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Hazal Merve BALLI, Cumali ÖZASLAN [1]

WEED FLORA OF LENTIL IN DIYARBAKIR PROVINCE, TURKEY

SUMMARY

Lentil is usually cultivated under rainfed conditions in various geographic regions of the globe. Thus, lentil productivity is constrained by various biotic and abiotic factors. Weeds are one of the biotic factors negatively influencing the productivity and profitability of the crop. Lentil is intensively cultivated in southeastern Anatolia region of Turkey under rainfed conditions. Weeds have been identified as one of the major challenges to lentil productivity in the region. Therefore, development of suitable management strategies is inevitable in the region. The development of effective weed management strategies relies on the basic knowledge of weed species/weed inventories. The current study was conducted to determine the weed flora in lentil production areas of Diyarbakır province situated in southeastern Anatolia region of Turkey. A total 55 fields were surveyed and data relating to weed species, their densities and frequency of occurrence were recorded. A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The overall weed species' density in the province was 35 weeds m^{-2}. The weed species having the highest density in the province were; *Sinapis arvensis* L. (7.38 plants/m^2), *Avena sterilis* L. (6.55 plants/m^2), *Ranunculus arvensis* L. (3.49 plants/m^2), *Papaver* sp. (2.78 plants/m^2), *Anthemis chia* L. (2.11 plants/m^2), *Vaccaria pyramidata* Medik. (1.72 plants/m^2), *Galium* spp. (1.43 plants/m^2) and *Vicia sativa* L. (1.19 plants/m^2). Similarly, the weed species having the highest frequency of occurrence were; *Sinapis arvensis* L. (87.96%), *Vaccaria pyramidata* Medik. (87.22%), *Papaver* sp. (84.38%), *Vicia sativa* (77.02%), *Ranunculus arvensis* (68.11%), *Avena sterilis* L. (67%), *Cephalaria syriaca* (L.) Schrad (61.93%), *Silene conica* L. (53.59%) and *Anthemis* sp. (52.60%). The current study has improved our understanding on the weed flora of lentil fields in Diyarbakır province of the country. The data generated through this study could be used to devise suitable weed management strategies for lentil in the province.

Keywords: Weed flora, Lentil, Diyarbakır, Southeastern Anatolia, Turkey.

[1]Cumali Özaslan (corresponding author: cumaliz@yahoo.com), Hazal Merve Balli, Department of Plant Protection, Faculty of Agriculture, Dicle University, 21100 Diyarbakır, TURKEY.

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INTRODUCTION

The increasing global population demands more food production than ever before. Therefore, cereals, oilseeds and legumes have an important position in human nutrition. Lentils (*Lens culinaris* Medik.) is one of the most important legume species, regarded as a high quality proteins source and used in human nutrition (El-Nahry et al., 1980; Desphande and Damodaran, 1990; Costa et al. 2006; Wang et al., 2009; Şehirali, 1988; Pekşen and Artık, 2005; Urbano et al., 2007). The crop is cultivated in temperate and sub-tropic climate regions worldwide (Şehirali 1988). Turkey is 3rd largest lentil producer following India and Canada. However, lentil production varies considerably from year to year globally and in Turkey (FAO, 2014; TÜİK, 2016).

Several biotic and abiotic factors affect the lentil production in the country. The plant protection problems, i.e., weeds, diseases and insects are among the major constraints impairing lentil production. However, weeds cause more nuisance than other plant protection agents (Tepe, 1997; Özer at al., 2001). The damage caused by weeds to lentil production is higher compared to the other agents since weeds compete and suppress lentil plants from the early stage of growing period. Competition for water is much more severe in arid areas and yield losses can reach ~93% during dry seasons (Şehirali, 1988). In addition, weeds also cause quality losses in lentil (Kuntay, 1944; Güncan, 1982; Yeğen, 1984; Çınar and Uygun 1987). Therefore, Sepetoğlu (1992) concluded that weeds should be controlled during the lentil growing season in order to obtain good yield. The weed surveys are critical to determine the distribution patterns of the weed species at spatial and landscape scales, and possible factors shaping the distribution patterns (Rankins et al. 2005; Ozaslan et al., 2016; Korres et al., 2015a, b).

