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Research Article

STUDYING CORRELATION RELATIONS AND PATH COEFFICIENT ANALYSIS BETWEEN YIELD AND AGRONOMIC TRAITS OF BREAD WHEAT IN COLD REGION OF ARDABIL

***Mojtaba Ghasemi Fahim**
Young Researchers and Elite Club, Ardabil Branch, Islamic Azad University, Ardabil, Iran
**Author for Correspondence*

ABSTRACT
World population is increasing at a fast rate and to meet its need there is a need to increase the crop yield. There is a need to identify factors affecting the grain yield such as wheat. This study was conducted in cold region of Ardabil in crop year of 2012 on 57 genotypes of bread wheat lines in random block project with three replications aiming at grain yield evaluation and identifying its relationship with some factors related to yield and studying the correlation between traits and analyzing it thoroughly. The results from variance analysis showed that statistically there was a significant difference between numbers of traits studied. In statistical analysis we studied and analyzed 4 main traits of the design. Among studied genotypes, genotype 48 showed maximum yield and genotype 42 the least. The simple correlation coefficient showed that the relationship between days number to flowering with that of days number to maturity was positive and significant in 5% probability level. Whereas there was no significant relationship between plant height and yield. Days number to flowering controls more than 10% of grain yield changes and controls most of grain yield changes among other studied traits. According to the positive partial regression coefficient of this traits, it can be said that selection of late blooming varieties have positively effect on grain yield.

Key words: *Correlation, Step Regression, Path Coefficients, Yield, Bread Wheat*.

INTRODUCTION
Due to population growth and the increasing need for food, increasing yield is one of the most important goals of wheat breeding. Increasing yield and improving crop cultivation conditions can be realized by applying agronomic principles and using plant Breeding Research. The objective of wheat breading is to obtain varieties that are winter-friendly, and resistant to draught and lodging and are free of seed abscission and spike density, from and early maturing are significant, and totally it will lead to a higher yield per unit area (Karimi, 1993). Yield is a complex quantitative trait that is greatly influenced by environmental factors such as soil fertility, light and temperature. Due to the large number of controling genes, yield and the impact of environmental factors on it the yield heritability is low so in order to increase yield in breading procedures.

The selection based on related components and traits with yield is highly important (Valesh, 1992). In order to increase yield in breading methods we can use topics on quantitative genetics and understand yield components that are important in its improvement (Ehdaei, 1996 and Farshadfar, 1998). Before that we should compute yield relation with its components, in the other hands, the correlation between yield trait and its related traits and components and due to effective factors in variation that is genotype and environment yield components effect should be determined (Falcoer, 1999 and Fashadfar, 1999). Understanding the genetic characteristics of train, their relation and how traits affect each other to gain desired goals in breeding are important. We can determine the best breeding method and the most effective traits through understanding these relations (Allah Gholipour and Salehi, 2004). With regards to the relationship between grain yield and main agronomic traits, finding appropriate indicators can be considerably important for yield improvement. Genotypic and phenotypic correlation between different traits helps the modifier in indirectly selection of main traits through less important traits. Path analysis was proposed by right for the first time and is a method that makes clear the relationship between traits and their direct or indirect effects on yield (HonarNajad, 2003). In this way, the correlation coefficients between traits are separated into components that measure their direct and indirect effects. I studies about yield-related traits we use causality method to study traits effects on yield and the relationship between traits. By using this method we can analyze the correlation between yield and its components and determine its direct and indirect effects (Farshadfar, 1998 and 1999). Leilah and AL-khateebs (2005) use 7 different statistical methods in their research such as causality analyze method to study the relationship between yield and its components in draught stress. Results showed that the traits including Spike number per square meter, weight of 100 seeds, seed weight per spike and biological yield of effective variants on yield and high proportion of direct and indirect effects Shahin Nia *et al.,* (2003) tested 145 bread wheat genotypes consisting of 90 breading lines and 55 domestic varieties by path coefficient analysis to study diversity rate and correlation between traits related to Baking quality and reported that the correlation between quality traits indicating a direct and significant relationship between protein percent and sedimentation with SDS along with other baking- related traits. They also reported that in stepwise regression, protein percent was included into the model in first and second stage as a justifying trait of many other quality changes. Also, path coefficient analysis indicates a the important of a direct and significant effect of traits such as protein percentage, seed moisture content, water absorption Zeleny sedimentation volume, bread volume and indirect effect of these traits through protein percent on sedimentation change with SDS.

