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The Species and Intensities of Weed Seeds Obtained from Wheat Flour Mill Plants in Turkey**

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ABSTRACT

Wheat production is more than 10% is in first place with potential in Konya plain of Turkey. Weed seeds mixed crop seeds cause quality and yield losses on production. This research was carried out to determine the species, intensity and frequency of weed seeds obtained from flour mill plants operating in Konya. Samples were taken from the 15 flour mill plants with working high capacity in the region. Identification of the weed seeds species in the sample was made. Comparison was made with live materials and reference documents by examining the seeds under a binocular while diagnosis of species. Also, the intensity and frequency of the species contaminated in wheat were determined. As a result of the study, 79 weed seed species belonging to 19 different families were identified. The species of families the most inclusive were Poaceae with 14 species and Leguminosae with 13 species. In order to determine intensity and frequency of species, weed seeds counted by hand, weighed in scale were recorded in laboratory. The highest weed seeds intensity as number and weight among the species were determined *Galium tricornutum* (rough bedstraw) with 16.16% and *Aegilops cylindrica* (jointed goatgrass) with 21.22% respectively. About the frequency of species, the most frequent species was *Convolvulus arvensis* (field bindweed) with 100%.

Introduction

Wheat is a crop plant which is essential for whole humanity. Many products are made from wheat today. Wheat means being full. The role and importance of flour obtained from wheat, bread and other products made from flour in human life is far too great. Wheat is a strategic product that is widely grown in the world, plays an important role in the nutrition and commercial life of many countries, is the most produced among crops and is used in human nutrition (Arısoy and Oğuz 2005).

In terms of world wheat production, China (133.6 million tons) ranks first. This country is followed by India (103.6 million tons), Russia (74.5 million tons) and USA (52.3 million tons). Turkey, on the other hand, ranks 11th in world wheat production with a production of 19 million tons (Anonymous 2019). It has an agricultural area of approximately 23 million ha in Turkey. Wheat is produced in approximately 7 million hectares of this area. Konya province ranks first in Turkey in terms of cultivation area (6.2 million decares) and production (1.92 million tons) (Anonymous 2020).

Today world population is increasing rapidly. Uncontrolled population growth is the most important fact gradually revealing the danger of hunger. Population growth increasing every day causes wheat yield to fall short. One of the most significant agricultural factors restricting wheat production is weeds because weeds cause decreases in the quality of wheat crop, and they also reduce yield of wheat produced in unit area. Weeds are the natural plants of agricultural and nonagricultural areas. Economically weeds mean, they are the plants which appear in and out of cultivated areas and do more harm than good for cultivated plants.

Weeds compete with crop plants for water, nutrients, space and light. These factors sometimes act alone and sometimes together. Because of some characteristics, they often have superior competitive power against crop plants. If measures are not taken, weeds can cause 20-40 % yield loss depending on the species of crop plants (Güncan 1982; Güncan and Karaca, 2018, Zimdahl, 2018, Güncan, 2019).

By contaminating with crop plant seeds, weed seeds decrease the nutritional value and spoil seed quality (Güncan 2002). In the research conducted in Turkey, it was determined that contamination rate of weed seeds

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in wheat product which was not passed through the selector was at an average of 1.17% numerically, at an average of 0.412% as weight (Güncan and Boyraz 2001). According to the findings, when wheat production in our country is accepted as 20 million tons, it is necessary to consider that 8.240 tons of weed seeds are consumed each year and sown again into the fields in case of not cleaning wheat product. The same researchers state that if the mentioned wheat is sown without cleaning, 5.600 weed seeds perdecare will be carried into the field just through the contaminated wheat seeds. In other words, 5-6 weed seeds per m² are carried through the mentioned way and this might cause a significant level of weed contamination. Tursun et al (2006) reported that the most common weed seeds contaminated with wheat were *Sinapis arvensis, Hordeum vulgare, Lolium temulentum, Boreava orientalis* and *G. tricornutum* respectively, and *H. vulgare, B. orientalis, S. arvensis*, and *L. temulentum* by weight, respectively in Kahramanmaraş. Karaca and Güncan (2009), carried out a study to determine the contamination ratio of *Secale cereale* to wheat product. It was determined that wild rye seed was contaminated in wheat product with an average of 1.1536% numerically and 0.9522% by weight in Konya province.

