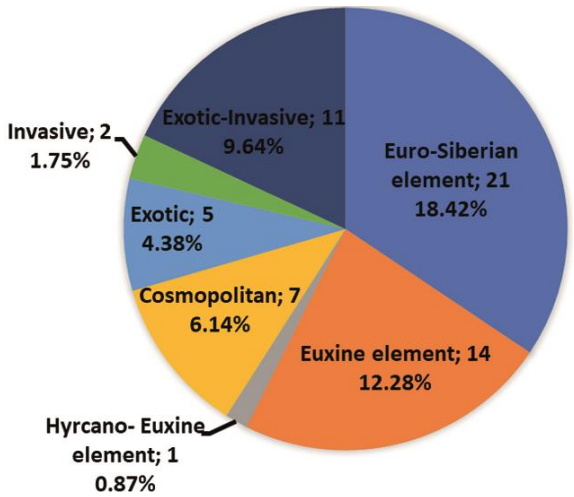

Figure 2. Phytogeographic regions of taxa

The following taxa are determined the most commonly growing ones in association with tea plants in tea plantations of Turkey: *Pteridium aqulinum* (L.) Kuhn., *Smilax excelsa* L., *Alnus glutinosa* (L.) Gaertn. subsp. *barbata* (C.A. Mey.) Yalt., *Crassocephalum crepidioides* (Bentham) S. Moore, *Calystegia silvatica* (Kit.) Griseb, *Commelina communis* L., *Microstegium vimineum* (Trin.) A. Camus., *Oplismenus undulatifolius* (Ard.) P. Beauw. and *Rubus* spp.

Life forms of the evaluated 114 taxa are determined as follow: 42 taxa (36.84%) perennial, 4 taxa (3.50%) biannual, 32 taxa (28.07%) annual and 13 taxa (11.40%) woody. In addition, 13 taxa (11.40%) rhizomatous-perennial, 4 taxa (3.50%) stoloniferous perennial, 2 taxa (1.75%) bulbous, 2 taxa (1.75%) tuberous perennial, 1 taxon (0.87%) stoloniferous-rhizomatous perennial and 1 taxon (0.87%) rhizomatous. Period of controll (according to months, considering cover-abundance and flowering period) of determined taxa are as follow: 2 taxa (0.45%) January, 5 taxa (1.12%) February, 23 taxa (5.18%) March, 36 taxa (8.10%) April, 56 (12.61%) taxa May, 76 (17.11%) June, 78 taxa (17.56%) July, 72 taxa (16.21%) August, 54 taxa (12.16%) September, 28 taxa (6.30%) October, 10 (2.25%) for November, 4 taxa (0.90%) for December. The most effective periods of controll of the weeds were determined as March, April and May (Figure 3) which is the begining of flowering period of the weeds (in another words; immature fruit or spore season).

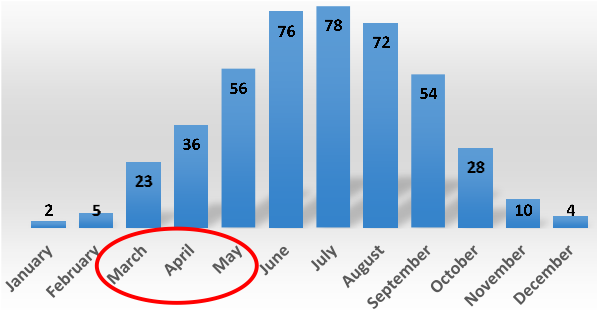

Figure 3. Start of period of weed control

Weed controlling period depends on different factors of which (1) biology of weed taxa and (2) age of plantations (and/or pruned season) are two of the most important ones (Figure 4).

Weeds are omnipresent and substantially reduce yield and quality of crops (Shrestha et al., 2019) and controlling them are crutial in young plantations for reducing mortality.