Hosseinzadeh *et al.,* (2009) in a study based on stepwise regression seed yield, as a dependent variable and biologic yield Shoot weight, leaf area in the canopy closure, plant height and days number to 50% flowering were included into the model as independent variables. Determination coefficient model was $R^2 = 1$. Biological yield had direct considerable effect on the increasing of grain yield. The negative direct effect of stem weight and plant height on grain yield was offset by the positive indirect effect via biological yield and made an increase in correlation of these traits with grain yield. On the contrary, the positive direct effect of day number to 50% flowering on grain yield offset by negative indirect effects via biological yield and made a decrease in the correlation of this with grain yield, so the most important traits as selection to improve yield included biological yield. Arminyan and Behroz (2011) reported that the correlation coefficients were positive and significant ($P< 0.01$) between grain yield with seed number per spike, spike length and flag leaf length and width. According to the results from stepwise regression spike length, tillers number, flag leaf length and seed numbers per spike were the most important traits in justifying the diversity of grain yield. The simple path coefficients analysis showed that spike length and seed number, respectively, had the most positive and significant effect ($P<0.01$) on seed yield per unit area. Also chain path coefficient analysis showed that tiller numbers had a direct and positive effect on seed yield ($P>0.05$). Also the effect of seed number per spike on the weight of 100 seeds and direct effect of spike length on seed numbers per spike was significant. Thus results from orthogonal decomposition indicate that there is no significant difference between domestic varieties compared to double haploid genotypes considering the most important economic characteristic, yield. Jabbari *et al.,* (2012) conducted a trial in simple lattice project 9×9 With two replications in both aqueous and drought stresses for 81 double haploid barley lines to study the relationship between morphologic traits with seed yield and determine the effective components and the contribution of each studied traits and measured traits such as duration of vegetative growth, duration of reproductive growth, plant height, awn length, main spike length, flag leaf sheath length, peduncle length, flag leaf length, flag leaf width, seed number per spike and seed yield. The study of correlations showed that traits such as seed numbers per spike, spike length, plant height, awn length and peduncle length have a high correlation with seed yield. The results from stepwise multiple regression showed that traits such as seed number per spike, spike length, peduncle length and awn length played the most significant role in justifying yield changes in both aqueous conditions and stress. The results from path analysis emphasized on the main roles of direct effects on grain yield and the importance of seed number per spike. Plant height, duration of reproductive growth and flag leaf sheath length played considerable role in seed yield variability by affecting mentioned components. These traits along with other determined traits can be introduced as the best selection criterion of genotypes with high yield.

Thus, in this study we can determine suitable selection criteria for yield improvement by determining function and contribution of each of studied components on the yield.

MATERIALS AND METHODS

In order to study the correlation between traits and yield in bread wheat, we conducted an experiment in Ardabil in the crop year of 2013 on 57 genotypes and bread wheat lines in a random block design with 3 replications. In the statistical analysis of this project 4 traits were studied and analyzed. We got 65 varieties and promising lines of bread wheat from Agricultural research and Natural Resources of Ardabil and were planted in crop year of 2012-2013 in a random block design with 3 replications and Agricultural Research and Natural resources. Planting was performed in the second half of Mehr. Each plot consisted of 5 plant rows of 3 meters. The distance between the rows was 20 cm. And planting of the storage pest damage, 8 genotypes didn't grow 8 genotypes were removed and the experiment was conducted with days number to maturity during period were recorded considering 50% flowering plants and physiologic maturing. Plant height was measured for 5 randomly selected plants. After maturing, two aside rows were considered as edge lines and we calculated the grain yield from 3 middle rows and area of half a square meter. In this research we used such software as path analysis, Minitab and SPSS.