Gökalp and Üremiş (2015) determined that the most common weed seeds contaminated numerically with wheat were *Avena sterilis*, *S. arvensis* and *G. tricornutum* and *A. sterilis, Silybum marianum* and *Hordeum murinum* by weight respectively in Mardin province. Baş et al (2016), found that in their study to detect weed seeds contaminated with wheat crops, *Agrostemma githago* and *Caucalis latifolia* were numerically very dense. They found that *Adonis* sp., *Ranunculus arvensis* and *G. tricornutum* were heavily contaminated in the Eastern Black Sea Region. Pala et al (2018) determined that the weed seeds were most intensely contaminated into the harvested wheat product belonged to the Poaceae family with 13 species. It was determined that the most common species were *Avena fatua* and *A. sterilis* in Diyarbakır province. In the research of Bozkurt and Tursun (2018) found that numerically, *S. arvensis, Cephalaria syriaca* and *Polygonum aviculare* were the most common weed seeds respectively. According to the weight ratio, the most common species were found as *Caucalis daucoides*, *C. syriaca* and *Galium aparine* in Muş province. In the studies conducted in Balıkesir and Çanakkale, *S. arvensis* and *G. aparine* were determined as the most frequently contaminated weed seeds numerically, while *H. vulgare* was the most contaminated species in both provinces by weight (Kaçan and Tursun 2019).

In a study conducted between the years of 1974 and 1990 in Germany, it was reported that weed seed contamination average rate of grains was 0.5 %, and this contamination increased to 2% in wheat (Fuchs and Voit, 1992). Similarly, in another study conducted in Spain, it was determined that weed seeds contaminated in grains dramatically (Trigo et al., 1991). Nikham et al (2002) were carried out a survey in the Victoria in Australia. Mainly wheat and barley seeds were collected. The main weed seeds in cereal samples were annual ryegrass (*Lolium multiflorum*), wild oats (*Avena* spp.), silver grass (*Vulpia bromoides* L.), lesser canary grass (*Phalaris minor*), brome grass (*Bromus* spp.) and paradoxa grass (*Phalaris paradoxa*).

Çetik (1985) reported that there are too many weeds growing in the cultivation areas of forage plants and in pasture-meadow areas in the Central Anatolia Region. The researcher stated that weed seeds quickly germinate under appropriate conditions, they might remain dormant for a long time under inappropriate conditions. It is stated that many of these weeds are eaten by animals. Güncan and Karaca (2018), on the other hand, states that some weeds are a good feed source for animals both in summer and winter, some of them are not eaten by animals when they are fresh in summer because of bitter substances that they contain, but when they are dried, their bitterness disappears and they are eaten hungrily by animals.

The aim of this study, to determine which weed species are contaminated with wheat by using the samples taken from under-sieve, purifier, washing and trieur parts in flour mill plants and the rate of contamination. It is known that weed seeds obtained from various sieve systems in flour mill plants are used as feed in animal husbandry in Turkey. However, a large number and species of weed seeds can be transported to agricultural fields with animal manures. No study has been found on this subject. Therefore, the species and intensities of weed seeds that can be transported to agricultural areas with animal manures will be revealed.

2. Materials and Methods

The material of this study conducted in 2012-2013 consists of weed seeds obtained from flour mill plants in Konya, weed seed collection, precision scale, binocular and diagnostic books.

Determining weed seeds and their intensities:

In the research, samples were taken from 15 flour mills with high operating capability in Konya province. These are the samples which were processed through different sieving systems such as sieve, purifier, washing and trieur parts of factory. Since the materials from which the seeds are obtained are of different weights and volumes, the samples were extracted from materials until 100 g of weed seeds were obtained per flour mill plant. One hundred grams of weed seeds obtained from each flour mill plant were separated according to their genus and species.

In the second phase of the research, weed seeds collected from samples were diagnosed. Following this process, weed seeds were counted by hand in the herbology laboratory and their weights were recorded after weighing on a precision scale. Besides, intensity (as number and weight) and frequency of occurrence were calculated for each weed seed in 1.500 g of sam-

ples collected from 15 flour mill plants. In the research, % intensity (as number and weight) and frequency of occurrence were calculated according to the following formula (Odum 1971; Uludağ 1993; Baş et al 2016).