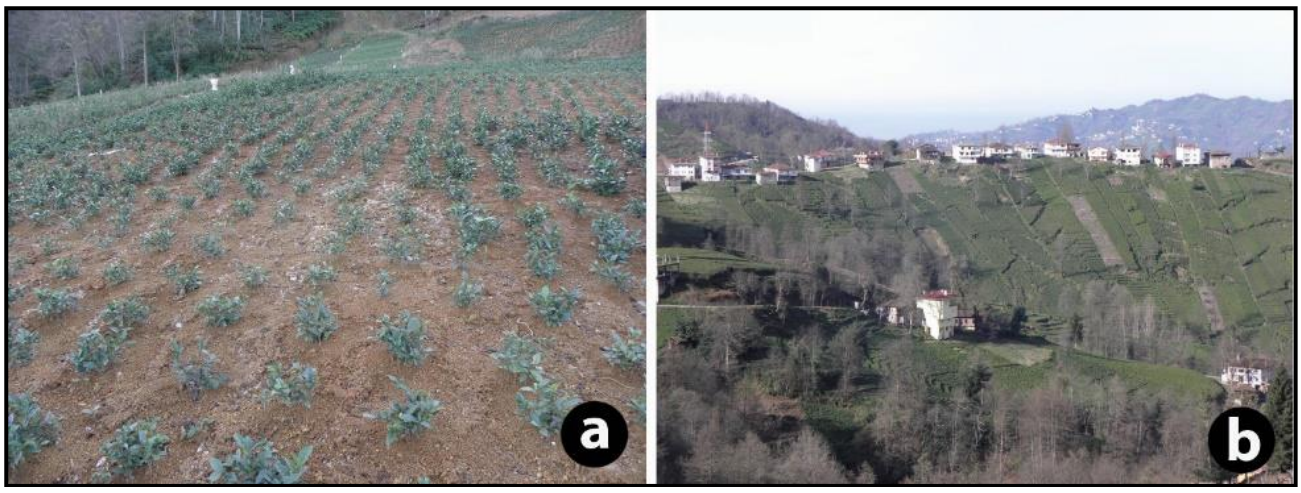

Figure 4. (a) Young tea plantation and (b) old tea plantations with pruned parcels

In NE Anatolia, tea harvesting season is between May to October and normally three times a year. But the flowering and/or seed and spore maturing period and weed controlling have started mainly from March and April. This is also the beginning of the critical period of crop development. Development of weed control strategies that lessen our reliance on herbicides for weed control may prove to be more cost effective (Hall et al., 1992). The suggestion is that the value of critical period studies rests with the eventual uncovering of the physiological basis for crop-weed competition and its eventual use for weed control (Weaver, 1984). Overlapping vegetation periods of cultivated plants and weeds result more problem than non-overlapping periods. So, we tried to determine the critical period of weed control in the present study. Most weed management professionals agree that management of invasive weeds must incorporate several methods to be successful (Walker and Buchanan, 1982; Sheley et al., 1996; Carruthers and D'Antonio, 2005; Beck, 2009). Classical biological control is an attractive alternative to other forms (mechanical etc.) of weed control (Beck, 2009). Manual and mechanical techniques such as pulling and cutting have been used traditionally in tea plantations. Weed control studies should started from April and repeated at least three times (before harvesting) in a year. On the other hand, dispersing time of mature diaspore of weed should be taking into account.

The tea plant is pruned every year by the farmers including 20% of the total owned area. Local people are tried to grow cultivated plants, such as beans, corns and potatos, in the prunned tea plantations in first and/or second pruned year for more family income. This results in yield reduction because of intensive pressure to tea plants in terms of nutrition and shading. Moreover, this causes the quality loss by mixing into the tea harvest. Biology, controlling methods and economic damages of the weed in tea plantations should be identified in detail. Thus, high-yielding dried tea can be achieved which importantly contribute economy of both local people and Turkey. Because of its highly sensitive growing conditions, especially depending on moist and hot climate, tea crop may be under the threat of climate change which is hosted determined and/or newly immigrate weeds in the region.

In spite of their negative impacts on crop production, weeds may also have positive socio-economic and other effects, because they are useful and serve as non-crop resources (Blanckaert et al., 2007; Srithi et al., 2017). As well, around the world, weeds are widely consumed and function as important sources of nutrients for local people (Srithi et al., 2017). For example, *Crassocephalum crepidioides* (redflower ragleaf) (Figure 5a) is one of the source of protein, natural antioxidant, and vitamins (Adjatin et al., 2013) and *Sicyos angulatus* (bur cucumber) (Figure 5b) is a source of honey (Terzioğlu et al., 2014).

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Figure 5. (a) *Crassocephalum crepidioides* and (b) *Sicyos angulatus* in tea plantations

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