



## Weed Flora of Cherry, Walnut, Apple, Almond and Pear Orchards in Northwestern Marmara Region of Turkey

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ARTICLE INFO	ABSTRACT
<p>Research Article</p> <p>Received : 06/10/2019 Accepted : 05/12/2019</p> <p>Keywords: Northwestern Marmara Region Orchards Weeds Flora Turkey</p>	<p>A study covering cherry, walnut, apple, almond and pear orchards in Edirne, Kırklareli and Tekirdağ provinces was carried out in 2015-2018 with the aim of determination of weed flora, weed frequencies and densities. Total of 64 species belonging to 30 families were identified in fruit tree orchards. Among all the families the most members were in Asteraceae 13 species, Poaceae, 11 species, Brassicaceae 5 species and Lamiaceae 3 species families. The dominant weed species were <i>Amaranthus retroflexus</i> L., <i>Polygonum aviculare</i> L., <i>Capsella-bursa pastoris</i> L. (Medik), <i>Convolvulus arvensis</i> L., <i>Lepidium draba</i> L., <i>Raphanus raphanistrum</i> L., <i>Chenopodium album</i> L., <i>Cichorium intybus</i> L. in Tekirdağ while <i>Datura stramonium</i> L. distribution in Edirne Uzunköprü and Kırklareli was remarkably high. Semi parasitic weed <i>Viscum album</i> and full parasite <i>Cuscuta campestris</i> Yunck were also detected in some orchards. <i>V. album</i> was widespread among pear trees while <i>Cuscuta campestris</i> Yunck was detected only in suckers emerged in apple and cherry orchards. According to density <i>A. retroflexus</i> has received the first order with 76 plant/m<sup>2</sup>, following <i>C. album</i> with 54 plant/m<sup>2</sup>, <i>Lactuca serriola</i> with 27 plant/m<sup>2</sup>, <i>D. stramonium</i> L. with 24 plant/m<sup>2</sup>, <i>Portulaca oleracea</i> with 21 plant/m<sup>2</sup></p>

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## Kuzey Marmara Bölgesi (Türkiye) Kiraz, Ceviz, Elma, Badem ve Armut Bahçelerinde Yabancı Ot Florası

MAKALE BİLGİSİ	ÖZ
<p>Araştırma Makalesi</p> <p>Geliş : 06/10/2019 Kabul : 05/12/2019</p> <p>Anahtar Kelimeler: Kuzey Marmara Bölgesi Meyve bahçeleri Flora Yabancı otlar Türkiye</p>	<p>Kuzey Marmara Bölgesinde kiraz, elma, badem ve armut bahçelerindeki yabancı ot türleri ve yaygınlık oranlarının belirlenmesi amacıyla Edirne, Kırklareli ve Tekirdağ İllerinde 2015-2018 yılları arasında sörvey çalışması yürütülmüştür. Çalışmada meyve bahçelerinde 30 familyaya ait 64 yabancı ot türü tespit edilmiştir. Bu familyalar içerisinde Asteraceae 13 tür, Poaceae 11 tür, Brassicaceae 4 tür, Lamiaceae 3 tür ile en çok türe sahip familyalar olarak saptanmıştır. Tekirdağ ilinde <i>Amaranthus retroflexus</i> L., <i>Polygonum aviculare</i> L., <i>Capsella-bursa pastoris</i> L. (Medik), <i>Convolvulus arvensis</i> L., <i>Lepidium draba</i> L., <i>Raphanus raphanistrum</i> L., <i>Chenopodium album</i> L., <i>Cichorium intybus</i> L. en yaygın olarak belirlenirken <i>Datura stramonium</i> L. yaygınlığı Edirne Uzunköprü ve Kırklareli’de daha yüksek bulunmuştur. Tespit edilen yabancı otlardan parazit <i>Viscum album</i> ve <i>Cuscuta campestris</i> Yunck elma ve kiraz bahçelerinde bulunmuştur. Yarı parazit <i>Viscum album</i> armut ağaçlarında yaygın olurken tam parazit <i>Cuscuta campestris</i> Yunck sadece elma ve kiraz bahçelerinde çıkan piçlerde parazit olarak görülmüştür. Yabancı otların yoğunlukları incelendiğinde <i>A. retroflexus</i> 76 bitki/m<sup>2</sup>, ile ilk sırayı alırken bunu 54 bitki/m<sup>2</sup> ile <i>C. album</i>, 27 bitki/m<sup>2</sup> ile <i>L. serriola</i> 24 bitki/m<sup>2</sup> ile <i>D. stramonium</i> L. ve 21 bitki/m<sup>2</sup> ile <i>Portulaca oleracea</i> izlemiştir.</p>

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## Introduction

Many factors affect plant growth and weeds are considered as one of the most important. Weeds compete with plants for water and nutrients, which are essential resources for plant growth. The weed infestation is more problematic in newly established orchards because young trees are more susceptible to weed competition due to slowly growth and less developed root system. In contrast with denser developed root systems weeds can reach deeper soil depths, uptake minerals and water, grow faster than crop plants and reduce the amount of sunlight that can reach to young plants. Weeds also reduces area that plants require for growth (Wisler and Norris, 2005).

