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Correlation and path coefficient analysis in some durum wheat varieties and their F_1 hybrids using line x tester analysis

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Abstract

The current experiment was carried out at Qlyasan research station/Faculty of Agricultural Sciences/University of Sulaimani, using seven durum wheat varieties according to lines × testers' analysis system producing twelve crosses. The parent's varieties (Bakrajo1, Gerardo 574 and Cham 3) were used as lines while the parental varieties (Ovanto, Acsad 65, Apio and Crezo) were used as testers. The seven parental varieties and their twelve F_1 crosses were planted in Completely Randomized Block Designs and replicated three times to calculate the simple correlation coefficient and path analysis. The results of this experiment showed that parent 1 exhibited the maximum values for the characters grain yield/plant, number of days to 50% anthesis, plant height and number of spikes/plant, while the cross Bakrajo 1 × Acsad 65 recorded the higher value due to grain yield/plant. The character grain yield/plant recorded highly significant and positive correlation with 1000-grain weight and significant positive correlation with plant height and number of spikes/plant. The maximum positive direct effect on grain yield/plant recorded by the character number of grain/spike reaching 0.567, while maximum positive indirect effect on grain yield/plant recorded by Spike length *via* number of grains/spike with 0.432, the results showed that number of grains/spike, spike length as well as number of grains/spike have major contribution in increasing the yield and it must be considered when selecting wheat varieties in breeding programs.

Introduction

Durum wheat (*Triticum durum* L.) is the most important cereal crop in the world and widely grown occupying 17% of the world cultivated land [1]. Yield of wheat is complex quantitative character that results to the actions and interactions of various component traits [2]. It is also widely recognized that genetic architecture of yield can be resolved better by studying its component characters. This enables the plant breeder to breed for high yielding genotypes with desired combinations of characters. Linear correlation between yield and several of its components can present a confusing picture due to inter-relationships between component characters themselves [3]. The selection character may be yield, or one or more of the yield components. Breeding for the high yield crops needs much information on the nature and magnitude of variation in the obtainable materials, relationship of yield with other agronomic characters and the degree of environmental impact on the expression of these component characters. Correlation analyses are used to determine relationships between two characters, such that the values of two characters are analyzed on a paired basis, the results may be either positive or negative. A correlation result is of great value in the

evaluation of the most efficient procedures for selection of outstanding genotypes. When there is a positive correlation of the major yield characters, component breeding would be very influential but when these characters are negatively correlated, it would be difficult to practice simultaneous selection for them in developing a variety [4]. Path coefficient analysis is a standardized regression coefficient that allows partitioning of correlation coefficient into direct and indirect effects of various characters towards dependent variable, and also helps in evaluating the cause-effect relationship as well as effective selection. Path coefficient analysis demonstrates an important position in defining the degree of correlation between the yield and the other characters [5].Yield is consisting of the contribution of several characters that are correlated among themselves and with the yield. The suggested path coefficient analysis of Dewey and Lu (1959) [6], calculated to detect the relative importance of characters contributing to kernel yield [7]. Determination of correlation and path coefficients between yield and other characters is important for the selection of superior genotypes for effective breeding programs in maize. Correlation coefficients in general represent associations among independent characteristics and the degree of linear relation between these characteristics. It is not adequate to describe this relationship when the causal association among characteristics is needed [8]. Path analysis is used to determine the amount of direct and indirect effect of the causal components of the effect component and provides more information among variables than do correlation coefficients sense this analysis provides the direct effects of specific characters on yield, and indirect effects *via* other characters [9]. The present study was destined to determine the specific characters that affects kernel yield in durum wheat to develop a suitable selection criterion for future wheat breeding program.

Materials and Methods

Three wheat varieties, *Bakrajo 1*, *Jerardo 574* and *Cham 3* were used as lines, were crossed with four varieties, *Ovanto, Acsad 65, Apio* and *Crezo*, which were used as testers. The F_1 seeds of twelve (3×4) crosses along with their parents were planted in a triplicated Completely Randomized Block Design on November 25, 2008, at Qlyasan Research Station/Faculty of Agricultural Sciences/University of Sulaimani. Each replicate was consisted of the seven parents and twelve F_1 crosses, with a three meter single row for each entry. Row to row and plant to plants spacing were kept 30 and 15 cm, respectively. Other cultural and agronomic practices were kept uniform for the whole experiment. Five plants from each parent and hybrid were selected randomly and data were recorded on number of days to 50% anthesis, plant height (cm), number of spikes/plant, spike length, number of grains/spike, 1000-grain weight (g) and grains yield/plant (g). The data were analyzed statistically using analysis of variance according to Al-Rawi and Khalafallah (1980) [10]. Data for the traits showing significant differences were further analyzed for line × tester according to Singh and Chaudhary (1985) [11]. The correlation coefficients were calculated to determine the degree of association of characters with yield and also among themselves in each environment. Phenotypic correlations were computed by using the formula given by Singh and Chaudhary (1985) [10]. The path coefficient analysis was carried out as suggested by Dewey and Lu (1959) [6], Soomro (2010) [12], Singh and Chaudhary (1985) [11], Arbuckle (2009) [13], through (Analysis of Moment Structures) AMOS Ver. 18 Software.

