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The study of correlation between traits evaluated at farm and laboratory conditions at 58 lines and varieties of bread wheat

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ABSTRACT: *Triticum aestivum* is the most important crop in the world. This study was designed at the Agriculture and Natural Resources Research Station of Ardabil and Agriculture Laboratory of Islamic Azad University, Ardabil Branch in 2011-2012 crop years. In this experiment, 55 wheat lines and three varieties were investigated as control. This study was conducted in laboratory in a randomized complete block design (CRD) with three replications and was conducted in farm augmented design so that controls cultivars was examined with three replications and new lines were broadcast randomized into the three replications. The results showed that there were significant and positive relationship between spike weights with spike length, number of spikelet per spike, number of grains per spike, grain weight per spike and 1000 grain weight. Also results showed that there is a positive and significant relationship between grain weights per spike with 1000 grain weight ($r=0.578^{**}$), in other words, 1000 grain weights are also increased with increasing grain weights per spike. The results showed that there was positive and significant relationship between germination speed coefficient with all traits and this relationship was negative and significant with germination time mean. In other words, all traits are increased with increasing germination rate, in case, mean germination time mean is reduced.

Keywords**:** Wheat, Correlation, Germination indices, Morphological traits, Yield

INTRODUCTION

Triticum aestivum is the most important crop in the world. Extensive extent and high adaptation of this plant as well as its diverse consumptions in the human nutrition lead to presented as the most important cereal in the world, especially in developing countries and it can provided 20 percent food resources of the world people (Farzi and Shekari Mosta'li Bigloo, 2010a). There is a need to increase in wheat productivity world wide, in particular in developing countries and for further increase wheat yield potential genetically, it is important for us to understand the physiological and genetic basis of yield (Shahryari et al, 2008; Yang et al, 2006). According to evaluation which performed in the international bureau of food regulation, wheat demand rate in the world will increase significantly by 2010, while available resources to producing wheat has the limitations. So, it is predicted that there is lack of wheat supply about 100 million tone in the global market at 2020 (Farzi and Shekari Mosta'li Bigloo, 2010b). The meaning of path analysis had presented first by Wright (1926) and also it was used first in plants by Dewey Wolve to determine cause and effect relations between yield and the most important yield components. Mohammadi et al (2003) reported high correlation between grain yield and harvest index and called it as an important index to select productive varieties. Reynolds et al (2000) by evaluated different wheat's in CIMMYT international center and concluded that there is a linear relation between drought stress and grain yield of wheat. Amini et al (2005) and Golparvar et al (2003) reported that there is a positive and significant correlation between grain yield and harvest index, biological yield and 1000 grain weight.

The main objective to the following research is to correlation between traits evaluated at farm and laboratory conditions at bread wheat.

MATERIALS AND METHODS

This study was designed at the Agriculture and Natural Resources Research Station of Ardabil and Agriculture Laboratory of Islamic Azad University, Ardabil Branch in 2011-2012 crop years. In this experiment, 55 wheat lines received from the International Research Institute of Wheat and Maize (CIMMYT) and varieties of Bezostaya, Katya and Konya were investigated as control. Pedigree of tested lines is included in Table 1. This study was conducted in laboratory in a randomized complete block design (CRD) with three replications and was conducted in farm augmented design so that controls cultivars was examined with three replications and new lines were broadcast randomized into the three replications. In Laboratory, First, seeds were disinfected in a solution of sodium hypochlorite 15% for 30 seconds. After placing the seeds in Petri (25 seeds per Petri) distilled water (6 mm in each Petri) was poured into the Petri and was prevented tangible changes in water potential until the end of the experiment. To prevent Bunt and disinfection of the all seeds, fungicide carboxin thiram ratio 2 in a thousand was added and mixed to distilled water. Studied traits in laboratory included seedlings fresh weight, root fresh weight, seedling length, root length, seedling dry weight, root dry weight and also germination indices were calculated using the following formula (Table2), while studied traits in farm included spike weights, spike length, number of spikelet per spike, number of grains per spike, grain weight per spike, 1000 grain weight, days to heading, plant height and grain yield. Computer software SPSS was used for statistical computing.