Weed infestation is problem in Turkey due to high humidity and high temperature characteristics. Variations in weed species and population densities have been observed every year depending on several factors such as climate, cultural practices and cropping system. Dense weed infestations complicate harvesting and other agricultural practices. Tillage and herbicide applications are done to control weeds. But both operations increase crop production expenditure. Besides tillage is short lived and carries a risk of tree root and trunk damage during tilling by tractor mounted tillers. On the other hand herbicides are selective and each herbicide controls certain weeds. Additionally the competition of weed species varies depending on factors such as growth period. Grass weeds retain more water than broadleaf weeds during growing period (Nasr et al., 2013). Thus precautions on control of grass weeds must be taken in dry soil conditions in summer. Therefore, knowledge of the type of weed species present in the agricultural area is essential for effective herbicide application and weed management.

Several researchers carried out studies in apple and pear orchards in Central Anatolia and identified 82 and 59 species respectively (Eşitmez and Işık, 2016; Yazlık and Tepe, 2001). However weed flora of orchards in Northwestern Marmara Region is little known and there is no current record on presence of weed species. On this purpose we carried out a study in Edirne, Kırklareli and Tekirdağ Provinces of Northwestern Marmara Region in order to determine weed species coinfecting apple, pear, walnut, almond and cherry orchards.

## Material and Method

A survey covering fruit tree growing areas was carried out in 2015-2018. In order to determine all species orchards were visited regularly four times (winter: February; spring: mid April - mid May; summer: mid June - mid July; autumn: mid September - mid October) a year. Orchard visits were conducted in Tekirdağ Province Şarköy, Malkara and Süleymanpaşa districts; Edirne Province Keşan and Uzunköprü districts; Kırklareli Province Merkez district. Provinces were selected based on production data of Turkish Statistical Institute and sampled orchards were selected randomly (Table 1).

During visits presence or absence of weed species was recorded for each orchard. Weed samples were collected, put separately in a nylon bag and transferred to Tekirdağ Viticulture Research Institute for further systematic research. In addition weed density was evaluated by counting plants or shoots of weeds at 1 m<sup>2</sup> frame. A quadrat of size 1 m x 1 m was thrown five times in each orchard and then averages count

were used to determine number of weeds in m<sup>2</sup>. Frequency of occurrence (f%) of species was calculated as the number of orchards where the species was recorded divided by the total number of orchards visited (Odum, 1971; Sırma et al., 2001). In addition blooming periods of each weed species were observed and recorded.

For species identification the herbarium of each species were prepared by slow drying of plant samples at room temperature. After complete drying each weed sample were stucked on to cardboard, covered by nylon and labelled. Collection site, province, collection date were recorded on each label. Weeds were identified by comparing plant morphology with published literatures of Yunker (1932), Royer and Dickson (1998), Dawson et al., (2019).

Table 1 Information about number of surveyed orchards

	Edirne	Kırklareli	Tekirdağ
Total number of orchards	31	21	177
Walnut	10	5	47
Pear	7	7	34
Cherry	4	2	58
Apple	7	3	32
Almond	3	4	6
Orchard size(da)	1-50	10-50	1-70
Minimum weather temperature		9.6°C	
Maximum weather temperature		30.7°C	

## Results and Discussion

After species identifications 64 species belonging to 30 families were recorded in pear, almond, cherry, apple and walnut orchards. Cherry and apple orchards included 61 species while pear, almond and walnut orchards had 58, 52 and 43 species respectively (Table 2, Figure 1). In survey area the predominance was shown by Asteraceae family having 13 species followed by Poaceae, Brassicaceae and Lamiaceae each having 11, 5 and 3 species. As Euphorbiaceae, Plantaginaceae, Solanaceae, Geraniaceae and Apiaceae include 2 species the rest of families like Cucurbitaceae, Rubiaceae, contain only one species. Compared to other families Asteraceae (20.2%), Poaceae (17.3%) and Brassicaceae (7.93%) showed higher relative frequencies.

