Pak. J. Weed Sci. Res., 19(2): 123-156, 2013

WEED POPULATION INDICES IN IRRIGATED WHEAT FIELDS OF ZANJAN PROVINCE OF IRAN

Seyed Hossien Nazer Kakhki[1*], Mehdi Minbashi Moeini[2], Sirous Hassan Nejad[3], Hossien Jafary[1] and Maryam Aleefard[4]

ABSTRACT

In order to identify and determine the abundance of weed species in irrigated wheat fields of Zanjan province, Iran, 128 wheat fields in seven counties during 2000 to 2008 were investigated. With counting weed species in each sampling quadrate, population indices were calculated. In each field longitude, latitude and elevation were recorded using GPS (global positioning system). These data were used for producing weed species maps in irrigated wheat fields in Zanjan province. Results showed that 97 weed species were observed within irrigated wheat fields. The most important broadleaved weed species were knotweed (Polygonum aviculare L.), bedstraw (Galium tricornatum Dandy.) and salsify (Tragopogon sp. L.), respectively. Dominant grass weed species were feral rye (Secale cereale L.), blackgrass (Alopecurus mysuroides Huds.), downy brome (Bromus tectorum L.) and bulbous bluegrass (Poa bulbosa L.), respectively. Field bindweed (Convolvulus arvensis L.), common lambsquarters (Chenopodium album L.), hoary cress (Cardaria draba [L.] Desv.) and Canada thistle (Cirsium arvense [L.] Scop.) were the most important disturbing plants prior to harvesting respectively in irrigated wheat fields of Zanjan province. Analysis of weed population based on Shannon-Wiener diversity index showed that the counties were grouped in three clusters. Tarom County was placed in first cluster and had lowest diversity among the counties. Zanjan, Eijrood and Abhar counties had the most species diversity and were placed in second cluster. Mahneshan, Khodabandeh and khorramdarreh were placed in third cluster. Evolution weed population based on Sorensen similarity index showed that, Eijrood with the Abhar had the most composition species similarity, where as Tarom had the lowest similarity with the other counties.

Key words: Abundance index, Diversity index, Similarity index

[1]Agricultural and Natural Resources Research Center of Zanjan Province, Zanjan, Iran. [2]Iranian Research Institute of Plant Protection, Tehran, Iran. [3]Faculty of Agriculture, Tabriz University, Tabriz, Iran, [4]Azad University, Oloom–Va-Tahghighat Branch, Tehran, Iran. *Corresponding author's email:shnkakhki@irpp.ir

INTRODUCTION

Wheat cultivation area in Iran during 2008-09 growing season was about 6.65 million ha from which 2.29 m ha (36.75%) derived from irrigated fields and 4.36 m ha (63.25%) derived from rainfed fields. Total wheat production in this year was 13.48 m t from which 66.54% were produced under irrigated conditions and the remaining (33.46%) were produced in rainfed conditions. About 7% of whole wheat cultivation area and 4% of the wheat yield were produced in Zanjan province. In this province, the average of the wheat yield was 4114.29 kg ha^{-1} (Anonymous, 2009). Among the factors decreasing the wheat yields, weeds have an important role. According to a research, average damages coming from the pretense of weeds in wheat fields, was about 23 percent (Khalaghani, 2007). Wide distribution, fast growing ability and the high level of reproduction of weeds are the important barriers in control of this natural enemy in the wheat fields. The composition and the diversity of weeds in a region depend on the appearance of the new species, adaptation and the cultivating measures (Damghani and Kamkar, 2009). The results of some researches show that the weeds flora depends on the climatic conditions, temperature and the amount of rainfall in spring and in summer. However, the weeds dispersion of weed community in response to environmental conditions occurs independently (Thomas and Dale, 1991a; 1991b).

Mapping of weed distribution in wheat fields and their demographic characteristics would be an important step forward in the integrated management of the weeds in the wheat fields. Information on pretense of a specific weed species in the region will provide great help to make a decision on applying proper control measures. Use of herbicides in a field should be based on weeds flora, and the efficiency of herbicides on weed species. Moeini *et al*. (2008b) showed that 87 weed species were observed within irrigated wheat fields in Tehran province. The most important broadleaved weed species were flixweed (*Descurania sophia* [L.] Webb.), *Polygonum aviculare*, fumitory (*Fumaria vaillantii* Loisel.) and *Galium tricornatum*, respectively. Dominant grass weed species were winter wild oat (*Avena ludoviciana* Durieu.), wild barley (*Hordeum spontaneum* C.Koch.) and *Secale cereale*, respectively. *Convolvulus arvensis*, *Cirsium arvense* and *Cardaria draba* were the most widely distributed plants prior to harvesting in irrigated wheat fields of Tehran province, respectively. Keshavarz *et al.* (2008) studied the dispersion and dominance of weeds in the wheat field of the Kohgiloyeh and Boier Ahmad province and showed that 27 species of 13 families were competing with the wheat from which *Gallium tricornutum* occurred most dominantly. In

the Sari region of JamkhanhIn wheat and barley fields 22 weed species belonging to 9 families were identified (Yazdani *et al*., 2008).

Nowadays, using the GPS and GIS (Geographic Information System) contributes efficiently in surveying of infested wheat fields and drawing maps of distribution and population of weeds. Mapping of weeds distribution using GPS were used in some crops by some researchers (Rew *et al*., 1996; Stanford *et al*., 1996). The most important use of weed distribution maps is to select the best control measures for in different fields (Krueger *et al*., 1998; Williams *et al*., 2000). The percent study aimed to identify the dominant weed species in the wheat fields and to map the distribution and the abundance of each species in the irrigated wheat fields of Zanjan province.

MATERIALS AND METHODS

Weed samplings were performed during ten years (2000 to 2009) from 128 irrigated wheat fields in counties (Eijrood**,** Mahneshan, Khodabandeh, Tarom, Khorram Darreh, Zanjan and Abhar) of Zanjan province, Iran. The number and the names of counties are shown in Table-1. The time for sampling in the different regions of the province started by beginning of stem elongation until the end of heading stages of wheat. Geographical characteristics of each field (longitude, latitude and elevation) were recorded using the GPS. Sampling method in each field was according to the methodology defined by the Moeini *et al*. (2008a). After throwing a 0.25 m^2 quadrate, the genus and species of weeds were precisely identified and then the number of weeds from each species was counted separately in each quadrate. According to the following equations (from 1 to 5), frequency, uniformity, density, mean density and abundance index of species in each county were calculated.

$$F_k = \frac{\sum Yi}{n} * 100$$

Equation 1:

F_k: Frequency of the species K. Y_i: The presence (1) or absence (0) of the specie K in the field number i. n: The number of the fields surveyed

$$U_k = \frac{\sum_{1}^{n}\sum_{1}^{m} X_{ij}}{\sum_{1}^{m} m}$$

Equation 2:
U_k: Uniformity of the field for the species K. X_{ij}: The presence (1) or absence (0) of the specie K in the quadrate i in the field j. n: The number of the fields surveyed. m: The number of throwing quadrate

$$D_{ki} = \frac{\sum_{1}^{m} Z_j}{m} * 4$$

Equation 3:
D_{ki}: Density (plant per square meter) of the species K in the field number i. Z_j: The number of plants in quadrate (0.25 square meters). m: The number of thrown quadrate

$$MFD_{ki} = \frac{\sum_{1}^{n} D_{ki}}{n} * 4$$

Equation 4:
MFD_k: Mean field density of the species K. D_{ki}: Density (plant per square meters) of the specie K in the field number i. n: The number of the fields surveyed

Equation 5: $AI_k = F_k + U_k + MFD_k$

AI_k: Abundance Index of the species K

After performing the necessary calculations and the determination of the population indices of weeds, the geographical characteristics of each surveyed field was recorded and transferred to the form of a database which was in Access. The database layers in GIS were drawn. In the first step, the information listed in the software Arc Map from the collection of software Arc GIS (ESRI, 2007), based on longitude and latitude were recorded and a point data layer was provided. Then the main information layer of the various weeds species was prepared. In the next step by using the Overlay techniques in GIS, this information was connected to the map of Tehran province georefrence. Finally, the distribution maps of different weeds species of irrigated wheat fields were produced for Zanjan province.

In each county the Shannon-Wiener (H ') species diversity index (Booth *et al*., 2003) was used to show weed diversity, $H' = \Sigma [P_i (Ln\ P_i)]$

Pi: the relative Frequency of the species i, that like $P_i = n_i/N$ calculated and Ln is the natural logarithm.

After calculating the Shannon-Wiener index for each county, the uniformity was calculated using the uniformity index (E), (Booth *et al*., 2003).

$E = H'/Ln\ S$

H': the Shannon-Wiener diversity index. S: indicating the number of weed species observed in each community (county), where it is used in the equations of Ln.

In case of uniformity of weed community, if the value tend to be zero, it would be an indication for the degree of non-uniformity or dominance of a certain species of weeds, but if the value tends to be 1 it would indicate that the community has a higher uniformity (higher diversity on weed species and lack of a dominance of a certain species). After calculating the, Shannon-Wiener index, and uniformity index in the 7 counties, we used cluster analysis for comparison and classification of the counties using the software Pcord (Mesdaghi, 2005).

Although the highest value for Shannon-Wiener index implies a high diversity of weeds in each county, however for comparison of counties more statistical analyses would be needed. For this purpose, we use T test analyses.