The information obtained from surveys makes an important contribution to the development of effective regional or site-specific weed management strategies (Önen and Özer, 2001; Özaslan et al., 2002; Önen et al., 2018). However, there is no information available on the weed flora of lentil fields in Diyarbakır province. Therefore, the current survey study was conducted with an objective to determine the weed flora prevailing in the lentil fields of Diyarbakır province, Turkey. The results will contribute towards the development of site-specific weed management practices in the region. It was hypothesized that different fields will differ in weed species composition.

MATERIAL AND METHODS

Geographic location

Survey studies were carried out in six districts of Diyarbakır province during 2017. Diyarbakır is located in the north of Mesopotamia in the central part of the Southeastern Anatolia Region. It is surrounded by Elazığ and Bingöl provinces from the north, Siirt and Muş from the east, Mardin from the south, and Şanlıurfa, Adıyaman, Malatya from the west. The total area of the province is

15,362 km^2 and lies between 37.90° and 40.23° north latitudes, and 40.37° and 41.20° east longitudes.

The frequency of occurrence of the observed weed species was computed using following formula:

Frequency of Occurrence (%) = (N/M)100

Where: N = Number of lentil fields where particular species was observed, M = Total number of lentil fields surveyed.

For density (plant/m^2) calculation, arithmetic averages were taken by counting the weeds in the quadrate according to their types and species, and density was calculated. The density was calculated by following Odum (1971) and Uygur (1991). The plants having density <0.05 were denoted with letter K.

Surveyed Fields

The geographic locations of the surveyed fields recorded with the help of GPS and are represented in Figure 1.

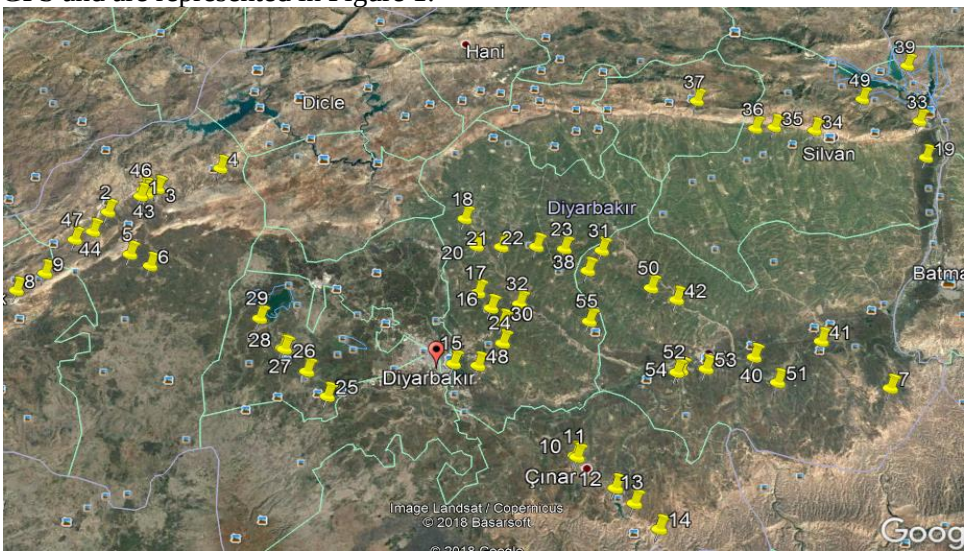

Figure 1. The locations of lentil fields surveyed during the study

Survey Studies

Survey studies were carried out during April and May, when weed species could be easily identified. Surveys were conducted in 55 fields. Survey fields were selected from separate directions and locations representing the whole province. Lentil production areas were surveyed by stopping at every 5 km randomly. In order to avoid the border effect of the fields, surveys were started by entering 10 meters in each field. A 1 m² quadrate was used for density determination. The number of quadrates to be placed was determined through preliminary observations. The quadrates to be placed within a field were; 3 for lentil fields smaller than 0.5 ha, 5 for 0.5-1.0 ha, and 8 for >1.0 ha (Bora and Karaca 1970; Önen et al., 2018). The whole plant was accepted as a plant for broad-leaved weed species, whereas each tiller was considered as a plant for

grasses. The recorded data on coverage area and density from different sub-sampling sites of the same field were averaged to get the coverage and density for whole field. Herbarium of the recorded weed species were prepared and stored in the Department of Plant Protection, Dicle University Diyarbakır, Turkey. The recorded weed species were identified with the help of Davis (1965-1988); Önen (2015); Özer et al. (1999).

