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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Determination of weed species, density, frequency and coverage areas in sugar beet (*Beta vulgaris* L.) fields located in Kahramanmaras and Adana provinces

Kahramanmaraş ve Adana illerinde yer alan şeker pancarı (*Beta vulgaris* L.) tarlalarında sorun olan yabancı ot türleri, yoğunluğu, rastlanma sıklığı ve kaplama alanlarının belirlenmesi

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Ö Z E T / A B S T R A C T

Aims: This study was carried out to determine the weed species, density, frequency and general coverage area in sugar beet fields located at several districts in Kahramanmaras and Adana provinces. At the same time, it is aimed to determine the changes occurred in sugar factory production areas and weed species and density 20 years after 2000-2001.

Methods and Results: In order to calculate the weed density seen in the study areas, 40 frames per 1 ha were used. The species, density, frequency of incidence and general coverage areas of weeds were calculated. Weed species; *Sinapis arvensis* L., *Chenopodium album* L., *Echinochloa colonum* (L.) Link., *Cuscuta campestris* Yunck., *Amaranthus retroflexus* L., *Sorghum halepense* (L.) Pers., *Elymus repens* (L.) Gould., *Convolvulus arvensis* L., *Cirsium arvense* (L.) Scop. and *Cardaria draba* (L.) Desv. were detected very intensely in sugar beet fields. The frequency of incidence and general coverage area of important weed species was calculated between 64.9-50.1 % and 62.8-50.0 %.

Conclusions: A total of 88 weed species belonging to 26 families were determined in the sugar beet fields in the districts of Kahramanmaraş and Adana. From these weed species, 1 species belongs to holoparasite and pteridophyta, 18 species belong to monocotyledons and 68 species belong to dicotyledon class. According to the results of the research carried out 20 years ago in Kahramanmaras sugar beet fields, significant increases were observed both in the number of species and in the number of species that are very dense.

Significance and Impact of the Study: Weed species and densities, detected in sugar beet fields in Kahramanmaraş and Adana provinces, vary according to district. Holoparasite *C. campestris* and some weed species with rhizome and stolon stems are a major threat to sugar beet in terms of density.

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INTRODUCTION

There are two important production sources of sugar, which has an important place in human nutrition, sugar beet (*Beta vulgaris* L.) and sugar cane (*Saccharum officinarum* L.). While sugar cane is widely used in sugar production in world countries only sugar beet is used in Turkey (FAO, 2020a). According to FAO reports, Russia ranked first in the world in the production of *B. vulgaris*, with its annual production reaching 42.065.957 tons, followed by France with 39.579.925 tons and the United States with 30.068.647 tons. Turkey ranked fifth with a production of 18.900.000 tons (FAO, 2020b). On the other hand, the most three productive provinces in Turkey were; Konya was 1st place with a production 7.228.473 tons, Eskisehir was in the 2nd place with 1.973.635 tons and Yozgat was in the 3rd place with 1.644.549 tons. Kahramanmaras province was in the 13th place in *B. vulgaris* production with 3.740.580 tons (TUİK, 2020).

Weeds, diseases and pests are the leading plant protection factors that cause yield losses in sugar beet production. Weeds compete with the sugar beet (nutrients, water and light, etc.), significantly reducing the yield and quality of sugar beet. In addition to this primary damage, it can cause secondary damage by being an intermediate host to many fungal and viral diseases (Kadıoglu et al., 1997, Üremis and Uygur, 2004; Sertkaya et al., 2005; Isık and Akca, 2018; Üstüner, 2018; Üstüner and Öztürk, 2018; Özkil et al., 2019).

One of the ways to minimize the yield losses caused by weeds is to know the weed species and their biology in sugar beet fields. The early detection of weed species in the sugar beet field, the correct herbicide and dose selection, the correct time and method significantly increase the control efficiency (Bayat et al., 1996; Mutlu and Üstüner, 2017; Ustuner et al., 2020).

The average loss of product due to weeds in sugar beet production in the world is 5.8 % (Cramer, 1967). While these losses can reach 45 % in countries located in Asian continent, it is known that this rate can be between 6-40 % in Turkey (Güncan, 2000; Akca and Isık, 2016). *Cuscuta campestris* Yunck. caused 38.77 % yield losses in sugar beet in Kahramanmaras (Üstüner, 2018). According to Bosak and Mod (2000), depending on the weed density and species (*C. album*, *Abutilon theophrasti* Medik., *Amaranthus blitoides* S. Watson and *Ambrosia artemisiifolia* L.) in the sugar beet field, yield loss occurs 20 30 % at varying rates. Jursik et al. (2008) reported that *B. vulgaris* yield decreased by 80-93 % when weed control was not done in Central Bohemia. According to Mirshekari et al. (2010) only *Amaranthus retroflexus* L. caused a yield loss of 17 % in the sugar beet field. It causes 50-100 % yield loss in the sugar beet field when weeds were not cotrolled (Deveikyte et al., 2015; Jursik et al., 2008). In Germany and Russia, it was reported that competitive weeds such as *C. album* and *A. retroflexus* cause more than 80 % loss in sugar beet yield (Roland et al., 2017).

Weed species intensively found in sugar beet fields in England, Germany, Russia, Egypt, Northern Europe, Southern Europe, Central Bohemia, Spain, Bangladesh, Greece, Iran and the USA were; *Stellaria media* (L.) Vill., *C. album*, *Sinapis arvensis* L., *Echinochloa. crus-galli* (L.) P. Beauv., *A. retroflexus, Galium* sp., *Malva neglecta* Wallr., *Matricaria chamomilla* L., *Fallopia convolvulus* (L.) A. Löve., *Poa annua* L., *Polygonum aviculare* L., *Polygonum* sp., *Avena fatua* L. A. blitoides, *Setaria viridis* (L.) P. Beauv., *Lamium* sp., *Viola* sp., *Veronica* sp., *Thlaspi arvense* L., *Agropyron repens* (L.) P. Beauv., *Convolvulus arvensis* L., *Cirsium arvense* (L.) Scop., *Veronica arvensis* L., and *Kochia scoparia* (L.) Schrad. (Schweizer, 1979; Blaszyk et al., 1980; Salimi et al., 2004; Mitchell, 2005; Salehi et al., 2006; Petersen, 2008; Jursik et al., 2008; Kunz et al., 2015; Kunz et al., 2016; Bayat et al., 2019; Bhadra et al., 2020).

