Quantitative evaluation of predominant of weeds in winter wheat and barley fields in Eastern Azerbaijan, Iran

Evaluación cuantitativa de malezas predominantes en campos de trigo y cebada de invierno en Azerbaiyán Oriental, Iran

Behrouz S. VAFAEE ✉, Vajiheh NARIMANI, Alireza FAROKHZAD and Raheleh CHASEMZADEH

Plants and Diseases Department, Agricultural and Natural Resources Research Institute, East Azerbaijan, Tabriz, Iran. Email:behrouz_sv@yahoo.com ✉ Corresponding author

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ABSTRACT

In order to determine the density and abundance of dominant weeds in the East Azerbaijan province of Iran, a total of 93 fields, consisting of 73 winter wheat and 20 winter barley fields were studied. Field products were sampled from stem (mid-spring) until the end of fruition in different regions of the province. Weeds were counted and identified according to genus and species, and their stage of development was registered. The entire sample contained 136 weed species from 100 Genera, belonging to 28 families. The most frequently encountered weeds were members of the *Brassicaceae*, with 20 species, *Poaceae*, with 17 species, and *Asteraceae*, with 16 species. Of the 136 weed species, the majority (88%) were dicotyledonous, while the remainder was monocotyledonous. Moreover, 78% of the weeds were annual/biennial. The current study revealed predominant weed species in wheat and barley fields of East Azerbaijan province of Iran. Moreover, we demonstrated that proper weed management will substantially help to reduce the damage to wheat and barley fields.

Key words: Abundance, density, weed, wheat, barley

RESUMEN

Con el fin de determinar la densidad y abundancia de las malezas dominantes en la provincia de Azerbaiyán Oriental de Irán, se estudiaron un total de 93 campos (73 de trigo de invierno y 20 de cebada de invierno). Los productos de campo se muestrearon desde el tallo (a mediados de primavera) hasta el final de la fructificación en diferentes regiones de la provincia. Las malezas se contaron e identificaron de acuerdo al género y la especie y se registró su estado de desarrollo. La muestra completa tuvo 136 especies de malezas de 100 géneros, pertenecientes a 28 familias. Las malezas más frecuentemente encontradas fueron los miembros de las Brassicaceae, con 20 especies, Poaceae con 17 especies y Asteraceae con 16 especies. De las 136 especies de malezas, la mayoría (88%) fueron dicotiledóneas, mientras el resto fue monocotiledóneas. Por otra parte, el 78% de las malezas fueron anuales/bianuales. El estudio reveló especies de malezas predominantes en campos de trigo y cebada de la provincia de Azerbaiyán Oriental de Irán. Además, se demostró que el manejo de malezas adecuado contribuirá sustancialmente a reducir el daño a campos de trigo y cebada.

Palabras clave: Abundancia, densidad, malezas, trigo, cebada

INTRODUCTION

Due to ever increasing world population, and the on-going food crisis in many countries, especially those in the developing world, wheat as a commodity has emerged as an economic-political tool. The pre-eminence of wheat crops, which are members of the family *Poaceae* and Genus *Triticum*, has several advantages over other grains in terms of yield, water requirements, and disease resistance. Wheat is an annual plant which arose in the Fertile Crescent, but its particular adaptability has led the spread of its cultivation throughout the world, extending to central Alberta and Siberia (Pena *et al*., 2002).

The cultivation of wheat arose in the Neolithic period, approximately 10,000 years ago, through selection of indigenous grasses for large kernels. Today it is a major source of nutrition for man (Briggel and Curtis, 1987), following only rice and maize in terms of importance. Of the surface area of Iran, 9.6% (15.6 million hectares) is devoted to farming, of which 13 million hectares is used for agriculture and 2.6 million hectares to horticulture. Of

the cultivable land in Iran, 6.5 million hectares is devoted to wheat, comprising 4 million hectares of dry farming and the remainder for irrigated wheat cultivation (44.4% of cultivable land in Iran). Given the global mean yield for dry and irrigated wheat production of 2.7 tons/hectare, it can be calculated that some 17 million tons of wheat are cultivated annually in Iran. East Azerbaijan province is a major corn producing region in Iran, in which more than 125,000 hectares of cultivable land is devoted to irrigated wheat and barley production (Figure 1). As such, production of these corns is an important element of the state economy.