RESULTS AND DISCUSSION

A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The plant families with the most number of species were Asteraceae 13 species, Fabaceae 12 species, Brassicaceae 8 species, Apiaceae 6 species and Lamiaceae 5 species. Other families were represented by 1-4 species.

Considering the frequency of occurrence of recorded weed species, 9 species had >50% frequency of occurrence. These species were; *Sinapis arvensis* L. (87.96%), Vaccaria *pyramidata* Medik. (87.22%), *Papaver* sp. (84.38%), *Vicia sativa* (77.02%), *Ranunculus arvensis* (68.11%), *Avena sterili*s L. (67%), *Cephalaria syriaca* (L.) Schrad (61.93%), *Silene conica* L. (53.59%) and *Anthemis* sp. (52.60%) (Figure 2).

The density of 8 species in the province had more that 1 plant m^{-2}. These species were; *S. arvensis* (7.38 plants/m^2), *A. sterilis* (6.55 plants/m^2), *R. arvensis* (3.49 plants/m^2), *Papaver* sp. (2.78 plants/m^2), *Anthemis chia* L. (2.11 plants/m^2), *V. pyramidata* (1.72 plants/m^2), *Galium* spp. (1.43 plants/m^2) and *V. sativa* (1.19 plants/m^2).

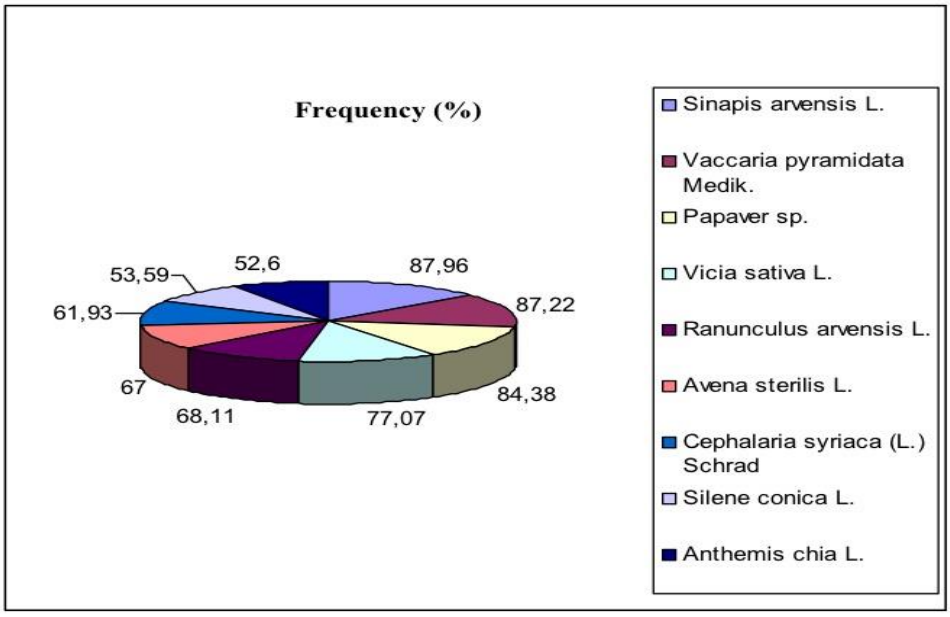

Figure 2. Weed species having >50% frequency of occurrence in lentil fields of Diyarbakır province