In a study by Üstüner (2018), the effect of *C. campestris* was investigated on leaf and tuber yield of sugar beet fields in Kahramanmaras province of Turkey. Sugar beet leaf numbers and associated hectare yield decreased considerably when the plants were infected with the parasite plant. Crop yield was calculated to be 79.573 kg/ha for uninfected plots while it was determined as 57.341.kg/ha for the infected ones (Üstüner and Öztürk, 2018).

This study was carried out to determine the weed species, family, density, frequency of incidence and general coverage areas that are a problem in *B. vulgaris* fields in Afsin, Ekinözü, Elbistan, Göksun, Dulkadiroglu and Türkoglu districts of Kahramanmaras province and Tufanbeyli district of Adana province. At the same time, it was investigated whether there was a change in weed species and density according to the research carried out 20 years ago in Kahramanmaras sugar beet cultivation areas.

MATERIALS and METHODS

In this research, the survey plan was organized according to the districts where the Elbistan Sugar Factory gave a production quota permit. Therefore, surveys were carried out to determine the weed species density, frequency of incidence and coverage area that are a problem in the sugar beet fields located in Afsin, Ekinözü,

Elbistan, Göksun, Dulkadiroglu and Türkoglu districts of Kahramanmaras province and Tufanbeyli district of Adana province during 2020 and 2021 cultivation period. While Elbistan sugar factory gave a production quota to Dulkadiroglu and Türkoglu districts 20 years ago, today Malatya sugar factory gives a production quota to these districts. It was also investigated how the weed species, density and production areas changed in Kahramanmaras Elbistan sugar factory production areas compared to results obtained 20 years ago by Tursun et al. (2003).

The survey studies applied were shown in Table 1. Density, frequency of incidence and general coverage areas of weed species were calculated by taking the average of these two years. Weed density was calculated by throwing a total of 4052 frames in the districts where the research was conducted.

This study was conducted in sugar beet production area located in 7 districts Kahramanmaras and Adana provinces. The distance between two fields were more than 3 km and the samples were taken starting from 15 m inside the sugar beet field edge. In each 1 da area, 4 frames (1 m^2) were used and weeds obtained and counted (Odum,1971; 1983; Kadıoglu et al., 1995; Üremis and Uygur, 2002; Üremis et al., 2020). The number of weeds in 1 m^2 was calculated by dividing the total number of each species. Weed density was calculated by using the formula (1):

Density=B/n formula (Güncan, 2016) (1)

where; B=Total weed number in the sample, n=Number of sample.

As suggested by Üstüner and Güncan (2002), density scale was used as follows;

A. Highly dense (average more than 10 weeds / m^2)
B. Dense (average 1-10 weeds / m^2)
C. Medium dense (average 0.1-1 weeds / m^2)
D. Low density (average of 0.01 to 0.1 weeds / m^2)
E. Rare (average of less than 0.01 weeds / m^2)

Species, frequency of incidence and general coverage of weeds were calculated by using the following formulas:

Frequency of incidence (%) = Number of surveyed locations where a species occured/Number of total surveyed locations x 100 (2)

General Coverage (%) = Coverage of a weed species in survey areas/Number of total surveyed locations (3)

(Odum, 1971 and 1983; Uygur, 1997).

The weed species were identified by using the reference "Flora of Turkey and East Aegean Islands and Weeds of the West" (Davis et al., 1965-2000; Whitson et al., 1992).

Table 1. Average number of frames used in the weed survey in sugar beet fields in 2020 and 2021

Districts	Sugar beet plantation area (da)*	Number of frames
Afsin	11.914	800
Dulkadiroglu	1.533	370
Ekinözü	1.300	350
Elbistan	31.400	1250
Göksun	3.361	410
Türkoglu	1.670	382
Tufanbeyli	4.309	490
Total	**54.187**	**4.052**

* Data according to TUİK (2020).

Figure 1. Tufanbeyli district and the districts of Kahramanmaras province where surveys were carried out in sugar beet fields

The survey was conducted before hand or machine hoeand post-emergence herbicide in April and May in 2020 and 2021 years. Sampling areas are shown with dots on the map given in Figure 1. Twenty years ago, Tursun et al. (2003) conducted a weed survey in Kahramanmaras province. The results obtained in our study conducted in the sugar beet field were also compared with the survey results obtained by Tursun et al. (2003) years ago.

RESULTS and DISCUSSION

This research carried out in the districts of Kahramanmaras Adana provinces in 2020 and 2021 years. The number of species and families of the weeds on the sugar beet fields located in the districts (Afsin, Dulkadiroglu, Ekinözü, Elbistan, Göksun, Tufanbeyli and Türkoglu) are shown in Table 2. In the surveys; 88 weed species belonging to 26 families, including 1

holoparasitic plant and pterydophyta, 18 monocotyledonae and 68 dicotyledonae were detected (Table 3).

