EFFECT OF CLIMATIC CONDITIONS ON WEED FREQUENCY OF WHEAT FIELDS AND COMPARISON OF GOLESTAN PROVINCE CITIES BY CLUSTER ANALYSIS (A Case study of Iran)

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ABSTRACT

Weed survey of wheat fields was conducted in Golestan province of Iran during 2000-2004. The results showed that among 78 weed species recorded in province, Avena ludoviciana Durieu. in narrow leaved group and Sinapis arvensis L. in broad leaved group had the highest frequency, respectively. Also the results indicated that only the frequency of Alhagi camelorum, Lolium rigidum Gaude., Scandix sp., Suaeda altissima(L.)Pall., Sonchus sp. and Veronica persica Poir. was affected by the climatic conditions, so that semi arid climate has a significant difference with humid and semi humid climate but there was no difference between humid and semi humid climates. Except V. persica (which had higher frequency in humid climate (P=0.01)), the entire weeds mentioned above had higher frequency in semi arid conditions than other climates significantly. According to weed frequency, cluster analysis conclusions showed Gorgan, Bandar -e-Turkman, Gonbad, AQ Qala and Ali Abad cities were in first, Kord kuy and Bandar-e-Gaz in second and the other cities in third cluster

Key words: Climates, cluster analysis, weeds frequency, Golestan Province, Iran.

INTRODUCTION

Golestan province is an important agricultural region in Iran because of extensive and fertile lands. This province is located in the northern east of Iran (Lat 28º, 23'-36º, 15'N, Long 56º, 30'-54º, 15'E) between Atrak boundary

river in the north and Alborz mountain chain in the south. Changes in the height and closeness to the sea has made its climate too varied. Based on meteorological data, cultivated lands in this province are located in 3 climates, semi arid, semi humid and humid.

Wheat is one of the most important crops grown in this region with more than 350000 ha in 2003 (Anonymous, 2003). Weed competition with wheat reduces wheat yields and thus reduces farm income. In addition, cultural practices, including hand weeding, and herbicides used to control weeds cost money and further reduce economic returns to growers.

Weed surveys are useful for determining the occurrence and importance of weed species in crop production systems (Frick and Thomas, 1992; McCully et al., 1991; Thomas, 1985; McClosky,*et al.* 1998). Documenting the weed species present in wheat fields can help elucidate document weed species shifts in response to climatic changes. Knowing the kind of weed species and its relative importance, allows herbicides distribution among cities carried out properly also facilitates the establishment of priorities for research and other Extension activities (McClosky, *et al.* 1998), for example inhibits from the excessive application of herbicides and causes less pollution in environment. Keeping in view these objectives, a survey was conducted in wheat fields of Golestan province in Iran to highlight the distribution of weed species in different climatic zones.

MATERIALS AND METHODS

A weed survey of wheat (*Triticum aestivum* L.) was conducted in Golestan province, for a five years period during 2000-2004 (from May to July). In this research, several cities were selected in each climate and wheat fields were surveyed for weeds using the quantitative survey method of Thomas (1985). The fields surveyed were randomly selected. An inverted "W" pattern was used to systematically walk each sample field. In small fields (less than 5 hectare) in each tip of the inverted "W" contained one quadrate thus a total of 5 quadrates were used. In larger fields (between 5-15 ha) in each leg one additional quadrate was used, thus a total of 9 quadrates were employed in the larger fields. In very large fields (more than 15 hectare) 13 quadrates were used. Each quadrate was $0.5*0.5m^2$. All weeds in each quadrate were identified, counted, and recorded for subsequent data entry and

