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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Determination of Important Weed Species, Densities and Frequencies in Hazelnut (*Corylus avellana* L.) Orchards in Düzce Province*

Düzce İli Fındık (*Corylus avellana* L.) Bahçelerinde Görülen Önemli Yabancı Ot Türleri, Yoğunlukları ve Rastlanma Sıklıklarının Belirlenmesi

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Abstract

Hazelnut (*Corylus avellana* L.) cultivation has strategic value for Türkiye, which is a leader in global hazelnut production. This study aims to determine the important weed species, densities, and frequencies in hazelnut orchards in Düzce province. The presence of weeds is a significant challenge in hazelnut cultivation as they compete with the crop for nutrients, water, and sunlight, while also serving as hosts for pests and pathogens. Effective weed management is critical to maintaining yield and quality. Field research was conducted in 50 hazelnut orchards in 8 districts of Düzce and weed densities and frequencies were calculated using the Odum & Barrett method. In the survey studies conducted in Düzce hazelnut orchards, it was determined that 103 weed taxa belonging to 31 families and the ones with the species with the densest populations included *Potentilla reptans* (creeping cinquefoil) (35.46 plants m^{-2}), *Poa pratensis* (meadow grass) (12.15 plants m^{-2}), and *Bromus hordeaceus* subsp. *hordeaceus* (soft brome) (11.97 plants m^{-2}). The most frequent species were calculated to be *Potentilla reptans* (creeping cinquefoil) (81.80%), *Oenanthe silaifolia* (narrow-leaved water-dropwort) (78.34%) and *Lapsana communis* (nipplewort) (60.72%). Among the families identified, the *Poaceae* family has the highest number of species (19), followed by *Fabaceae* (14) and *Asteraceae* (13). Studies have detected those motorized scythes and herbicides, whose increased use may cause environmental effects and increase pest problems, are widely used in weed control. Identifying weed species and understanding their density and frequency will contribute to the adoption of more precise and environmentally friendly control methods and thus to increasing productivity and sustainability in hazelnut cultivation. Based on these findings, by applying targeted weed control measures, yield losses can be significantly reduced, beneficial organisms can be protected and the overall productivity and economic sustainability of hazelnut agriculture in Düzce Province can be contributed.

Keywords: Weed, Hazelnut, Survey, Density, Frequency, Düzce

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Öz

Fındık (*Corylus avellana* L.) yetiştiriciliği, küresel üretimde lider konumda olan Türkiye için stratejik değer taşımaktadır. Bu çalışmanın amacı Düzce ili fındık bahçelerinde bulunan önemli yabancı ot türlerini, yoğunluklarını ve sıklıklarını belirlemektir. Yabancı otların varlığı; besin maddesi, su ve güneş ışığı için ürünle rekabet ederken, aynı zamanda zararlılar ve patojenler için de konukçu görevi gördükleri için fındık yetiştiriciliğinde önemli bir zorluktur. Etkili yabancı ot yönetimi, verim ve kaliteyi korumak için kritik öneme sahiptir. Düzce'de 8 ilçede 50 fındık bahçesinde Odum & Barrett yöntemine göre sürvey çalışması yapılarak yabancı ot yoğunlukları ve sıklıkları hesaplanmıştır. Düzce fındık bahçelerinde yapılan çalışmalarda 31 familyaya ait 103 yabancı ot türü ve en yoğun popülasyona sahip olanlarının *Potentilla reptans* (reşatınotu) (35.46 bitki m^{-2}), *Poa pratensis* (çayır salkımotu) (12.15 bitki m^{-2}) ve *Bromus hordeaceus* subsp. *hordeaceus* (başakotu) (11.97 bitki m^{-2}) olduğu belirlenmiştir. En sık görülen türler arasında *Potentilla reptans* (reşatınotu) (%81,80), *Oenanthe silaifolia* (attohumu) (%78.34) ve *Lapsana communis* (şebrek) (%60.72) yer almaktadır. Tespit edilen familyalar arasında *Poaceae* familyası en fazla tür sayısına (19) sahip olup onu *Fabaceae* (14) ve *Asteraceae* (13) takip etmektedir. Teşhis edilen türler arasında en çok temsil edilen familyalar *Poaceae, Fabaceae* ve *Asteraceae* olmuştur. Yapılan çalışmalarda yabancı ot kontrolünde motorlu tırpanların, çevresel etkilere ve haşere sorunlarının artışına sebep olabilecek herbisitlerin yaygın olarak kullanıldığı belirlenmiştir. Yabancı ot türlerinin, yoğunluklarının ve rastlanma sıklıklarının belirlenmesi; daha kesin ve çevre dostu kontrol yöntemleri benimsenmesine ve böylece fındık yetiştiriciliğinde üretkenlik ve sürdürülebilirliğin arttırılmasına katkıda bulunacaktır. Bu bulgulara dayanarak hedefe yönelik yabancı ot kontrol önlemlerinin uygulanması ile verim kayıplarını önemli ölçüde azaltılabilir, faydalı organizmalar korunabilir ve Düzce ilindeki fındık tarımının genel verimliliğine ve ekonomik sürdürülebilirliğine katkıda bulunulabilir.

Anahtar Kelimeler: Yabancı ot, Fındık, Sürvey, Yoğunluk, Rastlanma sıklığı, Düzce

1. Introduction

Hazelnuts, whose homeland is the Black Sea coast, are cultivating primarily in Türkiye, in Europe in Spain, Italy, France, and Russia; in Asia in Georgia, Azerbaijan, Iran, and China; and in America in the USA and Chile. Also, efforts are intending to expand hazelnut production in many countries worldwide (Anonymous, 2019a). Hazelnut cultivation is one of the main livelihoods of the Black Sea Region countryside in Türkiye. Thusly, most of the hazelnut production in the world is carried out in Türkiye (Yenisu, 2017). For this reason, hazelnut cultivation has significant strategic value for our country.

