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THE STUDY OF GENETIC VARIABILITY IN ASSOCIATION WITH ZINC UPTAKE EFFICIENCY IN *Triticum aestivum* L GENOTYPES

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Abstract: Diversity in agro ecosystems can improve the sustainability of cropping systems in terms of low external inputs and unpredictable climate changes. Agricultural ecosystems in the world are widely related to economical and social status. The major aim of agricultural ecosystems management is to maximize nutrient flow and human service materials. Nutrient efficiency in wheat is very complex. It includes nutrient acquisition efficiency and nutrient use efficiency. In this study 26 winter wheat genotypes were used to investigate the interactive effects between genotypes and the use efficiencies of the Zn micronutrient of the grain. An experiment was carried out in Agricultural and Natural Resources Research and Education, Center of West Azerbaijan, in which Genotypes were planted in complete randomized block design with three replications. The traits such as plant height, biological and grain yield, harvest index, length of spike, number of kernel per spike, thousand kernel weight and spike weight were measured or calculated. Concentration of Zn in the grain was measured by dry combustion using Perkin Elmer 2380 Atomic Absorption Spectroscopy. Zinc uptake was calculated by multiplying grain Zn concentration in the grain yield. It was revealed that biomass weight of whole plot, plant height, number of kernel per spike, grain yield of main culms, biological yield, length of spike and number of spikelet/spike were positively correlated with grain yield, while the grain protein percentage was negatively correlated with the grain yield. Variance analysis showed that there were highly significant differences among traits. The results obtained in this study indicate that nutrient use efficiency of the Zn varies widely within wheat genotypes. Some genotypes were identified as being Zn use efficiency. These are considered as low-input genotypes. It seems that a special breeding programmer of crop cultivars for low Zn nutrient and stress condition could be successful. Improving the cultivar response to Zn nutrient will help to reduce inputs and hence protect the environment.

Keywords: Wheat, Zn use efficiency, Genetic variability, low input.

Introduction

Mineral elements play essential roles in biochemical and physiological functions of any biological system. In plants, appropriate mineral availability is necessary to every aspects of development including seed germination, seedling development (Welch, 1999), yield formation as well as mineral deposition in grain (Yilmaz et al., 1998; Welch, 1999).Deficiencies of elements such as zinc are well known in all cereals and cereal-growing countries. Increasing the quality of products in order to prevent malnutrition and some diseases caused by nutrient deficiencies, especially iron and zinc is very important. Achieving sustainable agricultural goals, it is possible to improve the quantity and quality of products via producing cultivars with desirable genetic traits. These cultivars are resistant to nutrient deficiencies and have high efficiency in nutrient uptakes (Hasanzadeh Gorttapeh and Mozafari, 2004).

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Wheat (*Triticum* spp.) is the major staple food crop in different parts of the world. It is cultivated in about half of areas in developing countries such as the Middle East, central India and the Mediterranean region of west Asia and the other countries including Ethiopia, Argentina, Chile, Russia, the United State, Italy, Spain and Canada. Generally, wheat production is low in developing countries due to usage low level inputs (e.g., fertilizer, water) in semi- arid regions. In addition, yields may be reduced by insects attacks, poor crop management and deficient weed control (Connor, 2011).Considering the high geographic diversity in different regions, it is necessary to evaluate the cultivars with different characteristics; then these crops should be applied in breeding programs to prevent the yield reduction and to raise nutrients uptake efficiency (Haneklaus and Schnug, 1993; Hassanzadeh Gorttapehand Salehzadehi, 2010).Yields of crops are often limited by low levels of mineral micronutrients in soil such as zinc (Zn), especially in calcareous soils of arid and semiarid regions. Zinc deficiency in most agricultural soils of the country is a neglected point in production chain. High-yielding wheat varieties should be planted in fertile soils. They have lower yields than their potential due to lack of nutrients including Zinc. Since some of the nutrients may be lost or become inaccessible in various ways. Achieving the optimal yield per unit is possible by applying chemical fertilizers (Dambroth and Bassam. 1990).