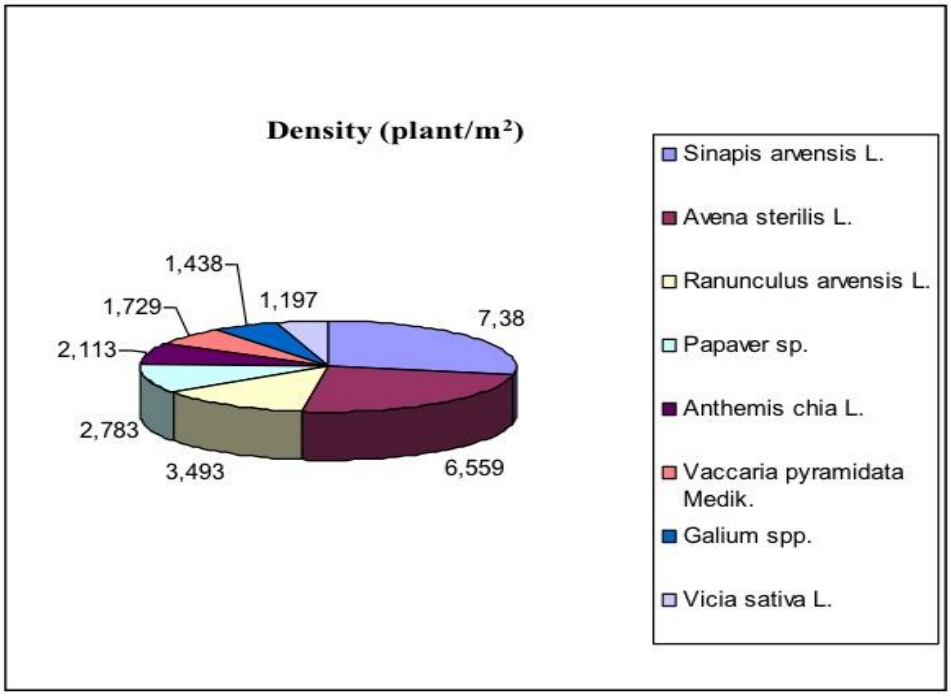

Figure 3. Weed species having density >1 plant m^{-2} in lentil fields of Diyarbakır province

Table 1. Weed species, their plant families, frequency of occurrence and density in lentil fields of Diyarbakır province

Weed Species	**Density (plants m^{-2})**	**FO (%)**
Parasitic Plant Species		
Fam: Orobanchaceae		
Orobanche creneta Forsk.	0.162	12.49
Orobanche ramosa L.	0.065	6.48
MONOCOTYLEDONEAE		
Fam: Liliaceae		
Bellevalia sp.	0.080	13.42
Allium pallens L. supsp. *pallens* L.	K	1.38
Ornithogalum narbonense L.	K	5.55
Fam: Poaceae		
Avena sterilis L.	6.559	67
Bromus tectorum L.	K	4.22
Hordeum spontaneum L.	0.416	17.55
Hordeum bulbosum L.	K	8.71
DICOTYLEDONEAE		
Fam: Apiaceae (Umbelliferae)		
Bubleurum rotundifolium L.	0.105	20.49

Echinophora tenuifolia L.	K	11.16
Falcaria vulgaris Bernh.	K	5.09
Pimpinela rhodontha Boiss.	K	1.85
Scandix pecten-veneris L.	0.881	41.16
Turgenia latifolia (L.) Hoffm.	0.268	19.53
Fam:Araceae		
Dracunculus vulgaris Schott.	K	1.38
Fam: Aristolochiaceae		
Aristolochia bottae Jaub. & Spach.	0.124	15.83
Fam: Asteraceae (Compositae)		
Centaurea solstitialis L.	0.213	44.61
Centaurea balsamita Lam.	K	4.68
Gundelia tournefortii L.	K	2.83
Crepis alpina L.	0.645	43.56
Cirsium acarna L.	K	2.94
Echinops orientalis Trautv.	K	2.64
Notabasis syriaca (L.) Cass.	K	39.54
Anthemis chia L.	2.113	52.60
Lactuca serriole L.	0.434	38.06
Carduus pycnocephalus L.	K	19.10
Scolymus maculatus L.	0.094	32.45
Scorzonera hispanica L.	K	7.22
Tragopogon longirostis BISCH. EX SCHULTZ BIP.	K	12.96
Fam: Brassicaceae (Cruciferae)		
Sinapis arvensis L.	7.380	87.96
Cardaria draba (L.) Desv.	0.107	19.90
Conringia persica Boiss.	K	1.85
Crambe orientalis L.	K	1.85
Neslia apiculata Fısch.	K	27.91
Myagrum perfoliatum L.	0.193	7.87
Sisymbrium officinale (L.) SCOP.	0.008	4.72
Thlaspi perfoliatum L.	K	1.85
Fam: Boraginaceae		
Buglossoides arvense (L.) I.M. Johnst.	K	13.81
Anchusa azurea Miller.	K	3.51
Alkanna tinctoria (TAUSCH)		1.85
Fam: Campanulaceae		
Campanula strigosa Banks Et Sol.	K	15.38
Fam: Caryophyllaceae		
Vaccaria pyramidata Medik.	1.729	87.22
Cerastium dichotomum L.	K	7.05
Silene conica L.	0.865	53.59
Silena conoidea L.	K	1.85