If the observed t (t_{obs}) to compare with critical t (t_{crit}) in the t table was larger it implies that there is a statistical difference between two counties of the weeds society. Otherwise the two societies have similar diversity.

For the calculation, the variance of Shannon - Wiener was calculated in both counties, $H'var = 1/N \times \{\sum P_i (Ln\ P_i)^2 - [\sum P_i (Ln\ P_i)]^2\}$

The degrees of freedom (df) was calculated as,

$df = (H'var_1 + H'var_2) / [(H'var_1^2/a) + (H'var_2^2/b)]$

$H'var_1$: variance Shannon - Wiener county 1, $H'var_2$: variance Shannon - Wiener county 2, a: number of weed species observed in the wheat fields of county 1, b: the number of weed species in the wheat fields of county 2.

Using of the obtained degree of freedom, value of critical t (t_{crit}) for the desired level of significance (p = 0.05) was determined. The final step was the calculation of observed t. For this purpose both Shannon – Wiener index and the diversity index was calculated in two counties (Booth *et al*. 2003). $t_{obs} = (H'_1 - H'_2) / [(H'var_1) + (H'var_2)]^{0.5}$

RESULTS AND DISCUSSION

Eijrood County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Eijrood County included greater bur-parsley (*Turgenia latifolia* [L.] Hoffm.), *Polygonum aviculare*, field poppy (*Papaver dubium* L.) and *Galium tricornatum* (Table-2). The abundance indices for these weeds were 86.78, 86.30, 83.10 and 61.85, respectively. The most frequently occuring grass weed species in the irrigated wheat fields in the Eijrood County includes *Poa*

bulbosa, *Secale cereale* and *Bromus tectorum* with abundance index of 28.40, 22.75 and 19.50, respectively. *Convolvulus arvensis*, *Cirsium arvense*, *Cardaria draba*, *Chenopodium album*, Russian knapweed (*Acroptilon repens* [L.] DC.) and prickly lettuce (*Lactuca serriola* L.) were the most important disturbing plants prior to harvesting in irrigated wheat fields with abundance indices of 132.10, 78.65, 51.35, 39.30, 31.70 and 26.70, respectively (Table-2).

Mahneshan County

The most frequently occuring broad leaf weeds in the irrigated wheat fields in the Mahneshan County include *Polygonum aviculare*, rosa (*Rosa persica* Michx. ex. Juss.), goldbachia (*Goldbachia laevigata* DC.) and *Galium tricornatum*. The abundance indexes for these weeds were 98.52, 66.12, 59.30 and 54.83 respectively. The most frequently occuring grass weed species of irrigated wheat fields in the Mahneshan County include barley (*Hordeum* sp. L.), *Bromus tectorum* and *Poa bulbosa* with abundance index of 61.91, 49.84 and 28.18 respectively. *Chenopodium album*, *Cirsium arvense*, *Convolvulus arvensis* and carthamus (*Carthamus oxycantha* Bieb.) were the most important disturbing plants prior to harvesting in the irrigated wheat fields with abundance indexes of 90.97, 32.21, 16.29 and 15.94 respectively (Table-3).

Khodabandeh County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Khodabandeh county include *Polygonum aviculare*, *Galium tricornatum*, *Turgenia latifolia* and *Tragopogon sp.* The abundance indexes for these weeds were 152.99, 86.80, 70.62 and 66.16 respectively. The most frequently occuring grass weed species of irrigated wheat fields in the Khodabandeh County include *Secale cereale*, *Alopecurus mysuroides* and *Poa bulbosa* with abundance index of 45.30, 22.45 and 16.22 respectively. *Convolvulus arvensis*, *Chenopodium album*, *Cardaria draba*, *Cirsium arvense*, *Lactuca serriola* and *Acroptilon repens* were the most important disturbing plants prior to harvesting in the irrigated wheat fields with abundance indexes of 102.35, 75.85, 68.66, 38.91 and 28.07, respectively (Table-4).

Tarom County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Tarom County include *Galium tricornatum*, *Polygonum aviculare* and *Fumaria* sp. (Table-5). The abundance indexes for these weeds were 138.06, 107.66 and 83.49 respectively. The most frequently occuring grass weed species in the irrigated wheat fields in the Tarom County includes rigid ryegrass (*Lolium* sp. Gaudin.), *Avena ludovicana* and littleseed canarygrass (*Phalaris minor* Retz.) with abundance indices of 66.94, 22.63 and 21.42, respectively. *Chenopodium album*, *Convolvulus arvensis* and *Acroptilon repens* were

the most important disturbing plants prior to harvesting in irrigated wheat fields with abundance indices of 100.41, 100.25 and 62.90 respectively (Table-5).

Khorram Darreh County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Khorram Darreh county include cornflower (*Centaurea depressa* M.B.), tuberous geranium (*Geranium tuberosum* L.), *Polygonum aviculare* and corn gromwell (*Lithospermum arvense* L.) (Table-6). The abundance indexes for these weeds were 120.52, 89.04, 87.32 and 86.40 respectively. The most frequently occurring grass weed species in the irrigated wheat fields in the Khorram Darreh County includes *Alopecurus mysuroides* and *Secale cereale* with abundance index of 137.40 and 14.16, respectively. *Convolvulus arvensis*, *Chenopodium album*, *Cardaria draba* and *Lactuca serriola* were the most important disturbing plants prior to harvesting in irrigated wheat fields with abundance indices of 126.24, 112.10, 72.12 and 45.56, respectively (Table-6).

Zanjan County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Zanjan county include *Polygonum aviculare*, *Galium tricornatum*, *Tragopogon* sp. and haresear mustard (*Conringia orientalis* [L.] Dumort.) (Table 7). The abundance indexes for these weeds were 107.91, 103.65, 66.14 and 53.18, respectively. The most frequently occuring grass weed species in the irrigated wheat fields in the Zanjan County includes *Alopecurus mysuroides* and *Secale cereale* with abundance index of 30.70 and 27.50 respectively. *Convolvulus arvensis*, *Chenopodium album*, *Cardaria draba* and *Acroptilon repens* were the most important disturbing plants prior to harvesting in irrigated wheat fields with abundance indexes of 137.69, 64.38, 59.19 and 35.08 respectively (Table-7).

Abhar County

The most frequently occurring broad leaf weeds in the irrigated wheat fields in the Abhar county include *Polygonum aviculare*, *Descurania Sophia* and *Fumaria* sp. (Table-8). The abundance indexes for these weeds were 118.31, 74.71 and 73.96 respectively. The most frequently occuring grass weed species in the irrigated wheat fields in the Abhar County includes *Secale cereale* and *Bromus tectorum* according with abundance index of 23.90 and 14.14, respectively. *Chenopodium album*, *Convolvulus arvensis*, *Cardaria draba* and *Lactuca serriola* were the most important disturbing plants prior to harvesting in irrigated wheat fields with abundance indexes of 122.16, 121.46, 99.23 and 60.82 respectively (Table-8). Comparing abundance index of the dominant of broad leaves, grass and disturbing plants prior to harvesting of the counties of Zanjan province can be

stated that the counties of Eijrood, Mahneshan, Khodabandeh, Tarom, Khorram Darreh and Zanjan the dominant of broad leaves are the most problematic weeds and disturbing plants prior to harvesting and grass are in the next degree of importance, respectively. In the county of Abhar the dominant of disturbing plants prior to harvesting are the most problematic weeds, broad leaves and grass are in the next degree of importance, respectively.

Zanjan Province

Based on the data shown in the table 9, 97 weed species was observed within irrigated wheat fields in Zanjan province. Based on the results obtained on the dominant weed species within irrigated wheat fields of 7 counties of Zanjan province (Tables 2 to 8) we can conclude that the most important broadleaved weed species within irrigated wheat fields of Zanjan province were *Polygonum aviculare*, *Galium tricornatum* and *Tragopogon* sp. respectively. Figure 1 shows the distribution of this species in irrigated wheat fields in the Zanjan province. The most dominant grass weed species were *Secale cereale*, *Alopecurus mysuroides*, *Bromus tectorum* and *Poa bulbosa* respectively. Figure 2 shows the distribution of this species in irrigated wheat fields in the Zanjan province. *Convolvulus arvensis*, *Chenopodium album*, *Cardaria draba* and *Cirsium arvense* were the most widely disturbing plants in irrigated wheat fields of Zanjan province prior to harvesting respectively. Figure 3 shows the distribution of this species in irrigated wheat fields in the Zanjan province. The species of weeds in the most irrigated wheat fields of the Zanjan province have proper distribution. In the fields that a high density of the weeds was observed, an appropriate controlling method would be applicable. Based on the results of weeds dominancy in irrigated wheat fields of the counties of Zanjan province, it can be concluded that the most dominant weed species in irrigated wheat fields in the province are broadleaved weeds. These species have high uniformity and distribution in the irrigated wheat fields in Zanjan province while the grass species have not similar distribution in the irrigated wheat fields all over the province. It is for instance true for rye that was observed in most regions of the province except in the Tarom County (due to the warm weather in this area). Dominant grass weed species in the Tarom region were *Lolium sp.*, *Avena ludovicana*, *Phalaris minor* and *Alopecurus mysuroides* have high density in Khorram Darreh, Abhar, Zanjan and Khodabandeh counties and low density in other areas.