The results of recent researches in different parts of the country have proven the effective role of this vital element in increasing the wheat quantity (Malkoti, 2001). Results relating to zinc fertilizers use, showed the low absorption of this element (less than 1%) and different ability of cultivars in its absorption (Pecetti et al., 1992.). Studying the absorption of nutrients including Mg, Ca, K, P, N and Zn in 15 wheat cultivars, Sarik et al. (1990) found a high genetic diversity among wheat cultivars in terms of nutrientusage efficiency while some cultivars are more tolerant to its deficiency. Smith (1934) stated that the absorption of nutrients by the plant is influenced by genetic traits.

Breeding programs had a significant importance in terms of nutrient usage efficiency, plant characteristics, soil type and climatic factors. Haneklaus and Schnug (1993) observed a remarkable difference in the nutrients absorption, especially zinc, manganese and phosphorus in different wheat cultivars during their experiments. Investigating the different wheat varieties response to low-energy elements, Takar (1991) stated that deficiency of low-energy elements reduced the production potential in many soils of India. However, resistant cultivars application has been an effective step towards increasing products per unit area. Regarding demands for food, attempt should be focused in improving the quality and quantity of this product. Therefore, it is possible to assess desirable cultivars by identifying local lines with high efficiency of nutrient uptake, classifying favorable traits and determining the correlation between desirable traits and using them in breeding programs to correct high-yielding wheat cultivars and commercial cultivars.

The aim of this study was to introduce wheat varieties with high zinc uptake efficiency for cultivating and using in breeding programs. The results of this paper can be remarkable due to the limited sources of zinc and its deficiency in Iranian soil (Malkoti, 2001).

Material and method

Experiment was conducted at Research Station of Dr. Nakhjivani, West Azerbaijan Agricultural and Natural Resources Research and Esucation Center, Urmia, Iran. (Latitude 37º53’N and longitude 45º10’E and altitude 1325m) during the 2010 and 2011.The annual rainfall ranged from 300mm to 350mm. The mean annual temperature was around 13.1°C. The coldest and hottest months of year were December and July, respectively. The results showed that the irrigation water had a very low salinity and sodium which was in class c2s1 based on Will Cox classification. The site soil was non-saline, sandy loam with a small amount of lime and pH 8. Phosphorus content was too low.

Table 1 - Physico-chemical characteristics of the experimental site (Dr. Nakhjivani Research Station)

Cu	Zn	Mn	Fe	Available K	Available P	Clay	Silt	Sand	Total N	Organic C	Neutralizing	Total acidity saturation	Electrical conductivity	Saturation percent	Depth	Sample View
Mg per Kg						Percent						)pH(	)ds/m(	)s.p(	)cm(	
0.66	0.54	0.7	4.7	280	3.1	9	8	83	0.07	0.65	2.5	8	0.67	25	30 - 0	Composite sample

The field has been prepared in fall. After performing physic-chemical analysis (Table 1), required chemical fertilizers were distributed uniformly at the field. The experimental design was a split plot in a randomized complete block design with three replications. The experiment was consisted of seeds 23 selected lines and 3 common varieties (Alamut, Zarin and Shahryar). The first factor was consisted of three treatments: control (without fertilizer), consuming NPK, NPK+Zn. The second factor was Seeds of lines and wheat cultivars. All crop managements were carried out and weeds were controlled with application of 2, 4-D (1.5 L/ha) in tiller stage. Traits such as biological and grain yield, harvest index and 1000 grain weight were measured at the end of the experiment. Zinc concentration was measured for the grain and zinc yield was calculated according to formula (1)

Zinc yield=zinc concentration × grain yield/ha (1)

Zinc absorption efficiency was calculated from the formula (2):

$$\text{Zinc absorption efficiency} = \frac{\text{(Zn uptake in the fertilizer plot - Zn uptake in control plots)}}{\text{The amount of Zn fertilizer applied}} \quad (2)$$