Intensity (%)=T/nx100

Frequency (%)=M/nx100

T= Total number of weed seed in the collected sample

M= Number of samples in which weed species was encountered

n= Number of samples

Weight (%)=A/Bx100

Number (%)=C/Dx100

A= Weight of selected weed seed

B=Seed weight in total

C=Number of selected weed seed

D=Number of seeds in total

To name the weeds in Turkish, the book entitled "Türkiye'nin Yabancı Otları" by Uluğ et al (1993) and the dictionary entitled "Bitki Terimleri" by Akalın (1952) were used. For the morphological and biological characteristics of the plants, the book entitled "Türkiye'nin Çayır-Mera Bitkileri" was employed. While diagnosing weed seeds, the weed seed collection prepared in previous years by Academic Member Prof. Dr. Ahmet GÜNCAN from Selcuk University, Faculty of Agriculture, Department of Plant Protection was used. In addition, Bischof's (1978) book entitled "Common Weeds from Iran, Turkey, the Near East and North Africa" on weed diagnosis was used. Weed seeds that could not be identified in the study were stated as others.

3. Results and Discussion

In the research, 79 weed species belonging to 19 families were determined and identified. Among these identified species, Fabaceae which included 15 species and Poaceae which included 12 species were the families which had the most species.

According to the results obtained in the research, the weed seed having the highest number was *G. tricornutum* (Fam: Rubiaceae) with the number of 39.539 *P. aviculare* and *Polygonum convolvulus* (Fam: Polygonaceae) follow this species with the numbers of 38.313 and 37.736 respectively. The fewest number of weed seed is 1 and it belongs to *Trifolium alexandrinum, Medicago hispida, Medicago sativa, Nicis benedictus, Onopordum caucalis, Patroselinum* sp. The heaviest weed seed was *Aegilops cylindrica* (Fam: Poaceae) with 289,077 g *A. fatua* (Fam: Poaceae) and *P. convolvulus* (Fam: Polygonaceae) follow it with 150,764 g and 133,449 g respectively. The weed seed having the lowest weight is *Trifolium alexandrinum* (Table 1).

Table 1
Number and weight of weed seeds determined from the wheat flour mill plants in Konya Provinces

Weed Species/Families	*Seed (number)	*Seed Weight (g)
Apiaceae (Umbelliferae)		
Bifora radians Bieb.	693	8.184
Bifora testiculata (L.) sprengex Schultes	535	5.808
Caucalis daucoides L.	7	0.307
Caucalis latifolia L.	75	1.386
Caucalis orientalis	6	0.002
Patroselinum sp.	1	0.001
Asteraceae (Compositae)		
Carthamus persicus Willd.	91	0.18
Centaurea deprassa Bieb.	560	6.359
Centaurea melitensis	5	0.02
Centaurea repens L.	102	0.087
Centaurea solstitialis L.	2	0.005
Cirsium lanceolatum (L.) Scop.	14	0.129
Onopordum acanthium L.	350	2.274
Onopondum caucalis	1	0.006
Boraginaceae		
Anchusa italica Retz.	36	0.807
Borogo sp.	24	0.179
Lithospermum arvense L.	5.954	18.728
Lycopsis orientalis	9	0.041
Brassicaceae (Cruciferae)		
Boreava orientalis Jaub and Spach	433	21.654
Euclidium syriacum (L.) R.Br.	140	0.714
Neslia apiculata Fisch.	872	4.142
Rapistrum rugosum (L.) All.	966	7.952
Thilapsi arvense L.	4.737	4.46
Caryophyllaceae		
Agrostemma githago L.	933	11.507
Gypsophila sp.	23.689	58.836
Silene caucalis	627	0.953
Silene conoidea L.	7.299	16.954
Vaccaria pyramidata Medik	13.566	37.4
Chenopodiaceae		
Beta lomatogona Fisch and Mey.	31	0.247
Chenopodium sp.	6.078	5.342

Table 1(Continue)
Number and weight of weed seeds determined from the wheat flour mill plants in Konya Provinces