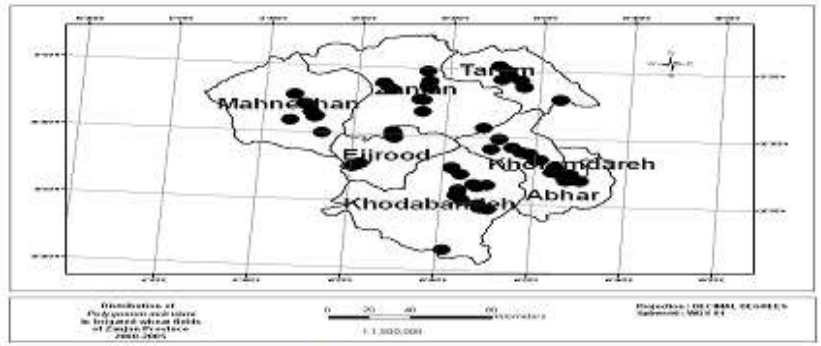
Analysis of weed population based on Shannon-Wiener (H') diversity index showed that with 75%similarity, the counties were grouped in three clusters (Figure 4). Tarom County was placed in first cluster, with the value of 2.79 and had lowest diversity among the

counties. Zanjan, Eijrood and Abhar counties with the values of 3.62, 3.59 and 3.53 were placed in second cluster and showed the highest species diversity. Mahneshan, Khodabandeh and khorramdarreh counties were placed in the third cluster (Fig. 4).

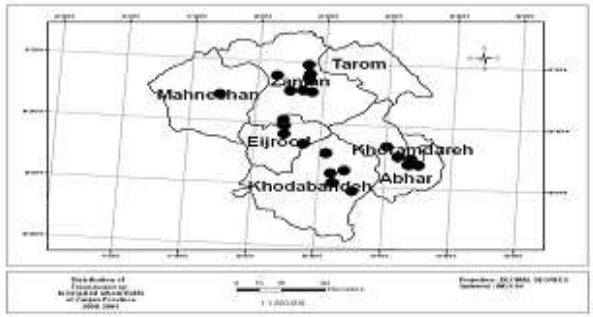
High species diversity is an indication for diverse society and absence of the dominant species in a society. The results obtained from Simpson's index and Samson's diversity index confirms this subject. High Samson's diversity index addresses high diversity and absence of the dominant species in weed society and on the contrary its low values imply that some species occur with high density (Nejad *et al*., 2009). The lower value of Samson's diversity index in the Tarom County (7.09) is verified with the low index of Shannon-Wiener and both together imply that the society is not uniform. The lower value of abundance index indicates the low species diversity and the presence of dominant species (table 10). The dominant weeds of this county were *Convolvulus arvensis*, *Polygonum aviculare*, *Chenopodium album* and *Galium tricornatum* (Table-5) and that is considered diverse weed species. The data from Figure 5 shows that the Tarom County has the lowest uniformity of weed species. With the similarity of 75%, the 7 counties were grouped in two clusters. Tarom County with the lowest uniformity in the weed distribution was placed in first cluster (Fig. 5).

Comparisons performed by t-test showed that Tarom County has a significant difference in weed diversity with the other counties (except Khorramdarreh County) (Table-11). The observed T (t_{obse}) between the Tarom county and any other counties (except khorramdarreh county) was higher than 2 and t_{crit} (Table-11) with degrees of freedom calculated for any counties at p=0.05 was higher than 1.96. Since the T observed (t_{obse}) was higher than t_{crit} (Table-12) there was a significant and statistical difference between the weed societies of Tarom County with the other counties of the provinces. However, there was no significant difference between the weed society of Tarom and khorramdarreh counties. One may conclude that the results of t test parallel with the results of the Shannon- Wiener index.

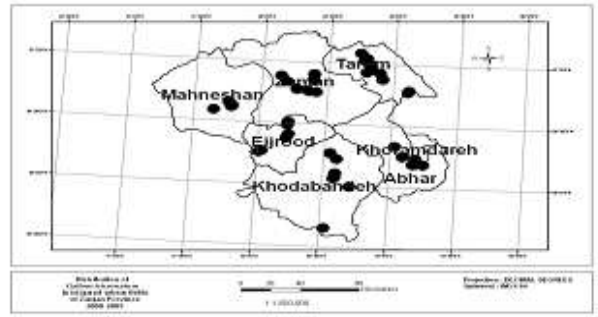
Sorensen similarity index (Table-13) showed that Eijrood and Abhar counties share the most similar species (numerical value of 0.69). These results are in parallel with the results of the t-test, since from the species diversity point of view, there was no significant difference between the two counties (Table-11). However, based on the Sorensen similarity index (Chao *et al*., 2006) Tarom County has the lowest similarity with other counties in the province, which can be concluded from Table-11.



The distribution of *Polygonum aviculare* in irrigated wheat fields

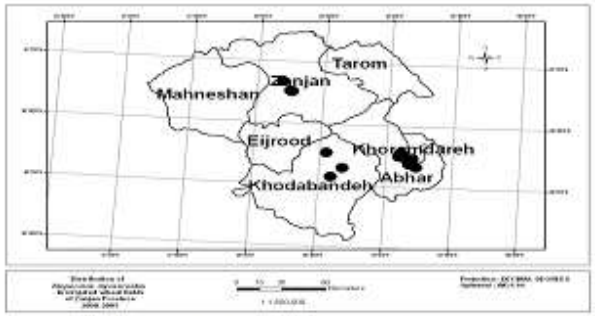


The distribution of *Tragopogon sp.* in irrigated wheat fields



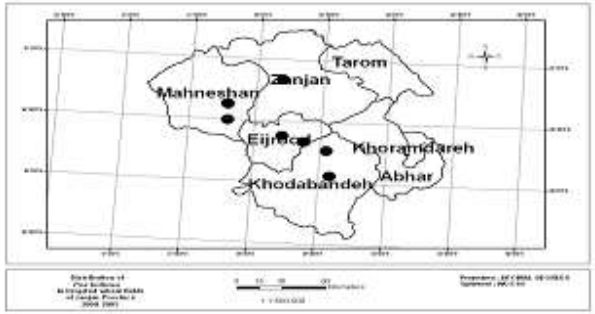
The distribution of *Galium tricornatum* in irrigated wheat fields

Figure 1. The distribution of the dominant broadleaved weed species in irrigated wheat fields in the Zanjan province



The distribution of *Alopecurus mysuroides* in irrigated wheat fields

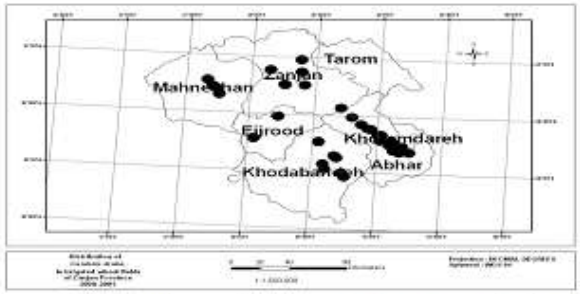
The distribution of *Secale cereale* in irrigated wheat fields



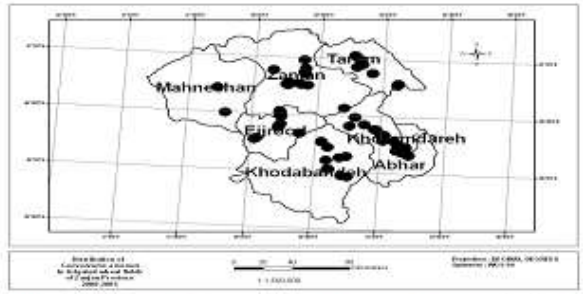
The distribution of *Poa bulbosa* in irrigated wheat fields

The distribution of *Bromus tectorum* in irrigated wheat fields

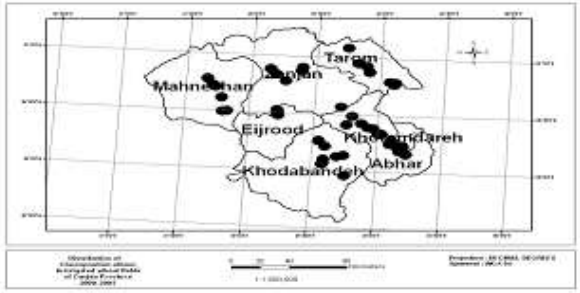
Figure 2. The distribution of the dominant grasses weeds species in irrigated wheat fields in the Zanjan province



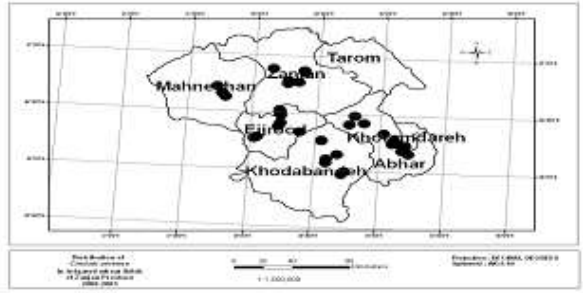
The distribution of *Cardaria draba* in irrigated wheat fields



The distribution of *Convolvulus arvensis* in irrigated wheat fields



The distribution of *Chenopodium album* in irrigated wheat fields



The distribution of *Cirsium arvense* in irrigated wheat fields

Figure 3. The distribution of the most important disturbing plants prior to harvesting in irrigated wheat fields in the Zanjan province

