Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Scholars Research Library

European Journal of Zoological Research, 2013, 2 (4):82-88
(http://scholarsresearchlibrary.com/archive.html)

Scholars Research Library
ISSN: 2278–7356

Investigate the relationship and path coefficient analysis between yield and its components in the number of winter wheat genotypes in the cold region of Ardabil

Farzaneh Pordel-Maragheh

Young Researchers Club, Ardabil Branch, Islamic Azad University, Ardabil, Iran

---

ABSTRACT

In order to investigate the relationship between traits and analysis to causal relationships in winter wheat, an experiment was conducted on 9 promising wheat lines and Shahriar cultivars (control) in a randomized complete block design with two replications at Agriculture and Natural Resources Research Station of Ardabil in 2012. The statistical analysis of the survey included 14 important traits such as total number of tillers, number of fertile tillers, number of infertile tillers, spike length, grain weight per spike, plant height, biomass, peduncle length, peduncle weight, seed weight, days to flowering, days to maturity, harvest index and grain yield. Results of variance analysis showed that there are significant differences between 10 wheat genotype in terms the number of fertile tiller, number of spike per square meter, grain weight per spike, peduncle weight, days to flowering, days to maturity, harvest index, grain yield (at 1% level), biomass and seed weight (at 5% level), indicates that there is variation among the genotypes studied. Correlation coefficients indicated that the peduncle elongation and reduction in the number of infertile tillers will have a positive effect on performance. The high correlation between grain yield and number of grains per spike indicates that this attribute can also be a good measure for the selection of high yielding varieties. Grain yield had the highest correlation with the length of the spike (0.903) between traits. Multiple stepwise regression analysis for the grain yield showed that characteristics such as infertile tillers and peduncle length remained in the model and about 92% of the variations are controlled by these traits. The significant coefficient in the regression equation show effective traits in increasing the grain yield. So that the peduncle length increase and reduction in the number of infertile tillers will have a positive impact on performance. Path analysis of remained characters in the regression model showed that peduncle length had the most direct effect (0.672) with grain yield and infertile tiller had the negative and direct impact on grain yield (-0.193). Also the number of infertile tillers had more indirect effect through peduncle length than the indirect effect length of peduncle through the number of infertile tillers on the yield. So, the most important traits were identified as selection criteria to improve the yield which included infertile tillers and peduncle length.

Key words: winter wheat, correlation, stepwise regression, path coefficients, performance

---

INTRODUCTION

Wheat with the scientific name of *Triticum aestivum* is the most important crop in the world. As a result of its wide range and high adaptability and also the various usages of this crop in human feeding it is known as the most important crop in the world particularly in developing countries and it accounts for approximately 20% of world's food sources [1] and has always been of interest as the raw material for bread preparation, wheat and bread as the symbol of God's blessing have been highly respected and it has been considered a misdeed to squander it. Although, currently there are various types of crops being planted all over the world and people rely less upon wheat for their feeding, this strategic crop is being focused upon by world people and various investigations are being conducted to improve its quality and quantity. Correlation between traits is also important in plant breeding, because it measure the amount and type of genetic and non-genetic relationship between two or more traits. Genotype and phenotypic

correlations between different traits may help plant breeders in indirect selection for important traits through least important traits that they are easier to measure. Genotype correlation between traits is mainly due to genes linkage. This correlation represent amount of covariance at two similar genes or strongly continuity between two different traits and environmental correlations is due to the fact that an environment can cause different simultaneous variance in the two traits [2].

One of the main goals of wheat breeding is to increase grain yield per area unit. Regarding the relationship between grain yield and important agronomic, finding the appropriate indicators to apply selection can have significant role to improved yield [3] although, these correlations are useful in determining the main components but they do not show the relative importance of direct and indirect effects. Path analysis is a method that reveals the relationships between traits and their direct and indirect effects on performance. This method requires the identification of causal relationships among traits [4]. In order to find correlations and describe the relationship between characteristics at individual and genotypes, factor analysis is used based on the number of index influence on these characteristics [5]. In this method, the hidden factors that cause the correlation between traits are identified and a group of variables are identified that have the highest interclass correlation and show less dependence with other groups.