Convolvulaceae		
Convolvulus arvensis L.	9641	94.612
Dipsacaceae		
Cephalaria aristata (C.) Koch	682	2.962
Cephalaria syriaca (L.) Schrad.	46	0.45
Fabaceae (Leguminosae)		
Lathyrus aphaca L.	67	0.893
Lathyrus sp.	213	0.429
Medicago hispida Gaertn.	1	0.038
*Medicago rigidula (*L.) All.	3	0.155
Medicago sativa L.	1	**0
Melilotus officinalis (L.) Desr.	2.627	4.626
Onobrichis sativa Lam.	4	0.47
Trifolium alexandrinum	1	**0
Vicia fabae	37	4.669
Vicia pannonica	495	21.7
Vicia peregrina L.	8	0.226
Vicia sativa L.	246	14.355
Vicia villosa Roth.	60	1.433
Labiatae (Lamiaceae)		
Marrubium peregrinum	298	0.426
Salvia sclarea L.	24	0.077
Lilliaceae		
Allium sp.	8	0.038
Ornithogalum narbonense L.	5	0.039
Malvaceae		
Althaea sp.	14	0.97
Malva parviflora L.	6	0.048
Poaceae (Gramineae)		
Aegilops cylindrica Host.	6.997	289.077
Alopecurus myosuroides Huds.	221	0.358
Avena fatua L.	7.050	150.764
Avena sativa	1.354	32.3
Avena sterilis ssp. *Ludoviciana*	29	0.363
Lolium multiflorum Lam.	1.335	7.539
Lolium temulentum L.	847	7.694
Panicum italicum	3.244	13.023
Phalaris minor Retz.	4.890	11.112
Poa bulbosa L.	560	1.121
Secale cereale L.	2.535	95.892
Setaria lutescens (Weigel ex Stuntz) F. T. Hubbard	4.058	12.791
Sorghum halepense (L.) Pers.	38	0.144
Sorghum sp.	193	3.797
Polygonaceae		
Polygonum aviculare L.	38.313	91.329
Polygonum convolvulus L.	37.736	133.449
Rumex crispus L.	96	0.125
Ranunculaceae		
Adonis aestivalis L.	4	0.039
Adonis flammea Jacq.	3	0.019
Consalida orientalis (Gay) Schröd.	1.264	1.587
Ranunculus arvensis L.	499	6.064
Resedaceae		
Reseda lutea L.	2.894	2.968
Rubiaceae		
Galium aparine L.	7.885	24.8
Galium tricornutum Dandy.	39.539	111.679
Scrophulariaceae		
Veronica triphyllos L.	391	0.436
Solanaceae		
Hyoscyamus niger L.	238	0.226
Diğer		
Nicis benedictus	1	0.025
Others	39.475	140.024
TOTAL	284.025	1.500

* In the 1.500 g sample
** Quite close to 0

When Table 2 is examined, numerically the most intensive species according to the % calculations were *G. tricornutum* with 16.17 %, *P. aviculare* with 15.67 % and *Polygonum concolvulus* with 15.43 % respectively. While *A. cylindrica* had the highest intensity with 21.22% as weight, *A. fatua* with 11.07% and *P. convolvulus* with 9.80% followed them. When frequency of occurrence is taken in to consideration, it is

seen that *Convolvulus arvensis* with the rate of 100 % was present in all samples. This species was followed by *Lithospermum arvense, Gysophila* sp., *P. aviculare, S. cereale* and *Vaccaria pyramidata* with the rate of 93,33%.

Similarly, Tursun et al (2006), Gökalp and Üremiş (2015) and Baş et al (2016) found *G. tricornutum* and *A. sterilis* as the most contaminated species the wheat crop in their studies. Also Bozkurt and Tursun (2018) found that numerically, *P. aviculare* were the most common weed seeds respectively.

Table 2
Number (%), weight (%) and frequency (%) of weed seeds obtained from the wheat flour mill plants in Konya Province