RESULTS AND DISCUSSION

After examining the data, the variance analysis of the measured traits was done; the results showed that there was a significant difference between studied genotypes considering day number to flowering, day number to maturity, plant height and yield in the probable level of 1% (Table 1) indicating high genetic diversity between measured genotypes. Change in coefficients in all studied traits was less than 10 showing high accuracy in experiment. As you can see there was a significant difference between genotypes with regards to agronomic and morphologic traits at 1% probable level. Many of researchers such as AhmadiZadeh *et al.,* (2011), Habibpoor *et al.,* (2011), Rashidi *et al.,* (1999) obtained considerable genetic diversity in the studied wheat genotypes suggesting enriched genes in wheat germplasm in Iran.

Table 1: Variance analysis of studied traits

S.O.V	df	Mean of Square			
		Days to flowering	Days to maturity	Plant height	Yield
Genotype	56	13.628**	5.715**	299.36**	889352.1**
Error	114	1.965	2.567	0.146	8744.515
C.V.%		0.94	0.73	2.2	3.47

***: shows significant in 1% probable level*

Results of average comparisons in Duncan method showed 5% probable level which genotypes 11 and 12 were the latest flowering and genotypes 15 was the early flowering among studied genotypes considering day number to flowering. Genotypes 12 and 33 were the latest genotypes and genotypes 6 and 27 were the early genotypes with regards maturity. Genotypes 2, 52 and 53 were the highest feet varieties and genotypes 3 and 8 were dwarf considering plant height among measured genotypes. Studying the mean yield of studied genotypes showed that among studied genotypes number 48 was the highest yield one, and genotypes 36, 53, 37, 32, 13, 12, 21, 33, 57, 10, 3 were placed in next position and have letter B in common, and are of product genotypes and genotypes 42 had the least yield. Grains get their maximum height until flowering and significant change in plant height at the remaining stages of growth. In breeding programs of breeding drought resistance, in order to consider a trait as an indirect selection criterion in addition to high heritability with yield or drought resistance it should have a strong significant correlation. So in order to measure the relationship between measured traits, we used person correlation coefficient. The study of correlation coefficient between studied traits showed that the relationship between days number to flowering with grain yield was positive and significant in 5% probable level in other words, the late varieties with long vegetative growth were highly-yield (Table 3). Also the results showed that the relationship between days number to flowering was positive and significant in 5% probable level compared to day number to maturity. Whereas there was seen no significant relationship between plant height and yield. The relationship between yield and plant height was significant in some studies (Gent, 1995; Ehdaei *et al.*, 1994) and was not significant in some others (Islam *et al.*, 1998; Balyan and Lohia, 1998). The results from stepwise multiple regression showed that between studied traits considered as independent variable (X), the traits such as day number to flowering control more than 10%yield-related changes and control the largest grain yield changes between other studied traits and due to positive partial regression coefficient of this trait we can say that selection of the late flowering varieties will positively affect grain yield (Table 4).