Hence, improving wheat grain yield through breeding and improving yield components are among the most efficient methods in breeding programs, thus studying the relations between yield components and yield plays an important role in this context. Analysis of path coefficients is a method for separation of correlation coefficients into their direct and indirect effects through other traits and can provide useful information about the relations between traits and how they are affected by each others. The contribution made by each component of yield to account for grain yield can also be affected indirectly by rest of the components [6]. Khan et al [7] after investigating the correlation between the traits of bread wheat showed that there is a high correlation between grain yield and grain number per spike, 1000 grain weight and harvest index. In an investigation on vernal wheat Gupta and Chaturvedi [7] showed that harvest index, plant height, date of maturity, biological yield and date of flowering had a direct effect on grain yield. Moghaddam et al [5] showed in their study that grain number per spike and 1000 grain weight produced high correlation with grain yield and had a highly significant direct effect on this trait. Mondal et al [9] concluded from the path coefficients in path analysis conducted on 99 bread wheat genotypes in India that grain number per spike, 100 grain weight and tiller number per plant had a direct effect on grain yield, whereas traits such as height and date of maturity had a negatively direct effect on grain yield. Bakhit et al [10] by examining the correlation and path analysis in Durum wheat in Egypt showed that spike number per plant had the highest direct effect on grain yield. Dakioku and Akaya [11] by conducting path analysis on wheat genotypes for yield and its components reported that spike number per m2 and grain weight per spike had a positively direct effect on grain yield and grain number per spike had a positively indirect effect on yield through grain weight. Hoxha and Sulovari [12] by studying the relation between production and some quantitative traits of hard wheat by path analysis showed that plant height, period of vegetative growth and mean spike weight had direct effect on yield, whereas traits such as leaf area, fertile tiller number, spike length, spikelet number, harvest index and leaf angle had indirect effect on yield.

Mohammadi Gonbad et al [13] by exploring the relations between yield and its components in bread wheat genotypes under condition of heat stress showed that in a favorable conditions spike number per m2 had the highest positively direct effect on grain yield, whereas in an unfavorable condition biomass had the highest positively direct effect on grain yield among the study traits.

Zakizadeh et al [14] showed in their study that the greatest direct effects on grain yield belonged to traits such as spike number per m2, grain weight per spike and biological yield. Ahmadizadeh [15] by path analysis and examining the correlation during an investigation conducted on genetic variation of local masses of durum wheat in terms of antioxidant activities and some of physiological traits under drought condition showed that under these conditions plants being selected based on traits such as grain number per spike, plumule length (in mean stress), 1000 grain weight, total tiller number and stem length (in intensive stress) and damage on membrane (20% polyethylene glycol stress) produce a high amount of yield.

Mollasadeghi [16] by studying the correlation and path analysis of bread wheat showed that the highest direct effect belonged to grain number per main spike, whereas the lowest one belonged to grain number per secondary spikes. The highest positively indirect effect belonged to grain number per main spike that was controlled through grain number per secondary spikes, whereas the highest negatively indirect effect belonged to grain number per main spike that was controlled through 1000 grain weight per main spike.

Mollasadeghi et al [17] after an investigation conducted on correlation and path analysis of morphological traits for 9 bread wheat genotypes under the condition of terminal drought stress reported that grain yield had a positively direct effect on harvest index, whereas straw yield had a negatively direct effect on harvest index. In addition,

among traits effective on grain yield, four traits namely grain number per spike, grain weight, 1000 grain weight and biological yield had the highest positively direct effect on grain yield, whereas three traits namely spike length, spike weight and biological yield had the highest direct effect on straw yield.