The maximum density of weed species was found in Elbistan (280.70 plant / m^2) followed by Afsin (230.84), Göksun (217.05), Tufanbeyli (196.70), Türkoglu (166.58), Dulkadiroglu (162.02) and Ekinözü (127.49), respectively. The average density of weed species seen in this research area was calculated as 197.34 plant / m^2. The highly dense (weed dense > 10) weed species were; 15.13 plant / m^2 for *S. arvensis*, 14.10 for *C. album*, 13.61 for *E. colonum*, 12.88 for C. campestris, 12.56 for *A. retroflexus*, 12.21 for *S. halepense*, 11.66 for *E. repens*, 11.37 for *C. arvensis*, 11.27 for *C. arvense* and 10.67 for *C. draba* were highly (very) dense, while 9.74 plant / m^2 for *B. tectorum*, 6.79 for *P. oleracea*, 5.93 for *A. repens*, 5.27 for *E. arvense*, 5.25 for *P. australis*, 3.09 for *G. aparine,* 2.66 for *C. dactylon*, 2.10 for *S. viridis*, 1.82 for *S. nigrum*, 1.71 for *X. strumarium*, 1.72 for *P. rhoeas*, 1.62 for *E. crus-galli*, 1.58 for *M. neglecta*, 1.51 for *P. aviculare*, 1.46 for *H. europaeum*, 1.40 for *D. glomerata*, 1.37 for *H. trionum*, and 1.34 for *T. terrestris* were dense (Table 3).

The frequency of incidence of the weed species was determined between 64.90 and 50.10 % for *S. arvensis, E. colonum, C. album, A. retroflexus, E. repens, B. tectorum, C. arvense, S. halepense, C. arvensis* and *C. campestris* in Kahramanmaras province and Tufanbeyli district. At the same time, it was determined that the general coverage area of weeds (*S. arvensis, C. campestris, S. halepense, C. arvense, C. arvensis, E. colonum, A. retroflexus, C. album* and *P. australis*) varied between 62.85 and 50.00 %.

Table 2.The number of species and families of the weeds on the sugar beet fields

Districts	Number of families	Number of species
Afsin	25	81
Ekinözü	22	58
Elbistan	26	88
Göksun	24	80
Dulkadiroglu	22	64
Tufanbeyli	25	78
Türkoglu	22	66

Table 3. Density of weed species and families according to districts

WEED SPECIES	DENSITIES (weed / m^2)							
	AFS.	ELB.	EKİ.	GÖK.	DULK.	TÜRK.	TUF.	PROVINCIAL AVERAGE
HOLO PARASITIC PLANTS								
Family: Cuscutaceae								
Cuscuta campestris Yunc.	15.98	18.58	8.75	13.90	11.00	10.58	11.40	12.88
PTERIDOPHYTA								
Familya: Equisetaceae								
Equisetum arvense L.	10.67	10.79	0	15.45	0	0	0	5.27
MONOCOTYLEDONEAE								
Family: Poaceae								
Aegilops columnaris Zhuk.	1.26	1.45	0.01	0.2	0.03	0.02	1.50	0.64
Alopecurus myosuroides Hudson	1.30	1.50	0.02	0.80	0.15	0.36	0.71	0.69
Avena fatua L.	1.20	1.60	0.1	1.00	0	0	1.40	0.76
Avena sterilis L.	0	0	0	0	0.43	0.39	0	0.12
Bromus tectorum L.	10.90	12.0	1.30	11.35	10.75	11.21	10.65	9.74
Cynodon dactylon(L.) Pers.	0.70	6.40	0.02	5.20	0.40	0.87	5.00	2.66
Dactylis glomerata L.	2.30	2.50	0.7	0.3	0.5	0.71	2.80	1.40
Digitaria sanguinalis (L.) Scop.	0.1	0.2	0.3	0.4	1.38	1.55	1.60	0.79
Echinochloa colonum (L.) Link.	19.30	23.10	10.20	10.30	10.10	10.65	11.60	13.61
Echinochola crus-galli (L.) P.Beauv.	2.50	3.40	0.88	1.10	0.7	0.11	2.65	1.62
Elymus repens (L.) Gould.	11.25	13.90	10.55	11.50	12.50	10.45	11.50	11.66
Hordeum vulgare L.	0.2	0.3	0.41	0.21	0.15	0.11	0.26	0.23