Stress susceptibility index (SSI) was Calculated from formula (3)

S=1- (Ydi/ Ypi)/ 1-D (3)

D= YD/YP

Ydi=Mean yield under Zn deficiency (control without fertilizer)

Ypi=Mean yield after applying Zn fertilizer

YD=Mean yield of all lines under Zn deficiency (control without fertilizer),

YP= Mean yield of all lines after applying Zn fertilizer (non-stress)

All data were statistically analyzed by the means of variance analysis followed by Duncan's multiple test. Simple correlations between traits were calculated and local lines were classified according to different characteristics and also environmental sensitivity index.

Results and Discussion

The results of analysis of variance are presented in Table 3. Based on the table, fertilizer and genotype effect were statistically significant on seed yield, biological yield, harvest index, 1000 grain weight, zinc concentration in seed and zinc yield per hectare, in probability level of 1%.

Mean Comparison of traits in fertilizer treatments is presented in Table 4. Maximum grain yield, biological yield, harvest index and 1000 grain weight were achieved from NPK+Zn fertilizers treatment due to increasing nutrients uptake and photosynthesis rate. Moreover, Zn concentration in grain and its adsorption per unit area were highest.

Table 2- Number, code and collected site of lines and varieties

Collected site	Identification Code	Genotype number	Collected site	Identification Code	Genotype number
Ardabil	Kc-330	14	East Azerbaijan	Kc-20	1
Ardabil	Kc-2143	15	East Azerbaijan	Kc-30	2
Ardabil	Kc-2147	16	East Azerbaijan	Kc-40	3
Ardabil	Kc-2149	17	East Azerbaijan	Kc-44	4
Ardabil	Kc-2151	18	East Azerbaijan	Kc-50	5
Ardabil	Kc-2155	19	East Azerbaijan	Kc-58	6
Khorasan	Kc-3079	20	West Azerbaijan	Kc-113	7
Khorasan	Kc-3095	21	West Azerbaijan	Kc-132	8
Khorasan	Kc-1717	22	West Azerbaijan	Kc-145	9
Khorasan	Kc-1773	23	West Azerbaijan	Kc-1974	10
West Azerbaijan	Alamut	24	Zanjan	Kc-4144	11
West Azerbaijan	Zarin	25	Kurdistan	Kc-4173	12
West Azerbaijan	Shahriyar	26	Kurdistan	Kc-4175	13

Mean comparison of genotype on grain yield, biological yield, harvest index, 1000 seed weight, zinc concentration in seed and its yield are presented in Table 5. Maximum grain yield (6.9 ton/ha) was obtained from Shahriar cultivar, followed by Zarrin, East Azarbaijan (line 2), Kurdistan (genotype 12), Zanjan (genotype 11) and Ardebil (genotype 15) with4.09, 4.07, 3.99, 3.92 and 3.72 tons/h, respectively while the lowest grain yield (2.5 t/h) was achieved from khorasan (genotype 23) cultivar.

The biological yield trend was similar to grain yield. Shahriar cultivar produced the highest yield among the studied genotypes. Zarrin and genotypes (2, 12 and 11) had the most biological yield, respectively. Biological yield in Ardebil and Khorasan was the lowest (Table 5).

Harvest index is an important characteristic that indicates the ratio of grain yield to biological yield. According to experiments, Selection based on harvest index increases grain yield and fertilization in plants (Viedt and Spanakakis, 1989.).

The highest 1000-seed weight was obtained from Shahriar and Zanjan (genotype 11), respectively which was significantly higher than the others (Table 5). This trait is one of the most important components of grain yield and its increase can improve the grain yield. The Zinc concentration in grain was significantly higher in genotypes 20 and 21 than the others.

This trait had the lowest amount in genotypes 1, 9 and 13, respectively. It showed diversity among genotypes in terms of Zn absorption and its storage. Genotypes with high ability for storing are more important. They have high quality in the food chain.