Fam: Convolvulaceae		
Convolvulus betonicifolius Mill.	K	25.66
Convolvulus galaticus Roston. Ex Choisy	K	2.77
Fam: Dipsacaceae		
Cephalaria syriaca (L.) Schrad	0.653	61.93
Fam: Euphorbiaceae		
Euphorbia sp.	0.856	38.23
Euphorbia aleppica L.	0.086	13.42
Euphorbia helioscopia L.	0.540	15.71
Fam: Fabaceae		
Astragalus fodinarum Boiss & Noe	K	1.85
Alhagi pseudoalhagi (Bieb.) Desv.	K	1.85
Lathyrus aphaca L.	K	10.34
Lathyrus rotundifolius Willd.	K	1.85
Pisum sativum L.	K	5.18
Vicia hybrida L.	0.570	44.38
Vicia assyriaca Boiss.	0.257	36.41
Vicia sativa L.	1.197	77.07
Vicia narbonensis L.	K	8.95
Trifolium nigrescens L.	0.176	9.83
Trifolium hybridum L.	-	1.85
Fam:Gentianaceae		
Flavus herba	K	4.62
Fam: Geraniaceae		
Geranium tuberosum L.	K	1.85
Fam: Guttıferae		
Hypericum triquetrifolium Turra.	K	5.55
Fam: Irıdaceae		
Gladiolus atroviolaceus Boiss.	K	3.70
Fam: Lamiaceae		
Lallemantia iberica (Bieb.) Fisch. & Mey.	K	16.79
Molucella laevis L.	K	3.24
Phlomis sieheana Rech.Fil.	K	8.79
Salvia verbenaca L.	K	1.85
Satureja hortensis L.	K	1.38
Fam:Linaceae		
Linum mucranatum Bertol. subsp. *armenum* Davis	K	1.85
Linnum flavum L.	K	1.38
Fam: Malvaceae		
Alcea sp.	K	1.85
Fam: Papaveraceae		
Fumaria asepale Boiss.	0.159	10.74
Papaver sp.	2.783	84.38
Fam: Poaceae		
Alopecurus myosuroides Huds.	K	3.81

Lolium perenne L.	K	2.94
Phalaris canariensis L.	K	3.75
Poa pratensis L.	K	1.85
Fam: Polygonaceae		
Polygonum aviculare L.	0.065	5.77
Fam: Primulaceae		
Anagallis arvensis L.	K	11.11
Fam: Ranunculaceae		
Adonis aestivalis subsp. *parfivlora* (FISCH. EX DC.) BUSCH	0.612	43.86
Delphinium elatum L.	K	8.79
Ranunculus arvensis L.	3.493	68.11
Fam:Rubiaceae		
Galium spp.	1.438	39.56
Asperula orientalis Boiss & Holen	K	1.85
Galium tricornutum Dandy.	K	7.54

FO = frequency of occurrences, K = the plants having "<0.05 plants/m^{-2}" density

Weeds directly harm lentil by lowering yield and quality, and indirectly cause serious problems by making harvesting difficult. The selection of effective management methods is only possible with the determination of the problematic weeds species in the lentil fields (Eroğlu, 2006). Therefore the first step of an effective weed management strategy is determining the species and their density (Önen and Özer, 2001).

A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The plant families with the most number of species were Asteraceae 13 species, Fabaceae 12 species, Brassicaceae 8 species, Apiaceae 6 species and Lamiaceae 5 species. Other families were represented by 1-4 species. Five out of 28 botanical families (i.e., Asteraceae, Brassicaceae, Fabaceae, Apiaceae 6 species and Lamiaceae) had >50% of the weed species observed during the surveys. The highest contribution of these families to the observed weed flora is attributed to the higher presence of weedy species in these families (Düzenli et al., 1993; Önen and Özer, 1995; Özer et al., 1999). The predominance of annuals can be attributed to their short life span and higher allocation resources for reproduction even under harsh climatic conditions (Sans and Masalles 1995). In some studies, annuals were reported to be dominant in lentil and other annual crops in Turkey (Uzun, 1988; Önen and Özer, 1995; Kızılkaya et al., 2001; Özaslan et. al., 2002; Özaslan, 2011; Arıkan et al., 2015).