Table 3 (continued). Density of weed species and families according to districts

Lolium temulentum L.	0.55	0.80	0.10	0.30	0.25	0.48	0.28	0.39
Phalaris canariensis L.	0.78	0.90	0.01	0.65	0.02	0.26	1.16	0.54
Phragmites australis (Cav.) Trin. ex Steud.	10.15	13.20	0.74	1.20	4.65	5.68	1.10	5.25
Poa annua L.	0.65	0.75	0.02	0.33	0.02	0.05	1.16	0.43
Setaria viridis (L.) P.Beauv.	1.24	1.80	1.00	1.20	3.30	4.73	1.40	2.10
Sorghum halepense (L.) Pers.	14.63	15.30	10.79	13.63	10.00	10.77	10.35	12.21
DICOTYLEDONEA								
Family: Amaranthaceae								
Amaranthus albus L.	0.28	0.40	0.01	0.56	0.02	0.01	0.35	0.23
Amaranthus blitoides S.Watson	0.11	0.28	0.2	0.01	0.02	0.03	0.44	0.16
Amaranthus retroflexus L.	11.20	11.00	10.27	15.30	13.50	10.55	16.10	12.56
Family: Apiaceae								
Caucalis platycarpos L.	0.01	0.02	0	0.03	0.01	0.02	0	0.01
Daucus carota L.	0.02	0.03	0.1	0.2	0.01	0.03	0.1	0.07
Eryngium campestre L.	0	0.02	0	0	0	0	0	0.00
Turgenia latifolia Hoff.	0.1	0.3	0	0.01	0.22	0.15	0.12	0.13
Family: Aristolochiaceae								
Aristolochia maurorum L.	1.25	1.45	0	1.80	0.32	0.18	0.2	0.74
Family: Asteraceae								
Achillea biebersteinii Afan.	0.25	0.17	0.13	0.18	0.10	0.01	0.4	0.18
*Achillea millefolium*L.	0.02	0.03	0	0	0	0.03	0.14	0.01
Acroptilon repens (L.) DC.	10.0	11.78	0.45	11.22	2.63	1.58	3.83	5.93
Anthemis austriaca Jacq.	0.06	0.05	0.01	0.02	0.15	0.18	0.01	0.07
Carduus nutans L.	0.04	0.07	0	0.02	0.08	0.09	0.01	0.04
Centaurea cyanus L.	0.01	0.03	0	0.04	0.22	0.16	0.2	0.09
Centaurea depressa L.	0.01	0.02	0	0.02	0	0	0.1	0.02
Centaurea solstitialis L.	0.5	0.6	0	0.01	0.14	0.16	1.27	0.38
Chondrilla juncea L.	0.1	0.2	0.1	1.4	0.02	0.01	0.08	0.27
Cichorium intybus L.	0.2	1.1	0.04	0.02	0.01	0.03	0	0.20
Cirsium arvense (L.) Scop.	13.00	12.00	10.28	11.40	10.20	11.59	10.40	11.27
Cirsium sipyleum C.A. Mey.	0.1	0.02	0	0	0	0	0.02	0.02
Erigeron canadensis L.	0	0.04	0	0.01	0	0.02	0	0.01
Lactuca serriola L.	0.64	0.75	0.12	0.24	0.5	0.32	0.9	0.50
Matricaria chamomilla L.	0.28	0.46	0.20	0.55	0.21	0.48	0.29	0.35
Scorzonera hispanica L.	0.01	0.02	0	0.01	0	0	0.03	0.01
Silybum marianum (L.) Gaertner	0.56	0.29	0	0.15	0.01	0.02	0.24	0.18
Sonchus arvensis L.	0.02	0.03	0.01	0.04	0.01	0.01	0.27	0.06
Sonchus oleraceus L.	0.01	0.04	0.01	0.12	0	0	0.03	0.03
Taraxacum officinale (L.) Weber. ex F.H. Wigg.	0.04	0.08	0	0.1	0	0	0.1	0.05
Tragopogon dubius L.	0	0.2	0	0	0	0	0	0.03
Tragopogon porrifolius L.	0	0.1	0	0.2	0	0	0	0.04
Xanthium spinosum L.	0.05	0.07	0.01	0.3	0.60	0.23	0.7	0.28
Xanthium strumarium L.	1.36	2.25	1.90	1.8	1.70	1.89	1.25	1.74
Family: Boraginaceae								
Anchusa officinalis L.	0.01	0.02	0	0.03	0.02	0.01	0.04	0.02
Anchusa spp.	0	0.001	0	0.02	0	0	0	0.00
Heliotropium europaeum L.	1.45	1.80	1.50	1.70	1.30	1.46	1.00	1.46
Family: Brassicaceae								
Cardaria draba (L.) Desv.	10.25	11.25	10.60	10.30	10.70	11.51	10.10	10.67

Table 3 (continued). Density of weed species and families according to districts

Raphanus raphanistrum L.	0.35	0.60	0.43	0.20	0.05	0.07	0.20	0.27
Sinapis arvensis L.	18.84	19.84	10.62	15.45	12.95	13.48	14.70	15.13
Family: Caryophyllaceae								
Vaccaria pyramidata Medik.	0.25	0.45	0.12	0.30	0.16	0.15	0.17	0.23
Family: Chenopodiaceae								
Chenopodium album L.	15.55	16.55	10.38	14.25	13.75	12.63	15.56	14.10
Chenopodium botrys L.	1.26	1.35	0	2.10	0	0	0.80	0.79
Chenopodium vulvaria L.	0.6	0.7	0	0.1	0	0	0.2	0.23
Salsola kali L.	1.48	2.20	0	1.10	0.71	0.38	1.00	0.98
Family: Convolvulaceae								
Convolvulus arvensis L.	12.50	13.10	10.27	11.10	10.30	11.62	10.70	11.37
Convolvulus galaticus L.	0.45	0.56	0.1	0.35	0	0	0.26	0.25
Family: Euphorbiaceae								
Chrozophora tinctoria (L.) A.Juss.	0.01	0.4	0.01	0	0	0	0.28	0.10
Euphorbia falcata L.	0.25	0.5	0	0	0	0	0	0.11
Family: Fabaceae								
Alhagi maurorum Medik.	0.67	0.72	0	0.3	0	0	0.2	0.27
*Medicago sativa*L.	0.28	0.35	0	0.02	0	0	0	0.09
Vicia cracca L.	0.1	0.26	0.25	0.3	0.1	0.22	0.4	0.23
Vicia narbonensis L.	0.15	0.30	0	0.2	0.17	0.15	0.15	0.16
Vicia sativa L.	0.2	0.5	0.1	0.1	0.02	0.03	0.20	0.16
Family: Lamiaceae								
Lamium amplexicaule L.	0.56	0.80	0.14	0.25	0.16	0.22	0.45	0.37
Family:Malvaceae								
Hibiscus trionum L.	1.79	5.10	0	1.00	0	0	1.70	1.37
Malva neglecta Wall.	1.5	2.50	1.20	1.10	1.30	1.25	2.20	1.58
Malva sylvestris L.	0.4	0.6	0.3	0.2	0.1	0.36	0.8	0.39
Family: Myrtaceae								
Metrosideros perforata (J.R.Forst. & G.Forst.) Druce	0	0.02	0	0	0	0	0.01	0.00
Family: Papaveraceae								
Fumaria officinalis L.	1.10	1.70	0.43	0.85	0.20	0.18	1.20	0.81
Fumaria spp.	0	0	0.1	0	0	0	0	0.01
Papaver rhoeas L.	1.70	2.58	1.90	1.5	1.27	1.38	1.70	1.72
Family: Polygonaceae								
Polygonum aviculare L.	1.80	1.40	1.00	1.70	1.90	1.25	1.50	1.51
Family: Portulacaceae								
Portulaca oleracea L.	3.8	10.72	2.40	10.40	3.60	5.82	10.82	6.79
Family: Ranunculaceae								
Consolida regalis Gray.	0.25	0.70	0	0.2	0	0	0.3	0.21
Consolida orientalis Gray.	0	0.20	0	0	0.0	0	0.2	0.06
Ranunculus arvensis L.	0.7	0.90	0.20	0.30	0.15	0.12	0.5	0.41
Family: Resedaceae								
Reseda lutea L.	0.15	0.46	0	0.25	0	0	0.01	0.12
Family: Rubiaceae								
Galium aparine L.	3.40	4.50	2.80	3.60	2.00	3.26	2.10	3.09
Family: Solanaceae								
Solanum nigrum L.	1.8	2.10	1.5	1.10	2.10	2.89	1.25	1.82
Family: Urticaceae								
Urtica urens L.	0.25	1.10	0.2	0.5	0.1	0.2	0.80	0.45
Family: Zygophyllaceae								
Tribulus terrestris L.	1.10	1.50	1.20	1.40	1.90	1.18	1.10	1.34
TOTAL	230.84	280.70	127.49	217.05	162.02	166.58	196.7	197.34