Results and Discussion

Data represent in Table 1 exhibited the performance of 19 Durum Wheat genotypes. In regards to the parental values due to the studded characters variety ***Bakrajo 1*** recorded the maximum values for characters grains yield/ plant, number of days to 50% anthesis, plant height and number of spikes/plant with 49.080, 153.700, 115.300 and 19.000, respectively, and gave the lowest value due to the characters spike length and number of grains/spike with 6.050 and 44.150, respectively. The lowest value due to the characters grains yield/ plant, number of days to 50% anthesis, number of spikes/plant and 1000-grain weight was recorded by the variety ***Cham 3*** with 33.320, 144.600, 15.000 and 37.510, respectively. The ***Ovanto*** variety gave the maximum value for number of grains/spike with 64.150. The variety ***Apio*** recorded maximum value for

spike length and 100gw with 7.270 and 43.740, respectively and also gave the lowest value for plant height with 77.670. In respect to the crosses values, cross ***Bakrajo 1 × Ovanto*** gave the maximum value for plant height and number of spikes/plant with 111.650 and 21.650 respectively, while cross ***Bakrajo 1 × Acsad 65*** gave maximum value for grains yield/plant with 64.510, and ***Bakrajo 1 × Apio*** for the character number of days to 50% anthesis with 150.300, while ***Bakrajo 1 × Crezo*** recorded the highest value for 1000-grain weight with 48.380 and the lowest value for number of days to 50% anthesis and number of grains/spike with 143.300 and 54.300 respectively. The cross ***Jerardo 574 × Ovanto*** recorded the highest value for spike length and number of grains/spike with 7.820 and 70.030 respectively. The lowest value for the characters plant height and number of spikes/plant recorded by ***Jerardo 574 × Apio*** with 75.300 and 15.650, while for the characters grains yield/ plant and 1000-grain weight were 45.470 and 37.710 respectively recorded by the cross ***Cham 3 × Ovanto***, while for the character spike length it was 6.970 recorded by the cross ***Cham 3 × Apio***.

Table 1: Mean performance of 19 Durum Wheat genotypes

No.	Parentage	Grains yield/ plant (g)	Number of days to 50% anthesis	Plant height (cm)	Number of spikes/ plant	Spike length (cm)	Number of grains/ spike	1000-grain weight (g)
1	Bakrajo 1 × Ovanto	61.30	150.70	111.65	21.65	7.15	62.33	45.30
2	Bakrajo 1 × Acsad 65	64.51	148.30	108.67	20.65	7.09	63.23	47.91
3	Bakrajo 1 × Apio	60.79	150.30	105.33	19.30	7.47	68.97	47.49
4	Bakrajo 1 × Crezo	56.17	143.30	111.30	22.00	7.01	54.43	48.38
5	Jerardo 574 × Ovanto	51.22	148.40	89.30	18.65	7.82	70.03	41.43
6	Jerardo 574 × Acsad 65	56.26	146.00	90.33	17.65	7.55	65.40	42.58
7	Jerardo 574 × Apio	47.94	147.00	75.30	15.65	7.15	63.03	42.21
8	Jerardo 574 × Crezo	54.46	146.70	88.70	17.30	7.43	65.80	45.51
9	Cham 3 × Ovanto	45.47	148.60	81.00	16.65	7.23	65.73	37.71
10	Cham 3 × Acsad 65	48.29	146.70	93.00	20.65	7.27	58.07	38.28
11	Cham 3 × Apio	50.41	146.60	80.00	17.65	6.97	65.33	39.56
12	Cham 3 × Crezo	48.37	145.60	88.00	17.65	7.77	61.67	47.14
13	Bakrajo 1	49.08	153.70	115.30	19.00	6.05	44.15	41.87
14	Jerardo 574	47.99	145.60	86.70	19.00	7.22	62.39	37.48
15	Cham 3	33.32	144.60	86.00	15.00	6.65	55.78	37.51
16	Ovanto	41.82	146.70	85.65	16.65	7.20	64.12	39.50
17	Acsad 65	40.19	140.30	89.30	16.00	7.20	51.40	43.65
18	Apio	47.43	146.00	77.67	18.00	7.27	63.69	43.79
19	Crezo	40.83	151.00	85.00	17.00	6.70	56.90	40.25
	Average	49.78	147.16	92.01	18.22	7.17	61.18	42.50
	Standard Deviation	7.89	3.00	12.26	1.98	0.40	6.37	3.69