Large variations were observed in density and frequency of occurrence of the recorded weed species in different surveyed fields (Table 1). The variation in the weed densities and frequency of occurrence can be explained by heterogeneity in the soil properties and microclimatic conditions (James et al., 2006; Onen et al., 2018).

In a study carried out in the lentil fields during 1984-1986 in Şanlıurfa, Diyarbakır and Mardin provinces a total 74, 30 and 56 weed species identified, respectively (Uzun 1988). The most frequently observed weed species were found as *Galium tricorne* With., *A. sterilis*, *Scandix pecten-veneris* L., *Lathyrus* spp., *R. arvensis*, *Geranium tuberosum* L., *Turgenia latifolia* (L.) Hoffm., *C. syriaca* (L.) Schrader and *Isatis tinctoria* L. However in the corent study a total of 89 weed species were identified. Beside the most common species in the province were; *S. arvensis*, *V. pyramidata*, *Papaver* sp., *V. sativa* (77.02%), *R. arvensis*, *A. sterilis*, *C. syriaca*, *S. conica* and *Anthemis* sp. (Figure 2). When the results of the two studies are compared, it is seen that the number of species incresed in the region over time. In addition, it is observed that the problematic species had signifacantly changed in the region. These results are thought to be a result of the surveyed areas are partially different, the changes in the ecological conditions in the region and the differences seen in the cultivation applied (fertilizer, herbicides etc) over time.

CONCLUSIONS

It is concluded cosmopolite species were the most problematic weeds in the surveyed fields and it is possible to imply a general recommendation for their management. The existence of large-scale spatial variation in weed distribution and soil properties necessitates the adoption of site-specific management practices for successful weed management in the region. Nonetheless, use of integrated weed management practices for the recorded species could lower weed pressure in the region.

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REFERENCES

Arıkan L, Kitiş YE, Uludağ A and Zengin H. 2015. Determination of prevalence and densities of weeds observed in citrus orchards of Antalya province. Turkish Journal of Weed Science. 18(2):12-22 (In Turkish)

Bora T, Karaca I. 1970. Kültür Bitkilerinde Hastalığın ve Zararın Ölçülmesi, Ege Üniversitesi Ziraat Fakültesi Yardımcı Ders Kitabı, 167-43, İzmir.

Costa GEA, Monici KSQ, Reis SMPM and Oliveria AC. 2006. ChemicalComposition, Dietary Fibreand Resistant Starch Contents of Raw Cooked Pea, Common Bean, Chickpea and Lentil Legumes. Food Chemistry, 94:327-330.

Çakmaklı Ü. 1982. Türkiye'de Ekimi Yapılan Bazı Sarı ve Kırmızı Mercimek Çeşitlerinin Kimyasal Bileşimi Üzerine Bir Araştırma. Ege Üniversitesi Mühendislik Fakültesi Dergisi, 7(1):9-17.

Çınar A, Uygun N. 1987. Bitki Koruma. Çukurova Üniversitesi, Ziraat FakültesiDers Kitabı, No: 32, 285s, Adana.

Davis PH. 1965-1988. Flora of Turkey and the East Aegean Island, Edinburg University Press, Edinburg (Volume, 1-10).

Desphande SS, Damodaran S. 1990. Food Legumes:Chemistry andTechnology . Advances in Cereal Science and Technology. American Association of Cereal Chemists, Incorporated. St.Paul, Minnesota, USA, p.147-241.

Düzenli A, Türkmen N, Uygur FN, Uygur S and Boz Ö. 1993. Important weeds of Aegean region and their botanical features. Türkiye 1. Herboloji Kongresi, 3-5 Adana, Turkey. (In Turkish)

El-Nahry FI, Mourad FE, Abdel Khalik SM and Bassıly N.1980. Chemical ompositionand Protein Quality of Lentils (Lens) Consumed in Egypt. Plant Foods for Human Nutrition, 30(2):87-95.