Weed Species	Seed Number (%)	Seed Weight (%)	Frequency (%)
Adonis aestivalis	0.0016	0.0028	13.3333
Adonis flammea	0.0012	0.0266	13.3333
Aegilops cylindrica	2.8613	21.2244	86.6666
Agrostemma githago	0.3815	0.8448	33.3333
Allium sp.	0.0032	0.0026	13.3333
Alopecurus myosuroides	0.0903	0.0262	46.6666
Althaea sp.	0.0057	0.0071	6.6666
Anchusa italica	0.0147	0.0592	33.3333
Avena fatua	2.8829	11.0693	86.6666
Avena sativa	0.5536	2.3715	73.3333
Avena sterilis ssp. *Ludoviciana*	0.0081	0.0266	13.3333
Beta lomatogona	0.0126	0.8158	20
Bifora radians	0.2833	0.6008	53.3333
Bifora testiculata	0.2187	0.4264	13.3333
Boreava orientalis	0.1770	1.5898	53.3333
Borogo sp.	0.0098	0.0131	6.6666
Carthamus persicus	0.0372	0.0132	40
Caucalis daucoides	0.0028	0.0254	33.3333
Caucalis latifolia	0.0306	0.1017	60
Caucalis orientalis	0.0024	0.0001	6.6666
Centaurea deprassa	0.2290	0.4668	86.6666
Centaurea melitensis	0.0020	0.0014	13.3333
Centaurea repens	0.0417	0.0651	66.6666
Centaurea solstitialis	0.0008	0.0003	6.6666
Cephalaria aristata	0.2788	0.2174	40
Cephalaria syriaca	0.0188	0.0330	26.6666
Chenopodium sp.	2.4855	0.3922	53.3333
Cirsium lanceolatum	0.0057	0.0094	40
Consalida arientalis	0.5168	0.1165	80
Convolvulus arvensis	3.9425	6.9465	100
Euclidium syriacum	0.0572	0.0524	66.6666
Galium aparine	3.224	1.8212	53.3333
Galium tricornutum	16.1689	8.1996	86.6666
Gypsophila sp.	9.6872	4.3198	93.3333
Hyoscomus niger	0.0973	0.0195	26.6666
Lathyrus aphaca	0.0273	0.0655	46.6666
Lathyrus sp.	0.0053	0.0314	6.6666
Lithospermum arvense	2.4348	1.3750	93.3333
Lolium multiflorum	0.5459	0.5535	80
Lolium temulentum	0.3463	0.5649	46.6666
Lycopsis arientalis	0.0036	0.0030	33.3333
Malva parviflora	0.0024	0.0035	13.3333
Marrubium peregrinum	0.1218	0.0312	60
Medicago hispida	0.0004	0.0027	6.6666
Melilotus officinalis	1.0742	0.3396	73.3333
Medicago rigidula	0.0012	0.0113	20
Medicago sativa	0.0004	0	6.6666
Neslia apiculata	0.3565	0.3041	80
Nicis benedictus	0.0004	0.0018	6.6666
Onobrichis sativa	0.0016	0.0034	26.6666
Onopordum acanthium	0.1431	0.1669	73.3333
Onopordum caucalis	0.0004	0.0004	6.6666
Ornithogalum narbonense	0.0020	0.0028	6.6666
Panicum italicum	1.3265	0.9461	53.3333
Patroselium sp.	0.0004	*0	6.6666
Phalaris minor	1.996	0.8158	86.6666
Poa bulbosa	0.2290	0.0823	66.6666
Polygonum aviculare	15.6675	6.7055	93.3333
Polygonum convolvulus	15.4316	9.7980	73.3333
Ranunculus arvensis	0.2040	0.4452	60
Rapistrum rugosum	0.3950	0.5838	80
Reseda lutea	1.1834	0.2179	86.6666
Rumex crispus	0.0392	0.0091	46.6666

Table 2 (Continue)
Number (%), weight (%) and frequency (%) of weed seeds obtained from the wheat flour mill plants in Konya Province

Salvia sclarea	0.0098	0.0056	33.3333
Secale cereale	1.0366	7.0405	93.3333
Setaria lutescens	1.6594	0.9391	53.3333
Silene caucalis	0.2564	0.0699	6.6666
Silene conoidea	2.9848	1.2447	86.6666
Sorghum halepense	0.0155	0.0105	26.6666
Sorghum sp.	0.0789	0.2787	13.3333
Thilapsi arvense	1.9371	0.3274	66.6666
Trifolium alexandrinum	0.0004	*0	6.6666
Vaccaria pyramidata	5.5476	2.7464	93.3333
Veronica triphyllos	0.1598	0.0320	26.6666
Vicia fabae	0.0151	0.3428	6.6666
Vicia pannonica	0.2024	1.5981	33.3333
Vicia peregrina	0.0032	0.0165	6.6666
Vicia sativa	0.1005	1.0539	26.6666
Vicia villosa	0.0245	0.1052	13.3333
TOTAL	99.9145	99.9722	

***** Quite close to 0

Intensity (Numerically)
0,0 6 % ≤ very intensive
0.02-0.06 % Intensive
0.01-0.02 % quite intensive
0.01% ≥ rarely encountered weed seeds

Frequency of Occurrence:
50 % ≤ very frequent
25-50 % frequent
10-25 % quite frequent
10 % ≥ rarely encountered weed seeds

In his study conducted in Van, Tepe (1998) determined that *S. cereale* took place on the top in terms of weight and numerical contamination. In our study, the mentioned species ranked among the top five and its frequency of occurrence was found as 93,3333 %. Also Karaca and Güncan (2009), determined that *S. cereale* seed was contaminated in wheat product with an average of 1.1536% numerically and 0.9522% by weight in Konya province.