The related researches were carried out in different parts of Turkey. In a research covering apple orchards in Kayseri 129 weed species belonged to 33 families consisted of 2 monocotyledonous and 31 dicotyledonous were identified. The species identified were mostly belonged to Asteraceae 21 species, Poaceae 15 species and Brassicaceae 13 species families (Eşitmez ve Işık, 2016). In another research in Van 59 weed species from 22 families and 82 species from 28 families were found in pear and apple orchards respectively (Yazlık and Tepe, 2001).

Dicotyledons comprise the highest proportion with 51 species (81.2%), following monocotyledons with 12 species (18.8%). Poaceae and Cyperaceae were the only monocotyledon families in research areas. The number of dicotyledon weeds in cherry, apple, pear, almond and walnut orchards were 59, 59, 52, 41 and 23 species respectively. Although all monocotyledons were observed in walnut orchards cherry, apple, pear and almond plantations contain only 11 species.

Table 2 Botanical names, family, life form and presence of weeds species in orchards

Family	Scientific name	Life form	Life span	C	Ap	P	Al	W
Amaranthaceae	<i>Amaranthus retroflexus</i> L.	Th	A	+	+	+	+	+
Apiaceae	<i>Bifora radians</i> Bieb.	Th	A	-	+	-	-	-
	<i>Conium maculatum</i> L.	Th	A/Bi	+	+	+	+	+
Asteraceae	<i>Artemisia absinthium</i> L.	H	Bi	-	+	-	-	-
	<i>Carduus nutans</i> L.	H	Bi	+	+	+	+	+
	<i>Cirsium arvense</i> L.	G	P	+	+	+	+	-
	<i>Conyza canadensis</i> L.	Th	A	+	+	+	-	-
	<i>Cichorium intybus</i> L.	H	P	+	+	+	-	-
	<i>Lactuca serriola</i> L.	H	A/Bi	+	+	+	+	+
	<i>Senecio vulgaris</i> L.	Th	A	+	+	+	+	+
	<i>Silybum marianum</i> (L.) Gaertn	H	Bi	+	+	+	+	-
	<i>Sonchus arvensis</i> L.	Th	P	+	+	+	+	+
	<i>Taraxacum officinale</i> F.H.Wigg.	H	P	+	+	+	+	-
	<i>Xanthium strumarium</i> L.	Ch	A	+	+	+	+	+
<i>Xanthium spinosum</i> L.	Th	A	+	+	+	+	+	
Apocynaceae	<i>Cynanchum acutum</i> L.	Ch	P	+	+	+	+	+
Boraginaceae	<i>Heliotropium europaeum</i> L.	Th	A	+	+	+	+	+
Brassicaceae	<i>Capsella-bursa pastoris</i> (L.) Medik.	Th	A	+	+	+	+	+
	<i>Lepidium draba</i> L.	H	A	+	+	+	+	+
	<i>Raphanus raphanistrum</i> L.	Th	A	+	+	+	+	+
	<i>Sinapis arvensis</i> L.	Th	A	+	+	+	+	-
	<i>Sisymbrium altissimum</i> L.	Th	A	+	+	+	-	+
Caryophyllaceae	<i>Stellaria media</i> (L.) Will	Th	A	+	+	+	+	+
Chenopodiaceae	<i>Chenopodium album</i> L.	Th	A	+	+	+	+	+
Convolvulaceae	<i>Convolvulus arvensis</i> L.	H	P	+	+	+	+	+
Cucurbitaceae	<i>Echballium elaterium</i> L.	H	P	+	+	+	+	+
Cuscutaceae	<i>Cuscuta capestris</i> Yunck.	Th	A	+	+	-	-	-
Cyperaceae	<i>Cyperus rotundus</i> L.	G	P	+	+	+	+	+
Euphorbiaceae	<i>Euphorbia helioscopia</i> L.	Th	A	+	+	+	+	+
	<i>Mercurialis annua</i> L.	Th	A	+	+	+	+	+
Fabaceae	<i>Trifolium repens</i> L.	Th	P	+	+	+	+	+
Geraniaceae	<i>Geranium dissectum</i> L.	Th	A	+	+	+	+	-
	<i>Geranium molle</i> L.	Th	A	+	+	+	+	-
Lamiaceae	<i>Ballota nigra</i> L.	H	P	+	+	-	+	-
	<i>Lamium amplexicaule</i> L.	Th	A	+	+	+	+	-
	<i>Melisa officinalis</i> L.	H	P	+	+	-	-	-
Fumariaceae	<i>Fumaria officinalis</i> L.	Th	A	+	+	+	+	-
Malvaceae	<i>Malva neglecta</i> Wallr.	Th	A	+	+	+	+	-
Oxalidaceae	<i>Oxalis corniculata</i> L.	H	P	+	+	+	-	+
Papaveraceae	<i>Papaver rhoeas</i> L.	Th	A	+	+	+	+	-
Plantaginaceae	<i>Plantago lanceolata</i> L.	H	P	+	+	+	+	+
	<i>Plantago major</i> L.	H	A/P	+	+	+	+	+
Poaceae	<i>Elymus repens</i> (L.) Gould.	H	A	+	+	+	+	+
	<i>Alopecurus myosuroides</i> Huds	H	A	+	+	+	+	+
	<i>Avena fatua</i> L.	Th	A	+	+	+	+	+
	<i>Bromus tectorum</i> L.	Th	A	+	+	+	+	+
	<i>Cynodon dactylon</i> L.	G	A/P	+	+	+	+	+
	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Th	A	+	+	+	+	+
	<i>Eleusine indica</i> (L.) Gaertn.	Th	A	+	+	+	+	+
	<i>Lolium perenne</i> L.	H	P	-	-	-	-	+
	<i>Poa annua</i> L.	Th	A	+	+	+	+	+
	<i>Setaria viridis</i> (L.) Beauv	Th	A	+	+	+	+	+
<i>Sorghum halepense</i> (L.) Pers.	H	A	+	+	+	+	+	
Polygonaceae	<i>Rumex crispus</i> L.	H	P	+	+	+	+	+
	<i>Polygonum aviculare</i> L.	Th	A	+	+	+	+	+
Portulacaceae	<i>Portulaca oleacea</i> L.	Th	A	+	+	+	+	+
Primulaceae	<i>Anagallis arvensis</i> (L.) U. Manns & Anderb.	Th	A	+	+	+	+	-
Rosaceae	<i>Potentilla reptans</i> L.	H	A/P	+	-	-	-	+
Rubiaceae	<i>Galium aparine</i> L.	Th	A	+	+	+	-	-
Santalaceae	<i>Viscum album</i> L.	Ph	P	+	-	+	+	-
Scrophulariaceae	<i>Veronica hederifolia</i> L.	Th	A	+	+	+	+	-
Solanaceae	<i>Datura stramonium</i> L.	Th	A	+	+	+	-	+
	<i>Solanum nigrum</i> L.	Th	A/P	+	+	+	+	+
Zygophyllaceae	<i>Tribulus terrestris</i> L.	Th	A	+	+	+	+	+

