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QUANTITATIVE EVALUATION OF PREDOMINANCE OF WEEDS IN WINTER WHEAT (*Triticum aestivum* L.) AND BARLEY (*Hordeum vulgare* L.) FIELDS IN EASTERN AZERBAIJAN IRAN

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ABSTRACT

In order to determine the density and abundance of dominant weeds in the Eastern Azerbaijan province of Iran, a total of 93 fields, consisting of 73 winter wheat (Triticum aestivum L.) and 20 winter barley (Hordeum vulgare L.) fields were studied. Field products were sampled from stem (mid-spring) until the end of fruiting 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. From 136 weed species, the majority (88%) was dicotyledonous, while the remainder was monocotyledonous. Moreover, 78% of the weeds were annual/biennial. The results of this study showed that environmental (such as local climatic and ecological factors) and management factors (such as cultivation) determine the predominance of weed species in wheat and barley fields. Moreover, we demonstrated that proper weed management will substantially help reduce the damage to wheat and barley fields.

Key words: Barley, quantitative evaluation, wheat, weeds.

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.

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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).

One of the factors reducing the yields of barley (*Hordeum vulgare*) and wheat (*Triticum aestivum*), 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 countries such as Iran (Montazeri *et al*., 2005). 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. Soiroeder *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 longitudinally 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 (1997) 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).

The prevalence of weed species has been documented in a number of studies in Eastern Azerbaijan, with particular emphasis on weeds infesting wheat and barley fields (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 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.

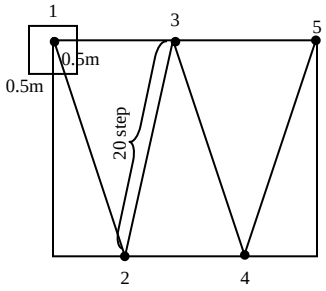
MATERIALS AND METHODS

Ninety-three fields consisting of 73 wheat fields and 20 barley fields distributed between 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) 5, (b) 9, and (c) 13 (Fig. 1).

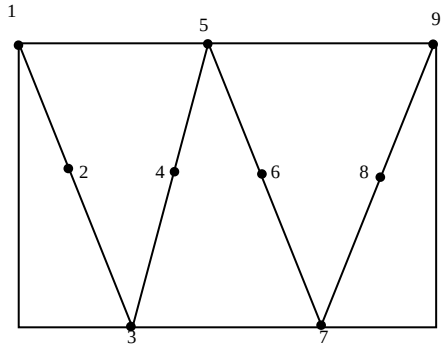
The sampling was carried out starting with the first appearance of stem towards the end of April, and continuing until the appearance of ears around the end of June, in irrigated barley and wheat fields. Sampling was made in different fields during different periods of time. The number of weeds in plots 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.

The climate of cites was determined according to Demarton method along with the main crops (Table-1). Soil condition and characteristics were assigned in each studied region (Table-2). Climate temperature and monthly rain registered in some cities are given in Tables-3 and 4. Geographical length and width were recorded for all of the studied cites (Table-5).

a) 1-5 hectare fields



b) 6-16 hectare fields



c) Larger than 16 hectare fields

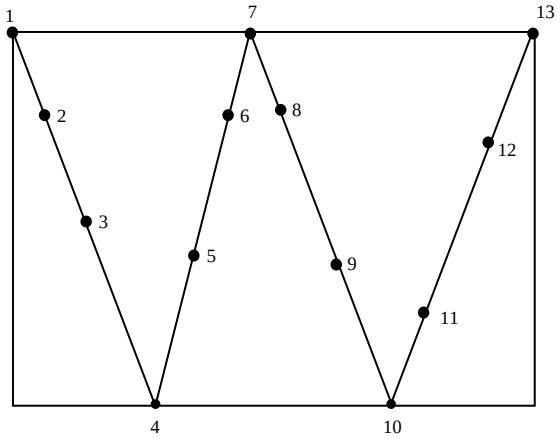


Fig. 1. Sampling pattern using (W) method.

Table-1. Climate condition and crops of every studied region in Eastern Azerbaijan (cities names are mentioned according to the highest cultivation).

S.No	City	Climate	Horticultural	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, and 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

Table-2. Soil condition and characteristics of each studied region.

S.No.	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. Climate temperature (°C) registered in 2001.

	Month											
City	**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

Table-4. Monthly rainfall (mm) in cities during 30 years reported in 2001.

	Month											
City	**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

Table-5. Geographical length and width of studied cities.

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

RESULTS AND DISCUSSION

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 dicotelyedon and the rest were monocotyledon. Moreover, 78% of weeds were annual or biennial, while 22% were perennial (Tables-6 and 7). These results suggest that broad-leaf weeds were more abundant than narrow weeds in wheat and barley fields.