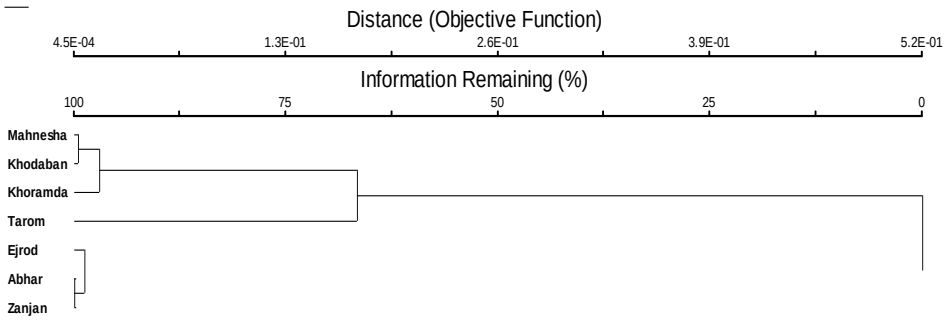


Figure 4. Cluster analysis of diversity by Shannon-Wiener Index in 7 counties of Zanjan province

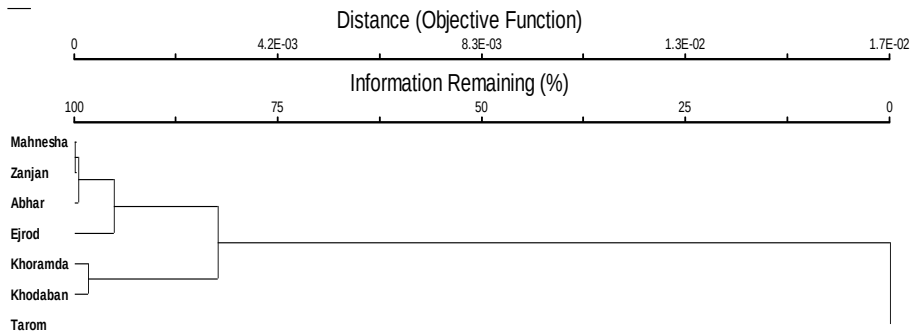


Figure 5. Cluster analysis for uniformity of species in counties of Zanjan province

Table-1. Number of fields surveyed in each county in Zanjan province based on the area under irrigated wheat cultivation

the area under irrigated wheat cultivation in each county (ha)	Number of fields surveyed
Less than 500 ha	2
500 to 1,000 ha	3
1,000 to 5,000 ha	4
5,000 to 10,000 ha	6
10,000 to 15,000 ha	8
15,000 to 30,000 ha	11
30,000 to 60,000 ha	15
More than 60,000 ha	one field added to 15 for each 10000 ha

Table-2. Weeds of irrigated wheat fields in Eijrood based on abundance index.

No.	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Convolvulus arvensis*	Convolvulaceae	87.5	41.25	3.35	132.10
2	*Turgenia latifolia*	Apiaceae	50	31.25	5.53	86.78
3	*Polygonum aviculare*	Polygonaceae	56.25	26.25	3.80	86.30
4	*Papaver dubium*	Papaveraceae	43.75	26.25	13.10	83.10
5	*Cirsium arvense*	Asteraceae	56.25	18.75	3.65	78.65
6	*Galium tricornatum*	Rubiaceae	37.5	20	4.35	61.85
7	*Chenopodium album*	Chenopodiaceac	31.25	17.5	2.60	51.35
8	*Conringia orientalis*	Brassicaceae	31.25	13.75	1.15	46.15
9	*Centaurea depressa*	Asteraceae	31.25	13.75	0.95	45.95
10	*Vicia villosa*	Fabaceae	31.25	10	1.10	42.35
11	*Veronica sp.*	Scrophulariaceae	25	15	2.20	42.20
12	*Cardaria draba*	Brassicaceae	25	12.5	1.80	39.30
13	*Euphorbia sp.*	Euphorbiaceae	25	12.5	1.15	38.65
14	*Lithospermum arvense*	Boraginacea	25	11.25	1.34	37.59
15	*Acroptilon repens*	Asteraceae	25	6.25	0.45	31.70
16	*Descurania sophia*	Brassicaceae	25	5	0.40	30.40
17	*Tragopogon sp.*	Asteraceae	18.75	10	0.60	29.35
18	*Poa bulbosa*	Poaceae	18.75	7.5	2.15	28.40
19	*Lactuca serriola*	Asteraceae	18.75	7.5	0.45	26.70
20	*Secale cereale*	Poaceae	18.75	3.75	0.25	22.75
21	*Alyssum linifoium*	Brassicaceae	18.75	3.75	0.25	22.75

22	*Fumaria sp.*	Fumariaceae	18.75	3.75	0.15	22.65
23	*Hypecoum pendulum*	Papaveraceae	18.75	3.75	0.15	22.65
24	*Consolida orientalis*	Ranunculaceae	12.5	6.25	2.30	21.05
25	*Bromus tectorum*	Poaceae	12.5	6.25	0.75	19.50
26	*Minuartia hamata*	Caryophillaceae	12.5	5	0.90	18.40
27	*Scandix pecten-veneris*	Apiaceae	12.5	5	0.50	18.00
28	*Rosa persica*	Rosaceae	12.5	5	0.45	17.95
29	*Ranunculus arvensis*	Ranunculaceae	12.5	3.75	0.15	16.40
30	*Consolida sp.*	Ranunculaceae	12.5	3.75	0.15	16.40
31	*Adonis aestivalis*	Ranunculaceae	12.5	2.5	0.25	15.25
32	*Vaccaria oxydonata*	Caryophillaceae	12.5	2.5	0.15	15.15
33	*Silene conidea*	Caryophillaceae	12.5	1.25	0.10	13.85
34	*Goldbachia laevigata*	Brassicaceae	6.25	5	0.50	11.75
35	*Neslia apiculata*	Brassicaceae	6.25	5	0.25	11.50
36	*Geranium tuberosum*	Geraniaceae	6.25	3.75	0.95	10.95
37	*Lathyrus sativus*	Fabaceae	6.25	3.75	0.75	10.75
38	*Achillea millefolium*	Asteraceae	6.25	3.75	0.35	10.35
39	*Phragmites australis*	Poaceae	6.25	3.75	0.30	10.30
40	*Ranunculus sp.*	Ranunculaceae	6.25	3.75	0.30	10.30
41	*Ixiolirion tatricum*	Amaryllidaceae	6.25	2.5	0.20	8.95
42	*Malva sp.*	Malvaceae	6.25	2.5	0.20	8.95
43	*Gobelia sp.*	Fabaceae	6.25	2.5	0.15	8.90
44	*Aegilops sp.*	Poaceae	6.25	2.5	0.10	8.85

45	*Lithospermum arvense*	Boraginacea	6.25	2.5	0.10	8.85
46	*Falcaria scioides*	Apiaceae	6.25	1.25	0.60	8.10
47	*Raphanus raphanistrum*	Brassicaceae	6.25	1.25	0.150	7.65
48	*Heterocaryum macrocarpum*	Boraginacea	6.25	1.25	0.10	7.60
49	*Sonchus arvensis*	Asteraceae	6.25	1.25	0.10	7.60
50	*Alyssum sp.*	Brassicaceae	6.25	1.25	0.05	7.55
51	*Salvia ceratophylla*	Lamiacea	6.25	1.25	0.05	7.55
52	*Vaccaria oxydonata*	Caryophillaceae	6.25	1.25	0.05	7.55
53	*Alcea sp.*	Malvaceae	6.25	1.25	0.05	7.55
54	*Falcaria scioides*	Apiaceae	6.25	1.25	0.05	7.55

Table-3. Weeds of irrigated wheat fields in Mahneshan County respectively according abundance index.

No.	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Polygonum aviculare*	Polygonaceae	66.67	41.77	12.08	120.52
2	*Chenopodium album*	Chenopodiaceac	60	25.32	5.65	90.97
3	*Rosa persica*	Rosaceae	40	24.05	2.93	66.98
4	*Hordeum sp.*	Poaceae	33.33	24.05	4.53	61.91
5	*Goldbachia laevigata*	Brassicaceae	40	17.72	1.58	59.30
6	*Galium tricornatum*	Rubiaceae	40	13.92	0.91	54.83
7	*Bromus tectorum*	Poaceae	33.33	11.39	5.12	49.84
8	*Cardaria draba*	Brassicaceae	33.33	7.59	0.69	41.61
9	*Ceratocephalus falcatus*	Ranunculaceae	26.67	11.35	0.83	38.85
10	*Turgenia latifolia*	Apiaceae	26.67	7.59	0.38	34.64
11	*Cirsium arvense*	Asteraceae	26.67	5.06	0.48	32.21