Data in Table 2 explain the simple correlation coefficient among studded characters. It was noticed that grains yield/plant recorded positive and highly significant correlation with plant height, number of spikes/plant and 1000-grain weight which were 0.604, 0.742 and 0.683 respectively. Plant height gave positive and highly significant correlation with number of spikes/plant, while it recorded positive and significant correlation with 1000-grain weight. The character number of spikes/plant recorded positive and significant correlation with 1000-grain weight which was 0.459. The character spike length correlated positively and high significantly with number of grains/spike recording 0.760. Our findings were in accordance with the results of previous authors concerning the correlation between grain yield, spikes number and number of grains/spike (Sharma and Rao, 1989; Singh and Sharma, 1994; Subhani and Khaliq, 1994; Khan *et al.*, 1999; Mohammad *et al.*, 2002; Aycicek and Yildirim, 2006) [14, 15, 16, 17, 18, and 19]

Table 2: Correlation coefficient analysis among the studied characters

Characters	Grains yield/plant	Number of days to 50% anthesis	Plant height (cm)	Number of spikes/ plant	Spike length (cm)	Number of grains/ spike	1000-grain weight (g)
Grains yield / plant	**1.000**						
Number of days to 50% anthesis	0.316	**1.000**					
Plant height (cm)	0.604	0.367	**1.000**				
Number of spikes/plant	0.742	0.255	0.757	**1.000**			
Spike length (cm)	0.294	-0.337	-0.291	0.037	**1.000**		
Number of grains/spike	0.368	0.036	-0.371	-0.028	0.760	**1.000**	
1000-grain weight (g)	0.683	-0.022	0.544	0.459	0.262	0.056	**1.000**

**. Correlation is significant at the 0.05 level (2-tailed) ,* $t_{0.05}(17)=2.110$

***. Correlation is significant at the 0.01 level (2-tailed) ,* $t_{0.01}(23)=2.898$

Data in Table 3 explain the Path coefficient analysis indicating to direct and indirect effect of studded characters in grain yield. The maximum positive direct effect was recorded by the character number of grains/spike with 0.567 and followed by number of spikes/plant and 1000-grain weight with 0.389 and 0.387 respectively. The character spike length gave direct negative effect in grain yield recording -0.163. Concerning the indirect effect maximum positive value was recorded by spike length *via* number of grains/spike recording 0.432 and followed by the character plant height *via* number of spikes/plant recording 0.294. The maximum negative indirect effect was -0.210 recorded by plant height *via* number of grains/spike.

Table 3: Path coefficient analysis among the studied characters

Characters	Number of days to 50% anthesis	Plant height (cm)	Number of spikes/ plant	Spike length (cm)	Number of grains/ spike	1000-grain weight (g)
Number of days to 50% anthesis	**0.062**	0.023	0.016	-0.021	0.002	-0.001
Plant height (cm)	0.088	**0.239**	0.181	-0.070	-0.089	0.130
Number of spikes/plant	0.099	0.294	**0.389**	0.014	-0.011	0.179
Spike length (cm)	0.055	0.047	-0.006	**-0.163**	-0.124	-0.043
Number of grains/spike	0.021	-0.210	-0.016	0.432	**0.567**	0.032
1000-grain weight (g)	-0.009	0.211	0.178	0.102	0.022	**0.387**
Grains yield/plant *Correlation*	***0.316***	***0.604***	***0.742***	***0.294***	***0.368***	***0.683***

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Appendix 1: Regression Analysis

Multiple R	**0.937****
R^2	0.878
Adjusted R^2	0.817
Standard Error	0.428

ANOVA Table

S.O.V	***df***	***SS***	***MS***	$F_{Cal.}$	$F_{0.05}$	$F_{0.01}$
Regression	6	15.804	2.634	14.392**	2.996	4.821
Residual	12	2.196	0.183			
Total	18	18.000				

Appendix 2: Calculated (t) for correlation comparisons

Characters	Grains yield/ plant	Number of days to 50% anthesis	Plant height (cm)	Number of spikes/ plant	Spike length (cm)	Number of grains/ spike
Number of days to 50% anthesis	1.371					
Plant height (cm)	3.125	1.624				
Number of spikes/plant	4.559	1.086	4.776			
Spike length (cm)	1.268	-1.478	-1.256	0.152		
Number of grains/spike	1.632	0.149	-1.645	-0.115	4.828	
1000-grain weight (g)	3.858	-0.091	2.673	2.130	1.121	0.230

**. Correlation is significant at the 0.05 level (2-tailed) ,* $t_{0.05}(17)=2.110$

***. Correlation is significant at the 0.01 level (2-tailed) ,* $t_{0.01}(23)=2.898$