Mean comparison of Zn Yield (Zn concentration × grain yield) is shown in Table 5. The highest yield of zinc (31.8 kg ha-1) was produced in Shahriar cultivar due to its higher grain yield. This characteristic was lowest in genotypes (3, 23), respectively due to less grain yield or zinc adsorption per unit area. Regarding the results, wheat can absorb (122 to 318 g/h) zinc. Therefore, this element should be added to increase the soil fertility.

Table 3- Analysis of variance between Wheat cultivars with fertilizer treatments

Zn absorption (mg/ha)	Zn content (ppm)	1000 grain weight (gr)	Harvest index (%)	Biological yield (kg/ha)	Grain yield (kg/ha)	df	Sources
**33.38	169110216.1	**14.52	0.30	196772.8	289396.2	2	Block
**318.74	**198635112419.4	**680.27	**1924.82	**196584845.8	**84016702.3	2	Fertilizer
0.153	705619004.7	0.305	2.152	121468.2	371474.3	4	(I) Error
**122.11	**12465390911.6	**136.63	**6.855	**38191391.91	**5969603.1	25	Cultivar
14.69	151192446.6	1.23	0.494	257055.3	274954.1	50	Cultivar× Fertilizer
2.91	439199139.6	1.91	1.405	209167.87	208561.8	150	(п) Error
3.91	13.17	3.51	2.58	6.08	13.1		C.V

** means Significance in probability level of 1%

The analyses of variance about zinc efficiency are presented in Table 6. Based on the table, genotype effect on zinc adsorption was statistically significant at 1%. Mean Comparison of data showed that the zinc -use efficiency was higher in West Azarbaijan (genotype 10) among the others.

Table 4- mean Comparison of studied traits in fertilizer treatments

Zn absorption mg/ha) (	Zn content) ppm (	1000 grain weight) gr (	Harvest index (%)	Biological yield kg/ha) (	Grain yield (kg/ha)	treatment
45.70B	105356C	36.08C	40.23C	5741.32C	2308.7C	No Fertilizer
43.89C	166680B	40.19B	48.13B	8042.99B	3810.7B	Consuming NPK
48.01A	205440A	41.80A	49.39A	8786.29A	4299.1A	consuming NPK + Zn

Similar letters indicates no significant difference in probability level of 5% in each column.

Table 5 mean Comparison of studied traits in wheat genotype

Zn absorption mg/ha)(	Zn content Mg/kg)(	1000grain weight)gr(	Harvest index)%(	Biological yield kg/ha)(	Grain yield (kg/ha)	Genotype
133045IJ	36.21Y	34.6K	46.48ABCDE	7405.3DEFG	3501.5 CDE	1
193915B	46.85K	36.98HI	46.18BCDEF	8749.1B	4074.1 B	2
12239J	43.12U	35.28JK	45.27EFGH	6128KL	2818.7GH	3
135466IJ	43.35S	37.49GHI	45.90DEFG	6688.3HIJ	3126.2EFG	4
137924HIJ	47.25J	38.15GH	44.97FGH	6332.3JK	2890.4FGH	5
151870DEFGHI	49.62C	43.33C	45.55DEFG	6776.9HIJ	3135.8EFG	6
160642CDEFGH	47.39I	42.76CD	46.39ABCDE	7140.6EFGH	3376.4DEF	7
164197CDEFGH	45.10N	41.28EF	45.91CDEF	7566.6DE	3522.7CDE	8
149789EFGHI	42.75W	43.36C	47.06ABC	7076.7FGH	3394.4DEF	9
168166CDEF	48.85E	38.51G	45.52DEFG	7447.9DEF	3446.3CDE	10
176972BC	44.22Q	46.07B	44.93FGH	8596.3B	3928.3BC	11
172959BCD	43.93R	43.75C	45.43EFG	8712.1B	3997.0B	12
142022GHIJ	40.25X	41.72DEF	45.59DEFG	7431.8DEF	3444.1CDE	13
1551143DEFGHI	43.33T	37.02HI	47.01ABC	7308.5EFG	3494.4CDE	14
170778CDE	45.42M	42.61CD	45.59DEFG	8038.8C	3718.1BCD	15
146167FGHI	48.28G	37.55GHI	45.44EFG	6549.9IJK	3021.7EFGH	16
131461IJ	45.10N	34.89K	44.45GH	6676.6HIJ	3007.1EFGH	17
139441HIJ	44.59P	34.72K	46.03CDEF	6570.0IJK	3068.4EFGH	18
147619EFGHI	44.89O	36.95HI	46.97ABC	6426.0JK	3189.8EFG	19
138164HIJ	54.89A	37.08GHI	47.65A	5686.8L	2764.4GH	20
170854CDE	51.94B	36.29IJ	47.36AB	6948.7GHI	3352.2DEF	21
166666CDEF	48.72F	36.39IJ	46.82ABCD	7797.3CD	3371.2DEF	22
122232J	47.77H	36.48IJ	44.14H	5708.8L	2577.5H	23
149575EFGHI	49.48D	40.86F	45.93CDEF	6408.3JK	3020.5EFGH	24
176533BC	42.75V	40.73F	26.01CDEF	8800.9B	4097.9B	25
318132A	46.52L	48.44A	45.33EFGH	16632.4A	6946.9A	26