In the agricultural production of hazelnuts, which has a valuable place in terms of nutrition and consumption in the world and our country, the importance of fighting against diseases, pests, and weeds, which are among the factors that reduce productivity, is increasing today (Eker and Kolören, 2023; Yonat and Kolören, 2023). It has been known for years that the effects of weeds on crop plants cause a significant decrease in yield and quality. Weeds compete with cultivated plants for nutrients, water, and sunlight, and also host pests and pathogens, causing an increase in diseases and pests (Mennan et al., 2006; Öğüt Yavuz and Boz, 2007). Weeds can also make harvesting operations more costly because they make it difficult to harvest the grown crops. Hazelnut producers generally carry out weed control in the orchards before harvest time and one of these methods is to use plant protection products. However, inappropriate total herbicide applications can harm both the environment and the hazelnut plant. In recent years, it has also been thought that the increasing use of herbicides in hazelnut orchards has increased the hazelnut skunk population and thus the resulting crop damage (Köse et al., 2014). In our country, survey studies on weeds are not sufficient in hazelnut production areas, which have a strategic importance in economic and agricultural terms. In order to find the right solutions to the weed problem in hazelnut cultivation, identifying the species and determining their distribution and density is of primary importance (Mennan et al., 1999).

Mennan et al. (1999) identified 210 weed species belonging to 54 different families as a result of 108 survey studies carried out between 1997 and 1999 in order to detect the weed species that are problematic in the hazelnut orchards of the Black Sea Region. These identified weed species, 32 were monocotyledonous and 178 were dicotyledonous. The important weed species in the region, according to their frequency, are; *Pteridium aquilium*, *Rubus dicolor*, *Bellis perennis*, *Poa annua*, *Convolvulus arvensis*, *Mercurialis annua*, *Poa trivialis*, *Avena fatua* and *Urtica urens*.

Aslan et al. (2001) determined 253 weed species belonging to 37 different families as a result of the study carried out between 1997 and 1999 in order to determine the weed species that are problematic in the pistachio orchards of the Southeastern Anatolia Region. These determined weed species, 124 were annual and 129 were perennial. The number of endemic species is 18 and the endemism rate is 7.1%. The main families in the study area in terms of the number of species they contain are; *Leguminosae* (*Fabaceae*) 22.1% (56 species), *Cruciferae* (*Brassicaceae*) 11.1% (28 species), *Gramineae* (*Poaceae*) 6.7% (17 species), *Compositae* (*Asteraceae-Cichoraceae*) 5.9% (15 species) and *Ranunculaceae* 5.5% (14 species).

Yazlık et al. (2019) detected 68 weed species (herbaceous/shrub) from 29 families in the study conducted to understand the weed species found in fruit nursery production areas in Düzce and the effects of these species. The most detected species were in the *Poaceae* families with 11 species and the Asteraceae families with 10 species, followed by the *Brassicaceae* (6 species) and *Fabaceae* (5 species) families. While the majority of the species are annual (34 species) and perennial (22 species) in terms of lifespan, one species has a biennial lifespan, and 11 species have a common lifespan. In terms of life form, 67 species are herbaceous and only one species (*Rubus* sp.) is shrub. The environmental and socioeconomic impacts caused by the identified species were evaluated as positive and negative impacts, and the most impact type was determined in 44 taxa included in the scope of environmental and socioeconomic impact.

This study aims to determine the weed species that share the plant nutrients in the soil and have a role as vectors for many diseases and pests in the cultivation of hazelnuts, an agricultural product of strategic importance for Türkiye, in Düzce province, their density and frequency. The goal of this study is to facilitate the selection of the control method in hazelnut orchards and to encourage the application of the most appropriate friendly weed control methods for the environment that will prevent yield losses. In addition, by becoming aware of the beneficial weeds

growing in the hazelnut gardens in the province, it is envisaged that such species will be utilized and contribute to the country's economy.

2. Materials and Methods

2.1. Research Area

The territory of Düzce Province is surrounded by Sakarya from the west, Bolu from the south and southeast, and Zonguldak from the northeast. It has a 35 km long coastline on the Black Sea in the north (*Figure 1*). The area covered by the provincial territory is 259,300 hectares. Located on the same latitude as Kocaeli and Sakarya provinces, the westernmost and eastern ends of Düzce are between 30° 49' and 31° 51' east longitudes and are approximately 88 km long. The southernmost and northernmost points of the province are located between 40° 37' and 41° 06' northern latitudes, and the distance between the North and South extreme points is approximately 52 km. Along with the central district, it has 8 districts: Akçakoca, Cumayeri, Çilimli, Gölyaka, Gümüşova, Kaynaşlı, Yığılca (Anonymous, 2011).

Figure 1. Map of districts where weed surveys are carried out in hazelnut orchards in Düzce province (Saygılı, 2020)

55% (38.903 ha) of Düzce city center, 33% (3.992 ha) of Gümüşova, 62% (16.741 ha) of Gölyaka, 35% (806 ha) of Çilimli, 33% (778 ha) of Cumayeri, 42% (17.266 ha) of Akçakoca, 65% (32.666 ha) of Yığılca and %64 (11.350 ha) of Kaynaşlı are forest areas, a total of 51% (122.502 ha) of Düzce province is forest area. Approximately 86% of Düzce, 2.200 km², is mountainous and rugged and the mountains are separated by deep valleys in many places (Anonymous, 2022c). According to long-term average meteorological data in Düzce Province, the month with the most rainfall is December, and the month with the least rainfall is July. The total annual rainfall is 829.8 mm per m² (Anonymous, 2022d).

The cultivated agricultural land of Düzce province is 74.854 hectares and approximately 30.000 hectares of the agricultural area in question is irrigable. 12.092 hectares of agricultural land are irrigated in the province. Only 35% of the real area of Düzce province can be used as agricultural land. 122.034 hectares of the land, that is, approximately 47%, is forest area. Düzce has 7,932 hectares of pasture and meadow area, and the remaining 37.919 hectares of its land assets are non-agricultural land. A very small part of the actual area of Düzce province is Class I agricultural land. The total of first, second and third class land, defined as absolute agricultural land, reaches only 15% of the land asset (Anonymous, 2019b).