Mollasadeghi and Shahryari [18] in an investigation on relations of some of the most important morphological indicators with grain yield demonstrated that the highest direct effect on grain yield belongs to biological yield (2.143) followed by weight of main spike (0.129), they claimed that biological yield and weight of main spike can be used as criteria for selection aimed at improving the yield of wheat grain.

Therefore, in this study, with determining the role and contribution of each component of the performance, we can specify appropriate selection indicators for performance modification.

MATERIALS AND METHODS

In order to investigate the relationship between important agronomic traits, yield and its components and also analysis to causal relationships in winter wheat, an experiment was conducted on 9 promising wheat lines and Shahriar cultivars (control) in a randomized complete block design with two replications at Agriculture and Natural Resources Research Station, located 12 kilometers south of Ardabil (Khalkhal road) in 2012. The station has a cold semi-arid climates, the temperature is often below zero in winter. Altitude is 1352 mm, average rainfall 307.1 mm, longitude length and width 48° and 15' of eastern longitude, 38° and 15' northern latitude. The average annual minimum and maximum temperatures is respectively 1.98 and 18.18 and the maximum absolute temperature is 21.8° C. list the 9 wheat lines and Shahriar cultivars (control) is shown in Table 1. Seed consumption has been 452 seeds per square meter and fertilizer consumption rate based on soil test results has been 92 kg nitrogen and phosphate and 62 kg potassium. Thus, total phosphorus and potash fertilizer was used in the autumn and nitrogen fertilizer was used at three stages tillering and heading. Broadleaf weed control was performed using 2, 4-D herbicide in the tillering stage. During the growth period characteristics such as time to 52% flowering and physiological maturity were recorded. Half-foot three lines were harvested when crop handling and the average of three samples, unfertilized spike dry matter per unit area and harvest index were determined. Plant height and number of grains per Spikes was measured the average of 12 spikes randomly harvested. Yield per unit of harvested crop were measured from each plot. Seed weight was measured after final harvest of the plots. In this study traits such as total number of tillers, the number of fertile tiller, the number of infertile tiller, length of spike, grain weight per spike, plant height, biomass, peduncle weight and length , days to flowering, days to maturity, harvest index, grain yield and seed weight were evaluated. Distance between two plants was considered 25 and between two rows were 75. Crop care was uniformly carried out for all treatments during the experiment. Care such as weeds was done with specific chemicals when tillering. In this study, the software SPSS, Minitab and Path analysis was used.

Table 1 – List of study genotypes in this investigation

-86-1	ahryar
-86-2	-80-4
-86-3	loudan/3/Bb/7C*2//Y50E/3*Kal/4/MV 17
-86-4	an 7578. 128/4/Chil/24*Star
-86-5	an 7578. 128/5/Chil/2*Star
-86-6	an 7578. 128/6/Chil/2*Star
-86-7	)800994W/Vee//F900K/3/Pony/Opata
-86-8	ır*5/Aga//Sni/3/Trk13/4/Drc
-86-9	ilinmiyen 96. 40
-86-10	⊃ 909 Mima

RESULTS AND DISCUSSION

Results the variance analysis in the agronomic and morphological traits showed (Table 2) that there are significant differences between 10 wheat genotype in terms traits such as number of fertile tillers, number of spike per square meter, grain weight per spike, peduncle weight, days to flowering, days to maturity, harvest index, grain yield (at 1% level), biological yield and thousand grain weight (at 5% level) that indicates there is variation among the genotypes but there is no significant difference in terms traits such as the number of infertile tillers, plant height and peduncle length. This indicates that the studied genotypes are close to each other in terms these traits. Coefficients of variation (CV %) except for plant height and number of infertile tillers was below 22% for other traits which indicate a high accuracy measurement or experimental error are low. As can be seen, there was significant difference between genotypes for agronomic and morphological traits at 1% level. The issue has high potential value in wheat breeding programs. Results of yield average comparable by Duncan's multiple range test showed that (Table 3) the highest yield belong to the cultivar 4 with 3.9 and the lowest yield belong to the cultivar 5, with 2.1 tons per acre.