Table 2: Results from comparison of studied genotypes in Duncan method

Genotype	Days to flowering		Days to maturity		Plant height		Yield	
1	124	F-J	175.7	B-H	122.7	C	4978	D-k
2	127.7	A-C	175	C-I	137.3	A	5012	C-I
3	122.3	J-M	173.3	G-J	92.6	L	5081	B-H
4	126.6	B-E	175.3	C-I	112.3	E-G	4884	F-L
5	123.3	H-K	174.3	E-J	102.3	J	4172	T-V
6	125.7	C-H	127	J	117.3	D	4564	M-R
7	121	L-M	173.7	G-J	127.7	B	4987	D-K
8	128	A-C	176.7	A-E	92.6	L	4748	H-O
9	123.7	G-J	175.7	B-H	112.3	E-G	4692	I-Q
10	127.7	A-C	174	F-J	107.7	G-I	5137	B-G
11	129	A	176.3	A-F	110	F-H	4494	O-S
12	129	A	178.3	A	127.7	B	5272	B-E
13	127	A-D	175	C-I	127.3	B	5284	B-D
14	125	D-I	176.3	A-F	112.3	E-G	4967	E-L
15	120.7	M	176	A-G	102.7	J	4292	R-U
16	128.3	AB	175	C-I	117.3	D	4708	I-Q
17	123.3	H-K	174.3	E-J	112.7	EF	4954	F-L
18	125.3	D-I	176	A-G	107.3	HI	4730	I-P
19	125	D-I	176	A-G	102.7	J	4499	O-S
20	124.3	E-J	173	I J	112.3	E-G	3941	V-X
21	127.3	A-D	174.7	D-I	115	DE	5266	B-F
22	125.3	D-I	176.3	A-F	112.3	E-G	4917	G-L
23	125	D-I	176.7	A-E	112.7	EF	4091	U-W
24	125.3	D-I	174.7	D-I	112.3	E-G	4927	G-L
25	121.3	K-M	173.7	G-J	117.7	D	3749	X
26	125	D-I	175	C-I	107.3	HI	4411	Q-T
27	124	F-J	172	J	107.7	G-I	4092	U-W
28	123	I-L	175	C-I	112.3	E-G	3858	WX
29	126	C-G	176	A-G	122.7	C	4319	R-U
30	126	C-G	177	A-C	112.3	E-G	4911	G-L
31	128	A-C	176	A-G	115	DE	4901	G-L
32	126	C-G	176.7	A-E	122.3	C	5300	BC
33	126.3	B-F	178.3	A	112.3	EF	5161	B-G
34	127.3	A-D	176.3	A-F	107.3	HI	4989	D-J
35	123	I-L	175	C-I	97.6	K	5374	B
36	123	I-L	176	A-G	112.3	E-G	5376	B
37	125	D-I	177	A-D	112.7	EF	5319	BC
38	125.3	D-I	175.3	C-I	112.3	E-G	4717	I-Q

39	127.3	A-D	174.3	E-J	112.7	EF	4858	G-M
40	124	F-J	175	C-I	97.3	K	4423	P-T
41	123.3	H-K	174.3	E-J	110	F-H	3450	Y
42	123	I-L	176.3	A-F	117.7	D	2669	z
43	127	A-D	177	A-D	112.3	E-G	3697	XY
44	124	F-J	177	A-D	117.7	D	4525	N-S
45	125	D-I	175.3	C-I	117.3	D	4916	G-L
46	124	F-J	175.3	C-I	117.3	D	4854	G-M
47	121.3	K-M	177	A-D	107.7	G-I	4227	S-V
48	125.3	D-I	178	AB	122.3	C	5737	A
49	127	A-D	175.3	C-I	112.7	C	4649	L-Q
50	127	A-D	174.3	E-J	125	BC	4663	K-Q
51	124	F-J	175	C-I	112.3	E-G	4439	P-T
52	127	F-J	174.3	E-J	137.7	A	4807	H-O
53	124.3	E-J	174.3	E-J	137.7	A	4073	U-W
54	126	C-G	176.3	A-F	105	IJ	4815	H-N
55	121	LM	174	F-J	107.3	HI	4667	J-Q
56	121	LM	175.3	C-I	97.6	K	4281	R-U
57	123.3	H-K	175.3	H-J	97.3	K	5152	B-G

Table 3: Correlation coefficients between studied traits

	Days to flowering	Days to maturity	Plant height	Yield
Days to flowering	1			
Days to maturity	0.393*	1		
Plant height	0.238	0.39	1	
Yield	0.316*	0.195	0.068	1

*** and * respectively show a significant relationship in 1% and 5% probable level*

Table 4: Results from multiple regression analysis in stepwise method

Model	Non Standardized coefficients		Beta	T	Prob.
	B	Standard Error			
α	-5411.6	4079.6	-	-1.33	0.19
Days to flowering	80.68	32.65	0.316	2.47	0.017

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