Similar letters indicates no significant difference in probability level of 5% in each column.

Table 6- Mean comparison of Zn- use efficiency and stress susceptibility index in different genotypes at 5%

MS			
SSI	Zn- use efficiency	df	Sources
1.7518	0.1702	2	Replication
1.8865	0.4464**	25	Cultivar
1.1756	0.10570	50	Error
3.60	15.84		CV

means Significance in probability level of 1% **

Statistically, this genotype didn't have any difference with most of genotypes except 6, 13, 18, 21 and 25. Khorasan cultivar (genotype 21) had the lowest zinc efficiency (Table 7). Researchers mentioned the effects of genotype and environment, including climatic and soil conditions, as effective factors in the absorption and storage of nutrients (Sorm, 1984).

Table 7- mean comparison of Zn- use efficiency in different genotypes at 5%

Zn- use efficiency	Genotype	Zn- use efficiency	Genotype
0.7343ABCDE	14	1.0177AB	1
0.6950ABCDE	15	0.9542AB	2
0.7585ABCD	16	0.5985ABCDE	3
0.1873DEF	17	0.8326ABC	4
0.7518ABCD	18	0.8169ABCD	5
1.0292AB	19	0.4353BCDEF	6
0.1116F	20	1.0411AB	7
0.7675ABCD	21	0.9284AB	8
0.9530AB	22	1.087A	9
0.2305CDEF	23	0.5958ABCDE	10
0.4932ABCDEF	24	0.7188ABCDE	11
0.6302ABCDE	25	0.1057FG	12
1.025AB	26	0.8491ABC	13

Investigating of different genotypes based on stress susceptibility index (Fisher and Maurer, 1984)

The genotypes were classified based on stress susceptibility index(Fisher and Maurer,1984).Based on this coefficient, since the difference of genotype yields under stress conditions is less than normal condition or the obtained number is closer to 1, this genotype is more resistant to environmental stress. According to the results of this study, genotypes were classified in three groups: resistant (1-3), semi-sensitive (3-6) and sensitive (more than 6). The numbers and classifications of each group are presented in Table 9. Khorasan cultivar (genotype No. 22) was the most sensitive to zinc deficiency. Zarrin and Shahriar were more resistant than other genotypes and the remaining genotypes were placed in semi-sensitive group. Correlation coefficients between the measured traits are presented in Table 9. Grain yield had a significant and positive correlation with biological yield and 1000 grain weight and their increasing can improve grain yield. The zinc use efficiency and its concentration in grain, grain yield and zinc yield had positive and significant correlation ($p<0.95$), which meant improve zinc use efficiency by increasing each of them.