Of the factors reducing the yields of barley and wheat, weeds are the most damaging. The annual damage resulting from weed infestation of grain crops in the world is estimated to be more than five billion dollars, approximately equal to the total lost from agricultural and horticultural diseases and pests (Gadiri, 2007). Weed control is thus an important element for successful cultivation of wheat and barley throughout the world; even in developed countries, weeds reduce grain yield by 5%, and this damage can reach as high as 25% in developing countires (Montazeri *et al*., 2005), such as Iran. Without proper identification and evaluation of weed species, it is impossible to take appropriate measures for weed control. Decision making for proper regional weed management and control requires thorough description with respect to species identification, and consideration of weed dispersal and expansion ability.

Weed communities are affected by environmental, biological, and land management factors**.** Scroeder *et al*. (1993) determined the abundance and dispersion of main weeds in cultivars by collection of data from 26 European countries. On the basis of this work, they specified the onset of resistance of some weed species to common pesticides in specific time periods. Others have studied the weed dispersion in annual spring agricultural crops at the embryonic stage (Thomas and Donaghy, 1991). During their three year study period, they observed changes in the incidence and dominance of a considerable number of weeds species. A 22-year follow-up study by Webster and Cobe of the southern U.S.A. suggested that the incidence of certain weeds, i.e. *Sena obtusifolia, and Cynodon dactylon* increased considerably, whereas *Digitaria spp, Xanthium strumarium,* and *Sorghum halepense* declined in abundance during the study period 1974-1995 (Webster and Cobe, 1997).

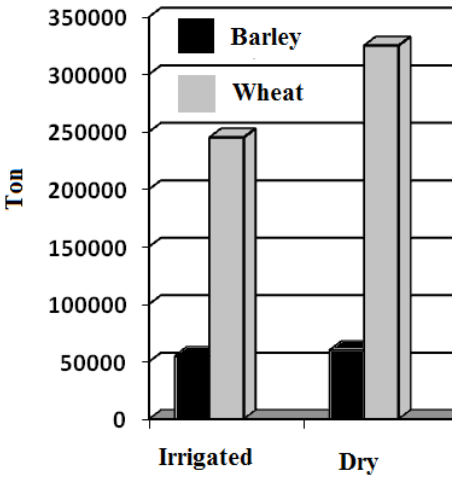

Figure 1: Total production of irrigated and dry wheat and barley in East Azerbaijan province of Iran in 2003.

The prevalence of weed species has been documented in a number of studies in East Azerbaijan, with particular emphasis on weeds infesting wheat and barley fields (IMI: Annual statistical report, 2001; Narimani, 2005). Most of the studies were local, rather than province-wide in their scope, and did not emphasize ecological factors. Furthermore, these studies have typically been of brief duration, and so have not been sensitive to changes in weeds communities and their regional dispersion over a period of years. In order to provide the basis for rational crop management in East Azerbaijan, we conducted a comprehensive identification and evaluation of weeds in several regions of the province during a five year period. The study was intended to establish a framework for future research, and also to devise basic criteria for maintaining performance of these critical cereal crops.

MATERIALS AND METHODS

Ninety three fields consisting of 73 wheat and 20 barley fields distributed among 19 towns were studied in the five year interval 2000-2004. Each year, 3-4 towns were evaluated by first determining the number of cultivated fields belonging to each town, with calculation of the corresponding areas of wheat and irrigated barley fields. These fields were selected randomly, and the crops were sampled based on a classification of field size into three ranges: (a) 1-5 hectare, (b) 6-16 hectare, and (c) greater than 16 hectares fields. Our samples were taken from the field using for each range, defined by

the five vertices of the W-pattern separated by 20 paces, with sampling of weeds in 0.25 m^2 plots. The number of sampling nodes in the W-pattern increased with field size as follows: (a) five, (b) nine, and (c) 13 (Figure 2).