analysis. Weed frequency (the number of fields in which a species occurred) was calculated and expressed as a percentage of the total number of fields. Relative frequency was obtained by dividing the parameter by the sum of the values for that parameter for all species and multiplying by 100. The effects of climates were determined by subjecting the weed frequency data to ANOVA by SPSS package and LSD was used to determine significant differences among mean values at 0.05 probability level. Cluster analysis based on the minimum of variances is carried out for clustering the cities on basis of weed frequency (proc cluster must identify the pair of clusters with the minimum distance) [SAS Manual; Stokes *et al.*, 1995]. Hierarchical models such as Complete Linkage, Ward's and Single Linkage were used for determination of cluster number (SAS Manual; Stokes *et al.*, 1995; Toghraii, 2002). In the single linkage method, the distance between two clusters is determined by the minimum distance among all individual pairs in a cluster (Toghraii, 2002). In wards linkage method, the distance between two cluster are not calculated but, in this manner, the clusters are formed which they have been the highest homogeneity (Toghraii, 2002). In complete linkage method, distance between two clusters is determined by the maximum distance among all of individual pairs in a cluster (Toghraii, 2002). Using the statistic parameters that were calculated from 3 mentioned methods, the final number of clusters was determined. K-means none hierarchical models (In this methods, before determining of clusters, the number of them must have been determined) was performed for cluster numbers that were suggested by 3 mentioned methods (Toghraii, 2002). In this way, the data divided to K groups or clusters. The center of all clusters was selected and every observation was allocated to the nearest cluster. This working was continued for all of the observations. After that observation allocating was finished, data clustering was stopped (Toghraii, 2002).

RESULTS AND DISCUSSION

A total of 78 weed species were recorded during this survey that 6 of them ranked in order of importance in Table-1. The results of this study showed that 73.1 % of weeds were dicotyledons weeds and others were monocotyledons weeds and 81% of weeds were annual and others were perennial. Based on the results *Avena luodoviciana*, *S.arvensis, Polygonum*

convolvulus L., *Phalaris minor* Retz., *Melilotus officinalis* (L.) Lam, *V. persica and Polygonum aviculare* L. had the highest frequency in province respectively.(Table-1). Generally *A.ludoviciana* with a frequency percentage value 48.42 (it occurred in 48.42% of the fields) in narrow leaved group and *S. arvensis* with a frequency percentage value 37.73 (it occurred in 37.73percent of the fields) in broad leaved group were the most important weeds respectively. (Table-1). *A. ludoviciana, Sinapis arvensis*, and*Chenopodium album* L. occurred in all of surveyed cities (10 cities). *Phalaris minor, Polygonum .aviculare, P.convolvulus* and *Veronica persica* were observed in 9 cities. *Brassica* sp., *Convolvulus arvensis Lolium rigidum, Melilotus officinalis* (L.) Lam. and *Stellaria media* (L.) Vill. were observed in 8 cities. About 56% of reported weeds were seen only in 1-3 cities.

The results further indicated that among the weeds recorded, only the frequency of *Alhagi camelorum, L.rigidum., Scandix* sp., *Suaeda altissima, Sonchus* sp. *and V. persica* was affected by climatic conditions, so that semi arid climate has a significant difference with humid and semi humid climates, but there was no difference between humid and semi humid climates. Except *V.persica*(which had higher frequency in humid climate (P=0.01)), the entire weeds mentioned above had significantly higher frequency in semi arid conditions than the other climates (Tables-3&4) In other words the frequency of these weeds decreased as to go far from the semi arid climate.

According to weed frequency, cluster analysis showed that Gorgan, Bandar-e-Turkman, Gonbad, AQ Qala and Ali Abad were in first, Minou Dasht, Kalale and Azad Shahr in the second and Kord kuy and Bandar-e-Gaz in the third cluster. *A.ludoviciana*, *P.aviculare* and *M. officinalis.* were the most troublesome weeds in cluster one. Younesabadi *et al.* (2002) have reported that *P.aviculare* and*M. officinalis* had the highest frequency in Bandar-e-Turkman *and A.ludoviciana* had the highest frequency in Gorgan and Gonbad. *P.convolvulus, A. ludoviciana* and *S.arvensis* had the highest frequency in cluster 2. *Phalaris minor, S.media* and *V. ersica* were the most important weeds in cluster 3. Younesabadi and her co-workers (2002) also showed that *S.media* had the highest frequency in Bandar-e- Gaz.

These results help us recognizing weed flora in each climate and in each city and help us with avoiding unnecessary and unsuitable distribution of herbicides in province and finally conserving life and environment and marching to sustainable agriculture.