Our study indicated that some species had particular association with the fields of specific cities. Furthermore, the dominant species of weeds were characteristic for each region of Eastern Azerbaijan, with little overlap in their distributions. This suggested that local climatic and ecological factors determine the predominance of weed species. 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 important factors determining the weed dispersion pattern. Dale and Thomas (1987) also 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 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 the diversity of weeds in our studied region, quarantine may in some case be necessary for weed control and prevention of weed transfer.

Table-6. Dominant narrow and broad leaf weeds in winter wheat fields in Eastern Azerbaijan in 2000-2004.

No. of Fields	Density mean	Uniformity (%)	Abund. (%)	Dominant weeds in wheat field	Year	City
3	3.2 6.7	26.7 20	33/3 33/3	*Poa bulbusa* *Polygonum aviculare*	2000	Ousko
4	3.6 6.2	30 25	50 25	*Galium* spp. *Polygonum aviculare*	2002	Ahar
3	10.4 2.1	46.7 20	100 33.3	*Chenopodium album* *Agropyron patulum*	2000	Azar shahr
3	3.73 35.2	33.33 100	66.67 100	*Avena fatua* *Chenopodium album*	2001	Bostan abad
5	28.8 4.8	16.67 13.33	16.67 33.33	*Adonis aestivalis* *Alopecurus myosuroides*	2000	Bonab&Ajabshir
4	5.2 9.6	35 80	50 100	*Hordeum spontanum* *Polygonum aviculare*	2001	Tabriz
2	1.11 3.6	21.43 21.43	50 50	*Fumaria officinalis* *Poa bulbusa*	2002	Jolfa
3	0.8 6.67	6.67 66.67	33.33 100	*Poa bulbusa* *Polygonum bellardi*	2003	charouimag
3	7.73 12.53	53.33 80	66.67 100	*Alopecurus myosuroides* *Convolvulus arvensis*	2001	Sarab
7	6.51 2.17	37.14 11.43	57.14 14.29	*Alyssum desertorum* *Poa annua*	2002	Shabestar
3	10.66 1.33	66.67 20	100 33.33	*Galium tricorne* *Hordeum murinum*	2003	Kaleibar
4	4 18.95	15 60	25 75	*Alopecurus myosuroides* *Polygonum patalum*	2003	Maraghe
8	9.8 8.4	22.5 35	25 50	*Alopecurus myosuroides* *Chenopodium album*	2002	Marand
4	6.71 1.6	79.17 12.5	75 25	*Polygonum patalum* *Setaria viridis*	2003	Malekan
5	6.4 1.44	60 16	100 20	*Galium tricorne* *Hordeum murinum*	2003	Miyaneh
3	24.27 5.86	46.67 26.67	66.67 33.33	*Fumaria officinalis* *Poa bulbusa*	2004	Varzegan
6	17.2 6.26	66.66 16.66	100 33.33	*Adonis aestivalis* *Alopecurus myosuroides*	2004	Heris
3	53.87 24.5	53.33 33.33	66.66 66.66	*Alopecurus myosuroides* *Asperugo procumbens*	2004	Hashtrud

Table-7. Dominant narrow and broad leaf weeds in winter barley fields in Eastern Azerbaijan in 2000-2004.

No of fields	Density mean	Uniformity (%)	Abundance (%)	Dominated weeds in barley field	Year	City
1	20	60	100	*Polygonum aviculare*	2000	Ousko
				-	2002	Ahar
1	28.8 68.8	100 100	100 100	*Descurainia Sophia* *Secale cereale*	2000	Azar shahr
1	8 9	60 100	100 100	*Achillea micrantha* *Poa* spp.	2001	Bostan abad
1	4.8	6.67	33.33	*Hordeum murinum*	2000	Bonab & ajabshir
2	11.6 7.2	70 50	100 50	*Chenopodium album* *Setaria viridis*	2001	Tabriz
2	19.6	50	50	*Geranium molle*	2002	Jolfa
				-	2003	Charouimag
5	11.52 0.24	20 4	20 20	*Amaranthus retroflexus* *Bromus* spp.	2001	Sarab
1	13.6	60	100	*Fumaria officinalis*	2002	Shabestar
1	3.2	60	100	*Vicia villosa*	2003	Kaleibar
				-	2003	Maraghe
				-	2002	Marand
2	5.2 2.4	50 20	50 50	*Cardaria draba* *Hordeum murinum*	2003	Malekan
1	4 16	60 100	100 100	*Alopecurus myosuroides* *Galium tricorne*	2003	Miyaneh
1	28.8	100	100	*Gallium tricorne*	2004	Varzegan
				-	2004	Heris
1	9.4 44.8	40 60	100 100	*Poa bulbusa* *Ranunculus arvensis*	2004	Hashtrud

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 Muller-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 Eastern Azerbaijan province of Iran has implication for further studies in which possible relationship among climate type, soil type and weed species could be investigated.

It is concluded that environmental and management factors can affect predominance of weed species in wheat and barley fields and by proper weed management, damage to wheat and barley fields can be reduced.

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