Table 2 - Variance analysis of studied traits

S. O. V	df	MS						
		total number of tillers	the number of fertile tiller	the number of infertile tiller	length of spike	grain weight per spike	plant height	Biological yield
Replication	1	56.23	2.1	3.73	1.562	0.112	735.4	1963.3
Genotypes	9	869.98**	905.9**	4.83	487.88**	1.209**	293.9	6236.9*
Error	18	65.41	2.58	0.47	37.114	0.152	695.7	1935.9
CV%		4.05	0.82	35.21	5.88	14.45	28.31	19.33

** and ** Significantly at p < 0.05 and < 0.01, respectively.*

Table 2 – Continue

S. O. V	df	MS						
		Peduncle length	Peduncle weight	1000 grain weight	Harvest index	Days to flowering	Days to maturity	Grain yield
Replication	1	54.75	0.001	30.75	3.9	0.001	3.55	3.83
Genotypes	9	31.76	0.009**	132.8*	32.31**	7.46**	118.9**	0.855**
Error	18	14.23	0.01	513.57	0.937	0.667	21.92	0.183
CV%		10.02	13.22	14.34	0.7	0.46	9.18	14.29

** and ** Significantly at p < 0.05 and < 0.01, respectively.*

Table 3 - Comparison of the yield average for 9 promising lines and one control varieties by Duncan at 5% level

Number	Genotypes	Grain (Ton / ha)	
C-86-1	ıahryar	2.66	bc
C-86-2	-80-4	3.71	a
C-86-3	loudan/3/Bb/7C*2//Y50E/3*Kal/4/MV 17	3.22	ab
C-86-4	an 7578. 128/4/Chil/24*Star	3.9	a
C-86-5	an 7578. 128/5/Chil/2*Star	2.1	c
C-86-6	an 7578. 128/6/Chil/2*Star	3.21	ab
C-86-7	)800994W/Vee//F900K/3/Pony/Opata	2.76	bc
C-86-8	ır*5/Aga//Sni/3/Trk13/4/Drc	2.81	bc
C-86-9	ilinmiyen 96. 40	2.8	bc
C-86-10	C 909 Mima	2.68	bc

Simple correlation between different traits is reflected in (Table 4). In the breeding research, improve drought tolerance that it is considered in order to find a trait as an indirect selection criterion, must be correlated with yield or drought tolerance, in addition high heritability. For this reason, Pearson's correlation coefficient was used. Results of simple correlation measure, is presented in Table 4. In this study, yield showed positive and significant correlations with its components, but showed no significant correlation with harvest index. Harvest index showed positive and significant correlations with traits such as number of spikes, grain weight per spike, peduncle length, grain weight and also showed negative and significant correlations (-0.858**) with infertile tiller. The results indicated that the highest correlation is a function of the number of grains per spike. Experiments Imam, et al (2007) also verifies this result. In the optimal conditions, the highest correlation with grains yield is related to the number of grain per spike. Accordingly, it may do the genotypic selection for greater grain yield using highest correlation with grain yield in any wet conditions. There was non-significant positive genotype correlation between tillers per plant with harvest index and grain weight. The results did not match the findings of Kouchaki and Nikkhah [19].

To investigate the effects of each trait on the dependent variable and also reduce the number of independent variables and eliminate variables that have negligible effect on the dependent variable and fitting the best model, stepwise regression method was used. In stepwise regression analysis, yield as the dependent variable (Y) and other evaluated traits was considered as an independent variable (X). To determine the characteristics cumulative effect on the performance, multivariate linear stepwise regression method was used. The results of this analysis are presented in Table 5. The results showed that infertile tillers and peduncle length explained 7.48% of yield variations. Considering the number of infertile tillers (X1), peduncle length (X2) and yield (Y), the following equation was obtained:

$$Y = 0.477^{ns} - 0.157^{*}X_1 + 0.087^{*} X_2$$

Significant coefficient in successful regression equation shows these traits to be effective in increasing the yield. The above equation showed that the positive influence of peduncle length and the number of infertile tiller that had negative effect on yield increase. by comparing the regression coefficients and correlation coefficients, it was determined that yield have significant and positive relationship with peduncle length (r=0.856**) and significant and negative relationship with number of infertile tiller (r=-0.833**).