Increasing quality of food along with preserving the environment is one of the main goals in today’s societies. In this regard, increasing soil fertility and preventing nutrients losing plays an important role in improving the quantity and quality of products. However, the quality of soil and environment should be protected in sustainable agriculture. Different factors have significant impacts on soil fertility such as type of cultivated product and the previous product, planting date (spring or autumn), amount of nutrients in soil, physical characteristics of the soil (texture and drainage), the purpose of planting (forage, grain, or dual purpose) and genotype type (7).

Table 8- classifying genotypes based on stress- susceptibility index (Fisher and Maurer, 1984)

Class	SSI	Genotype	Class	SSI	Genotype
Semi-sensitive	3.65	14	Semi-sensitive	3.46	1
Semi-sensitive	3.50	15	Semi-sensitive	3.80	2
Semi-sensitive	3.68	16	Semi-sensitive	3.53	3
Semi-sensitive	3.58	17	Semi-sensitive	3.49	4
Semi-sensitive	3.57	18	Semi-sensitive	3.49	5
Semi-sensitive	3.92	19	Semi-sensitive	3.56	6
Semi-sensitive	3.73	20	Semi-sensitive	3.56	7
Semi-sensitive	3.59	21	Semi-sensitive	3.57	8
sensitive	6.50	22	Semi-sensitive	3.86	9
Semi-sensitive	3.43	23	Semi-sensitive	3.36	10
Semi-sensitive	3.52	24	Semi-sensitive	3.68	11
Resistant	2.38	25	Semi-sensitive	3.70	12
Resistant	2.54	26	Semi-sensitive	3.478	13

Table 9: correlation coefficient between wheat lines and cultivars in measured traits

traits	1	2	3	4	5	6	7	8
1. grain yield	1							
2. Biological yield	**0.993	1						
3. Harvest index	-0.053	0.121-	1					
4. 1000 grain weight	**0.637	**0.624	0.175-	1				
5. Zn content	0.147-	0.119-	0.165	0.018-	1			
6. Zn absorption	**0.962	**0.962	0.014-	**0.633	0.109	1		
7. Zn- use efficiency	*0.321	*0.289	*0.349	0.124	*0.362	*0.294	1	
8. SSI	*0.319-	*-0.285	*0.304	*0.296-	0.187	0.239-	0.133	1

**and* means significance at 1% and 5%, respectively

The genotype is one of the main factors influences the products. Genotypes with ability of high nutrients absorption and storing them in their organs can enhance the quality of product and prevent malnutrition or some nutritional deficiency diseases. Moreover, cultivation of these genotypes can lead to less fertilizer use. Zn element has a significant role in raising production and quality improvement among the nutrients. Based on results of the paper, there was a high diversity in grain yield, biological yield, harvest index, Zn absorption and its yield among genotypes (Table 8). Genetic potential of genotypes is a determinant of environmental factors in optimal use and genotypes 2, 11, 12, 25 and 26 were the best in this regard. Some researchers also suggested that the yield potential varies among cultivars and local lines. The absorption and storage of nutrients were different among them (1, 2, 3, 4, 5, 7 and 10).Zinc- uptake efficiency differed among genotypes and those which absorbed more Zn element were more efficient (1, 2, 7, 8, 9, 19, 22 and 26). According to experiments, genotypes that responded to low levels of nutrients could be used to improve crops and produce high potential cultivars (9, 17, 21 and 19). Improving wheat cultivars in order to absorb more elements can increase the efficiency of low-energy elements adsorption in soil.

Finally, based on cluster method, treatments were placed in three main groups.

Samples with high seed yield, high Zn use efficiency and low susceptibility to its deficiency: shahriyar cultivar.

Samples with fairly high seed yield, fairly Zn use efficiency: 7, 21, 26, 42, 53, 56, 71, 89, and 94: Zarrin cultivar.

Samples with low seed yield, low Zn use efficiency: 4, 10, 12, 16, 20, 33, 68, 13, 74, 76, 77, 80, 83 and 100: Almut clutivarl.