RESULTS AND DISCUSSION

Correlation coefficients between evaluated traits at farm have come in Table 3. The results showed that there were significant and positive relationship between spike weights with spike length, number of spikelet per spike, number of grains per spike, grain weight per spike and 1000 grain weight. Correlation between the spike lengths with number of spikelet per spike, number of grains per spike, grain weight per spike**,** days to heading and plant height was positive and significant, in other words, these properties are also increased with increasing spike length. Also results showed that there is a positive and significant relationship between number of spikelet per spike, number of grains per spike**,** grain weight per spike and days to heading. The relationship between number of grains per spike with grain weight per spike and days to heading were positive and significant**.** Also results showed that there is a positive and significant relationship between grain weights per spike with 1000 grain weight ($r=0.578^{**}$), in other words, 1000 grain weights are also increased with increasing grain weights per spike. The results showed that there was positive and significant relationship between plant height with days to heading ($r=0.267^{*}$). This indicates that it is much more days to heading, plant height also increases.

Khalilzadeh (2000) has been reported positive and significant correlation between grain yields with number of days to heading in barley cultivars ($r=0.451^{*}$).

Jafarzadeh (2009) has observed positive and significant correlation of grain yields with harvest index ($r=0.40^{*}$) with investigation of 25 barley varieties and reported correlation the number of grain per spike with number of days to heading.

Iravani et al (2008) has been reported correlation between number of grains per spike with days to maturity ($r=0.502^{*}$).

Khajavi (2010), with an experiment was conducted on 20 genotypes of barley was observed that there was the highest correlation with grain yield between plant height, number of grains per spike and the number of fertile tillers. According to the same and antithetic reports of these correlations**,** it is clear that role determination of grain yield components probably depends on the evaluated cultivar or lines and environmental conditions (Golabady and Arzani, 2003).

Correlation coefficients between evaluated traits at laboratory have come in Table 4. There was negative and significant correlation between the mean time germination (MTG) with all traits, in other words, these properties are also decreased with increasing the mean time germination. The results showed that there was positive and significant relationship between coefficient of velocity of germination (CVG) with all traits and this relationship was negative and significant with mean time germination (MTG). In other words, all traits are increased with increasing of velocity of germination (CVG), in case, mean time germination (MTG) is reduced. Relationship between germination rate index (GRI)with all traits except mean time germination (MTG) was positive and significant. Relationship between final germination percent (FGP) with germination rate (Rs), mean daily germination (MDG), root fresh weight, root length and root dry weight were positive and significant. Also results showed that there was positive and significant relationship between mean daily germination (MDG), root fresh weight, root length and root dry weight, in other words, these traits are increased with increasing mean daily germination (MDG). The relationship between seedling fresh weight and seedlings dry weight was positive and significant ($r = 0.791^{**}$), in

other words, with increasing seedlings fresh weight increases seedling dry weight. Also results showed that the relationship between root fresh weight with seedling dry weight was positive and significant ($r = 0.745^{**}$), this indicates that whatever increase the root fresh weight; root dry weight will be more. The results showed that the correlation coefficient between seedling dry weight and root dry weight were positive and significant ($r = 0.506^{**}$). The correlation coefficients of other traits are reflected in Table 4**.**