AFS. =Afsin, ELB.=Elbistan, EKİ.=Ekinözü, GÖK.=Göksun, DULK.=Dulkadiroglu, TÜRK:=Türkoglu, TUF.=Tufanbeyli.

The weeds in the sugar beet fields in the districts of Kahramanmaras province and Tufanbeyli district (Adana province) were evaluated according to the survey results below:

Afsin district

In sugar beet fields in Afsin, 81 different weeds belonging to 25 families were determined. The density of weed species was 230.84 plant / m^2.

Density of weeds in this research area is ordered from the highest to the lowest as following; *E. colonum, S. arvensis, C. album, A. retroflexus, C. campestris, S. halepense, C. arvense, C. arvensis, E. repens, C. dactylon, E. arvense, C. draba, P. australis* and *A. repens* were highly (very) dense, while *P. oleracea, G. aparine, E. crus-galli, D. glomerata, S. nigrum, P. aviculare, Hibiscus trionum L., P. rhoeas, M. neglecta, Salsola kali, H. europaeum, X. strumarium, A. myosuroides, A. columnaris, C. botrys, A. maurorum, S. viridis, A. fatua, F. officinalis* and *T. terrestris* were dense respectively (Table 3).

The frequency of incidence of the weed species were 62.35 % for *E. colonum*, 61.90 % for *S. arvensis*, 58.70 % for *C. album* and 55.30 for % *A. retroflexus*. General coverage of the weeds was 58.85 % for *S. arvensis*, 56.80 % for *E. colonum* and 53.40 % for *A. retroflexus* (Table 4). Those whose frequency of incidence is greater than 40% and whose coverage area is greater than 30% are only included in this table.

Table 4. Weed frequency of incidence and general coverage of weeds in Afsin, Dulkadiroglu, Ekinözü and Elbistan districts

Districts	**Afsin**		**Dulkadiroglu**		**Ekinözü**		**Elbistan**	
Weed species	**Fre. (%)**	**Cov. (%)**	**Fre. (%)**	**Cov. (%)**	**Fre. (%)**	**Cov. (%)**	**Fre. (%)**	**Cov. (%)**
Echinochola colonum	62.35	56.80	52.35	51.80	51.43	50.30	63.35	58.80
Sinapis arvensis	61.90	58.85	53.90	55.85	52.10	51.70	64.90	62.85
Chenopodium album	58.70	52.80	52.70	51.80	50.50	50.40	61.70	54.80
Amaranthus retroflexus	55.30	53.40	50.30	51.40	50.25	50.60	58.30	56.40
Cirsium arvense	51.70	50.00	50.70	50.40	50.70	50.20	55.70	51.00
Cuscuta campestris	53.30	51.52	42.30	41.82	40.60	44.28	54.20	52.50
Sorghum halepense	54.60	50.90	48.60	50.90	47.55	48.70	52.75	51.42
Pharagmites australis	42.86	39.35	38.86	36.35	<20	<20	50.80	46.10
Bromus tectorum	40.38	37.53	41.25	38.37	<20	<20	52.90	45.73
Elymus repens	51.72	45.63	46.72	44.63	44.56	42.35	50.40	43.22
Portulaca oleracea	40.10	45.20	41.10	46.20	<30	<30	48.32	46.70
Convolvulus arvensis	52.41	47.60	51.41	46.60	49.41	45.10	50.25	47.60
Acroptilon repens	43.10	35.27	40.10	35.27	<30	<30	42.85	36.10
Equisetum arvense	41.84	36.30	<10	<10	0	0	<20	<20
Cardaria draba	40.21	37.68	41.21	38.17	32.60	30.10	41.55	39.10

Fre.=Frequency of incidence, Cov.=Coverage.

Dulkadiroglu district

In the *B. vulgaris* fields in Dulkadiroglu district, 64 different weeds belonging to 22 families were determined. The density of weed species was found to be 162.05 plant / m^2.

Density of weeds in this research area was ordered from the highest to the lowest as following; *C. album, A. retroflexus, E. repens, S. arvensis, B. tectorum, C. draba, C. arvensis, C. arvense, E. colonum, C. campestris* and *S. halepense* were highly (very) dense while *P. australis, P. oleracea, S. viridis, X. strumarium, D. sanguinalis, H. europaeum, M. neglecta, G. aparine, P. aviculare, P. rhoeas, S. nigrum, T. terrestris and A. repens* were dense, respectively (Table 3).

