INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 4, No. 3, p. 303-308, 2014
http://www.innspub.net

RESEARCH PAPER | OPEN ACCESS

Studying the correlation and analyzing the path coefficient between grain weight and the traits related to remobilization of assimilates in bread wheat genotypes

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Article published on March 20, 2014

Key words: Correlation, stepwise regression, path coefficient, yield, bread wheat.

Abstract

This research was conducted in a random block design with 3 replications in Ardabil in 2013 on 10 bread wheat genotypes to measure grain weight and determine its relation with few of traits related to grain weight and traits related to remobilization of assimilates to seed and study the correlation between traits and analyze it to causal relations in bread wheat. The statistical analysis of this design the following traits were measured: remobilization of stored materials, contribution of stem storage in yield, Eigen weight of stem at maturity, efficiency of carbohydrates transport, stem efficiency in storage transport and grain weight. The results from ANOVA showed that there was a significant difference between varieties for studied traits statistically. The results from average comparing showed that remobilization of stored materials among studied genotypes, just Alamout and Pishtaz were of 10 varieties of higher efficiency in carbohydrates transport. Contribution of stem storage varied from 9.14% in Pishtaz variety to 28.75% in Trakia variety. Gork79 was the lowest one in eigen weight of stem at physiological maturity and Konika 2002 was the highest one. Also considering remobilization of stored materials Trakia was the highest variety and Siosson was the lowest one. In addition, grain weight of Konika 2002 variety was the highest with 2495 mean and Alamout variety had the lowest grain weight. The relationship between remobilization of stored materials with contribution of stem storage in yield was positive and significant. Moreover, the relationship between carbohydrates transport efficiency with contribution of stored materials in stem to yield and eigen weight of stem at maturity was positive and significant. But the relationship between carbohydrates transport efficiency with stem efficiency to transport stored materials was negative and significant. And the relationship between grain weight and stem efficiency to transport stored materials was positive and significant. The results from multiple regressions in descending method showed that the remobilization of stored materials and contribution of stored materials to yield remained at regression model and remobilization of stored materials affected the grain weight directly and positively.

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Introduction

Wheat with scientific name *Triticum aestivum* is the first cereal and most important crop in the world (Arzani, 2005). High adaptability and diverse uses of this crop in human nutrition has caused that it be considered as the most important crops in the world, especially in developing countries. Wheat constitutes about 22% of the world's food supplies (Pordel Maragheh, 2013). Regarding the fact that the world population as of the beginning of 21st century is already more than 6 billion people which more than 700 millions of them are struggling with the lack of food and famine and up to 3 billion suffer from malnourishment (Aulinger, 2003). Wheat is not an only important commodity but it is as the best weapon in the world that its strategic importance is increasing day by day. Wheat bread has particular importance as the main food in the country. In addition, need for its presence is completely tangible as political economy weapon (Pordel Maragheh, 2013). The most important wheat consumption is for human nutrition in the world. It is also used in the rearing livestock, making paper and many other industries (Khodabandeh, 1993). 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). 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. 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 R2 = 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. Jabbari *et al* (2012) 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.

So in this research we can determine appropriate indices of selection for grain weight modification and grain yield by determining role and contribution of studied components on grain weight.

Materials and Methods

Position of Test Location

The test was conducted at farmland of Islamic Azad University in Ardebil in the crop year of 2013 with geographical coordinates 48 degrees 30 minutes east longitude and 38 degrees and 15 minutes north latitude and 1350 meters height above sea level. The climate of the region was semi-arid and cold and has a long dry season in summer, and the soil is clay loam which is poor in organic matter and is of 7%. The place of performing the test in the crop year of 91 was in fallow.

Test profile

Ten varieties (Table 1) of wheat were cultured in a randomized block design with three replications under favorable conditions of moisture and drought ending in the fall in 2013 at farmland in Islamic Azad University in Ardabil each plot consisted of 7 lines of 3 meters length and the planting was done manually with density of 300 seeds per square meter.

Table 1. The names of studied genotypes.

Number	Genotypes	Number	Genotypes
1	Sabalan	6	Siosson
2	Azara2	7	Alamout
3	Fengkang	8	Bezostaia
4	Trakia	9	Garak79
5	Pishtaz	10	Konia2002

Remobilization indicators

In order to determine the amount of remobilization of dry matter to seed, in main lines of each plot a number of similar plant were marked at heading stage and every 5 days, 5 plants from each plot were taken at each stage from heading to physiologic maturity. The harvested plants after drying, were weighed and the attributed related to TDM transport were calculated through the relationships proposed by Ehdayi, 1999 and Shakiba *et al* 1996:

And the attributes related to TDM transport through relationships proposed by Ehdayi (1999) and Shakiba *et al* (1996) were calculated as following:

Dry weight of stem at maturity stage, the maximum dry weight of stem after pollination, Remobilization of storage material from stem to grain.

100* (seed weight/ Remobilization of storage material from stem to grain) = contribution amount of stem reserves in grain yield (percent)

100* (maximum dry weight of stem after pollination / (Remobilization of storage material from stem) = efficiency of stem in the transfer of reserves to the seed.