Vaezi [20] claimed that the traits such as biological yield, harvest index, 1000 grain weight, straw yield and plant height are effective on grain yield through step by step regression. In the investigation conducted by Naghavi et al [21] grain number per spike had the highest regression coefficient and individually accounted for 82% of yield changes. After that, 1000 grain weight followed by spikelet number per spike, were introduced into the model and finally these three variables accounted 94% of yield changes. Moghaddam et al [5 and 22] by conducting two separate investigations studied wheat native to the Southeast and Southwest of Iran and after doing analysis, they found a significant regression for traits such as days number to flowering, plant height, spike number per plant, grain number per spike and 1000 grain weight. Mass et al [23] after doing a phased regression analysis for wheat demonstrated that grain yield is dependent upon the number of fertile tiller produced by each plant. Golparvar et al [24] after a study on 567 bread wheat genotypes concluded that traits such as grain number per plant and grain yield per spike had the highest positively direct effect on grain yield of plant, whereas the trait of grain number per spike had the highest negatively direct effect on it. Afyoni and Mahluji (2005) after conducting phased regression analysis on 42 lines and varieties of bread wheat demonstrated that traits such as grain filling period, grain number per spike, spike number per m^2 and plant height were introduced into the model earlier than other traits and were the most effective traits on grain yield. Zakizadeh et al [14] in an investigation titled as examining the genetic variation and relation between various traits and grain yield in bread wheat genotypes based on phased regression, realized that biological yield, grain weight per spike, spike number per m^2 were among the most important components of yield and made more effective contribution to grain yield.

Grain yield is a very complex feature resulting from the process of plant growth. Grain yield resembles a primary function where yield components to some extent are related to each other in its improvement [25]. Adams [26] based on studies which he conducted on balancing the yield components in so many crops concluded that grain yield is a result of interaction between numerous genes and environment and for this reason direct selection has not proven so successful for that and does lead to remarkable increase in yield and so that the selection for yield components has been suggested as a solution for evermore progress in yield increase. Unfortunately, negative correlations between yield components lead to trade off between them on selection. Although it is important to estimate the correlation between traits and yield, the simple correlation coefficients by itself doesn't completely specify the nature of relation between traits. Thus, path analysis was used to identify direct and indirect effects of traits effective on grain yield. The results (table 6) showed that peduncle length had the direct effect (0.672) with grain yield and the number of infertile tiller had the direct negative effect (-0.193) on the yield, also the number of infertile tiller had less indirect effect through peduncle length than indirect effect of the peduncle length through the number of infertile tiller on the yield.

Table 4- Simple correlation coefficients between the evaluated traits

Traits	the number of fertile tiller	the number of infertile tiller	length of spike	grain weight per spike	plant height	Biological yield	Peduncle length	Peduncle weight	1000 grain weight	Harvest index	Days to flowering	Days to maturity
the number of fertile tiller	1											
the number of infertile tiller	-0.638*	1										
length of spike	0.681*	-0.928**	1									
grain weight per spike	0.547	-0.84**	0.798**	1								
plant height	-0.475	0.278	-0.208	-0.241	1							
Biological yield	0.6	-0.089	0.105	0.272	-0.665	1						
Peduncle length	0.72*	-0.95**	0.979**	0.828**	-0.332	0.242	1					
Peduncle weight	-0.285	0.045	-0.012	-0.037	-0.39	-0.124	0.014	1				
1000 grain weight	0.24	0.057	-0.004	0.27	-0.417	0.544	0.007	-0.01	1			
Harvest index	0.401	0.083	-0.106	0.058	-0.432	0.451	-0.095	-0.17	0.801**	1		
Days to flowering	0.521	-0.844**	0.72*	0.634*	-0.524	0.216	0.807**	0.146	-0.229	-0.266	1	
Days to maturity	0.515	-0.858**	0.82**	0.676*	-0.093	-0.161	0.809**	0.017	-0.327	-0.2	0.718*	1
Grain yield	0.642*	-0.832**	0.903**	0.73*	-0.176	0.096	0.856**	-0.016	0.225	0.015	0.52	0.59