Once again, in their study including the West of Anatolia, Güncan and Boyraz (2001) reported the species intensively contaminated in wheat as *S. cereale, Vicia* spp., *G. aparine* and *G. tricornutum.* In our study, *G. tricornutum* took place on the top numerically and ranked forth as weight. *S. cereale* also had a considerable percentage in terms of weight and frequency of occurrence.

Similarly, in their study conducted in Samsun, Mennan and Işık (2003) determined that *G. aparine* took place on the top in terms of intensity, Tursun et al., (2006) determined that *G. tricornutum* ranked fifth. Also Kaçan and Tursun (2019) were determined *G. aparine* as the most frequently contaminated weed seeds numerically in wheat crop.

Among the species determined as a result of the study, *A. aestivalis, A. flammea, A. githago, Chenopodium* sp., *C. syriaca, C. aristata, Cirsium lanceolatum, H. niger L. temulentum, L. multiflorum* and *V. pyramidata* have been reported to be toxic to humans and animals in different literature (Watt et al., 1962; Muzik (1970); Seçmen and Leblebici, 1987; Picon et al., 1991; Suter, 2002; Wagstaff, 2008; Anonymous, 2021).

4. Conclusion

It can reduce the contamination of weed seeds in wheat product to minimum by taking some measures such as; using pure seeds, passing through a selector, performing cultural and chemical control in the weedy fields. Today in Turkey, many weed seeds continue to contaminate in wheat product and maintain their development because of the reasons mentioned above. Definitely, in order to prevent this situation, it is our responsibility to raise the awareness of our farmers, to avoid incorrect agricultural practices being applied and to take necessary measures and to put them into practice.

Wheat is purchased from the Central Anatolia and outside region of the flour mill plants in Konya. As a result of the study, the detection of species with different ecological demands such as *Alopecurus myosuroides, A. sterilis, Bifora testculata, C. syriaca* and *Sorghum halepense* shows this result. Thus, different species of weeds enter the region. Weed seeds from flour mill plants are also fed to animals as forage. There is a risk of contamination of animal manures and thus agricultural lands due to climate change. In addition, weed species that are not in the region can be transported to the agricultural lands of the region with the use of animal manure. Therefore, weed seeds obtained from flour mill plants should not be fed to animals as forage. Or it should be aged for at least 6 months. Also, toxic species such as *Lolium* spp., *Chenopodium* sp., *Cephalaria* spp., *Adonis* spp., *A. githago, Hyoscyamus niger, V. pyramidata* present in weed seeds can harm animal health. The alkaloids contained in these toxic weeds can cause reactions and threaten human and animal health.

On the other hand, highly contaminating species are known as major weeds in farmlands. The species such as palmer amaranth (*Amaranthus palmeri*) are often reported to be herbicide-resistant and have been increasing in recent years worldwide (Gaines et al. 2010; Owen et al. 2014). Herbicide resistant weed seeds have been reported as contaminants in commercial grains

(Michael et al. 2010; Shimono et al. 2010). The international grain trade is also a major pathway of introduction because various weed seeds contaminate grain commodities (Hulme 2009; Asai et al. 2007; Shimono and Konuma, 2008; Michael et al. 2010; Asav and Kadıoğlu 2014; Wilson et al. 2016).

With the increasing wheat import, weed seeds contaminated with wheat enter the country. The weed that adapts to a region can reach the economic thresholds level within a few years. In this way, a weed that was not previously found in the country may appear as a problem in the future.

5. References

Akalın Ş (1952). Büyük bitkiler kılavuzu, Ankara, 752 s.

Anonim (2020). Bitkisel Üretim. https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr (Date of access: 15.06.2021)

Anonymous (2019). Crop Production Data. http://www.fao.org/faostat/en/#data/QC (Date of access: 15.06.2021)

Anonymous (2021). Zehirli Yabancı Otlar. http://www.turkiyeherboloji.org.tr/otlar.asp?tur=6. (Date accessed: 28.05.2021).