There are first class alluvial soils in most of the Düzce plain. These soils lie on young sediments carried by streams and are generally layered. The transition between topsoil and subsoil is unclear. Alluvial soils are 75% suitable for agriculture and suitable for various products. Additionally, colivial and non-calcareous brown forest soils are found around Düzce. Collivial soils consist of materials accumulated in places where the slope decreases.

Non-limestone brown soils are rich in organic matter, acidic character and occur under deciduous forests. These soils are suitable for agriculture and are especially ideal for the production of beets, potatoes, vegetables, and fruits (Anonymous, 2022a).

Düzce province is located in the A3 square according to the vegetal square system of P.H. Davis (1965). This area is under the influence of the Euro-Siberian flora area and the Mediterranean (Mediterranean) flora area, which are generally distributed in the northwestern Black Sea region. Still, it is also under the slight influence of the Iranian-Turanian flora area. Düzce is located in the transition zone between Emcine (Central Western Black Sea) and Xsero-Euxine (Arid Western Black Sea) in terms of flora. While the effect of the sub-region (Sub-Euxine) of the European-Siberian flora area is seen in the Samandere Valley and the surrounding Abant Mountains (1600 m) in the southeast, the Mediterranean flora area effect is seen locally in the Uğursuyu Creek valley located in the front northern part. The Iranian-Turanian flora area effect is seen in the south of the area, in the transition zones to the Xero-Euxine flora area with xeriform character, in the high parts of Sinekli and Sakarca plateaus, and in the subalpine vegetation areas of the Abant Mountains at 1500-1600 m. Due to its geographical location and geomorphological structure, Düzce has a rich flora and vegetation diversity, that includes stream, remnant maquis, forest, sub-alpine and rock vegetation types, and the spread of rare plant habitats (Aksoy et al., 2016).

2.2. Field Studies

Table 1. Hazelnut orchard areas, number of trees, yield and production amounts and the number of orchards to be surveyed in Düzce city center and districts (Anonymous, 2024)

District	Production Area (Decare)	Number of Trees (Number)	Yield (kg Tree^{-1})	Production (Ton)	Number of Gardens to be Surveyed (Number)
Akçakoca	218.670	10.832.000	3	29.064	17
Cumayeri	54.000	2.675.000	2	5.825	4
Çilimli	35.250	1.762.000	4	6.631	3
Gölkaya	42.290	2.111.750	2	5.207	4
Gümüşova	34.760	1.735.500	3	4.635	3
Kaynaşlı	23.150	1.157.500	3	4.008	2
Yığılca	94.500	4.725.000	3	14.688	7
City Center	129.030	6.451.250	2	15.630	10
Total	631.650	31.450.000	3	85.688	50

The research was carried out in lands in the Survey region, Düzce province, City Center, Akçakoca, Yığılca, Cumayeri, Gölyaka, Çilimli, Gümüşova and Kaynaşlı districts. In this research, it was planned to conduct surveys in hazelnut orchards for a total of 50 orchards according to tree counts of every district. In determining the number of gardens to be surveyed, it was planned to carry out surveys in a total of 50 gardens, considering the difficulty of transportation, the time spent during the survey, the time and labor to be spent during the census. The distribution of these 50 gardens by districts was proportioned and distributed as in *Table 1*, considering the shares of each district in the total hazelnut garden area of the province. Various road routes were determined and in the selection of the points for sampling, the width of the hazelnut production area as well as their distance from each other in different directions to represent the district were taken into consideration.

In order to avoid edge effects in hazelnut gardens, approximately 10 m should be entered, and in the counts, a 1/4 m² square frame was thrown according to the size of the garden, as seen in *Figure 2*; Weed species found in the area within the frame and their densities per m² were determined for that counting point. The number of samples was determined according to the size of the hazelnut orchards, and the frame was thrown 4 times up for 1-5 decares, 6 times for between 5-10 decares, and at least 8 times for hazelnut orchards larger than 10 decares. When counting weed species, broad-leaved weeds were counted as the whole plant, and in narrow-leaved ones, each tiller (spike) was counted as a plant and recorded in the survey forms in this way. The frame was randomly thrown by moving in the direction of the diagonals of the entered garden. Plants entering the frame and those touching the outside of the frame were separated and counted according to weed species (Kara and Ata, 2021).

Figure 2. Weed species detection and counting in hazelnut orchards where survey studies were carried out

A sufficient number of plant samples from each weed species detected during the survey were collected and dried by pressing between newspaper papers in accordance with the technique to make them suitable for diagnosis (*Figure 2*). Then, samples were glued to standard-size cardboards (*Figure 3*) and turned into herbarium materials. Weed identification studies were carried out by Prof. Dr. Necmi AKSOY and Dr. Serdar ARSLAN in the Düzce University Faculty of Forestry (DUOF) Herbarium laboratory (*Figure 3*) and plant samples were recorded in the Düzce University Faculty of Forestry (DUOF) Herbarium inventory (Anonymous, 2022b).

Figure 3. Pressing and drying of plant samples in accordance with the technique & identification and registration of weed samples in the DUOF Herbarium

2.3. Evaluation of Population Measurements

After determining the weed species and their numbers, the frequency (F) of each species used in the evaluation of the population was determined. In determining the frequency, all weeds in the environment were recorded, regardless of whether they were included in the frame or not. Each Frequency (F, %) was calculated by using the number of survey points where each species is found (N) and the total number of sampled survey points (M). Frequencies were calculated according to Odum and Barrett (1971) and the following Equation (1) was used.

$$F = \left(\frac{N}{M}\right) \times 100 \qquad \text{(Eq. 1)}$$

Density (plant m^{-2}) was calculated by counting the individuals according to the genus and species of the weeds in the frame, multiplying the number of plants belonging to the species in each frame by four, taking the arithmetic averages according to the number of frames thrown, and densities of the weeds at that counting point were calculated. In these determined areas, the density and frequency of weeds according to the number of frames were calculated using Odum and Barrett (1971) and Uygur (1991). Using Bora and Karaca (1970), the density of weed species at the district level was determined on a weighted average basis. The density of weeds at the district level was calculated by multiplying the weed density (plant m^{-2}) determined for each census point by the area of that garden and dividing the sum of these multiplication results by the total hazelnut garden area surveyed in that

district. The average of the species at the provincial level was calculated by taking the average of the districts (Uygur et al., 1984).