Eroğlu N. 2006. Karaman'da nohutlarda sorun oluşturan yabancı otlar ve kritik periyodun belirlenmesi. Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Bitki Koruma Anabilim Dalı, Yüksek Lisans Tezi, 51s, Konya.

FAO 2014. Agricultural Statistics Database. http://www.fao.org/faostat/en/#data/QC (Erişim tarihi: 01.12.2017).

Güncan A. 1980. Anadolu'nun Doğusunda Buğday Ürününe Karışan Yabancı Ot Tohumları, Bunların Yoğunluları (Assosiation) Üzerinde Bir Araştırma, Yüzüncü Yıl Üniv. Zir.Fakültesi, Van.

Güncan A. 1982. Erzurum Yöresinde Buğday Ürününe Karışan Bazı Yabancı Ottohumlarının Çimlenme Biyolojisi Üzerinde Araştırmalar. A.Ü, Ziraat Fakültesi Yayınları. No: 270, Erzurum.

James JJ, Caird MA, Drenovsky RE and Sheley RL. 2006. Influence of resource pulses and perennial neighbors on the establishment of an invasive annual grass in the Mojave Desert. J. Arid Environ. 67, 528–534.

Kızılkaya A, Önen H, Özer Z. 2001. Soğan Verimine Yabancı Ot Rekabetinin Etkileri Üzerinde Araştırmalar. Türkiye Herboloji Dergisi, Cilt 4, Sayı 2, 58-65.

Korres NE, Norsworthy JK, Bagavathiannan MV and Mauromoustakos A. 2015a: Distribution of arable weed populations along eastern Arkansas Mississippi Delta roadsides: occurrence, distribution, and favored growth habitats. Weed Technology 29(3), 587–595.

Korres NE, Norsworthy JK, Bagavathiannan MV and Mauromoustakos A. 2015b: Distribution of arable weed populations along eastern Arkansas-Mississippi Delta roadsides: factors affecting weed occurrence. Weed Technology 29(3), 596–604.

Kuntay S. 1944. Türkiye Hububat Mahsulü İçinde Tohumları Bulunan Yabancı Otlar Üzerinde Araştırmalar. Ankara Yüksek Ziraat Enstitüsü Dergisi, 2(1)

Lee HC, Htoon AK, Uthayakumaran S and Paterson JL. 2007. Chemical and functional quality of protein isolated from Alkaline Extraction of Australian Lentil Cultivars: Matilda and Digger. Food Chemistry, 102(2007):1199-1207.

Odum EP. 1971. Fundamentals of Ecology. W.B. Saunders Company, Philadelphia, London, Toronyo.

Onen H, Akdeniz M, Farooq S, Hussain M and Ozaslan C. 2018. Weed Flora of Citrus Orchards and Factors Affecting Its Distributionin Western Mediterranean Region of Turkey. Planta Daninha, v35:e017172126.

Ozaslan C, Onen H, Farooq S, Gunal H and Akyol N, 2016: Common ragweed: An emerging threat for sunflower production and human health in Turkey. Weed Biology and Management 16(1), 42¬–55.

Önen H. 2015. (Ed.) Türkiye istilacı bitkiler kataloğu. T.C. Gıda, Tarım Ve Hayvancılık Bakanlığı Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü Bitki Sağlığı Araştırmaları Daire Başkanlığı, Ankara. ISBN: 978-605-9175-05-0.

Önen H, Özer Z. 1995. Kazova'da (Tokat) Şeker Pancarı Ekim Alanlarında Görülen Yabancı Otlar. VII. Türkiye Fitopatoloji Kongresi, 26-29 Eylül 1995, Adana.

Önen H, Özer Z. 2001. Tarla İçerisinde Yabancı Otların Dağılımları Arasındaki Farklılıkların Haritalanarak Belirlenmesi. Türkiye Herboloji Dergisi, Cilt 4, Sayı 2, 74-83.

Özaslan C, Önen H, Özer Z. 2002. Tokat Kazova'da İlkbahar ve Sonbaharda Ispanak (*Spinacia oleracea* L.) Yetiştiriciliğinde Sorun Olan Yabancı Otların Belirlenmesi. Türkiye Herboloji Dergisi, cilt 5, sayı 1, 52-61.