Table 1. Pedigree and characteristics of 58 wheat lines and cultivars

12Entry No	Cross	CROSS ID	SELECTION HISTORY	ORIGIN COUNTRY
check1	BEZOSTAYA	CHECK		RUS
check2	KATIA1	CHECK		BG-KC
check3	KONYA	CHECK		TR
1	LOCAL CHECK			
2	SHARK-1/3/AGRI/BJY//VEE/4/SHARK/F4105W2.1	TCI012033	-030YE-30E-6E-0E-1E-0E	TCI
3	RSK/CA8055//CHAM6/4/NWT/3/TAST/SPRW//TAW 12399.75	TCI-02-47	-0AP-0AP-25AP-0AP-4AP-0AP	TCI
4	PYN/PARUS/3/VPM/MOS83-11-4-8//PEW/4/Bluegil	TCI011322	-030YE-30E-2E-0E-1E-0E	TCI
5	F6038W12.1/ERYT25221//F6038W12.1	TCI012174	-030YE-30E-3E-0E-1E-0E	TCI
6	4WON-IR-257/5/YMH/HYS//HYS/TUR3055/3/DGA/4/VPM/MOS	TCI-02-80	-0AP-0AP-42AP-0AP-3AP-0AP	TCI
7	Ns46.11/3/Sdy/Ti.Rese1//KtA1/4/55.1744/MEX67.1//NO57/3/ATTILA	TCI011413	-030YE-30E-2E-0E-1E-0E	TCI
8	BSP01/18 (Duzi)			SA
9	CH111.14422	WW		SWITZERLAND
10	ID800994.W/VEE//PIOPIO/3/MNCH/4/FDL4/KAUZ	TCI011378	-030YE-30E-2E-0E-3AP-0AP	TCI
11	PBI1013.13.3/3233.35/3/STAR//KAUZ/STAR	CMSW01WM00425S	-030YE-30E-3E-0E-3E-0E	MX-TCI
12	PYN/PARUS/3/VPM/MOS83-11-4-8//PEW/4/Bluegil	TCI011322	-030YE-30E-2E-0E-1AP-0AP	TCI
13	PSK/NAC//SABALAN/3/GUN91/MNCH	TCI011656	-030YE-30E-10E-0E-1E-0E	TCI
14	SONMEZ			TE-TCI
15	TRK13 RESEL//TRAP#1/BOW/3/JAGGER 'SIB'	TCI-02-678	-0AP-0AP-4AP-0AP -1E-0E	TCI
16	093.44/N057/3/[258.2.2]/NAD//BEZ/6/IAS58/IAS55//ALD/3/MRNG/4/ALD/IAS58.103A//ALD/5/BUC/7/KAUZ//KAUZ/STAR	CMSW01WM00803S	-030YE-30E-4E-0E-1E-0E	MX-TCI
17	DEMETRA			UKR-MIR
18	ECONOMKA			UKR-MIR
19	T06/13			SA
20	Olifants			SA
21	SULTAN95			MX-OR
22	00*0100-51			US-AGRIPRO
23	POSTROCK			US-AGRIPRO
24	KUMA			RUS-KRAS
25	ANDIJON1			UZB
26	CORDIALE			UK
27	SERI			MX
28	SULTAN95			MX-OR
29	HEREWARD			UK

Continued table 1. Pedigree and characteristics of 58 wheat lines and cultivars

12Entry No	Cross	CROSS ID	SELECTION HISTORY	ORIGIN COUNTRY
30	Bul 5052-1/6/C126-15/Cofn/3/N10B/P14//P101/4/21183/CO652643//Lcr/KS6/5/Rpb 8-68/Chrc	TE 5649	-8T-2T-1T-2T-1T-0T	TR-TE
31	1-60-1//Emu"s"/Tjb84/3/1-12628/MV17			IR-Karadj
32	Chamran/5/Bez/4/On/6*Ph//Kf/3/Tob"s"/Napo//No66/6/Spn/Mcd//Cama/3/Nzt/4/Urles*2/Prl"s"			IR-Mashhad
33	Alamoot/Shiroodi			IR-Mashhad
34	Vopona/Hd2402/3/Tirchmir/Ico//Sabalan			IR-Mashhad
35	Alamoot/4/Gv/D630//Ald"s"/3/Azd			IR-Ardebil
36	(KS95U522/TX95VA0011)F1/Jagger	AP05T2413		AgriPro South
37	HATCHER			US-COL
38	MV-TALLER			HU-MV
39	DB 66			BG-KC
40	CADET/6/YUMAI13/5/NAI60/3/14.53/ODIN//CI13441/CANON	TCI-02-417	-0AP-0AP-1AP-0AP-5A-0AP	TCI
41	Sau41/Sad1/5/Agri"S"/093-44/3/Kkk/ltd/Lov29/4/FKong15//Bow/Pwn/6/1518-4-38K	TE 5857	-1T-2T-2T-1T-0T	TR-TE
42	PLK/LIRA/5/NAI60/3/14.53/ODIN//[CI13441]/4/GRK79/6/MNCH/7/CROC_1/AE.SQUARROSA (213)//PGO	CMSW01WM00578S	-030YE-30E-3E-0E-1E-0E	MX-TCI
43	SERI			MX
44	SULTAN95			MX-OR
45	JI5418/MARAS//SHARK/F4105W2.1	TCI011194	-030YE-30E-1E-0E-2E-0E	TCI
46	AGRI/BJY//VEE/3/BUL6687.12/4/F6038W12.1	TCI992137-030YE-0E-1E-0E-2E-0E		TR-YE
47	SONMEZ			TE-TCI
48	CATBIRD//CNO79*2/HE 1	A-29707		CHL
49	RAINER	RAINER		AUSTRIA
50	KOMAROM	KOMAROM		AUSTRIA
51	SOISSANA	SOISSANA		AUSTRIA
52	GT 4131-2KK	GT 4131-2KK		BG
53	GT 01N62-62	GT 01N62-62		BG
54	Lau/Agd/3/Odes95//Olv/B16	TE 5402	-3T-1T-1T-1T-1T-0T	TR-TE
55	BETTA			S.AFRICA