100* (maximum weight of stem/ (the special weight of stem at maturity- maximum weight Special to stem) = efficiency of carbohydrates transfer from stem to seed.

Statistical computations

In this research we used software such as Path Analysis, Mnitab-15, and SPSS.

Results and discussions

After studying the natural distribution of data, the measured traits were analyzed by variance analysis method; the results showed that there was a significant difference at 1% probable level among all studied traits of genotypes (table 1) indicating a higher genetic diversity among measured genotypes. The variable coefficient was less than 10 in all studied traits showing a highly precise test.

Table 2. variance analysis of studied traits.

S.O.V	df	Mean of Square					
		Remobilization of stored materials	Contribution of stored materials in stem to grain yield	Eigen weight of stem at maturity	Efficiency to transport Carbohyd-rates	Stem efficiency to transport stored materials	Grain weight
Rep	2	10	0.0013	0.11	0.00025	0.00025	640
Genotype	9	23371.7**	114.519**	39.232**	86.239**	61.295**	429500.3**
Error	18	7.111	0.029	0.144	0.018	0.031	501.22
C.V.%		0.95%	1.04%	2.32%	0.7%	0.87%	1.24%

**: shows significant in 1% probable level.

The results from mean comparison in Duncan method in 5% probable level showed that (table 2) among studied genotypes just Alamout and Pishtaz had the highest efficiency of 10 varieties in carbohydrates transport. Contribution of stored materials in stem varied from 9.14% in Pishtaz to 28.75% Trakia. Considering eigen weight of stem at physiological maturity Gork 79 was the lowest one and Konika 2002 was the highest. Also with regards to remobilization of stored materials of stem, Trakia was the highest and Siosson was the lowest one. And regarding grain weight Konika 2002 was the highest one with 2495 mean and was categorized in superior statistical group and Alamout genotypes was of the lowest grain weight.

Table 3. mean comparison of genotypes.

Grain weight		Stem efficiency to transport stored materials		Efficiency to transport Carbohyd-rates		Eigen weight of stem at maturity		Contribution of stored materials in stem to grain yield		Remobilization of stored materials		Genotypes
1591.6	e	17.95	e	14.4	h	15.4	d	16.9	e	269	e	Sabalan
2113	b	17.45	f	20.55	c	14.4	e	13.275	g	280.5	d	Azara2
1864.6	d	20.15	d	19.95	d	14.25	e	17.3	d	322.5	c	Fengkang
1535.6	d	26.7	a	21.9	b	14.15	e	28.75	a	441.5	a	Trakia
2051	c	16.1	h	18.05	f	14.7	e	9.14	i	187.5	h	Pishtaz
1859.6	d	17.05	g	13.8	i	18.05	c	7.85	j	146	i	Siosson
1234.6	h	26.55	a	31.9	a	14.6	e	22.35	b	276	d	Alamout
1850.6	d	23.75	b	19.2	e	21.4	b	12.7	h	235	g	Bezostaia
1351	g	21.8	c	14.2	h	12.6	f	18.65	c	252	f	Garak79
2495	a	13.35	i	16.1	g	23.8	a	15.75	f	393	b	Konia2002

In breading plans of draught resistant should be a significant correlation beside a higher heritability with yield or draught resistant to consider a trait as an indirect criterion of selection. So in order to measure the relationship between measured traits, Pearson correlation coefficients were used. The study of correlation coefficients between studied traits showed that (table 4) the relationship between remobilization of stored materials with contribution of stored material of stem to yield was positive and significant. Also the relationship between efficiency of carbohydrates transport with the contribution of stored materials of stem in yield and Eigen weight stem at maturity was positive and significant. But the relationship between efficiency of carbohydrates transport with stem efficiency to transport the stored materials was negative and significant. And the relationship between grain weights with stem efficiency to transport the stored materials was positive and significant. The results from multiple descending regressions showed that remobilization of stored materials and contribution of stored materials of stem in yield remained at regression model between studied traits as independent variable (x). Remobilization of stored materials had a direct and positive effect on grain weight.

Table 4. correlation coefficients between studied traits.

	Remobilization of stored materials	Contribution of stored materials in stem to grain yield	Eigen weight of stem at maturity	Efficiency to transport Carbohydrates	Stem efficiency to transport stored materials	Grain weight
Remobilization of stored materials	1					
Contribution of stored materials in stem to grain yield	0.784**	1				
Eigen weight of stem at maturity	0.256	0.496	1			
Efficiency to transport Carbohydrates	0.242	0.704*	0.642*	1		
Stem efficiency to transport stored materials	0.075	-0.553	-0.381	-0.794**	1	
Grain weight	0.075	-0.34	-0.226	-0.377	0.636*	1

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

Table 5. Results from multiple regression analysis in stepwise method.

Model	Non Standardized coefficients		Beta	T	Prob.
	B	Standard Error			
α	16.002	3.459	-	4.627	0.002
Remobilization of stored materials	0.036	0.019	0.889	1.916	0.097
Contribution of stored materials in stem to grain yield	-0.607	0.272	-1.037	-2.235	0.05

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