Özaslan C. 2011. Diyarbakır İli Buğday ve Pamuk Ekim Alanlarında Sorun Olan Yabancı Otlar ile Üzerindeki Fungal Etmenlerin Tespiti ve Bio-Etkinlik PotansiyellerininAraştırılması. Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Bitki Koruma Anabilim Dalı. Doktora Tezi, Konya

Özer Z, H Önen, Tursun N, Uygur FN. 1999. Türkiye'nin Bazı Önemli Yabancı Otları (Tanımları ve Kimyasal Savaşımları). Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Yayınları, No: 38, Kitap seri No: 16, ISBN: 975-7328-24-3.

Özer Z, Kadıoğlu İ, Önen H and Tursun N. 2001. Herboloji (Yabancı Ot Bilimi) Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Yayınları No:20 Kitap Serisi No:10, 3. Baskı, TOKAT.

Özer Z, Önen H, Tursun N and Uygur FN. 1999. Türkiye'nin Bazı Önemli Yabancı Otları (Tanımları ve Kimyasal Savaşımları). Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Yayınları No:38 Kitap Serisi No:16 Tokat.

Pekşen E, Artık C. 2005. Antinutritional Factors and Nutritive Values of Food Grain Legumes. The Journal of Agricultural Faculty of Ondokuz MayısUniversity, 20(2):111-121.

Radosevich SR, Holt JS. 1984. Weed Ecology Implications for VegetationManagement. A Wiley Interscience Publication, New York,United States of America, ISBN 0-471-87674-7, 265p.

Rao V. 2000. Principles of Weed Sicience. Science Publishers, Inc. Enfield (NH),555p, USA.

Sans FX, Masalles RM. 1995. Phenological patterns in an arable land weed community related to disturbance. Weed Research, 35(5), 321-332.

Sepetoğlu H. 1992. Yemeklik Dane Baklagiller. Ege Üniversitesi Ziraat Fakültesi Yayınları, Ders Notları:24, E.Ü. Ziraat Fakültesi Ofset Basımevi, Bornova-İzmir.

Sönmez S. 1976. Bolu ilinde Patateslerde Yabancı Ot Rekabeti ve Savaşı üzerine araştırmalar.

Şehirali S. 1988. Yemeklik Dane Baklagiller. AÜ, Ziraat Fak. Tarla Bit. Bö. AÜZF yay. No: 1089, Ders Kitapları Ser. No :314, Ankara

Tepe I. 1997. Türkiye'de Tarım ve Tarım dışı alanlarda sorun olan yabancı otlar ve mücadeleleri. Yüzüncü Yıl Üniversitesi Yay. No 32, Ziraat Fakültesi Yay.No: ISBN 975-7616-24-9, Van.

TÜİK 2016. Bitkisel Üretim İstatistileri. http://www.tuik.gov.tr/PreTablo.do?alt_id=1001 Erişim Tarihi:12.10.2017

Urbano G, Porres JM, Frias J and Vidal-Valverde C. 2007. NutritionalValue Shyam, D.m. Philip, and C. Stevenson. Lentil: An Ancient Cropfor Modern Times. XXIV, Hardcover ISBN: 978-1-4020-6312-1 Netherlands, p.47-93

Uygur FN. 1991. Herboloji Araştırma Yöntemleri. Ç. Ü. Ziraat Fakültesi Bitki Koruma Bölümü, Yardımcı Ders Notu, Adana.

Uygur FN, Koch W, Walter H. 1984. Yabancı ot bilimine giriş. Plits, 1984/2(1). Verlag Josef Margraf, Stuttgart 114s.

Uzun A. 1988. Türkiye'de mercimek (Lens esculenta Moench.) tarlalarında sorun olan yabancı otlarla mücadele imkanlarının araştırılması. Nihai rapor. Diyarbakır Zirai Mücadele Araştırma Enstitüsü, 47 s.

Wang N, Hatcher DW, Toews R and Gowalko EJ. 2009. Influence of Cooking and Dehulling on Nutritional Composition of Several Varieties of Lentils (*Lens culinaris*). Food Science and Technology, 42(4):842-848.

Yeğen O. 1984. Yabancı Otlar ve Mücadelesi. Ankara Üniversitesi, Ziraat Fakültesi Yayınları, 146s. Ankara.