Table 2. The formula used to calculate the index of germination

Germination indices	The Formula used
Coefficient of Velocity of Germination (CVG)	CVG= ΣNi/ΣNiTi× 100
Germination Rate Index (GRI)	GR= G1 / 1 + G2 / 2+ Gx/x + ….
Final Germination Percent (FGP)	FGP=Ng / Nt ×100
Mean Time Germination (MTG)	MGT= ΣNiTi / ΣNi = 100 / CVG
Germination Rate (RS)	Rs =1 / MTG
Mean Daily Germination (MDG)	MDG = FGP/d

Table 3. Simple correlation coefficients between for evaluated traits in farm

Characters	Spike weights	Spike length	Number of spikelet per spike	Number of grains per spike	Grain weight per spike	Days to heading	Plant height	1000 grain weight	Grain yield
Spike weights	1								
Spike length	0.658**	1							
Number of spikelet per spike	0.666**	0.619**	1						
Number of grains per spike	0.678**	0.531**	0.740**	1					
Grain weight per spike	0.939**	0.602**	0.668**	0.745**	1				
Days to heading	0.236	0.518**	0.526**	0.325*	0.189	1			
Plant height	0.071	0.293*	0.065	0.036	-0.038	0.267*	1		
1000 grain weight	0.573**	0.231	0.101	-0.092	0.578**	-0.115	-0.112	1	
Grain yield	0.15	-0.097	0.180	0.218	0.184	-0.017	0.151	0.044	1

* and **: Significant at $p < 0.05$ and < 0.01, respectively

Table 4. Simple correlation coefficients between for evaluated traits in laboratory

Characters	CVG	GRI	FGP	MTG	RS	MDG	Seedlings fresh weight	Root fresh weight	Seedling length	Root length	Seedling dry weight	Root dry weight
CVG	1											
GRI	0.740**	1										
FGP	0.274*	0.812**	1									
MTG	-0.998**	-0.745**	-0.291*	1								
RS	0.905**	0.706**	0.281*	-0.902**	1							
MDG	0.287*	0.822**	0.952**	-0.303*	0.296*	1						
Seedlings fresh weight	0.547**	0.348**	0.084	-0.544**	0.511**	0.059	1					
Root fresh weight	0.513**	0.493**	0.308*	-0.514**	0.432**	0.263*	0.547**	1				
Seedling length	0.331*	0.275*	0.110	-0.334*	0.315**	0.040	0.661**	0.393**	1			
Root length	0.579**	0.642**	0.454**	-0.577**	0.472**	0.392**	0.546**	0.800**	0.491**	1		
Seedling dry weight	0.594**	0.437**	0.112	-0.591**	0.554**	0.116	0.791**	0.387**	0.645**	0.535**	1	
Root dry weight	0.635**	0.616**	0.396**	-0.634**	0.542**	0.328*	0.518**	0.745**	0.410**	0.712**	0.506**	1

* and **: Significant at $p < 0.05$ and < 0.01, respectively

CONCLUSION

The results showed that there were significant and positive relationship between spike weights with spike length, number of spikelet per spike, number of grains per spike, grain weight per spike and 1000 grain weight.

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