12	*Lithospermum arvense*	Boraginacea	20	7.59	0.64	28.23
13	*Poa bulbosa*	Poaceae	20	7.59	0.59	28.18
14	*Vicia villosa*	Fabaceae	20	6.33	0.43	26.76
15	*Veronica sp.*	Scrophulariaceae	20	6.33	0.27	26.60
16	*Sonchus arvensis*	Asteraceae	20	5.06	0.37	25.43
17	*Phragmites australis*	Poaceae	13.33	10.13	0.59	24.05
18	*Adonis aestivalis*	Ranunculaceae	13.33	7.59	0.34	21.26
19	*Alyssum sp.*	Brassicaceae	13.33	5.06	0.14	18.53
20	*Papaver dubium*	Papaveraceae	13.33	3.79	0.16	17.28
21	*Convolvulus arvensis*	Convolvulaceae	13.33	2.53	0.43	16.29
22	*Aegilops sp.*	Poaceae	13.33	2.53	0.11	15.97
23	*Carthamus oxyacantha*	Asteraceae	13.33	2.53	0.08	15.94
24	*Hypecoum pendulum*	Papaveraceae	13.33	2.53	0.08	15.94
25	*Erysimum repandum*	Brassicaceae	6.67	6.33	0.75	13.75
26	*Descurania sophia*	Brassicaceae	6.67	3.79	0.91	11.37
27	*Alhagi pseudalhagi*	Fabaceae	6.67	3.79	0.26	10.72
28	*Cynodon dactylon*	Poaceae	6.67	2.53	0.75	9.95
29	*Tragopogon sp.*	Asteraceae	6.67	1.26	0.43	8.36
30	*Lactuca serriola*	Asteraceae	6.67	1.26	0.37	8.30
31	*Eremopyrum bonaepartis*	Poaceae	6.67	1.26	0.32	8.25
32	*Achillea millefolium*	Asteraceae	6.67	1.26	0.11	8.04
33	*Lamium amplexicaule*	Lamiacea	6.67	1.26	0.11	8.04
34	*Malcolmia Africana*	Brassicaceae	6.67	1.26	0.11	8.04
35	*Acroptilon repens*	Asteraceae	6.67	1.26	0.05	7.98
36	*Cyperus difformis*	Cyperaceae	6.67	1.26	0.05	7.98

37	*Fumaria sp.*	Fumariaceae	6.67	1.26	0.05	7.98
38	*Muscari neglectum*	Liliaceae	6.67	1.26	0.05	7.98
39	*Ranunculus sp.*	Ranunculaceae	6.67	1.26	0.05	7.98
40	*Rumex sp.*	Polygonaceae	6.67	1.26	0.05	7.98
41	*Vaccaria grandiflora*	Caryophillaceae	6.67	1.26	0.05	7.98
42	*Centaurea depressa*	Asteraceae	6.67	1.26	0.03	7.96

Table-4. Weeds of irrrigated wheat fields in Khodabandeh County respectively according abundance index.

No.	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Polygonum aviculare*	Polygonaceae	89.47	51.46	12.06	152.99
2	*Convolvulus arvensis*	Convolvulaceae	63.16	32.04	7.15	102.35
3	*Chenopodium album*	Chenopodiaceac	52.63	25.24	18.62	96.49
4	*Galium tricornatum*	Rubiaceae	57.89	24.27	4.64	86.80
5	*Cardaria draba*	Brassicaceae	47.37	25.24	3.24	75.85
6	*Turgenia latifolia*	Apiaceae	36.84	23.3	10.48	70.62
7	*Cirsium arvense*	Asteraceae	47.37	19.42	1.87	68.66
8	*Tragopogon sp.*	Asteraceae	42.1	21.36	2.7	66.16
9	*Conringia orientalis*	Brassicaceae	31.57	16.50	1.64	49.71
10	*Adonis aestivalis*	Ranunculaceae	31.58	12.62	1.35	45.55
11	*Secale cereale*	Poaceae	31.58	12.63	1.09	45.30
12	*Muscari neglectum*	Liliaceae	21.05	11.65	10.57	43.27
13	*Geranium tuberosum*	Geraniaceae	26.31	14.56	2	42.87
14	*Fumaria sp.*	Fumariaceae	31.58	8.74	0.57	40.89

15	*Ranunculus arvensis*	Ranunculaceae	21.05	12.62	6.02	39.69
16	*Lactuca serriola*	Asteraceae	31.58	6.80	0.53	38.91
17	*Acroptilon repens*	Asteraceae	21.05	6.80	0.22	28.07
18	*Plantago lenceolata*	Plantaginaceae	21.05	4.85	0.34	26.24
19	*Goldbachia laevigata*	Brassicaceae	21.05	3.88	0.19	25.12
20	*Euphorbia sp.*	Euphorbiaceae	15.79	7.78	0.76	24.33
21	*Alopecurus myosuroides*	Poaceae	15.79	5.82	0.84	22.45
22	*Centaurea depressa*	Asteraceae	15.79	5.82	0.38	21.99
23	*Lithospermum arvense*	Boraginacea	15.79	4.85	0.25	20.89
24	*Salvia sp.*	Lamiacea	15.79	3.88	0.46	20.13
25	*Sonchus arvensis*	Asteraceae	15.79	2.91	0.15	18.85
26	*Poa bulbosa*	Poaceae	10.53	4.85	0.84	16.22
27	*Achillea millefolium*	Asteraceae	10.53	3.88	1.77	16.18
28	*Papaver dubium*	Papaveraceae	10.53	4.85	0.34	15.72
29	*Hypecoum pendulum*	Papaveraceae	10.52	1.94	2.57	15.03
30	*Descurania sophia*	Brassicaceae	10.53	3.88	0.21	14.62
31	*Scandix pecten-veneris*	Fabaceae	10.53	2.91	0.17	13.61
32	*Vaccaria grandiflora*	Caryophillaceae	10.53	2.04	0.08	12.65
33	*Consolida orientalis*	Ranunculaceae	5.26	4.85	2.15	12.26
34	*Bromus japanicus*	Poaceae	5.26	2.91	0.29	8.46
35	*Veronica camplypoda*	Scrophulariaceae	5.26	2.91	0.21	8.38
36	*Silene conidea*	Caryophillaceae	5.26	2.91	0.13	8.30
37	*Bromus tectorum*	Poaceae	5.26	1.94	0.34	7.54
38	*Carthamus oxyacantha*	Asteraceae	5.26	1.94	0.08	7.28
39	*Alyssum sp.*	Brassicaceae	5.26	0.97	0.29	6.52

40	*Lolium sp.*	Poaceae	5.26	0.97	0.29	6.52
41	*Scariola orientalis*	Asteraceae	5.26	0.97	0.25	6.48
42	*Sorghum halepense*	Poaceae	5.26	0.97	0.21	6.44
43	*Aegilops crassa*	Poaceae	5.26	0.97	0.08	6.31
44	*Bongardia chrysogonum*	Podophyllaceae	5.26	0.97	0.08	6.31
45	*Reseda lutea*	Resedaceae	5.26	0.97	0.08	6.31
46	*Vicia villosa*	Fabaceae	5.26	0.97	0.08	6.31
47	*Anchusa ovata*	Boraginacea	5.26	0.97	0.04	6.27
48	*Holosteum glutionosum*	Caryophillaceae	5.26	0.97	0.04	6.27
49	*Ixiolirion tatricum*	Amaranthaceae	5.26	0.97	0.04	6.27
50	*Neslia apiculata*	Brassicaceae	5.26	0.97	0.04	6.27
51	*Polygonum convolvulus*	Polygonaceae	5.26	0.97	0.04	6.27
52	*Raphanus raphanistrum*	Brassicaceae	5.26	0.97	0.04	6.27
53	*Rosa persica*	Rosaceae	5.26	0.97	0.04	6.27
54	*Sinapis arvensis*	Brassicaceae	5.26	0.97	0.04	6.27

Table-5. Weeds of irrigated wheat fields in Tarom County respectively according abundance index.

No.	*WEED*	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Galium tricornatum*	Rubiaceae	78.95	47.37	11.74	138.06
2	*Polygonum aviculare*	Polygonaceae	57.89	35.79	13.98	107.66
3	*Chenopodium album*	Chenopodiaceac	57.89	32.63	9.89	100.41
4	*Convolvulus arvensis*	Convolvulaceae	63.16	30.53	6.56	100.25
5	*Fumaria sp.*	Fumariaceae	52.63	28.42	2.44	83.49
6	*Xanthium brasilicum*	Asteraceae	47.37	23.16	4.08	74.61
7	*Lolium sp.*	Poaceae	47.37	15.79	3.78	66.94

8	*Acroptilon repens*	Asteraceae	47.37	13.68	1.85	62.9
9	*Cyperus difformis*	Cyperaceae	38.58	11.58	2.35	52.51
10	*Raphanus raphanistrum*	Brassicaceae	36.84	11.58	0.84	49.26
11	*Amaranthus retroflexus*	Amaranthaceae	15.79	9.47	17.13	42.39
12	*Euphorbia sp.*	Euphorbiaceae	31.58	9.47	0.67	41.72
13	*Vicia villosa*	Fabaceae	26.32	13.68	0.75	40.75
14	*Lathyrus sativus*	Fabaceae	26.32	10.25	1.1	37.67
15	*Veronica camplypoda*	Scrophulariaceae	26.32	8.42	1.09	35.83
16	*Cynodon dactylon*	Poaceae	26.32	7.37	1.76	35.45
17	*Daucus carota*	Apiaceae	21.05	8.42	1.05	30.52
18	*Sorghum halepense*	Poaceae	21.05	6.31	1.55	28.91
19	*Echium sibthorpiana*	Boraginacea	21.05	5.26	0.21	26.52
20	*Filago pyramidata*	Fabaceae	5.26	1.05	17.13	23.44
21	*Avena ludovicana*	Poaceae	15.78	6.31	0.54	22.63
22	*Rapistrum rugosum*	Brassicaceae	15.79	6.31	0.25	22.35
23	*Phalaris minor*	Poaceae	15.79	5.26	0.37	21.42
24	*Sonchus arvensis*	Asteraceae	15.79	5.26	0.25	21.3
25	*Lathyrus aphaca*	Fabaceae	10.52	4.21	0.29	15.02
26	*Papaver dubium*	Papaveraceae	10.53	2.1	0.12	12.75
27	*Vaccaria grandiflora*	Caryophillaceae	10.53	2.1	0.08	12.71
28	*Melilotus officinalis*	Fabaceae	5.26	3.16	1.32	9.74
29	*Veronica persica*	Scrophulariaceae	5.26	3.15	0.33	8.74
30	*Anagallis arvensis*	Primulaceae	5.26	2.1	0.16	7.52
31	*Adonis aestivalis*	Ranunculaceae	5.26	2.1	0.12	7.48
32	*Malva sp.*	Malvaceae	5.26	1.05	0.29	6.6

33	*Alhagi pseudalhagi*	Fabaceae	5.26	1.05	0.12	6.43
34	*Bromus tectorum*	Poaceae	5.26	1.05	0.08	6.39
35	*Anchusa ovata*	Boraginacea	5.26	1.05	0.04	6.35
36	*Glycyrrhiza glabra*	Fabaceae	5.26	1.05	0.04	6.35
37	*Hordeum sp.*	Poaceae	5.26	1.05	0.04	6.35
38	*Malcolmia africana*	Brassicaceae	5.26	1.05	0.04	6.35
39	*Rumex sp.*	Polygonaceae	5.26	1.05	0.04	6.35

Table-6. Weeds of irrigated wheat fields in Khorram Darreh County respectively according abundance index.