3. Results and Discussion

3.1. Results

The densities and frequency of the weed species detected in the hazelnut orchards of Düzce province according to the areas where the research was conducted are given in *Table 2*. As a result of the research, 103 weed species belonging to 31 families were identified. *Potentilla reptans* (35.46 plants m^{-2}), *Poa pratensis* (12.15 plants m^{-2}), *Bromus hordeaceus* subsp. *hordeaceus* (11.97 plants m^{-2}), *Cynosurus cristatus* (10.52 plants m^{-2}), *Bromus sterilis* (8.97 plants m^{-2}), *Hordeum bulbosum* (8.43 plants m^{-2}), *Trifolium pratense* var. *pratense* (6.17 plants m^{-2}), *Holcus lanatus* (5.87 plants m^{-2}), *Alopecurus myosuroides* subsp. *myosuroides* (5.84 plants m^{-2}), *Trifolium campestre* (5.75 plants m^{-2}) species were determined as the 10 densest species throughout the province. The densest species are given in *Table 3*.

Considering the frequency; *Potentilla reptans* (81.80%), *Oenanthe silaifolia* (78.34%), *Lapsana communis* (60.72%), *Convolvulus arvensis* (51.37%), *Rubus tereticaulis* (43.87%), *Geranium pyrenaicum* (38.2%), *Trifolium campestre* (37.1%), *Trifolium pratense* var. *pratense* (32.13%), *Conyza canadensis* (31.81%), *Urtica dioica* subsp. *dioica* (31%, 72) took the first places. The most frequent species are given in *Table 4*.

The distribution of the weeds detected according to families as a result of the surveys carried out in the hazelnut orchards of Düzce province between April and July 2021 is shown in *Figure 4*. Among the families identified, *Poaceae* ranks first with 19 species, *Fabaceae* ranks second with 14 species, and *Asteraceae* ranks third with 13 species. These are followed by *Lamiaceae* with 7 species, Rosaceae with 7 species, *Boraginaceae*, *Caprifoliaceae*, *Geraniaceae*, *Plantaginaceae*, *Rubiaceae* with 3 species each, and *Caryophyllaceae*, *Convolvulaceae*, *Euphorbiaceae*, *Polygonaceae*, *Primulaceae* with 2 species each. Only one species from each of the 15 families could be identified respectively.

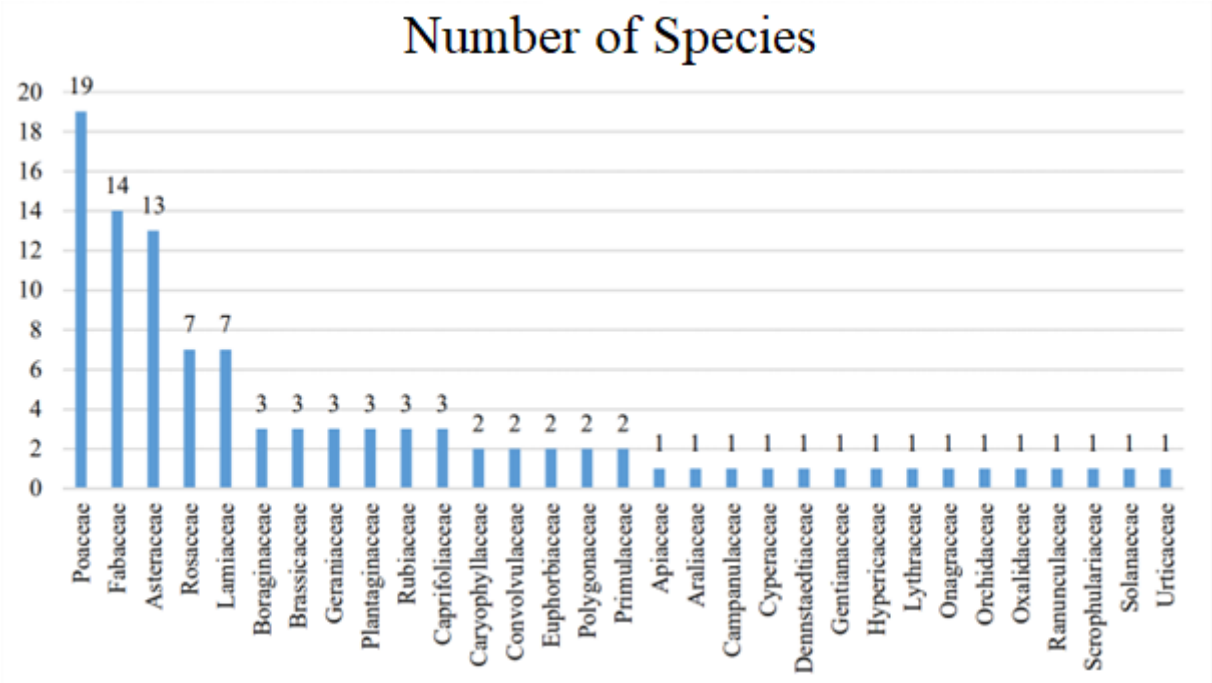

Figure 4. Distribution chart of weed species detected in hazelnut orchards in Düzce province according to families

1 ***Table 2. Weed species detected in hazelnut orchards in Düzce province, densities (plant m^{-2}) and frequencies (%)***