** and ** Significantly at p < 0.05 and < 0.01, respectively.*

Table 5 - Summary of stepwise regression analysis to estimate the yield 9 promising lines and 1 control cultivar (Shahriar)

Traits	Standardized Coefficients	B	sig	VIF
	Beta			
α	0.477	-	-	-
the number of infertile tiller	-0.157	-0.193	0.04	3.519
Peduncle length	0.087	0.672	0.03	1.412

Naghavi et al [21] claimed after their investigations that among the studied traits grain number per spike have the highest direct effect on yield, followed by 1000 grain weight which have the highest positively direct effect on spike yield, whereas the spikelet number only has the high positively indirect effect on yield through grain number per spike. Heydari et al [6] demonstrated that grain number per spike had the highest positively direct effect on grain yield over the two years of evaluation. Mobser et al [27] by examining the path analysis for grain yield of barley expressed that grain number per spike with a direct effect of 1.36 is considered the most important component effective on grain yield. In addition, the direct effect of spike number per unit area and grain weight was also positive. Mohammadi [28] after studying the relation of yield with its own components in 600 native bread wheat genotypes of Iran demonstrated that the highest direct effect on grain yield belongs to 100 grain weight trait. Tarinejad [29] reported that the direct effect of plant height on grain yield was negative and negligible (-0.051), and argued that due to the positively direct effect of traits such as grain number per main spike, 1000 grain weight per main spike on grain yield, selection for each of either of these traits will lead to increased yield. Moghaddam et al. [quoted by 29] reported that the direct effect of three main yield components on grain yield was positive in native masses of Southeastern Iran. Basirat [30] declared that the highest direct effect on grain yield belongs to grain number per spike. Ahmadzadeh [31] reported that the direct effect of 1000 grain weight and spike length on yield was positive.

Table 6 - Causality analysis of tuber yield with related traits in 9 wheat promising lines and 1 control cultivar (Shahriar)

Traits	Direct effect	Indirect effect through		Total correlation
		the number of infertile tiller	Peduncle length	
the number of infertile tiller	-0.193	-0.64	-	-0.833**
Peduncle length	0.672	-	0.183	0.856**