The sampling was carried out starting with the first appearance of stem towards the end of April, and continuing until the appearance of ears around the end of June, in irrigated barley and wheat fields. Sampling was made in different fields during different periods of time. The number of weeds in plots was counted and identified according to genus and species, with registration of their phenology stage. Total abundance and mean density were calculated assuming uniform distribution in entire fields. Finally, the weed, irrigated barley and wheat phenology stages were calculated.

RESULTS AND DISCUSSION

Table 1 reports the climate of towns in East Azerbaijan, determined according to Demarton method (IMI: Annual statistical report, 2006), along

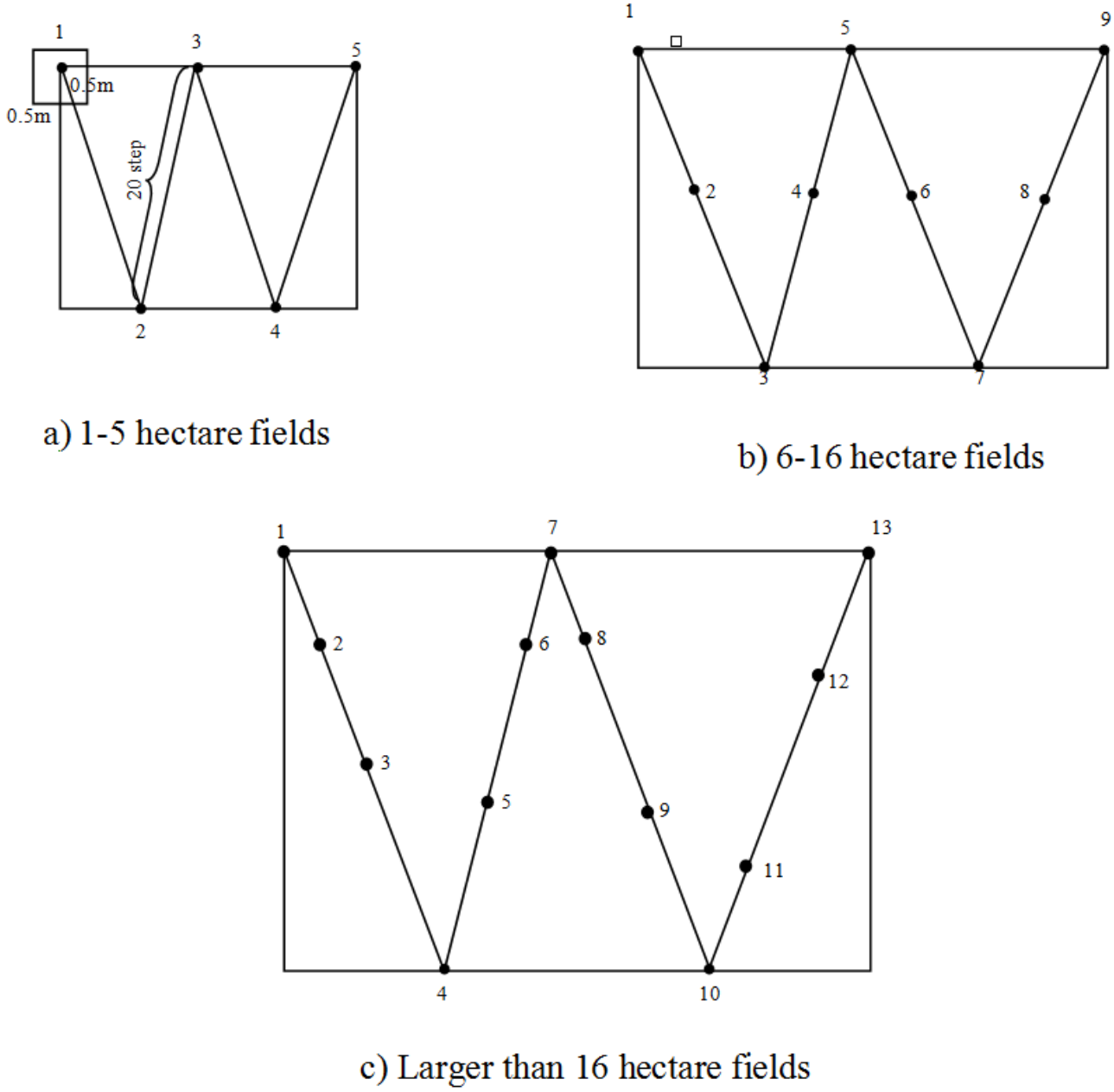

Figure 2. Sampling pattern using (W) method of ninety three fields consisting of 73 wheat and 20 barley fields distributed among 19 towns in the East Azerbaijan province of Iran from 2000 to 2004.

with the main crops. The soil type and chemistry by province is reported in Table 2. In the entire survey we found a total of 136 weed species belonging to 100 Genera from 28 families. The most diverse Genera were *Brassicaceae* with 20 species, *Poaceae* with 17 species and *Asteraceae* with 16 species. In total, 88% of the weed species were dicotyledon and the rest were monocotyledon. Moreover, 78% of weeds were annual or biennial, while 22% were perennial (Table 3). The results show that broad-leafed weeds were more abundant than narrow weeds. Given that broad leaf weeds cause less impairment of field performance (Davids, 1988), the control of narrow leaf weeds control should be a priority in East Azerbaijan.