Weed Species	Akçakoca		Cumayeri		Çilimli		Gölyaka		Gümüşova		Kaynaşlı		Yığılca		Center		Düzce	
	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.
Agrimonia eupatoria L.	0.00	0.00	0.00	0.00	33.33	2.15	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.50	10.00	0.43	7.20	0.39
Ajuga reptans L.	5.88	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.09
Alopecurus myosuroides subsp. *myosuroides* Huds	5.88	2.80	50.00	2.17	33.33	26.31	0.00	0.00	100.0	15.44	0.00	0.00	0.00	0.00	0.00	0.00	23.65	5.84
Anacomptis pyramidalis L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.06	0.00	0.00	1.79	0.01
Anagallis arvensis L. var. *arvensis*	29.41	2.36	50.00	0.41	33.33	0.26	0.00	0.00	66.67	1.56	0.00	0.00	42.86	1.04	30.00	0.77	31.53	0.80
Anthemis cotula L.	17.65	0.83	50.00	2.17	33.33	1.35	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.08	0.00	0.00	14.41	0.55
Asperula involucrata Wahlenb.	5.88	3.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.39
Avena barbata Pott ex Link	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	14.93	0.00	0.00	0.00	0.00	0.00	0.00	4.17	1.87
Avena fatua L.	5.88	2.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.35
Bellis perennis L.	5.88	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.02
Bituminaria bituminosa (L.) C.H.Stirt.	0.00	0.00	25.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.30	0.00	0.00	4.91	0.18
Brachypodium pinnatum (L.) P.Beauv.	0.00	0.00	25.00	13.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	1.68
Briza maxima L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	5.80	0.00	0.00	0.00	0.00	0.00	0.00	4.17	0.73
Bromus hordeaceus subsp. *hordeaceus* L.	5.88	0.19	0.00	0.00	0.00	0.00	25.00	95.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.59	6.36	11.97
Bromus japonicus Thunb	5.88	3.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	7.20	20.00	7.32	5.02	2.27
Bromus sterilis L.	11.76	9.75	50.00	4.25	0.00	0.00	0.00	0.00	100.0	47.41	0.00	0.00	0.00	0.00	20.00	10.36	22.72	8.97
Calepina irregularis (Asso) Thell.	5.88	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.03
Calystegia silvatica (Kit.) Griseb.	11.76	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	1.20	10.00	0.43	4.51	0.22
Campanula glomerata subsp. *hispida* (Witasek) Hayek	0.00	0.00	0.00	0.00	33.33	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17	0.09
Centaurium erythraea subsp. *erythraea* Rafn.	5.88	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.54	1.99	0.09
Cichorium intybus L.	11.76	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.08	0.00	0.00	3.26	0.04
Clinopodium vulgare L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	5.60	0.00	0.00	1.79	0.70
Convolvulus arvensis L.	41.18	1.92	25.00	0.13	66.67	9.95	50.00	4.83	66.67	7.00	50.0	3.65	71.43	2.88	40.00	1.05	51.37	3.93
Conyza canadensis (L.) Cronquist	41.18	1.50	75.00	17.70	33.33	1.04	25.00	0.89	0.00	0.00	50.0	6.22	0.00	0.00	30.00	1.13	31.81	3.56
Crepis setosa Haller f.	5.88	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.08	1.99	0.02

1 ***Table 2 (Continued). Weed species detected in hazelnut orchards in Düzce province, densities (plant m^{-2}) and frequencies (%)***

Weed Species	Akçakoca		Cumayeri		Çilimli		Gölyaka		Gümüşova		Kaynaşlı		Yığılca		Center		Düzce	
	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.
Crepis vesicaria L.	5.88	0.06	25.00	3.51	0.00	0.00	25.00	0.17	66.67	3.10	0.00	0.00	0.00	0.00	10.00	0.25	16.57	0.89
Cynosurus cristatus L.	0.00	0.00	0.00	0.00	33.33	80.23	0.00	0.00	66.67	3.90	0.00	0.00	0.00	0.00	0.00	0.00	12.5	10.52
Cynosurus echinatus L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.72	30.00	6.03	5.54	0.84
Cyperus esculentus L.	11.76	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.04
Dactylis glomerata subsp. *glomerata* L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	1.61	1.25	0.20
Dianthus armeria L.	0.00	0.00	25.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.09
Dipsacus laciniatus L.	0.00	0.00	0.00	0.00	0.00	0.00	25.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.07
Echium vulgare L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.20	10.00	0.04	3.04	0.03
Epilobium tetragonum subsp. *tetragonum* L.	0.00	0.00	0.00	0.00	33.33	1.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17	0.19
Euphorbia stricta L.	29.41	2.85	25.00	1.84	0.00	0.00	25.00	2.83	33.33	2.20	50.00	1.44	0.00	0.00	20.00	0.49	22.84	1.46
Filipendula vulgaris Moench	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	14.51	0.00	0.00	0.00	0.00	0.00	0.00	4.17	1.81
Fragaria vesca L.	11.76	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.86	2.72	0.25
Galega officinalis L.	5.88	0.33	50.00	3.85	0.00	0.00	0.00	0.00	33.33	2.07	0.00	0.00	14.29	0.38	10.00	0.21	14.19	0.86
Galium verum L.	0.00	0.00	25.00	22.84	33.33	2.05	0.00	0.00	33.33	10.54	0.00	0.00	0.00	0.00	0.00	0.00	11.46	4.43
Geranium asphodeloides Burm.f. subsp. *asphodeloides*	23.53	2.07	0.00	0.00	0.00	0.00	25.00	0.67	33.33	4.15	0.00	0.00	14.29	0.25	20.00	0.60	14.52	0.97
Geranium macrostylum Boiss.	0.00	0.00	25.00	0.88	0.00	0.00	25.00	4.00	33.33	12.29	0.00	0.00	0.00	0.00	0.00	0.00	10.42	2.15
Geranium pyrenaicum Burm.f.	11.76	0.40	25.00	0.28	33.33	3.46	25.00	3.27	33.33	0.73	50.00	8.34	57.14	6.00	70.00	14.20	38.20	4.59
Geum urbanum L.	23.53	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	0.13
Glechoma hederacea L.	23.53	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	6.76	4.19	1.21
Hedera helix L.	11.76	2.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.57	7.16	0.00	0.00	5.04	1.26
Holcus lanatus L.	17.65	2.71	75.00	25.26	0.00	0.00	0.00	0.00	33.33	1.24	0.00	0.00	0.00	0.00	60.00	17.73	23.25	5.87
Hordeum bulbosum L.	5.88	6.43	0.00	0.00	0.00	0.00	25.00	52.33	0.00	0.00	50.00	4.17	0.00	0.00	30.00	4.48	13.86	8.43
Hordeum murinum subsp. *leporinum* (Link) Arcang.	5.88	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.68	3.24	0.16
Hypericum androsaemum L.	5.88	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.01
Hypochaeris radicata L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	0.73	2.50	0.09
Knautia arvensis (L.) Coult.	0.00	0.00	25.00	0.42	0.00	0.00	0.00	0.00	33.33	7.46	0.00	0.00	14.29	0.06	0.00	0.00	9.08	0.99