No	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Alopecurus myosuroides*	Poaceae	65.00	53	19.4	137.40
2	*Convolvulus arvensis*	Convolvulaceae	90	32	4.24	126.24
3	*Centaurea depressa*	Asteraceae	30	90	0.52	120.52
4	*Chenopodium album*	Chenopodiaceac	70	35	7.1	112.10
5	*Geranium tuberosum*	Geraniaceae	55	28	6.04	89.04
6	*Polygonum aviculare*	Polygonaceae	60	25	2.32	87.32
7	*Lithospermum arvense*	Boraginacea	55	26	5.4	86.40
8	*Cardaria draba*	Brassicaceae	45	24	3.12	72.12
9	*Cirsium arvense*	Asteraceae	45	21	3.6	69.60
10	*Muscari neglectum*	Liliaceae	35	15	7.96	57.96
11	*Lactuca serriola*	Asteraceae	35	10	0.56	45.56
12	*Silene conidea*	Caryophillaceae	30	12	1.88	43.88
13	*Papaver dubium*	Papaveraceae	30	13	0.56	43.56
14	*Vicia villosa*	Fabaceae	35	8	0.44	43.44

15	*Tragopogon sp.*	Asteraceae	25	7	1.04	33.04
16	*Conringia orientalis*	Brassicaceae	20	9	1.88	30.88
17	*Galium tricornatum*	Rubiaceae	20	8	0.36	28.36
18	*Descurania sophia*	Brassicaceae	20	7	0.44	27.44
19	*Capsella bursa-pastoris*	Brassicaceae	20	5	1.6	26.60
20	*Fumaria sp.*	Fumariaceae	15	6	0.28	21.28
21	*Sonchus arvensis*	Asteraceae	15	4	0.16	19.16
22	*Ranunculus arvensis*	Ranunculaceae	10	5	0.28	15.28
23	*Secale cereale*	Poaceae	10	4	0.16	14.16
24	*Adonis aestivalis*	Ranunculaceae	10	2	0.12	12.12
25	*Cephalaria syriaca*	Dipsacaceae	10	2	0.08	12.08
26	*Lathyrus sativus*	Fabaceae	10	2	0.08	12.08
27	*Erysimum repandum*	Brassicaceae	5	3	0.2	8.20
28	*Falcaria scioides*	Apiaceae	5	2	0.72	7.72
29	*Acroptilon repens*	Asteraceae	5	1	0.2	6.20
30	*Euphorbia sp.*	Euphorbiaceae	5	1	0.12	6.12
31	*Veronica persica*	Scrophulariaceae	5	1	0.12	6.12
32	*Alyssum sp.*	Brassicaceae	5	1	0.04	6.04
33	*Asperugo procumbens*	Boraginacea	5	1	0.04	6.04
34	*Avena ludoviciana*	Poaceae	5	1	0.04	6.04
35	*Consolida orientalis*	Ranunculaceae	5	1	0.04	6.04
36	*Goldbachia laevigata*	Brassicaceae	5	1	0.04	6.04
37	*Hypecoum pendulum*	Papaveraceae	5	1	0.04	6.04

Table-7. Weeds of irrigated wheat fields in Zanjan County respectively according abundance index.

No.	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Convolvulus arvensis*	Convolvulaceae	78.95	50.53	8.21	137.69
2	*Polygonum aviculare*	Polygonaceae	68.42	32.63	6.86	107.91
3	*Galium tricornatum*	Rubiaceae	57.89	38.94	6.82	103.65
4	*Tragopogon sp.*	Asteraceae	47.36	16.84	1.94	66.14
5	*Chenopodium album*	Chenopodiaceac	36.57	24.74	3.07	64.38
6	*Cardaria draba*	Brassicaceae	36.84	17.89	4.46	59.19
7	*Conringia orientalis*	Brassicaceae	36.84	14.74	1.6	53.18
8	*Euphorbia sp.*	Euphorbiaceae	36.84	13.68	1.39	51.91
9	*Cirsium arvense*	Asteraceae	36.84	10.53	1.35	48.72
10	*Reseda lutea*	Resedaceae	31.57	11.58	1.39	44.54
11	*Fumaria sp.*	Fumariaceae	31.58	11.58	0.76	43.92
12	*Turgenia latifolia*	Fabaceae	26.31	11.58	5.35	43.24
13	*Papaver dubium*	Papaveraceae	31.58	9.47	0.63	41.68
14	*Goldbachia laevigata*	Brassicaceae	26.32	12.63	1.56	40.51
15	*Vicia villosa*	Fabaceae	26.31	12.63	0.76	39.70
16	*Vaccaria grandiflora*	Caryophillaceae	26.31	10.53	2.15	38.99
17	*Geranium tuberosum*	Geraniaceae	15.79	12.63	9.43	37.85
18	*Acroptilon repens*	Asteraceae	21.05	11.59	2.44	35.08
19	*Alopecurus myosuroides*	Poaceae	21.05	8.42	1.23	30.70
20	*Descurania sophia*	Brassicaceae	21.05	8.42	0.38	29.85
21	*Secale cereale*	Poaceae	15.79	10.53	1.18	27.50
22	*Centaurea depressa*	Asteraceae	21.5	5.26	0.25	27.01

23	*Cynodon dactylon*	Poaceae	15.79	7.37	2.78	25.94
24	*Xanthium sp.*	Asteraceae	15.79	4.21	0.46	20.46
25	*Hypecoum pendulum*	Papaveraceae	15.79	4.21	0.21	20.21
26	*Sonchus arvensis*	Asteraceae	15.78	3.15	0.75	19.68
27	*Bromus tectorum*	Poaceae	10.53	6.31	2.23	19.07
28	*Sorghum halepense*	Poaceae	10.53	2.1	4.93	17.56
29	*Lithospermum arvense*	Boraginacea	10.53	6.31	0.5	17.34
30	*Alyssum linifoium*	Brassicaceae	10.53	5.26	1.01	16.80
31	*Silene conidea*	Caryophillaceae	10.53	4.2	0.63	15.36
32	*Carthamus oxycantha*	Asteraceae	10.53	4.21	0.21	14.95
33	*Veronica sp.*	Scrophulariaceae	10.53	3.15	0.29	13.97
34	*Neslia apiculata*	Brassicaceae	10.53	3.16	0.17	13.86
35	*Holosteum glutionosum*	Caryophillaceae	10.53	2.1	0.13	12.76
36	*Lathyrus sp.*	Fabaceae	10.53	2.1	0.13	12.76
37	*Ranunculus arvensis*	Ranunculaceae	10.53	2.1	0.13	12.76
38	*Muscari neglectum*	Liliaceae	10.53	2.1	0.08	12.71
39	*Rosa persica*	Rosaceae	10.53	2.1	0.08	12.71
40	*Salvia sp.*	Lamiacea	5.26	5.26	0.04	10.56
41	*Anchusa ovata*	Boraginacea	5.76	4.21	0.29	10.26
42	*Sinapis arvensis*	Brassicaceae	5.26	4.21	0.59	10.06
43	*Vaccaria oxydonata*	Caryophillaceae	5.26	4.21	0.38	9.85
44	*Adonis aestivalis*	Ranunculaceae	5.26	4.21	0.34	9.81
45	*Stellaria media*	Caryophillaceae	5.26	3.16	0.46	8.88
46	*Scandix pecten-veneris*	Apiaceae	5.26	3.16	0.25	8.67
47	*Thlaspi perfoliatum*	Brassicaceae	5.26	2.1	0.5	7.86

48	*Viola sp.*	Violaceae	5.26	2.1	0.29	7.65
49	*Plantago lanceolata*	Plantaginaceae	5.26	2.1	0.13	7.49
50	*Ranunculus sp.*	Ranunculaceae	5.26	2.1	0.08	7.44
51	*Ceratocephalus falcatus*	Ranunculaceae	5.26	1.05	0.76	7.07
52	*Scariola orientalis*	Asteraceae	5.26	1.05	0.25	6.56
53	*Bromus japanicus*	Poaceae	5.26	1.05	0.13	6.44
54	*Malva sp.*	Malvaceae	5.26	1.05	0.13	6.44
55	*Achillea millefolium*	Asteraceae	5.26	1.05	0.08	6.39
56	*Echium sibthorpiana*	Boraginacea	5.26	1.05	0.08	6.39
57	*Alhagi pseudalhagi*	Fabaceae	5.26	1.05	0.04	6.35
58	*Hordeum sp.*	Poaceae	5.26	1.05	0.04	6.35
59	*Lactuca serriola*	Asteraceae	5.26	1.05	0.04	6.35
60	*Melilotus sp.*	Fabaceae	5.26	1.05	0.04	6.35
61	*Phalaris sp.*	Poaceae	5.26	1.05	0.04	6.35
62	*Poa bulbosa*	Poaceae	5.26	1.05	0.04	6.35

Table-8. Weeds of irrigated wheat fields in Abhar County respectively according abundance index.