It also emerged from our study that some species had particular association with the fields of specific towns and cities. Furthermore, the dominant species of weeds were characteristic for each region of East Azerbaijan, with little overlap in their distributions. This suggests that local climatic and ecological factors determine the predominance of weed species (Table 4). In an earlier study Thomas and Donaghy (1991) documented the structure of weed communities in spring cultivars, and compared the success and compatibility of different weed species in a region during a period with climate change. They suggested that temperature and precipitation are the key factors determining the weed dispersion pattern (Tables 5 and 6). Also, Dale and Thomas (1987) conducted a survey on weed communities in corn and oil seed crops. Using a cluster method analysis for an interval of four years, they evaluated 40 species of weeds in those crops as a function of soil and climatic factors, concluding that fluctuations in temperature and precipitation determined the temporal changes in weeds species.

Ferick and Thomas (1992) suggested that appearance and dominance of different weed species were affected by environmental changes and cultivation management policies. Due to generally uniform soil and climatic conditions in our studied region (Table 2), it seems plausible that environmental changes, cultivation management, and type of cultivation in each region are major factors determining the local dominance of weed species. Thus, in the Amberge bioclimatic divisions, to the north of the Sufian region, Marand and part of Ahar have a cold and semi-humid climate, whereas regions of the province in proximity to mountainous regions are cold and humid.

Weed control does not necessarily translate into complete extirpation of weeds from the field, such that renewed infestation is difficult to avoid. Moreover, it is of importance to consider the

Table 1. Climate condition and crops of every studied region in East Azerbaijan province of Iran (City names are mentioned according to the highest cultivation).