Arısoy, H., Oğuz, C., 2005. Tarımsal araştırma enstitüleri tarafından yeni geliştirilen buğday çeşitlerinin tarım işletmelerinde kullanım düzeyi ve geleneksel çeşitler ile karşılaştırmalı ekonomik analizi: Konya ili örneği. Yüksek lisans tezi, Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Konya.

Asai M, Kurokawa S, Shimizu N, Enomoto T (2007). Exotic weed seeds detected from imported small cereal grains into Japan during 1990's. *J Weed Sci Technol* 52:1–10.

Asav Ü, Kadıoğlu İ (2014). Rusya Federasyonu'ndan Türkiye'ye İthal Edilmek Üzere Trabzon Limanı' na Gelen Buğdaylardaki Yabancı Ot Tohumlarının Belirlenmesi. *Iğdır Univ. J. Inst. Sci. & Tech.* 4(4): 29-36, 2014.

Bischof F (1978). Common weeds from Iran, Turkey, the near east and north Africa. GTZ, Dag-Harmanrskjöld Weg I.D-6326, Eschborn I, 212, Germany.

Bozkurt M Tursun N (2018). Muş İlinde Buğday Ürününe Karışan Yabancı Ot Tohumları. *Turk J Weed Sci.*, 21(2):1-15.

Baş A, Karaca M, Güncan A (2016). Doğu Karadeniz Bölgesi'nde buğday ürününe karışan yabancı ot tohumlarının tespiti ve dağılışları. *Turkish Journal of Weed Science*, 19(2): 49-60.

Fuchs H, Voit B (1992). Purity and contamination in cereal seed samples-long term survey from result of seed testing, *Bayerisches Landwirtschaftliches Jahrbuch* 69, p. 757-777.

Gaines TA, Zhang W, Wang D, Bukun B, Chisholm ST, Shaner DL, Nissen SJ, Patzoldt WL, Tranel PJ, Culpepper AS, Grey TL, Webster TM, Vencill WK, Douglas Sammons R, Jiang J, Preston C, Leach JE, Westra P. (2010) Gene amplification confers glyphosate resistance in *Amaranthus palmeri*. PNAS 107:1029-1034

Gökalp Ö, Üremiş İ (2015). Mardin buğday ekim alanlarında bulunan yabancı ot türlerinin, yaygınlıklarının ve yoğunluklarının belirlenmesi. *Mustafa Kemal Üniversitesi Ziraat Fakültesi Dergisi* 20 (1) 13-22.

Güncan A (1982). Erzurum yöresinde buğday ürününe karışan bazı yabancı ot tohumlarının çimlenme biyolojisi üzerinde araştırmalar. Atatürk Üniversitesi, Ziraat Fakültesi Yayın No: 270, Erzurum, 64s.

Güncan A, Boyraz N (2001). Anadolu'nun batısında buğday ürününe karışan yabancı ot tohumları ve yoğunlukları, *Selçuk Üniversitesi Ziraat Fakültesi Dergisi*. 15(26), 161-172.

Güncan A (2002). Anadolu'nun doğusunda buğday ürününe karışan yabancı ot tohumları, bunların yoğunlukları. *Konya Ticaret Borsası Dergisi*, 5(11): 36-41.

Güncan A (2019). Yabancı Otlar ve Mücadele Prensipleri. Güncellenmiş ve ilaveli 7. Baskı. Akıncı Ofset Matbaa. 269 s. ISBN: 978 605 69156 1 1

Güncan A, Karaca M (2018). Yabancı Ot Mücadelesi. Güncellenmiş ve ilaveli 4. Baskı. Selçuk Üniversitesi Basımevi. 334 s. ISBN: 975 448 178 4.

Hulme PE (2009). Trade, transport and trouble: managing invasive species pathways in an era of globalization. *J Appl Ecol* 46:10–18.

Ikeda M, Nishi T, Asai M, Muranaka T, Konuma A, Tominaga T, Shimono Y (2021). The Role of Weed Seed Contamination in Grain Commodities as Propagule Pressure. *Biological Invasions.* 17 p. DOI: https://doi.org/10.21203/rs.3.rs-220124/v1

Kaçan K, Tursun N (2019). Balıkesir ve Çanakkale İllerinde Buğday Ürünü İçerisine Karışan Yabancı Ot Tohumlarının Belirlenmesi. *KSÜ Tarım ve Doğa Derg.*, 22(2): 248-259. DOI: 10.18016/ksutarimdoga.vi.488510

Karaca M, Güncan A (2009). Yabani Çavdar'ın (*Secale cereale L.* L.) bazı biyolojik özellikleri ve Konya ilinde buğday ürününe karışma oranının belirlenmesi, *Türkiye III. Bitki Koruma Kongresi*, Van.