No.	WEED	FAMILY	FREQUENCY (%)	UNIFROMATY (%)	MEAN DENSITY (plant/m2)	ABUNDANCE INDEX
1	*Chenopodium album*	Chenopodiaceac	70	40.74	11.42	122.16
2	*Convolvulus arvensis*	Convolvulaceae	80	37.04	4.42	121.46
3	*Polygonum aviculare*	Polygonaceae	70	42.59	5.72	118.31
4	*Cardaria draba*	Brassicaceae	70	25.92	3.31	99.23
5	*Descurania sophia*	Brassicaceae	55	17.59	2.12	74.71
6	*Fumaria sp.*	Fumariaceae	45	23.15	5.81	73.96
7	*Conringia orientalis*	Brassicaceae	40	22.22	6.84	69.06

8	*Cirsium arvense*	Asteraceae	45	15.74	1.71	62.45
9	*Lactuca serriola*	Asteraceae	45	14.81	1.01	60.82
10	*Papaver dubium*	Papaveraceae	45	12.04	0.95	57.99
11	*Geranium tuberosum*	Geraniaceae	35	16.67	5.91	57.58
12	*Sonchus arvensis*	Asteraceae	35	10.18	1.07	46.25
13	*Alopecurus arundinaceus*	Poaceae	30	12.96	2.16	45.12
14	*Lithospermum arvense*	Boraginacea	30	12.96	0.84	43.80
15	*Euphorbia sp.*	Euphorbiaceae	25	9.26	1.84	36.10
16	*Silene conidea*	Caryophillaceae	20	8.33	1	29.33
17	*Centaurea depressa*	Asteraceae	15	8.33	4.2	27.53
18	*Xanthium brasilicum*	Asteraceae	15	7.4	1.8	24.20
19	*Secale cereale*	Poaceae	20	3.7	0.2	23.90
20	*Ranunculus arvensis*	Ranunculaceae	15	7.4	0.72	23.12
21	*Acroptilon repens*	Asteraceae	15	5.55	0.72	21.27
22	*Galium tricornatum*	Rubiaceae	15	4.63	0.16	19.79
23	*Tragopogon sp.*	Asteraceae	15	4.63	0.16	19.79
24	*Vicia villosa*	Fabaceae	15	2.77	0.48	18.25
25	*Goldbachia laevigata*	Brassicaceae	10	5.55	2.24	17.79
26	*Scandix pecten-veneris*	Apiaceae	15	1.85	0.08	16.93
27	*Anchusa ovata*	Boraginacea	10	5.55	0.96	16.51
28	*Bromus tectorum*	Poaceae	10	3.7	0.44	14.14
29	*Echium sibthorpiana*	Apiaceae	10	2.77	0.28	13.05
30	*Veronica sp.*	Scrophulariaceae	10	2.77	0.16	12.93
31	*Stellaria media*	Caryophillaceae	10	2.77	0.12	12.89
32	*Vaccaria grandiflora*	Caryophillaceae	10	1.85	0.08	11.93

33	*Alyssum linifoium*	Brassicaceae	5	5.55	0.29	10.84
34	*Consolida orientalis*	Ranunculaceae	5	4.63	0.8	10.43
35	*Adonis aestivalis*	Ranunculaceae	5	3.7	1.04	9.74
36	*Thlaspi perfoliatum*	Brassicaceae	5	2.77	0.28	8.05
37	*Neslia apiculata*	Brassicaceae	5	2.77	0.12	7.89
38	*Phragmites australis*	Poaceae	5	1.85	0.36	7.21
39	*Polygonum convolvulus*	Polygonaceae	5	1.85	0.24	7.09
40	*Vaccaria oxydonata*	Caryophillaceae	5	1.85	0.2	7.05
41	*Anagallis arvensis*	Primulaceae	5	1.85	0.08	6.93
42	*Capsella bursa-pastoris*	Brassicaceae	5	1.85	0.08	6.93
43	*Lathyrus sativus*	Fabaceae	5	1.85	0.08	6.93
44	*Turgenia latifolia*	Apiaceae	5	0.92	0.24	6.16
45	*Veronica persica*	Scrophulariaceae	5	0.93	0.16	6.09
46	*Erysimum repandum*	Brassicaceae	5	0.92	0.12	6.04
47	*Achillea millefolium*	Asteraceae	5	0.92	0.08	6.00
48	*Hordeum murinum*	Poaceae	5	0.92	0.08	6.00
49	*Malcolmia Africana*	Brassicaceae	5	0.92	0.08	6.00
50	*Euphorbia heteradenia*	Euphorbiaceae	5	0.92	0.04	5.96
51	*Falcaria scioides*	Apiaceae	5	0.92	0.04	5.96
52	*Heterocaryum macrocarpum*	Brassicaceae	5	0.92	0.04	5.96
53	*Hordeum sp.*	Poaceae	5	0.92	0.04	5.96
54	*Muscari neglectum*	Liliaceae	5	0.92	0.04	5.96
55	*Rosa persica*	Rosaceae	5	0.92	0.04	5.96
56	*Lamium amplexicaule*	Lamiacea	5	0.92	0.02	5.94

Table-9. Frequency of occurring of weeds in irrigated wheat fields in Zanjan province

No.	Weed	Family	Frequency (%)
1	*Convolvulus arvensis*	Convolvulaceae	69.53
2	*Polygonum aviculare*	Polygonaceae	67.19
3	*Chenopodium album*	Chenopodiaceac	53.91
4	*Galium tricornatum*	Rubiaceae	43.75
5	*Cardaria draba*	Brassicaceae	37.50
6	*Cirsium arvense*	Asteraceae	36.72
7	*Fumaria sp.*	Fumariaceae	28.91
8	*Papaver dubium*	Papaveraceae	26.56
9	*Lithospermum arvense*	Boraginacea	24.22
10	*Tragopogon sp.*	Asteraceae	24.22
11	*Conringia orientalis*	Brassicaceae	23.44
12	*Lactuca serriola*	Asteraceae	23.44
13	*Vicia villosa*	Fabaceae	22.66
14	*Geranium tuberosum*	Geraniaceae	21.88
15	*Acroptilon repens*	Asteraceae	20.31
16	*Descurania sophia*	Brassicaceae	20.31
17	*Euphorbia sp.*	Euphorbiaceae	20.31
18	*Turgenia latifolia*	Apiaceae	19.53
19	*Alopecurus myosuroides*	Poaceae	18.75
20	*Sonchus arvensis*	Asteraceae	17.97
21	*Centaurea depressa*	Asteraceae	17.19
22	*Ranunculus arvensis*	Ranunculaceae	15.63
23	*Vaccaria grandiflora*	Caryophillaceae	15.63
24	*Goldbachia laevigata*	Brassicaceae	14.84
25	*Secale cereale*	Poaceae	14.06
26	*Adonis aestivalis*	Ranunculaceae	11.72
27	*Muscari neglectum*	Liliaceae	11.72
28	*Silene conidea*	Caryophillaceae	11.72
29	*Xanthium brasilicum*	Asteraceae	11.72
30	*Bromus tectorum*	Poaceae	10.16
31	*Veronica camplypoda*	Scrophulariaceae	10.16
32	*Alyssum linifoium*	Brassicaceae	9.38
33	*Rosa persica*	Rosaceae	9.38
34	*Hypecoum pendulum*	Papaveraceae	8.59
35	*Lolium sp.*	Poaceae	7.81
36	*Consolida orientalis*	Ranunculaceae	7.03
37	*Cynodon dactylon*	Poaceae	7.03
38	*Lathyrus sativus*	Fabaceae	7.03
39	*Poa bulbosa*	Poaceae	7.03
40	*Raphanus raphanistrum*	Brassicaceae	7.03