Th: Therophyte, G: Geophytes, H: Helophytes, Ch: Chamephyte, Ph: Phanerophyte, A: Annual, Bi: Biannual, P: Perannual, C: Cherry, Ap: Apple, P: Pear, Al: Almond, W: Walnut

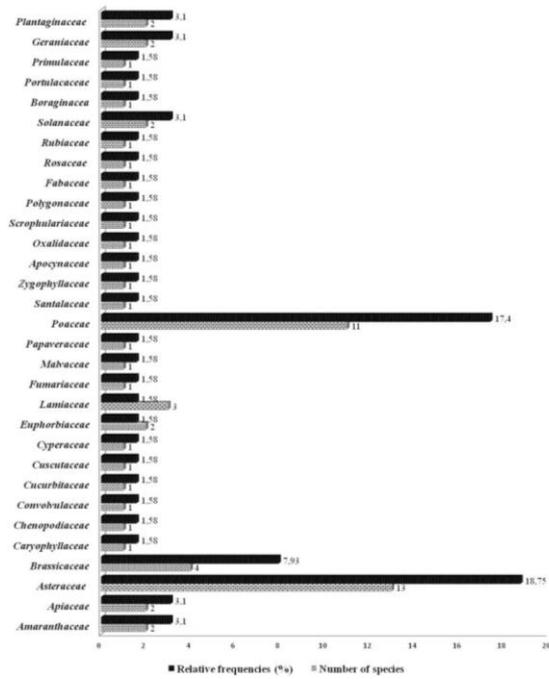


Figure 1 Relative frequencies of families and the number of species

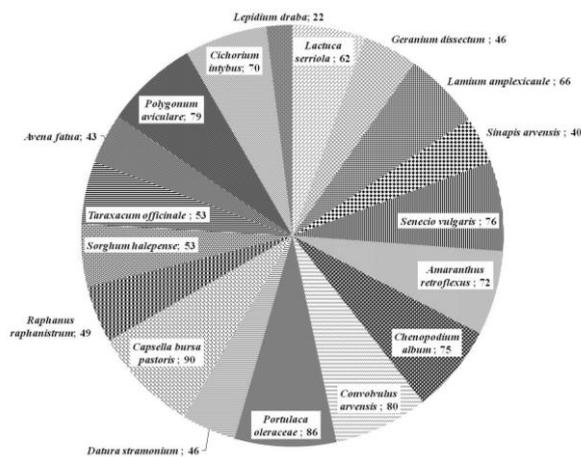


Figure 2 Frequency of distribution of some weed species in orchards

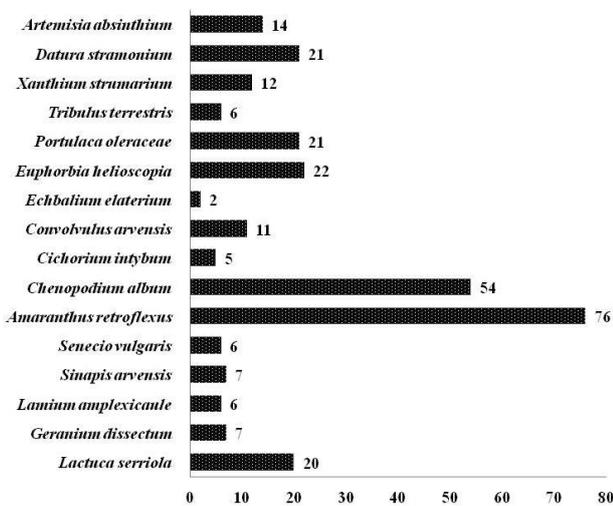


Figure 3 Average plant density of some weed species in study area (plant/m<sup>2</sup>)

Dicotyledons are broad-leaved weeds with paired cotyledons. Out of 64 weeds recorded 52 were broad-leaved dicotyledons. The most frequently encountered species in cherry, apple, pear, almond and walnut orchards were *Capsella bursa pastoris*, *Solanum nigrum*, *Convolvulus arvensis*, *Amaranthus retroflexus*, *Chenopodium album* and *Portulaca oleraceae* occurring in up to 80% of sampled areas (Figure 2).

The predominant species present in visited orchards in Tekirdağ were *Capsella bursa pastoris* (93%), *Polygonum aviculare* L. (86%), *Portulaca oleraceae* L. (83%) *Cichorium intybus* L. (80%) following *Convolvulus arvensis* (82%), *Senecio vulgaris* L. (81%), *Chenopodium album* L. (76%), *Amaranthus retroflexus* L. (76%), *Lactuca serriola* L.(70%), *Raphanus raphanistrum* L. (60%), *Lepidium draba* L. (56%), *Sorghum halepense* L. (44%). In contrast *Datura stramonium* (60%) was common in walnut growing areas. *A. retroflexus* can grow well in sandy, clay, loam soil types, has drought tolerance and is capable of producing over 200,000 seeds (Walsh, 1993; Stevens, 1957). *C. album* is highly adaptable to wide range of climate conditions and produce 200 and 20,000 seeds/plant (Korsmo et al., 1981; Ozer et al., 1998). In addition *S. halepense* is very competitive and adaptive to all kind of soil and climate conditions. With its self-compatible characteristic and seed longevity this weed can reproduce in any suitable condition and easily disperse. By rapid growing this weed directly shades newly planted rootstocks decreases nutrient and moisture availability to other plants (Holm et al., 1977). Besides *S. halepense* secrete some allelopathic compounds like dhurrin which has growth inhibition effect on other plants (Tesio and Ferrero, 2010).