The frequency of incidence of the weed species was 53.90 % for *S. arvensis*, 52.35 % for *E. colonum* and 52.70 % for *C. album*. General coverage of the weeds was 55.85 % for S. arvensis, 51.80 % for *E. colonum* and 51.40 % for *A. retroflexus* (Table 4).

Ekinözü district

In Ekinözü *B. vulgaris* fields, 58 different weeds belonging to 22 families were determined. The density of weed species was 127.49 plant / m^2.

Density of weeds in this research area was ordered from the highest to the lowest as following; *S. halepense, S. arvensis, C. draba, E. repens, C. album, C. arvense, A. retroflexus, C. arvensis* and *E. colonum* were highly (very) dense, while *C. campestris, G. aparine, P. oleracea, X. strumarium, H. europaeum, P. rhoeas, S. nigrum, B. tectorum, M. neglecta, T. terrestris, S. viridis* and *P. aviculare* were dense, respectively (Table 3).

The frequency of incidence of the weed species were 52.10 % for *S. arvensis*, 51.43 % for *E. colonum* and 50.50 % for *C. album*. General coverage of the weeds was 51.70 % for *S. arvensis*, 51.40 % for *C. album* and 50.60 % for *A. retroflexus* (Table 4).

Elbistan district

In the *B. vulgaris* fields in Elbistan, 88 different weeds belonging to 26 families were determined. The density of weed species was 280.70 plant / m^2.

Density of weeds in this research area was ordered from the highest to the lowest as following; *E. colonum, S. arvensis, C. album, A. retroflexus, C. arvense, C. campestris, S. halepense, P. australis, B. tectorum, E. repens, P. oleracea, C. arvensis, A. repens, C. dactylon, C. draba* and *E. arvense* were highly (very) dense, while *Hibiscus trionum L., G. aparine, M. chamomilla, A. columnaris, E. crus-galli, A. myosuroides, A. fatua, D. glomerata., H. europaeum, L. temulentum, M. neglecta, M. slyvestris, S. nigrum, X. strumarium, R. arvensis, S. viridis, P. aviculare, Achillea biebersteinii, V. pyramidata* and *L. serriola* were dense (Table 3).

The frequency of incidence of the weed species were found as 64.90 % for S. arvensis, 63.35 % for *E. colonum* and 61.70% for *C. album*. General coverage of the weeds was 62.85% for *S. arvensis*, 58.80 % for *E. colonum* and 56.40 % for *A. retroflexus* (Table 4).

Göksun district

In Göksun *B. vulgaris* fields, 80 different weeds belonging to 24 families were determined. The density of weed species was 217.05 plant / m^2.

Density of weeds in this research area was ordered from the highest to the lowest as following; *E. arvense, S. arvensis, A. retroflexus, C. album, C. campestris, S. halepense, E. repens,C. arvense, B. tectorum, A. repens, P. oleracea, C. arvensis, C. draba* and *E. colonum* were highly (very) dense, while *C. dactylon, G. aparine, C. botrys, A. maurorum., P. aviculare, X. strumarium, H. europaeum, Chondrilla juncea, P. rhoeas, T. terrestris, S. viridis, P. australis, M. neglecta, S. nigrum,E. crus-galli, S. kali* and *H. trionum* were dense (Table 3).

The frequency of incidence of the weed species was 54.90 % for *S. arvensis*, 53.70 % for *C. album* and 51.90 % for *A. retroflexus*. General coverage of the weeds was 53.15 % for *S. arvensis*, 52.60 for % *A. retroflexus* and 50.10 % for *C. arvense* (Table 5).

Tufanbeyli district

In Tufanbeyli *B. vulgaris* fields, 78 different weeds from 25 families were determined. The density of weed species was 196.70 plant / m^2.

Density of weeds in this research area is ordered from the highest to the lowest as following; *A. retroflexus, C. album, S. arvensis, E. colonum, E. repens, C. campestris, P. oleracea, B. tectorum, C. arvensis, C. arvense, S. halepense* and *C. draba* were high (very) dense, while *C. dactylon, A. repens, D. glomerata, M. neglecta, D. sanguinalis, G. aparine, H. europaeum, E. crus-galli, H. trionum, S. nigrum, X. strumarium, P. aviculare, S. viridis, P. annua, Phalaris canariensis* and *P. austrialis* were dense (Table 3).

The frequency of incidence of the weed species was 55.40 % for *S. arvensis*, 54.20 % for *C. album* and 52.70 % for *C. arvense*. General coverage of weeds were 53.60 % for *A. retroflexus*, 53.10 % for *S. arvensis* and 52.10% for *C. album* (Table 5).

Türkoglu district

In Türkoglu *B. vulgaris* fields, 66 different weeds belong to 22 families were determined. The density of weed species was 166.68 plant / m^2.

Density of weeds in this research area was ordered from the highest to the lowest as following; *C. album, C. arvensis, C. draba, S. arvensis, B. tectorum, S. halepense, E. colonum, C. arvense, A. retroflexus, E. repens* and *C. campestris* were highly dense, while *P. oleracea, P. australis, S. viridis, G. aparine, X. strumarium, D. sanguinalis, H. europaeum, M. neglecta, P. rhoeas, P. aviculare, S. nigrum, A. repens* and *T. terrestris* were dense (Table 3).

The frequency of incidence of the weed species was 53.90 % for *S. arvensis*, 52.70 % for *C. album* and 50.40 % for *A. retroflexus*. General coverage of the weeds was 51.85 % for *S. arvensis*, 51.40 for % *A. retroflexus* and 50.30% for *C. album* (Table 5).