Serial	City	Climate	Horticultural crops	Agriculture crops
1	Kaliebar	Ultra-cold humid	Apple, mulberry, pomegranate, walnut	Alfalfa, sorghum, wheat, barley, cotton
2	Bonab	Cold semiarid	grapes, apple	Onion, tomato, carrot
3	Maraghe	Cold semiarid	Apple, grapes, tomato, almond	Alfalfa, wheat, sorghum
4	Mianeh	Cold -semiarid	Apple, apricot, pear	Alfalfa ,tomato, wheat
5	Sarab	Ultracold semiarid	Apple, apricot, pear	Potato, alfalfa
6	Tabriz	Cold- semiarid	Apple, apricot, grapes	Tomato, alfalfa, wheat barley
7	Marand	Cold semiarid	Apple, apricot, grapes, walnut	Alfalfa, water melon, wheat
8	Jolfa	Cold semiarid	Apple, apricot, grapes	Alfalfa, watermelon, wheat
9	Hashtrud	Ultracold semiarid	Apple, pear	Alfalfa, watermelon, wheat
10	Ahar	Ultracold semiarid	Apple, apricot, cherry	Alfalfa, wheat, barley
11	Bostan abad	Ultracold semiarid	Apple, pear	Carrot, potato, Alfalfa
12	Heris	Mediterranean	Apple, apricot	Alfalfa, potato, wheat
13	Charouimag	Ultracold semiarid	Apple, apricot	Alfalfa, barley, wheat
14	Malekan	Cold semiarid	Apple, grapes	Alfalfa, tomato, onion, sorghum
15	Varzegan	Utracold semiarid	Apple, apricot	Alfalfa ,wheat, barley
16	Shabestar	Cold semiarid	Apple, apricot, peach	onion, tomato, Alfalfa, wheat
17	Ajabshir	Cold semiarid	Apple, grapes, almond	Potato, onion, tomato
18	Aazarshahr	Cold semiarid	Apple, apricot, almond, walnut	Potato, onion, tomato
19	Ousko	Cold semiarid	Apple, apricot, walnut	Alfalfa ,onion, sorghum

economic aspects of the plan when selecting methods for weed removal (Cousins *et al*., 1988). In our weed control management plan, we have considered all the existing methods and information which is compatible with natural environment.. This endeavor will eventually enable optimal cultivation, minimizing the economic impact of weed communities (Gadiri, 2007). Given the dominance of annual broad leaf weeds in our region, we predict the post-emergent pesticides such as 2,4-D should be most effective. Management in addition to herbicide application may be required for weed control. Given

Table 2. Soil condition and characteristics of each studied region in East Azerbaijan province of Iran.

Serial	City	Soil type	pH	Level of salinity
1	Kaliebar	Heavy	7.4-7.8	1>
2	Bonab	Heavy-very heavy	7.7-8.5	2-8
3	Maraghe	Heavy	7.6-8	1>
4	Mianeh	Heavy	7.4-8	1-3
5	Sarab	Heavy-very heavy	7.4-7.9	1>
6	Tabriz	Heavy-very heavy	7.6-8.5	1-8
7	Marand	Heavy-very heavy	7.5-8.1	1-2
8	Jolfa	Middle-heavy	7.6-8.3	1-7
9	Hashtrud	Heavy-very heavy	7.5-8	1-2
10	Ahar	Heavy	7.6-8.2	1>
11	Bostan abad	Heavy-very heavy	7.4-7.8	1>
12	Heris	Heavy-very heavy	7.4-7.8	1>
13	Charouimag	Very heavy	7.4-7.8	1>
14	Malekan	Heavy-very heavy	7.6-8.2	1-4
15	Varzegan	Very heavy	7.4-8	1>
16	Shabestar	Middle	7.4-7.8	1>
17	Ajabshir	Middle-heavy	7.8-8.2	1>
18	Azarshahr	Middle	7.4-7.9	1>
19	Ousko	Middle	7.4-7.8	1>

Soil texture is assigned according to the level of clay composition, with three ranges: Middle-loam (<27% clay), heavy clay loam (<27-40% clay) and very heavy-clay (>40% clay). Soil salinity as assigned according to three ranges: non saline (0-4 ds/m), low salinity (4-8 ds/m) and high salinity (8-16 ds/m). Level of salinity is reported in units of deci-siemens/meter (IMI; Annual statistical report; 2003).