*Solanum nigrum*, *C. bursa pastoris* require hot and longer daylight period but can grow in any type of soil. The soil and weather conditions of Northwestern Marmara Region is appropriate for growth of these species. On the other hand *P. oleraceae* likes more moist and fertile soils. Plants cannot grow healthy under dry conditions. According to our observations plenty of *P. oleraceae* plants were observed in most of irrigated orchards in both provinces.

Although *D. stramonium* was one of the predominant weed species in walnut orchards, it was not observed in any of the almond orchards. *D. stramonium* prefer arable and fertile soils. The weed distribution and population density were lowest in Tekirdağ due to unmanaged and non-tilled soils. On the contrary due to well managed-tilled soil and appropriate climate conditions in Kırklareli and Edirne *D. stramonium* was able to reproduce by several ways and disperse to new areas. The frequency of occurrence of this weed in Edirne province Uzunköprü district and Kırklareli province Kızılcıkdere village was estimated as 57% and 71% respectively. This weed has been reported as a weed in more than 40 crops in almost 100 countries (Holm et al., 1997). Approximately 56% yield reduction effect of this weed on maize and cotton were reported in different countries (Witt and Luke, 2017).

The blooming period of these dicotyledons differ as well. Some species flower in summer months while others flower in spring, autumn and winter (Table 3).

The increase of weed density in irrigated and fertile orchards was significant whereas rare distribution of several species were observed in non tilled and non irrigated areas. Physical and chemical characteristics of soil, moisture content, cropping system, tillage type, environmental and climatic conditions, weed control practices found to influence weed distribution and population density.