Residual effect = 0.0.513

REFERENCES

[1] Mollasadeghi, V. A.A. Imani, R. Shahryari and M. Khayatnezhad, **2011**. *Middle-East journal of Scientific Research* 7(2): 221-224.
[2] Poursaleh, M. **1994**. Cereals. Safar Publication. 144p.
[3] Allah Gholipour, **1997**. Correlation of some important agronomic traits of rice yield through path analysis. Master's thesis. College of Agriculture, Tehran University. Karaj.
[4] Ahmadzade, A. In **1998**. Evaluation of spring wheat lines come from landraces east of drought resistance. Breeding Master Thesis, Graduate Department of Plant Breeding, Islamic Azad University, Ardabil.
[5] Moghaddam, M., B. Ehdaei and J. G. Waines. **1997**. *Euphytica*. 95: 361-369.
[6] Heidari, B., G. Saeidi and B. E. Sayed-Tabatabaei. **2008**. *J. Sci. & Technol. Agric. & Nature. Resour*. 42: 135-144.
[7] Khan, H. A., SH. Mohammad and S. Mohammad. **1999**. *Crop Research-Hisar*. 17(2): 229-233.
[8] Gupta, RR., and BK. Chaturvedi. **1995**. *Agricultural Science Digest Karnal*. 15(4): 186-190.
[9]Mondal, A. B., D. P. Sadhu and K. K. Sarkar. **1997**. *Enviroment and Ecology*. 15(3): 537-539.
[10] Bakhit, BR., M. G. Mossad, MA. EL-Morshidy and AM. Tamam. **1989**. *Assiut-Journal of Agricultural sciences*. 20(3): 207-220.
[11]Dokuyuca, T., and A. Akaya. **1999**. *Rachis*. 18(2): 17-20.
[12]Hoxha, S., and H. Sulovari. **1999**. *CIMMYT*. Vol: 5. No: 6.
[13]Mohammadi Gonbad, R. A., Hosseini, S. A., Nouri-Nia, A., Tavakolu, M. R. And H. Quchag, in **2010**. Investigate the yield relationship and yield components of wheat genotypes by path analysis under heat stress. Eleventh Congress of Agronomy and Iran's intentions, Martyr Beheshti University in Iran. 882-885.
[14] Zaki Zadeh, M., M. Isma'ilzadeh Moghadam and D. Kahrizi. In **2010**. *Iranian Journal of Crop Science* 12 (1): 18-30.
[15] Ahmadi Zadeh, M. In **2010**, Evaluation of genetic diversity in native durum wheat under drought stress of antioxidant activity and some physiological characteristics, Breeding Master Thesis, Graduate Department of Plant Breeding, Islamic Azad University, Ardabil
[16] Mollasadeghi, V.**2010**. Effect of potassium humate on yield and yield components of wheat genotypes under end seasonal drought stress condition. MSc. thesis in Plant Breeding. Islamic Azad University, Ardabil branch.
[17] Mollasadeghi, V. A.A. Imani, R. Shahryari and M. Khayatnezhad, **2011**. *Middle-East journal of Scientific* Research 7(2): 221-224.
[18] Mollasadeghi, V, and R, Shahryari, **2011**. *Advances in Environmental Biology*, 5(3): 538-542.
[19]Kouchaki, A. And Nikkhah. H. **2006**. *Iranian Journal of Crop Sciences* - Volume VIII Issue 1, pages 14 to 29.
[20] Vaezi, Sh., In **1994**. Genetic and geographic diversity of the collection of qualitative and quantitative properties of durum native wheat, Iran, MS Thesis, Tehran University, Karaj Agricultural College.

[21] Nagavi, M. R., Shahyazpour Shahbazi, A. and Talei, A. R., In **2002**. *Iranian Journal of Crop Sciences*, 4: 81-88.
[22] Moghaddam, M., B. Ehdaei and J. G. Waines. **1998**. *J. Genet. Breed*., 52:73-81.
[23] Maas, E.V., S.M. Lesch, L.E. Feancois and C.M. Grieve. **1996**. *Crop Sci*. 36: 142-149.
[24] Golparvar, A. R., Ganadha, and. R., Zali, A., And Ahmadi, A. In **2002**. *Seed and Plant*, 18:144-155.
[25] Pandy, J.P and J.H. Torrie, **1973**. *Crop Science* 13: 505-507.
[26] Adams, M.W. **1967**. *Crop Science* 7: 505-510.
[27] Mobasser, S., Noormohammadi, G., Kashani, A. And Moghaddam, M. In **2000**. *Iranian Journal of Crop Sciences.* Volume 2, (1): 15-22.
[28] Mohammadi, M. In **2000**. Correlation between yield and yield components in bread wheat landraces and cultivars of 600 multivariate statistical methods. Breeding Master Thesis, Faculty of Agriculture, Tehran University.
[29] Tari Nejad, A. In **1998**. Lines to evaluate the response of winter wheat landraces to water stress conditions. MA thesis breeding. Agricultural Faculty. No. 63.
[30] Basirat, M. In **1994**. Selection for drought resistance in wheat. Articles Congress of Agronomy. Faculty of Agriculture, Tehran University. Pp. 43-62.