Table 3. Dominant narrow and broad leaf weeds in winter wheat and barley fields in East Azerbaijan province of Iran from 2000 to 2004.

Serial	Province	Year	Dominant weeds in wheat field	Abundance (%)	Uniformity (%)	Density mean	Number of fields	Dominated weeds in barley field	Abundance (%)	Uniformity (%)	Density mean	Number of fields
1	Ousko	2000	*Poa bulbusa* *Polygonum aviculare*	33/3 33/3	26/7 20	3/2 6/7	3	*Polygonum aviculare*	100	60	20	1
2	Ahar	2002	*Galium spp.* *Polygonum aviculare*	50 25	30 25	3/6 6/2	4	-				
3	Azar shahr	2000	*Chenopodium album* *Agropyron patulum*	100 33/3	46/7 20	10/4 2/1	3	*Descurainia sophia* *Secale cereale*	100 100	100 100	28/8 68/8	1
4	Bostan abad	2001	*Avena fatua* *Chenopodium album*	66/67 100	33/33 100	3/73 35/2	3	*Achillea micrantha* *Poa spp.*	100 100	60 100	8 9	1
5'6	Bonab&ajabshir	2000	*Adonis aestivalis* *Alopecurus myosuroides*	16/67 33/33	16/67 13/33	28/8 4/8	5	*Hordeum murinum*	33/33	6/67	4/8	1
7	Tabriz	2001	*Hordeum spontanum* *Polygonum aviculare*	50 100	35 80	5/2 9/6	4	*Chenopodium album* *Setaria viridis*	100 50	70 50	11/6 7/2	2
8	Jolfa	2002	*Fumaria officinalis* *Poa bulbusa*	50 50	21/43 21/43	1/11 3/6	2	*Geranium molle*	50	50	19/6	2
9	charouimag	2003	*poa bulbusa* *Polygonum bellardi*	33/33 100	6/67 66/67	0/8 6/67	3	-				
10	Sarab	2001	*Alopecurus myosuroides* *Convolvulus arvensis*	66/67 100	53/33 80	7/73 12/53	3	*Amaranthusretroflexs* *Bromus spp.*	20 20	20 4	11/52 0/24	5
11	Shabestar	2002	*Alyssum desertorum* *poa annua*	57/14 14/29	37/14 11/43	6/51 2/17	7	*Fumaria officinalis*	100	60	13/6	1
12	Kaleibar	2003	*Galium tricorne* *Hordeum murinum*	100 33/33	66/67 20	10/66 1/33	3	*Vicia villosa*	100	60	3/2	1
13	Maraghe	2003	*Alopecurus myosuroides* *polygonum patalum*	25 75	15 60	4 18/95	4	-				
14	Marand	2002	*Alopecurus myosuroides* *chenopodium album*	25 50	22/5 35	9/8 8/4	8	-				
15	Malekan	2003	*Polygonum patalum* *Setaria viridis*	75 25	79/17 12/5	6/71 1/6	4	*Cardaria draba* *Hordeum murinum*	50 50	50 20	5/2 2/4	2
16	Miyaneh	2003	*Galium tricorne* *Hordeum murinum*	100 20	60 16	6/4 1/44	5	*Alopecurus myosuroides* *Galium tricorne*	100 100	60 100	4 16	1
17	Varzegan	2004	*Fumaria officinalis* *Poa bulbusa*	66/67 33/33	46/67 26/67	24/27 5/86	3	*Gallium tricorne*	100	100	28/8	1
18	Heris	2004	*Adonis aestivalis* *Alopecurus myosuroides*	100 33/33	66/66 16/66	17/2 6/26	6	-				
19	Hashtrud	2004	*Alopecurus myosuroides* *Asperugo procumbens*	66/66 66/66	53/33 33/33	53/87 24/5	3	*Poa bulbusa* *Ranunculus arvensis*	100 100	40 60	9/4 44/8	1

Table 4. Geographical length and width of studied cities of East Azerbaijan province of Iran.