Table 3 Blooming period of broad leaved weed species

Weed species	Bloom period	Weed species	Bloom period
<i>Amaranthus retroflexus</i> L.	July - Sept.	<i>Malva neglecta</i> Wallr.	June-Sept.
<i>Artemisia absinthium</i> L.	July-Sept.	<i>Melisa officinalis</i> L.	June-Aug.
<i>Anagallis arvensis</i> (L.) U. Manns & Anderb.	Apr.-Aug.	<i>Mercurialis annua</i> L.	July - Sept.
<i>Ballota nigra</i> L.	June-Oct.	<i>Oxalis corniculata</i> L.	May-Aug
<i>Bifora radians</i> L. Bieb	April-July	<i>Papaver rhoeas</i> L.	May-Aug
<i>Capsella-bursa pastoris</i> (L.) Medik.	April-May	<i>Plantago lanceolata</i> L.	April- Sept.
<i>Carduus nutans</i> L.	April-Aug.	<i>Plantago major</i> L.	April- Sept.
<i>Chenopodium album</i> L.	June-Sept.	<i>Polygonum aviculare</i> L.	April-Oct.
<i>Cirsium arvense</i> L.	May-Sept.	<i>Portulaca oleacea</i> L.	June- Sept.
<i>Cichorium intybus</i> L.	May-Aug.	<i>Potentilla reptans</i> L.	May-July
<i>Conium maculatum</i> L.	Apr.-July	<i>Raphanus raphanistrum</i> L.	July-Aug.
<i>Convolvulus arvensis</i> L.	May-Sept.	<i>Rumex crispus</i> L.	Apr.-Sept.
<i>Conyza canadensis</i> L.	July-Sept.	<i>Senecio vulgaris</i> L.	June-Aug.
<i>Cuscuta campestris</i> L.	July-Sept	<i>Silybum marianum</i> (L).Gaertn	July-Aug.
<i>Cynanchum acutum</i> L.	May-Oct.	<i>Sinapis arvensis</i> L.	March- Aug.
<i>Datura stramonium</i> L.	July-Oct.	<i>Sisymbrium altissium</i> L.	April- Aug.
<i>Echballium elaterium</i> L.	April-Oct.	<i>Solanum nigrum</i> L.	June- Sept.
<i>Euphorbia helioscopia</i> L.	May-Aug.	<i>Sonchus arvensis</i> L.	March-Aug.
<i>Fumaria officinalis</i> L.	May- Aug.	<i>Stellaria media</i> (L.) Will.	Feb.-June
<i>Galium aparine</i> L.	May- July.	<i>Taraxacum officinale</i> F.H.Wigg	Feb.- May
<i>Geranium dissectum</i> L.	May-Aug.	<i>Trifolium repens</i> L.	March-July
<i>Geranium molle</i> L.	May-Aug.	<i>Tribulus terrestris</i> L.	June-Nov.
<i>Heliotropium europaeum</i> L.	June-Sept.	<i>Viscum album</i> L.	March-May
<i>Lactuca serriola</i> L.	April-Aug.	<i>Veronica hederifolia</i> L.	March-June
<i>Lamium amplexicaule</i> L.	Apr.-Aug.	<i>Xanthium strumarium</i> L.	July-Sept.
<i>Lepidium draba</i> L.	Apr.-Aug.		

Table 4 Booming period of narrow leaved weed species

Weed species	Bloom period	Weed species	Bloom period
<i>Elymus repens</i> (L.) Gould.	May-June.	<i>Eleusine indica</i> (L) Gaertn.	June-Sept.
<i>Alopecurus myosuroides</i> L. Huds.	May-June	<i>Lolium perenne</i> L.	May-July
<i>Avena fatua</i> L.	Apr.-May	<i>Poa annua</i> L.	March-April
<i>Bromus tectorum</i> L.	Apr.-June.	<i>Setaria viridis</i> (L.) Beauv.	June-Sept.
<i>Cynodon dactylon</i> L.	July-Oct.	<i>Sorghum halepense</i> (L.) Pers.	July-Dec.
<i>Echinochloa crus-galli</i> (L.) P. Beauv.	July-Oct.	<i>Cyperus rotundus</i> L.	July-Nov.

Table 5 Number of species in each life form associated with five fruit trees.