Table-1. Frequency and relative frequency for the most important weed in the 2000 to 2004 survey in Golestan province of Iran.

	Frequency%	**Relative frequency**
A. ludoviciana Durieu.	48.42	10.45
Sinapis arvensis L.	37.73	8.27
Phalaris minor Retz.	28.95	5.67
Melilotus officinalis (L.)Lam.	25.02	4.63
Polygonum convolvulus L.	24.52	5.32
Polygonum aviculare L.	23.87	4.56

Table-2. Cluster analysis of Golestan province cities based on frequency of 78 reported weeds during 2000-2004.

Cluster	**Region**	**Weed (frequency)**
1	Gorgan Gonbad Bandar-e-Turkman Ali Abad AQ Qala	*Avena ludoviciana* Durieu. (53.74) *Polygonum aviculare* L.(42.99) *Melilotus officinalis* (L.)Lam.(36.82
2	Minou Dasht Kalale Azad Shahr	*Phalaris minor* Retz.(61.58) *Stellaria media* (L.)Vill.(58.87) *Veronica persica* Poir.(53.66)
3	Kord kuy Bandar-e-Gaz	*Polygonum convolvulus* L.(52.69) *Avena ludoviciana* Durieu. (52.43) *Sinapis arvensis* L. (37.78)

Table-3. ANOVA of climatic condition effects on weed frequency in Golestan province.

Scientific name of weeds		**SS**	**df**	**MS**	**Probability**
Alhagi camelorum	Treat	933.64	2	466.82	0.004

	(Climate) Error Total	234.81 1168.45	7 9	33.54	
Lolium rigidum Gaud.	Treat (Climate) Error Total	1428.35 818.49 2246.84	2 7 9	714.17 116.93	0.029
Scandix sp.	Treat (Climate) Error Total	107.66 20.25 127.92	2 7 9	53.83 2.89	0.002
Sonchus sp.	Treat (Climate) Error Total	66.73 0.09 66.82	2 7 9	33.37 0.012	0.0001
Suaeda altissima (l.) Pall.	Treat (Climate) Error Total	89.60 67.88 157.48	2 7 9	44.80 9.7	0.053
Veronica persica Poir.	Treat (Climate) Error Total	2091.49 1763.18 3854.67	2 7 9	1045.74 251.88	0.065

Table-4. Comparison of the effect of different climate means on weed frequency by LSD.

	Climate(i)	Climate(j)	Mean difference	Probability
Alhagi camelorum L.	Semi arid	Semi humid	20.59*	0.005
		Humid	26.12*	0.001
	Semi humid	Semi arid	-20.59*	0.005
		Humid	5.52	0.219
	Humid	Semi arid	-26.12*	0.001
		Semi humid	-5.52	0.219
Lolium rigidum Gaud.	Semi arid	Semi humid	29.82*	0.02
		Humid	29.94*	0.02
	Semi humid	Semi arid	29.82*	0.02
		Humid	0.12	0.99
	Humid	Semi arid	-29.94*	0.02
		Semi humid	-0.12	0.99
Scandix sp.	Semi arid	Semi humid	7.36*	0.002
		Humid	8.74*	0.001
	Semi humid	Semi arid	-7.36*	0.002
		Humid	1.39	0.29
	Humid	Semi arid	-8.74*	0.001
		Semi humid	-1.39	0.29
Sonchus sp.	Semi arid	Semi humid	6.46*	0.000
		Humid	6.46*	0.000
	Semi humid	Semi arid	-6.46*	0.000

	Humid	Humid Semi arid Semi humid	0 -6.46* 0	1.000 0.000 1.000
Suaeda altissima (L.) Pall.	Semi arid Semi humid Humid	Semi humid Humid Semi arid Humid Semi arid Semi humid	6.36* 8.1* -6.36* 1.73 -8.1* -1.73	0.05 0.02 0.05 0.46 0.02 0.46
Veronica persica Poir.	Semi arid Semi humid Humid	Semi humid Humid Semi arid Humid Semi arid Semi humid	-6.66 -33.54* 6.66 -26.88* 33.54 26.88	0.64 0.05 0.64 0.05 0.64 0.48

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