Mennan H, Işık D (2003). Buğday tohumluğunda bulunan yabancı ot tohumlarının yoğunlukları ve bitkiye dönüşüm oranlarının saptanması, *Türkiye Herboloji Dergisi*, 6(1), 8-15.

Michael PJ, Owen MJ, Powles SB (2010). Herbicide-resistant weed seeds contaminate grain sown in the Western Australian grainbelt. *Weed Science*, 58:466–472

Muzik T (1970). Weed Biyology and Control. *McGraw, Hill Book Company*, Toronto.

Niknam SR, Moerkerk M and Cousens R (2002). Weed seed contamination in cereal and pulse crops. *13th Australian Weeds Conference*: papers & proceedings: weeds, threats now, & forever? 8-13 September 2002, 59-62.

Odum EP (1971). Fundamentals of Ecology. W. B. Saunders Company, Philadeiphia, London, Toronto, 574 p.

Pala F, Mennan H, Çığ F, Dilman H (2018). Diyarbakır'da Buğday Ürününe Karışan Yabancı Ot Tohumlarının Belirlenmesi. *Turkish Journal of Agricultural Research*. 5(3):183-190 DOI:10.19159/tutad.342885 ISSN: 2148-2306, e-ISSN: 2528-858X

Picon SJ, Blanco Carmona JG, Garces Sotilis MD. (1991). Occupational asthma caused by vetch (*Vicia sativa*). *The Journal of Allergy and Clinical Immunolgy*, 88(1):135-136.

Seçmen Ö, Leblebici E, (1987). Yurdumuzun Zehirli Bitkileri. Ege Üniversitesi Fen Fakültesi Baskı İşleri, 102 s, Bornova-İzmir.

Shimono Y, Konuma A (2008). Effects of human-mediated processes on weed species composition in internationally traded grain commodities. *Weed Research*, 48:10–18.

Shimono Y, Takiguchi Y, Konuma A (2010). Contamination of internationally traded wheat by herbicide resistant *Lolium rigidum*. *Weed Biol Manage*ment, 10:219–228.

Suter R.J (2002). Suspected Cyanide Poisoning in Cows Fed vetch (*Vicia sativa*) hay. *Australian Veterinary Journal*, 80(5): 282.

Tepe I (1998). Van'da buğday ürününe karışan yabancı ot tohumlarının yoğunluk ve dağılımları, *Türkiye Herboloji Dergisi*, 1(2), 1-13.

Trigo MM, Bootello ML, Cabeduzo B (1991). Contribution to a Knowledge of the Weeds of Cereals in Andalusia: Structure of Dispersal. *Proceedings of the 1991 Meeting of the Spanish*

Weed Science, Society, Madrid, Spain.

Tursun N, Kantarcı Z, Seyithanoğlu M (2006). Kahramanmaraş'ta Buğday Ürününe Karışan Yabancı Ot Tohumlarının Belirlenmesi. *KSÜ, Fen ve Mühendislik Dergisi*, 9(2), s.110-115.

Uludağ A (1993). Diyarbakır ve yöresinde buğday, mercimek kültürlerindeki önemli yabancı otların dağılışı ve bunların biyolojik özellikleri üzerinde araştırmalar. Cumhuriyet Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Tokat.

Uluğ E, Kadıoğlu İ, Üremiş İ, (1993). Türkiye'nin yabancı otları ve bazı özellikleri, Tarım ve Köyişleri Bakanlığı, Zirai Mücadele Enstitüsü Müdürlüğü, Yayın No:78, Adana, 513.

Wagstaff DJ (2008). International Poisonous Plant Checklist: An Evidence-Based Reference. CRC Press. Taylor & Franchis Group. 464s.

Watt JM, Gerdina M, Brandwijk B (1962). Medicinal and Poisonous Plants of Southern and Eastern Africa. E. and S. Livinstone LTD. London 173-75 and 475-477.

Wilson CE, Castro KL, Thurston GB, Sissons A (2016) Pathway risk analysis of weed seeds in imported grain: a Canadian perspective. NeoBiota 30:49–74

Zimdahl RL (2018). Fundamentals of Weed Science, 5th Edition, Academic Press, 758p.