Life form	Number of species				
	Cherry	Apple	Pear	Almond	Walnut
Therophyte	37	38	36	32	28
Hemicryptophyte	18	18	16	14	10
Geophytes	3	3	3	3	3
Chamaephyte	2	2	2	2	2
Phanerophyte	1	0	1	1	0

Table 6 The floristic elements of weed species in survey areas

Floristic elements	Number of species	Percentage (%)
Cosmopolitan	34	53.1
Eur + Asian	18	28.1
Eur-Asia+North Africa	7	10.9
Europe	1	1.58
Medirerranean	1	1.58
North Africa	1	1.58
South America	1	1.58
North America	1	1.58

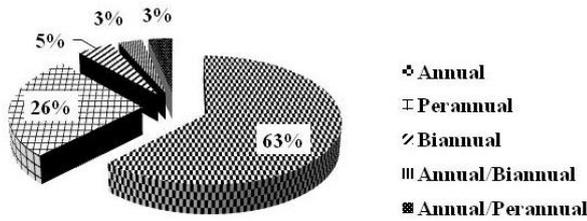


Figure 4 The percentage of weed species in terms of life span

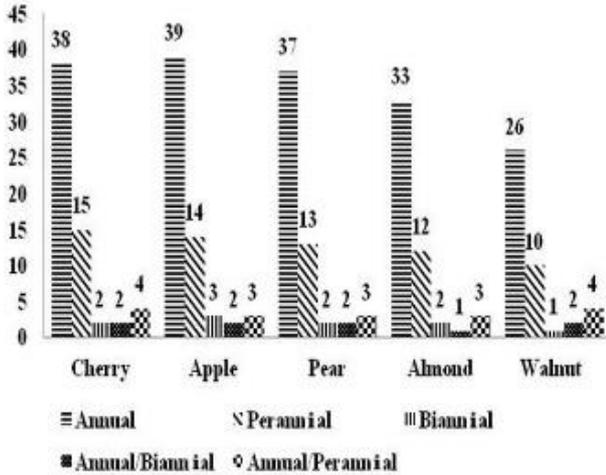


Figure 5 The number of weed species in each fruit tree in terms of life span

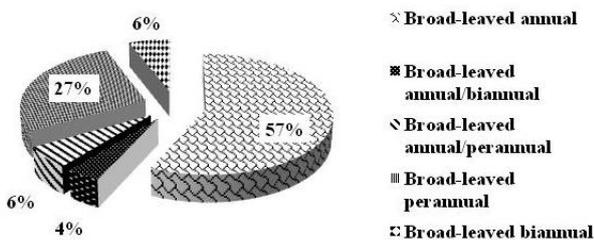


Figure 6 Relative frequencies of broad leaved weeds in terms of life span

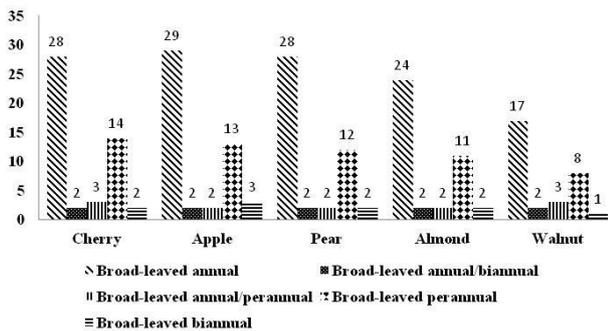


Figure 7 The number of broad leaved weed species in each fruit tree in terms of life span

The highest weed density was noted for *A. retroflexus* and *C. album*, with 76.00 and 54 plant/m<sup>2</sup>, respectively. The other dense weeds were *Datura stramonium*, *Euphorbia helioscopia*, *P. oleracea* and *Lactuca serriola* with 24, 22, 21 and 20 plants/m<sup>2</sup> (Figure 3). The density of *D. stramonium* (21 plant/m<sup>2</sup>) and *A. retroflexus* (52 plant/m<sup>2</sup>) was higher in walnut orchards, *Artemisia absinthium* (21 plant/m<sup>2</sup>) was predominant in apple growing areas, *P. oleracea* and *C. album* was predominant in almond and pear plantations.

Among broad leaved species one species was parasitic weed. European mistletoe *Viscum album* was observed on almond, cherry and pear trees. Compared to apple the intensity of dodder infection was higher in cherry trees. Widespread distribution of this weed in Tekirdağ Province Malkara and Süleymanpaşa districts, Edirne Province Keşan district and Kırklareli Province Merkez district was observed. The number of parasitized fruit trees was counted as 77 in Kızılıçkdere Village of Kırklareli. The higher distribution of this weed is considered to be due to abundant presence of pollinator insects and vector birds.

Additionally to mistletoe another parasitic weed dodder *Cuscuta campestris* Yunck was found attached to newly emerged apple scions and cherry rootstocks (Figure 5). This parasite was detected in two locations in Tekirdağ. Cherry rootstocks were heavily parasitized in infested orchard. (Figure 5). Dodder are a group of over 150 species in the genus *Cuscuta* (McNeal et al., 2007). Dodder is a parasitic annual that relies on its host for survival. These species have a wide variety of host plants and in our survey *C. campestris* was seen attached to young apple scions and cherry rootstocks.