	Eastern length				Northern width			
	Minimum		Maximum		Minimum		Maximum	
City	º	minute	º	minute	º	minute	º	minute
Whole	45	05	48	21	36	45	39	26
Azarshahr	45	40	46	10	37	34	37	53
Osku	45	23	46	21	37	39	38	03
Ahar	46	45	47	33	38	18	39	05
Bostan Abad	46	29	47	15	37	34	38	05
Bonab	45	45	46	9	37	11	37	32
Tabriz	45	50	46	36	37	42	38	29
Jolfa	45	17	46	31	38	39	39	00
Sarab	47	00	47	56	37	44	38	15
Shabestar	45	05	46	20	38	00	38	28
Kaleibar	46	25	47	32	38	36	39	26
Marageh	46	09	46	44	37	01	37	45
Marand	45	14	46	12	38	17	38	53
Malekan	45	55	46	26	36	57	37	17
Miyaneh	47	17	48	21	37	02	37	54
Heris	46	22	47	22	38	04	38	24
Hashtroud	46	28	47	19	37	12	37	39
Charoimag	46	39	47	35	36	45	37	24
Arasbaran	46	02	46	52	38	23	38	47
Ajabshir	45	27	46	20	37	15	37	42

Table 5. Climate temperature (°C) registered in 2001 in cities of East Azerbaijan province of Iran.

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tabriz												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5
Maragheh												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5
Miyaneh												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5
Ahar												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5
Sarab												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5
Jolfa												
Max	3.5	3.5	8.9	15.3	21.9	27.6	31.9	33.6	30.2	22.8	14.3	7.2
Min	-4.2	-5.2	-1.7	4.5	9.7	14.8	19.1	20.5	16.1	10.3	4.1	0.1
Ave	-0.4	0.8	3.4	9.9	15.8	21.2	25.5	27.1	23.2	16.6	9.2	3.5

the diversity of weeds in our studied region, quarantine may in some case be necessary for weed control and prevention of weed transfer.

The present study is directed towards the creation of a weeds dispersion map in the region, which is itself motivated by the need to improve agricultural management, thus bringing economical benefits in addition to other important results. The plant dispersion map must sample the plant communities in a region, so as to provide a more clear vision of existing communities. In other words, a correct prediction of the growth of the region's plant communities would enable the correct strategic planning for weed control the region. The creation of plant dispersion and growth maps are supported by extensive field research, with plant classification, sequence studies, and the analysis of effective strategies for intervening in plant communities, as shown by Mueller-Dombois and Ellenberg (1974). The intended map would also provide a background profile of the plant dispersion in the region, serving as a baseline for future studies. Using such maps it is possible to detect temporal changes in the composition of plant communities, and study the impact of interventions intended to ameliorate agricultural yield in the region. Our finding of unique weed species in wheat and barley fields of East Azerbaijan province of Iran has implication for further studies in which possible relationship among climate type, soil type and weed species could be investigated.

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Table 6. Monthly rain (mm) in cities during 30 years reported in 2001.

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tabriz	19.4	14.9	29.0	35.8	45.0	17.1	6.6	4.1	3.5	17.1	29.8	24.0
marageh	29.4	23.6	50.7	53.7	53.8	10.4	3.8	3.2	2.7	11.0	41.8	36.7
Miyaneh	34.1	22.0	36.2	39.1	38.2	15.5	8.6	3.4	3.5	14.7	32.3	27.5
Ahar	19.4	16.8	29.7	34.2	50.9	31.2	11.7	8.8	10.6	25.9	35.1	19.8
Sarab	17.1	9.5	21.0	35.9	45.1	19.7	17.8	9.2	5.9	15.9	25.7	14.2
Jolfa	8.2	6.2	14.3	25.0	33.7	26.8	7.0	2.7	6.9	12.1	22.4	11.1

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