1 ***Table 2 (Continued). Weed species detected in hazelnut orchards in Düzce province, densities (plant m^{-2}) and frequencies (%)***

Weed Species	Akçakoca		Cumayeri		Çilimli		Gölyaka		Gümüşova		Kaynaşlı		Yığılca		Center		Düzce	
	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.
Knautia degenii Borbás ex Formanek	0.00	0.00	0.00	0.00	66.67	1.77	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	2.31	13.96	0.51
Lapsana communis L.	52.94	1.85	50.00	0.55	33.33	0.77	100.0	3.31	66.67	2.12	100.0	2.00	42.86	1.06	40.00	1.29	60.72	1.62
Lapsana communis subsp. *intermedia*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	1.40	1.25	0.17
Lathyrus nissolia L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	2.63	50.00	0.52	0.00	0.00	0.00	0.00	10.42	0.39
Lathyrus sativus L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.56	1.25	0.07
Lolium perenne L.	0.00	0.00	50.00	4.94	0.00	0.00	25.00	6.30	33.33	12.00	50.00	5.21	0.00	0.00	80.00	16.99	29.79	5.68
Lotus corniculatus var. *corniculatus* L.	0.00	0.00	50.00	0.82	33.33	0.54	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.08	10.00	0.89	13.45	0.29
Lysimachia nummularia L.	0.00	0.00	0.00	0.00	0.00	0.00	25.00	2.44	33.33	1.02	0.00	0.00	0.00	0.00	0.00	0.00	7.29	0.43
Lythrum cf. *hyssopifolia* L.	5.88	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.01
Medicago arabica (L.) Huds.	17.65	1.05	0.00	0.00	0.00	0.00	25.00	4.33	66.67	3.37	0.00	0.00	0.00	0.00	20.00	0.69	16.16	1.18
Melissa officinalis L.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	71.43	16.03	0.00	0.00	8.93	2.00
Mentha sp.	11.76	1.31	0.00	0.00	0.00	0.00	75.00	9.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.85	1.32
Mercurialis annua L.	5.88	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.02
Moenchia mantica (L.) Bartl.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	2.49	0.00	0.00	0.00	0.00	0.00	0.00	4.17	0.31
Myosotis alpestris subsp. *alpestris*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	2.63	0.00	0.00	0.00	0.00	0.00	0.00	4.17	0.33
Oenanthe silaifolia M.Bieb.	52.94	3.13	50.00	2.14	66.67	3.35	100.0	6.36	100.0	10.37	100.0	8.27	57.14	2.52	100.0	5.14	78.34	5.16
Oxalis corniculata L.	35.29	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.14	4.65	0.00	0.00	11.55	1.09
Plantago lanceolata L.	0.00	0.00	0.00	0.00	0.00	0.00	25.00	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.13	0.29
Plantago major subsp. *major* L.	23.53	0.85	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.44	0.00	0.00	14.29	0.75	0.00	0.00	8.89	0.25
Poa pratensis L.	11.76	2.02	0.00	0.00	33.33	11.04	0.00	0.00	33.33	68.05	50.00	4.31	28.57	5.28	40.00	6.49	24.63	12.15
Poa trivialis L.	0.00	0.00	50.00	3.77	0.00	0.00	50.00	19.36	33.33	0.73	0.00	0.00	0.00	0.00	40.00	6.09	21.67	3.74
Potentilla reptans L.	52.94	21.25	50.00	5.72	100.0	38.31	100.0	70.62	100.0	34.20	100.0	42.89	71.43	18.76	80.00	51.89	81.80	35.46
Prunella vulgaris L.	29.41	2.70	50.00	7.37	33.33	11.31	0.00	0.00	0.00	0.00	50.00	8.62	42.86	0.92	30.00	3.46	29.45	4.30
Pteridium aquilinum (L.) Kuhn	17.65	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	1.91	28.57	0.28	10.00	0.13	13.28	0.37
Pulicaria dysenterica (L.) Bernh.	5.88	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.11
Ranunculus constantinopolitanus	5.88	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.57	0.40	20.00	0.90	6.81	0.18

1 ***Table 2 (Continued). Weed species detected in hazelnut orchards in Düzce province, densities (plant m^{-2}) and frequencies (%)***