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C A S E    0         5        10        15        20        25
  Label  Num  +---------+---------+---------+---------+---------+
           5   ⇩⇘
          20   ⇩▫
          18   ⇩▫
           4   ⇩▫
          13   ⇩▫
           1   ⇩▫
          17   ⇩▫
           6   ⇩▫
          14   ⇩▫
          16   ⇩⇳⇩⇘
          24   ⇩▫⇔
           9   ⇩▫⇔
          19   ⇩▫⇔
           3   ⇩▫⇔
          23   ⇩⇗⇔
          11
⇩⇘▫⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇩⇘
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25 ⇩▫⬄⬄

15 ⇩▫⬄⬄

21 ⇩▫⬄⬄

12 ⇩▫⬄⬄

10 ⇩▫⬄⬄

22 ⇩⇳⇩⬃⬄

8 ⇩▫⬄

7 ⇩▫⬄

2 ⇩⬃⬄

26
⇩⇩⇩⬃

Table 3- Dendrogram of the studied treatments

Sarik and Momsilovich (16) reported increasing fertilizer use efficiency by examining the nitrogen uptake efficiency among wheat genotypes. The zinc element investigation in stress susceptibility index showed that genotypes 25 and 26 were highly resistant and genotype 22 was very sensitive (Table 11). The resistant genotypes can be used in breeding programs.

Conclusion

Increasing the quality of food along with preserving the environment damage is among the main goals in sustainable agriculture. It has been proven that increasing soil fertility and preventing the nutrients loss lead to improve quality and quantity of products. Distinct factors impact on soil fertility including type of crop(forage, grain or both of them), previous crop, cultivation date, nutrients content in soil and type of genotype. Genotype is the main factor in improving the quality and quantity of products.

Based on this paper, there was a great diversity in grain yield, biological yield, harvest index, Zn absorption and its yield (table 9). Also, the genetic potential was the most important factor in optimal use.Zarrin and Shahriyar cultivars were the best in condition of samples No. 7, 53 and 56. Some researchers stated that yield potential is different among cultivars and local lines. Moreover, absorption and storage of nutrients are various (Altin and Frey, 1990; Dambroth and El Bassam, 1990; Damisch and wilberg, 1991; Fichbeck, 1988; Haneklaus and Schnug, 1993; hassanzadeh-Gorttapeh, 2007) as well as Znuse efficiency. Samples with higher ability toabsorb nutrient (Zn) had the highest efficiency (genotypes 4, 7, 10, 26, 33, 80, 94 and Shahriyar cultivar).

Superior genotypes or genotypes which react to low levels of nutrients can be used in breeding programs. As a result, high potential lines can be produced while increasing the efficiency of low-input elements. Saric and Momcilovic (2004) showed increasing the efficiency of fertilizer application by examining the Nuse efficiency in superior lines. Investigating SSI indicated that Zarrin and Shahriyar cultivars were very tolerant and genotype 94 was sensitive. Resistant and sensitive cultivars have a great importance in breeding activities. Takkar (2001) stated that superior genotypes should be considered and produced in order to prevent malnutrition.

According to this paper, it seems that it is possible to modify and produce cultivars to increase the quality of production in low nutrient conditions. Appling this method, we can significantly reduce consumption of fertilizer in agriculture and prevent the environment damage. Furthermore, it is possible to select genotypes with high efficiency in nutrients absorption and storage (i.e. zinc) using modern technologies and biotechnologies such as RAPDs, RFLPs and PCRs due to genetic variation among genotypes.

Suggestions

1-Considering the different susceptibility of wheat genotypes to zinc element, it is recommended to pay attention to the specific sensitivity of plants at the time of fertilizer consuming.

2- It is suggested to investigate uperior genotypes for absorbing different amounts of fertilizer and obtaining accurate results about selection of efficient cultivars.

3- It is also important to study the selection of best genotypes in order to reduce the inputs (fertilizers, water, etc.) per unit area

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