Table 5. Frequency of incidence and general coverage of weeds in Göksun, Tufanbeyli and Türkoglu

Districts	Göksun		Tufanbeyli		Türkoglu	
Weed species	**Fre. (%)**	**Cov. (%)**	**Fre. (%)**	**Cov. (%)**	**Fre. (%)**	**Cov. (%)**
Sinapis arvensis	54.90	53.15	55.40	53.10	53.90	51.85
Chenopodium album	53.70	50.20	54.20	51.20	52.70	50.30
Amaranthus retroflexus	51.90	52.60	50.30	53.60	50.40	51.40
Cirsium arvense	50.70	50.10	52.70	50.00	45.70	43.00
Elymus repens	50.20	41.22	51.40	42.72	48.40	41.22
Sorghum halepense	47.65	48.90	45.65	42.90	47.65	44.00
Convolvulus arvensis	46.41	44.60	51.21	50.60	50.20	50.00
Echinochola colonum	45.35	42.43	51.85	47.43	44.35	42.80
Cuscuta campestris	43.30	41.50	44.30	43.50	41.30	40.60
Portulaca oleracea	42.32	40.70	44.32	42.70	43.32	41.70
Acroptilon repens	41.85	40.10	46.85	41.10	44.85	37.10
Bromus tectorum	40.90	38.10	44.90	40.10	50.10	47.73
Equisetum arvense	40.25	33.55	<30	<30	<20	<20
Cardaria draba	35.10	32.86	38.80	37.86	34.10	33.90
Phragmites australis	<30	<30	<30	<30	<30	<30

Fre.=Frequency of incidence, Cov.=Coverage.

In this study, species of weeds, density, frequency of incidence and general coverage were determined in sugar beet fields in Kahramanmaras province and Tufanbeyli district (Adana province) in Turkey. In the sugar beet fields, 88 weed species from 26 families were detected. One species of these belongs to holo-parasitic and the ferns, 18 monocotyledonae and 68 dicotyledonae. The density of the weeds was calculated as 197.34 (plant / m^2) in the districts of Kahramanmaras and Tufanbeyli district. In terms of the number of weed species, Elbistan ranks first with 88 species and 26 families, followed by Afsin with 81 species and 25 families, Göksun with 80 species and 24 families, Tufanbeyli with 78 species with 25 families, Türkoglu with 66 species with 22 families, Dulkadiroglu with 64 species with 22 families, and Ekinözü with 58 species and 22 families

Tursun et al. (2003) carried out a survey during the vegetation period of 2000-2001 in *B. vulgaris* fields in Kahramanmaras provinces and determined 41 weed species belonging to 22 families (1 parasitic, 1 cryptogamae, 2 monocotyledoneaus and 18 dicotyledoneaus). Important weed species were found to be *A. retroflexus*, *C. album*, *C. arvensis*, *S. nigrum* and *S. arvensis*.

In the surveys carried out after 20 years in the production areas of Elbistan sugar factory in Kahramanmaras, it was observed that the districts where sugar beet was produced were changed. In the research conducted 20 years ago, survey studies were carried out in Kahramanmaras districts (Center district, Andırın, Caglayancerit, Elbistan, Göksun, Pazarcık and Türkoglu). In the present research which conducted in 2020 and 2021, sugar beet production quotas are given in Afsin, Elbistan, Ekinözü, Göksun and Tufanbeyli districts. The main reason for this change is that the factory started its sugar beet purchase campaign in November. On the other hand, central district, Türkoglu, Pazarcık and Andırın districts have to harvest in September. Therefore, the factory will have to start a buying campaign 40-45 days before these districts, which means an increase in factory input costs.

Unlike 20 years ago, in the present research, it was determined that *E. colonum, C. campestris, E. arvense, E. repens* and *C. arvensis* species were also found to be very common. This study proves that both weed species and densities can vary from year to year, even in the same region.

Although the weed species observed in sugar beet fields were similar according to the provinces in Turkey (Eskisehir, Adapazarı, Burdur, Ankara, Erzurum, Kastamonu, Tokat, Bayburt, Van, Sakarya, Kahramanmaras, Kayseri, Konya and Bitlis province), density, frequency of incidence and the coverage areas differed numerically (Göbelez, 1972; Önen, 1995; Kordali, 2002; Özkan and Kaya, 2008; Akca and Isık, 2016;

Üstüner, 2018; Üstüner and Öztürk, 2018; Kulan, 2019; Cal and Kara, 2020).

This study was found to be similar to other studies in terms of weed species in Turkey, but numerical and proportional differences were observed. The reasons of this difference are due to factors such as the altitude of the region, soil structure, climate, irrigation system and plant communities.

Weed species that were seen in sugar beet fields in other countries (England, France, Germany, Greece, Southern Germany, Italy, Czech Republic, Russia; Egypt, Lithuania, South European, Central Bohemia, Spain, Iran, Bangladesh and USA) were *A. retroflexus, C. album, S. arvensis, S. media, E. crus-galli, P. annua* and *S. viridis* showed partial similarity, but species not seen in Turkey were also reported. It was observed that the numerical differences in terms of weed density and frequency of incidence are also high (Schweizer, 1979; Blaszyk et al., 1980; Schweizer and May, 1993; Bosak and Mod, 2000; Salimi et al., 2004; Mitchell, 2005; Salehi et al., 2006; Petersen, 2008; Jursik et al., 2008; Mirshekari et al., 2010; Stevanato et al., 2011; Kunz et al., 2015; Kunz et al., 2016; Zargar et al., 2010; Bayat et al., 2019; Bhadra et al., 2020 and Jursík et al., 2020).

There are 60 weed species reported as major infesting species among 250 weed species in sugar beet crop in the world, of which approximately 70 % are broad leaved and 30 % are grass weeds (Schweizer and May, 1993; May and Wilson, 2006).