Weed Species	Akçakoca		Cumayeri		Çilimli		Gölyaka		Gümüşova		Kaynaşlı		Yığılca		Center		Düzce	
	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.	Freq.	Dens.
Raphanus raphanistrum L.	17.65	0.34	0.00	0.00	0.00	0.00	25.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.33	0.10
Rorippa sylvestris (L.) Besser	5.88	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.06
Rubus tereticaulis P.J.Müll.	41.18	1.38	0.00	0.00	0.00	0.00	75.00	4.63	33.33	1.32	100.0	4.52	71.43	2.25	30.00	1.31	43.87	1.93
Rumex crispus L.	17.65	0.47	0.00	0.00	0.00	0.00	0.00	0.00	33.33	3.07	0.00	0.00	0.00	0.00	0.00	0.00	6.37	0.44
Rumex obtusifolius L.	11.76	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.06
Salvia forskahlei L.	11.76	0.21	25.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	50.00	9.10	0.00	0.00	0.00	0.00	10.85	1.20
Sanguisorba minor L.	5.88	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.20	30.00	0.47	6.27	0.10
Scrophularia scopolii var. *scopolii*.	41.18	5.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.57	2.05	0.00	0.00	8.72	0.97
Securigera varia (L.) Lassen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.20	0.00	0.00	1.79	0.03
Setaria glauca (L.) P.Beauv.	5.88	0.21	0.00	0.00	33.33	16.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90	2.08
Sherardia arvensis L.	0.00	0.00	75.00	1.64	0.00	0.00	0.00	0.00	66.67	10.41	0.00	0.00	14.29	0.24	50.00	3.60	25.74	1.99
Solanum nigrum L.	5.88	1.73	0.00	0.00	33.33	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.90	0.25
Sonchus asper subsp. *glaucescens* (Jord.) Ball	11.76	0.21	25.00	0.13	66.67	3.10	0.00	0.00	0.00	0.00	0.00	0.00	42.86	1.38	10.00	1.63	19.54	0.81
Sophora jaubertii Spach	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29	0.30	0.00	0.00	1.79	0.04
Sorghum bicolor (L.) Moench	0.00	0.00	0.00	0.00	33.33	30.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17	3.78
Taraxacum macrolepium Schischk.	5.88	0.78	0.00	0.00	0.00	0.00	25.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.86	5.11	0.23
Trachystemon orientalis (L.) G.Don	23.53	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.57	1.22	10.00	0.56	7.76	0.35
Trifolium campestre Schreb.	5.88	0.32	50.00	2.67	33.33	7.54	0.00	0.00	33.33	10.37	100.0	15.45	14.29	0.70	60.00	8.99	37.10	5.75
Trifolium hybridum var. *hybridum* L.	0.00	0.00	25.00	0.59	0.00	0.00	25.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.25	0.37
Trifolium pratense var. *pratense* L.	11.76	1.00	25.00	1.55	66.67	4.79	75.00	25.02	0.00	0.00	50.00	15.12	28.57	1.90	0.00	0.00	32.13	6.17
Trifolium repens L.	35.29	8.49	25.00	5.86	0.00	0.00	25.00	0.70	33.33	7.90	0.00	0.00	57.14	9.47	50.00	5.04	28.22	4.68
Urtica dioica subsp. *dioica* L.	23.53	2.23	0.00	0.00	33.33	1.73	75.00	4.38	33.33	4.68	50.00	2.39	28.57	3.30	10.00	2.07	31.72	2.60
Veronica filiformis Sm.	5.88	0.32	0.00	0.00	0.00	0.00	25.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.86	0.10
Vicia sativa subsp. *nigra* var. *nigra* (L.) Ehrh.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	3.95	0.00	0.00	0.00	0.00	10.00	0.18	5.42	0.52
Vicia sativa subsp. *nigra* var. *segetalis* (Thuill.)	5.88	0.05	0.00	0.00	0.00	0.00	0.00	0.00	33.33	0.44	0.00	0.00	14.29	0.08	10.00	0.32	7.94	0.11
Xanthium orientale subsp. italicum (Moretti) Greuter	5.88	0.20	25.00	1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.86	0.24

Table 3. Weed species with the highest density in hazelnut orchards in Düzce province

Weed Species	Akçakoca Dens.	Cumayeri Dens.	Çilimli Dens.	Gölyaka Dens.	Gümüşova Dens.	Kaynaşlı Dens.	Yığılca Dens.	Center Dens.	Düzce Dens.
Potentilla reptans L.	21.25	5.72	38.31	70.62	34.20	42.89	18.76	51.89	35.46
Poa pratensis L.	2.02	0.00	11.04	0.00	68.05	4.31	5.28	6.49	12.15
Bromus hordeaceus subsp. *hordeaceus* L.	0.19	0.00	0.00	95.00	0.00	0.00	0.00	0.59	11.97
Cynosurus cristatus L.	0.00	0.00	80.23	0.00	3.90	0.00	0.00	0.00	10.52
Bromus sterilis L.	9.75	4.25	0.00	0.00	47.41	0.00	0.00	10.36	8.97
Hordeum bulbosum L.	6.43	0.00	0.00	52.33	0.00	4.17	0.00	4.48	8.43
Trifolium pratense var. *pratense* L.	1.00	1.55	4.79	25.02	0.00	15.12	1.90	0.00	6.17
Holcus lanatus L.	2.71	25.26	0.00	0.00	1.24	0.00	0.00	17.73	5.87
Alopecurus myosuroides subsp. *myosuroides* Huds	2.80	2.17	26.31	0.00	15.44	0.00	0.00	0.00	5.84
Trifolium campestre Schreb.	0.32	2.67	7.54	0.00	10.37	15.45	0.70	8.99	5.75

Table 4. Weed species with the highest frequency in hazelnut orchards in Düzce province