The rest of weeds were narrow leaved monocotyledons. These resemble long grasses with parallel veins and round stems. *Bromus tectorum*, *Agropyron repens*, *Alopecurus myosuroides*, *Poa annua*, *Sorghum halepense*, *Echinochloa crus-galli*, *Setaria viridis*, *Cynodon dactylon*, *Avena fatua*, *Eleusine indica.*, *Lolium perenne* are grass from Poaceae and *Cyperus rotundus* from Cyperaceae family were recorded in orchards in Northwestern Marmara. These narrow leaved monocotyledons bloom at different periods, some flowering in winter and some in summer (Table 4).

As regard to life span recorded weeds classified in five groups: Annuals, biannuals, perennials and some with both annual/biennial and annual/perennial characteristics. Among 64 species 39 were annuals, 16 were perennials, 3 species were biennial, 2 species were annual/biennial and 4 species were annual/perennial (Figure 4, Figure 5). The majority of broad leaved dicotyledons were annual weeds (Figure 6, Figure 7).

Based on our records more than half of monocotyledons were annual weeds (Figure 8). Walnut orchards contain all narrow leaved weeds while *Lolium perenne* perennial weed was not present in cherry, apple, pear and almond orchards (Figure 9).

Life form analysis of weed flora in Northwestern Marmara showed dominant presence of therophytes (38 species) whereas hemicryptophytes were recorded the second most frequent life form (20 species) following Geophytes (3 species) Chamaephytes (2 species) and Phanerophyte (1 species) (Figure 10). Most of the species in apple, cherry, almond and walnut trees were therophytes (Table 5).

Most of the weeds in surveyed areas belong to the cosmopolitan floristic element, followed by Eur-Asian+ North African (Table 6). The others were Mediterranean, North Africa, South America and North America which has only one species.

Some of the recorded weeds in our study including *Solanum nigrum*, *Sorghum halepense* and *Taraxacum officinale* are known as alternate host of several nematode species, pathogens, many viral diseases including *Raspberry Ringspot Nepovirus*, *Cherry Raspleaf Virus*,

*Tomato Ringspot Virus* and *Tobacco Ringspot Nepovirus* (Hansen et al., 1974; Holm et al.,1977; Holm et al., 1991; Mountain et al., 1992). These weeds are also main hosts of several aphids and moths (Landolt, 2002).

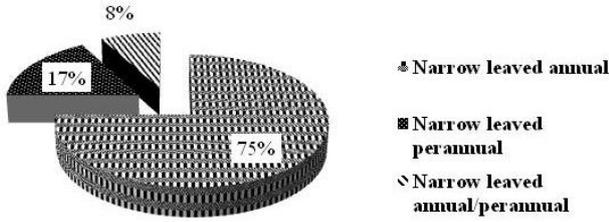


Figure 8 Relative frequencies of narrow leaved left weeds in terms of life span

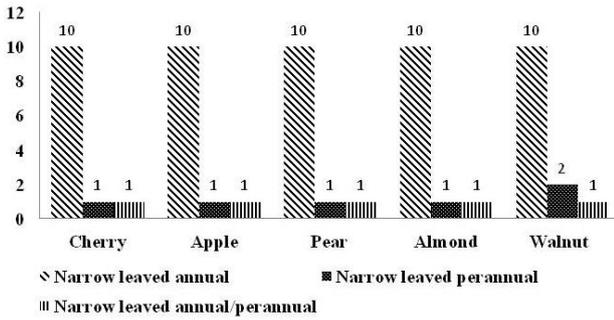


Figure 9 The number of narrow leaved weed species in each fruit tree in terms of life span

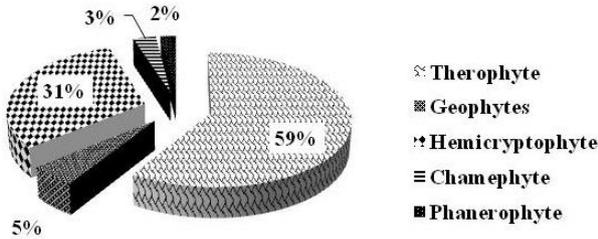


Figure 10 Life form percentages recorded in the study area

## Conclusion

This study provide the information on recent weed flora of Northwestern Marmara Region of Turkey. The weed flora constitute 64 species of which some were reported important competitors. Within 64 species 39 were annuals, 16 were perennials, 3 species were biannual, 2 species were annual/biannual and 4 species were annual/per annual. The weed flora of orchards has not been studied and our findings will promote for further studies to solve weed problems.

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