According to Zargar et al. (2010), weed species that are very dense in Iranian sugar beet fields were; *Hibiscus trionum* L., *C. album, A. retroflexus* and their densities were 14.8, 33.3 and 23.0 plant / m^2, respectively. Weed species that were highly dense in Prague, Czech Republic *B. vulgaris* fields were; 13.70 plant / m^2 for *A. retroflexus,* 9.50 plant / m^2 for *E. crus-galli,* 54.21 plant / m^2 for *C. album,* 20.14 plant / m^2 for *A. theophrasti* and 19.12 plant / m^2 for *Beta maritima* (Jursík et al., 2020). The weeds in sugar beet fields in Franconia in southern Germany were *C. album, C. arvense, C. arvensis, Mercurialis annua* L., *Polygonum* sp., *Sonchus* sp. and *Solanum nigrum* each occurred on >25 % (Meinecke et al., 2014). Weed density in sugar beet fields in Rovigo (Italy) and Pithiviers (France) was calculated as 4.50 plant / m^2 for *S. halepense*, 3.70 plant / m^2 for *S. nigrum*, 2.20 plant / m^2 for *C. album*, and 1.20 plant / m^2 for *A. theophrasti* (Stevanato et al., 2011).

In different sugar beet production areas in Turkey, weed species, density, frequency of occurrence and general coverage areas may vary significantly in different provinces of Turkey (Adapazarı, Ankara, Bayburt, Bitlis, Burdur, Erzurum, Eskisehir, Kastamonu, Tokat, Usak and Van). *A. retroflexus, Anagallis arvensis* L., *Anchusa azurea* Miller., *Boreava orientalis* Jaub and Spach., *Bromus tectorum* L., *Capsella bursa-pastoris* (L.) Medik., *Cardaria draba, Centaurea cyanus* L., *C. album*, *C. arvense*, *C. arvensis*, *C. dactylon*, *Lithospermum* sp., *E. cruss-galli*, *Euphorbia falcata*, *Erodium cicutarium* (L.) L'Herit., *E. tuberosum*, *E. arvense*, *Geranium tuberosum*, *P. aviculare*, *Portulaca oleracea* L., *M. chamomilla*, *G. spinosa*, *Senecio vulgaris* L., *S. viridis, S. arvensis, S. nigrum*, *Sonchus* sp., *S. halepense*, *Taraxacum officinale* Web., *Tragopogon* sp., *Vicia* sp., *Veronica* sp., *Fallopia convolvulus*, *Fumaria discolor*, *F. officinalis*, *P. aviculare,* and *Xanthium strumarium* L. were the most common species, although the species and density vary numerically according to the provinces (Göbelez, 1972; Kordali, 2002; Özkan and Kaya, 2008). It is observed that the densities of weed species, that were important in sugar beet fields, differ from province to province (Önen, 1995 in Tokat; Tursun et al., 2003 in Kahramanmaras; Akca and Isık, 2016 in Kayseri; Kulan, 2019 in Eskisehir; Akar and Ögüt Yavuz, 2020 in Usak; Cal and Kara, 2020 in Sakarya). Although most of these weed species were widely seen in various countries, they were rarely seen in Turkey. The reason could be the climate conditions, soil chemical compounds and altitudes of the region as well as the different agrosystems and irrigation systems used in the survey areas.

ÖZET

Amaç: Bu çalışma, Kahramanmaraş ve Adana illerinde çeşitli ilçelerde bulunan şeker pancarı tarlalarında yabancı ot türü, yoğunluğu, sıklığı ve genel kaplama alanını belirlemek amacıyla yapılmıştır. Ayrıca 2000-2001 yıllarından 20 yıl sonra şeker fabrikası üretim alanları ile yabancı ot türleri ve yoğunluğunda meydana gelen değişimlerin belirlenmesi amaçlanmıştır.

Yöntem ve Bulgular: Çalışma alanlarında görülen yabancı ot yoğunluğunu hesaplamak için 1 hektara 40 çerçeve kullanılmıştır. Yabancı otların türü, yoğunluğu, görülme sıklığı ve genel kaplama alanları hesaplanmıştır. Şeker pancarı tarlalarında çok yoğun olarak tespit edilen yabancı ot türleri sırasıyla, *Sinapis arvensis* L., *Chenopodium album* L., *Echinochloa colonum* (L.) Link., *Cuscuta campestris* Yunck., *Amaranthus retroflexus* L., *Sorghum halepense* (L.) Pers., *Elymus repens* (L.) Gould., *Convolvulus arvensis* L., *Cirsium arvense* (L.) Scop. ve *Cardaria draba* (L.) Desv. olarak belirlenmiştir. Önemli yabancı ot türlerinin sıklığı ve genel kaplama alanı % 64.9-50.1 ve % 62.8-50.0 arasındadır.

Genel yorum: Kahramanmaraş ve Adana illerinde yer alan ilçelerdeki şekerpancarı tarlalarında 26 familyaya bağlı toplam 88 yabancı ot türü tespit edilmiştir. Bu yabancı ot türlerinden 1 tür tam parazit ve Pteridophyta, 18 Monokotiledon ve 68 tür Dikotiledon sınıfına aittir. Kahramanmaraş şeker pancarı tarlalarında 20 yıl önce yapılan araştırma sonuçlarına göre hem bugün belirlenen tür sayısında hem de çok yoğun görülen tür sayısında önemli artışlar olduğu gözlenmiştir.

Çalışmanın Önemi ve Etkisi: Kahramanmaraş ve Adana illerinde bulunana şeker pancarı tarlalarında tespit edilen yabancı ot türleri ve yoğunluklarının ilçeden ilçeye değişiklik gösterdiği belirlenmiştir. Holo parazit *C. campestris* ile rizom ve stolon gövdeli bazı yabancı ot türleri yoğunluk bakımından şeker pancarı için önemli bir tehdittir.

Anahtar Kelimeler: Şeker pancarı, yabancı ot, yoğunluk, rastlama sıklığı, genel kaplama alanı.

CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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