Weed Species	Akçakoca Freq.	Cumayeri Freq.	Çilimli Freq.	Gölyaka Freq.	Gümüşova Freq.	Kaynaşlı Freq.	Yığılca Freq.	Center Freq.	Düzce Freq.
Potentilla reptans L.	52.94	50.00	100.0	100.0	100.0	100.0	71.43	80.00	81.80
Oenanthe silaifolia M.Bieb.	52.94	50.00	66.67	100.0	100.0	100.0	57.14	100.0	78.34
Lapsana communis L.	52.94	50.00	33.33	100.0	66.67	100.0	42.86	40.00	60.72
Convolvulus arvensis L.	41.18	25.00	66.67	50.00	66.67	50.00	71.43	40.00	51.37
Rubus tereticaulis P.J.Müll.	41.18	0.00	0.00	75.00	33.33	100.0	71.43	30.00	43.87
Geranium pyrenaicum Burm.f.	11.76	25.00	33.33	25.00	33.33	50.00	57.14	70.00	38.20
Trifolium campestre Schreb.	5.88	50.00	33.33	0.00	33.33	100.0	14.29	60.00	37.10
Trifolium pratense var. *pratense* L.	11.76	25.00	66.67	75.00	0.00	50.00	28.57	0.00	32.13
Conyza canadensis (L.) Cronquist	41.18	75.00	33.33	25.00	0.00	50.00	0.00	30.00	31.81
Urtica dioica subsp. *dioica* L.	23.53	0.00	33.33	75.00	33.33	50.00	28.57	10.00	31.72

3.2. Discussion

In this study, it was observed that weed control was generally carried out in the hazelnut orchards where surveys were carried out. Although herbicide is mostly applied in the control, it has been observed that the use of motorized scythes is also common. It is known that weeding is at high density due to the rainfall regime of the Black Sea Region. High weed density in hazelnut orchards, especially during fertilization periods, can cause yield losses in the product by sharing nutrients in the soil, but can also be a host for diseases and pests. To prevent this, knowing the weed species, their density, and frequency may be advantageous to the producer or technical staff in deciding on the periods and methods of control. By selecting the appropriate herbicide according to weed density and type and determining the control method that will protect nature, beneficial organisms can also continue their activities. The identified species are new records detected in the hazelnut orchards of Düzce province.

Öğüt Yavuz and Boz (2007) aimed to determine the weed species found in the nurseries of Aydın province in summer and winter, their frequency, number per m² and coverage areas. According to the research they conducted between 2004 and 2005, a total of 20 species belonging to 13 families, 7 of which are monocotyledonous and 13 of which are dicotyledonous, were identified among the weeds detected in the summer period. Among these species, Purslane (*Portulaca oleraceae*) ranks first with a frequency of 87.80%. A total of 47 weed species belonging to 20 families, 12 of which are monocotyledonous and 35 of which are dicotyledonous, were detected during the winter period. Among these species, Chickweed (*Stellaria media*) ranks first with 79.80%.

Ahkemoğlu and Uygur (2018) studied six different orange gardens in Adana Province in 2015 and 2016; and concluded that weeds, which interact with various factors in the agroecosystem, can host plant disease agents and harmful arthropods and nematodes, serve as the main host and alternative host, or can be a wintering place for these organisms. Based on the idea that "one of the examples of this relationship is the interaction between weeds and mealybugs", the study planned to investigate the weed species in the gardens and the mealybug species on them. In total, 78 weed species belonging to 24 plant families were identified. Citrus mealybug, *Planococcus citri* (Risso), which is the most important mealybug species for citrus gardens, common mallow (*Malva sylvestris* L.), toadflax (*Linaria* sp.), black nightshade (*Solanum nigrum* L.), red-root amaranth (*Amaranthus retroflexus* L.), crimson clover (*Trifolium incarnatum* L.), purslane (*Portulaca oleraceae* L.). Other species identified are *Chorizococcus rostellum* (Lobdell), *Peliococcus turanicus* (Kiritshenko), *Phenacoccus solani* (Ferris), and *Phenacoccus solenopsis* (Tinsley).

Sokat and Çatıkkaş (2019) investigated the weed species, their density and frequency in the almond production areas of Manisa and Muğla Province in 2017. As a result of this research, a total of 62 different weed species belonging to 27 families were identified. Of the mentioned species, 1 is a parasite (*Viscum album*), 13 are narrow-leaved, and 40 are broad-leaved weed species. In Muğla province, among broadleaf weeds, it was determined that the highest weed density and frequency were in the species *Oxalis pes-caprae* (18.57 plants m^{-2}; 60%), *Raphanus raphanistrum* (16.03 plants m^{-2}; 56%), *Convolvulus arvensis* (5.36 plants m^{-2}; 20%) and among grassweeds *Sorghum halepense* (8.72 plants m^{-2}; 38%), *Cyperus rotundus* (6.46 plants m^{-2}; 36%).In Manisa province, the most dense and frequent broadleaf weed species were *Ranunculus arvensis* (18.57 plants m^{-2}; 45%), *Crepis* spp. (16.12 plants m^{-2}; 55%), *Matricaria chamomilla* (15.19 plants m^{-2}; 65%), *Senecio vernalis* (9.48 plants m^{-2}; 32%) and among narrow-leaf weeds *Cynodon dactylon* (20.89 plants m^{-2}; 35%), *Poa annua* (20.5 plants m^{-2}; 31%), *Bromus tectorum* (18.57 plants m^{-2}; 28%).

4. Conclusions

In conclusion, in order to minimize the decrease in productivity caused by weeds in hazelnut cultivation and production; Knowing which weeds we will be fighting against and at what density they occur is important to choose a more appropriate, economical, and effective control method to protect against diseases and damage. Thus, with correct and conscious weed control, it will be possible to contribute to production, nature, and economy by preventing yield losses caused by weeds in hazelnuts. The effect of powdery mildew disease (*Erysiphe betae*) on yield, which has been a significant problem in hazelnut production in recent years, and its relationship with weeds as hosts may be a new research topic in this sense.

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Ethical Statement

There is no need to obtain permission from the ethics committee for this study.

Conflicts of Interest

We declare that there is no conflict of interest.

Authorship Contribution Statement

Concept: Kara, A.; Design: Kara, A., Ermeç, H.; Data Collection or Processing: Kara, A., Ermeç, H.; Statistical Analyses: Kara, A., Ermeç, H., Dıblan, S.; Literature Search: Ermeç, H., Dıblan, S.; Writing, Review and Editing: Ermeç, H., Dıblan, S.

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