41	*Veronica persica*	Scrophulariaceae	7.03
42	*Hordeum sp.*	Poaceae	6.25
43	*Scandix pecten-veneris*	Apiaceae	6.25
44	*Cyperus difformis*	Cyperaceae	5.47
45	*Echium sibthorpiana*	Boraginacea	5.47
46	*Lathyrus aphaca*	Fabaceae	5.47
47	*Achillea millefolium*	Asteraceae	4.69
48	*Avena ludovicana*	Poaceae	4.69
49	*Salvia ceratophylla*	Lamiacea	4.69
50	*Anchusa ovata*	Boraginacea	3.91
51	*Capsella bursa-pastoris*	Brassicaceae	3.91
52	*Carthamus oxycantha*	Asteraceae	3.91
53	*Ceratocephalus falcatus*	Ranunculaceae	3.91
54	*Neslia apiculata*	Brassicaceae	3.91
55	*Plantago lanceolata*	Plantaginaceae	3.91
56	*Vaccaria oxydonata*	Caryophillaceae	3.91
57	*Aegilops crassa*	Poaceae	3.13
58	*Daucus carota*	Apiaceae	3.13
59	*Euphorbia heteradenia*	Euphorbiaceae	3.13
60	*Falcaria scioides*	Apiaceae	3.13
61	*Phalaris minor*	Poaceae	3.13
62	*Phragmites australis*	Poaceae	3.13
63	*Alhagi pseudalhagi*	Fabaceae	2.34
64	*Amaranthus retroflexus*	Amaranthaceae	2.34
65	*Anagallis arvensis*	Primulaceae	2.34
66	*Erysimum repandum*	Brassicaceae	2.34
67	*Holosteum glutionosum*	Caryophillaceae	2.34
68	*Malcolmia africana*	Brassicaceae	2.34
69	*Malva sp.*	Malvaceae	2.34
70	*Rapistrum rugosum*	Brassicaceae	2.34
71	*Reseda lutea*	Resedaceae	2.34
72	*Sorghum halepense*	Poaceae	2.34
73	*Stellaria media*	Caryophillaceae	2.34
74	*Bromus japanicus*	Poaceae	1.56
75	*Cephalaria syriaca*	Dipsacaceae	1.56
76	*Heterocaryum macrocarpum*	Boraginacea	1.56
77	*Ixiolirion tatricum*	Amaryllidaceae	1.56
78	*Lamium amplexicaule*	Lamiacea	1.56
79	*Minuartia hamata*	Caryophillaceae	1.56
80	*Polygonum convolvulus*	Polygonaceae	1.56
81	*Rumex sp.*	Polygonaceae	1.56
82	*Scariola orientalis*	Asteraceae	1.56
83	*Sinapis arvensis*	Brassicaceae	1.56

84	*Thlaspi perfoliatum*	Brassicaceae	1.56
85	*Alcea sp.*	Malvaceae	0.78
86	*Alopecurus arundinaceus*	Poaceae	0.78
87	*Asperugo procumbens*	Boraginacea	0.78
88	*Bongardia chrysogonum*	Podophyllaceae	0.78
89	*Eremopyrum bonaepartis*	Poaceae	0.78
90	*Filago pyramidata*	Fabaceae	0.78
91	*Fumaria asepala*	Fumariaceae	0.78
92	*Glycyrrhiza glabra*	Fabaceae	0.78
93	*Gobelia sp.*	Fabaceae	0.78
94	*Hordeum murinum*	Poaceae	0.78
95	*Melilotus officinalis*	Fabaceae	0.78
96	*Scandix iberica*	Apiaceae	0.78
97	*Viola sp.*	Violaceae	0.78

Table-10. Shannon-Wiener diversity index, Simpson's index, Samson's diversity index, species number and uniformity of species

No.	County	Shannon-Wiener diversity index	Simpson's index	Simson's diversity index	species number	uniformaty of species
1	Mahneshan	3.25	0.05	21.16	42	0.87
2	Tarom	2.79	0.14	7.09	43	0.74
3	Eijrood	3.53	0.04	27.14	50	0.90
4	Khorramdarreh	3.17	0.06	17.11	41	0.85
5	Abhar	3.59	0.04	28.36	59	0.88
6	Zanjan	3.62	0.04	25.17	65	0.87
7	Khodabandeh	3.32	0.05	18.44	55	0.83

Table-11. t observation (t_{obser}) and degree of freedom (df) for survey of present or absent of difference in weed diversity in counties of Zanjan province by Shannon- Wiener variance.

(t_{obser}) (df)	Mahneshan	Tarom	Eijrood	Khorram Darreh	Abhar	Zanjan	Khodabandeh
Mahneshan	******	1.48	0.82	0.24	1.05	1.21	0.23
Tarom	437	******	2.55	1.30	2.95	3.35	2.14
Eijrood	276	701	******	1.12	0.20	0.31	0.74
Khorram Darreh	334	597	307	******	1.37	1.57	0.52
Abhar	265	782	305	230	******	0.11	1.01
Zanjan	175	910	315	326	502	******	1.23
Khodabandeh	289	1011	364	361	596	447	******

Table-12. T table (t_{crit}) for survey of present or absent of difference in weed diversity in counties of Zanjan province by Shannon-Wiener variance.

Degree of Freedom (df)	Probability Level (P)	
	0.05	0.1
1	12.71	6.31
2	4.30	2.92
3	3.18	2.35
4	2.78	2.13
5	2.57	2.02
6	2.45	1.94
7	2.36	1.89
8	2.31	1.86
9	2.26	1.83
10	2.23	1.81
11	2.20	1.80
12	2.18	1.78
13	2.16	1.77
14	2.14	1.76
15	2.13	1.75
16	2.12	1.75
17	2.11	1.74
18	2.10	1.73
19	2.09	1.73
20	2.09	1.72
21	2.08	1.72
22	2.07	1.72
23	2.07	1.71
24	2.06	1.71
25	2.06	1.71
26	2.06	1.71
27	2.05	1.70
28	2.05	1.70
29	2.05	1.70
30	2.04	1.70
35	2.03	1.69
40	2.02	1.68
45	2.01	1.68
50	2.01	1.68
55	2.00	1.67
60	2.00	1.67
70	1.99	1.66
80	1.99	1.66
90	1.99	1.66
100	1.98	1.66
120	1.98	1.66
150	1.98	1.66
In fin (∞)	1.96	1.64

Table-13. Sorensen similarity index showing similarity of weed species in seven counties of Zanjan province

	Mahneshan	Tarom	Eijrood	Khorram Darreh	Abhar	Zanjan	Khodabandeh
Mahneshan	****	0.45	0.62	0.53	0.59	0.64	0.58
Tarom		****	0.35	0.36	0.43	0.42	0.35
Eijrood			****	0.62	0.69	0.65	0.65
Khorram Darreh				****	0.66	0.55	0.56
Abhar					****	0.68	0.63
Zanjan						****	0.75
Khodabandeh							****

REFERENCES CITED

Anonymous. 2009. Agricultural statistics newsletter, Ministry of Jehade-E-Agriculture, Deputy of programming and economic, statistics and information technology office, crops during 2007-8. pp. 1.

Booth, B.D., S.D. Murphy and C.J. Swanton. 2003. Weed ecology in natural and agricultural systems. CABI Publishing. Pp. 303.

Chao, A., L. Robin, R. Chazdon, K. Colwell and S. Tsung-Jen. 2006. Abundance-based similarity indices and their estimation when there are unseen species in samples. Biomet. 62: 361-371.

Esri. 2007. ArcGIS version 9.2. ESRI Readlands CA.

Nejad, S.H., H. Alizadeh, V. Mozaffarian, M.R. Chaychi and M. Minbashi Moeini. 2009. Survey of density and abundance for barely field's Weeds in Azerbaijan -E-shargi province. Iran. J. Weed Sci. 5: 69-90.

Keshavarz, K., M. Minbashi and K. Saeydi. 2008. Distribution and determination of dominant weed species in cereal fields of Kohgiloyeh and Boyerahmad Province using GIS. Proc. 2nd National Weed Sci. Cong., Mashhad (Iran), 2: 7-11.

Khalaghani, J. 2007. Weed loss assessment in wheat fields. Final report. Iranian Research Institute of Plant Protection. pp: 47.

Krueger, D.W., H.D. Coble and G.G. Wilkerson. 1998. Software for mapping and analyzing weed distribution- gWeedMap. Agron. J. 90: 552-556.

Damghani, A.M. and B. Kamkar. 2009. A review on competition between weeds and crops. Gorgan University of Agricultural Sciences and Natural Resources Press, Gorgan, Iran. (In Persian).

Mesdaghi, M. 2005. Plant Ecology. Mashhad Jehad-E- Daneshgahi Publishing, Mashhad, Iran (In Persian).

Moeini, M., M.A. Baghestani, H. Rahimian and M. Aleefard. 2008a. Weed mapping for irrigated wheat fields of Tehran province using Geographic Information System (GIS). Iran. J. Weed Sci. 4: 97-118.

Moeini, M., M.A. Baghestani and H. Rahimian. 2008b. Introducing abundance index for assessing weed flora in survey studies. Weed Biol. Manage. 8: 172-180.

Rew, L.J., G.W. Cussans, M.A. Mugglestone and P.C.H. Miller. 1996. A technique for mapping the spatial distribution of *Elymus repense* with estimates of the potential reduction of herbicide usage from patch spraying. Weed Res. 36: 283-292.

Stanford, J.V., J.M. Lebars and B. Ambler. 1996. A hand held logger with integral GPS for producing weed maps by field walking. Comp. Electron. Agric. 14: 235-247.

Thomas, A.G and M.R.T. Dale. 1991a. Weed survey system used in Saskatchewan for cereal and oil seed crops. Weed Sci. 33: 34-43.

Thomas, A.G and M.R.T. Dale. 1991b. Weed community structure in spring-seeded crops in Manitoba. Can. J. Plant Sci. 71: 1069-1080.

Williams, M.M. and D.A. Mortensen. 2000. Crop/weed outcomes site-specific and uniform soil-applied herbicide applications. Prec. Agric. 2: 377-388.

Yazdani, M., P. Hematolah and M.A. Esmaili. 2008. Investigation of biodiversity, density and dominant species of weed in wheat and barley fields of Jamkhaneh region, Sari. Proc. 18th Iranian Plant Protec. Cong. Pp. 21 (In Persian).