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RESEARCH PAPER

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Path analysis and correlation coefficient under the effect of different locations for bread wheat

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Abstract

To estimating some genetic parameters and the direct and indirect effects of the components of the bread wheat grain. A field experiment was carried out at three different location by planting nine cultivar of bread wheat in mid-Nov. 2015. The experiment was applied according to the RCBD design with three replicates. Direct, indirect and total effects were estimated based on the path analysis of the Reciprocation-model. The environmental, genetic and morphological correlation coefficients were estimated between the pairs of studied traits. Direct effect values were higher than indirect effects for all genetic parameters. Plant height showed the highest direct effected on grain yield variation (0.733) in Kut location at Wasit governorate, while the number of tillers recorded the highest direct effect (0.736) in Diwaniyah location at Diwaniyah governorate. The highest correlation environment coefficient (0.525, 0.531, and 0.470). The highest genetic correlation were 0.918, 0.802 and 0.856. The highest phenotypic correlation were 0.889, 0.797 and 0.781 for the three location.

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Introduction

Wheat is an important cereal crop which is cultivated worldwide and was one of the first crops. The increasing wheat production is important to the economic stability and nutrition. The accurate assessments of direct and indirect effects for grain yield components and the growth of the crop characters which are effective means of selection to improve the grain yield (Khazratkulova *et al*, 2015, Subira *et al*, 2015). The rate of grain yield is depends on effect type for trait and its contributing (Khayatnezhad *et al*, 2010). The number of kernel and kernel mass was the most effective on wheat yield because it result from direct and indirect effects but it has interaction to consist a compilation model for crop (Mohammadi *et al*, 2007, Anwar *et al*, 2009, Kaya and Akcura, 2014).

The path and correlation analysis aim to estimate the magnitude of correlation among studied traits with its related traits into direct and indirect effects through path analysis (Demisie, 2016, Herrera *et al*, 2017) to shows their effects in the yield (Abd El-Mohsen and Amein, 2016).

There are many trait that cannot be separated each other because they are very interdependent and cannot be ignored, they have direct and indirect effects which in turn represent independent effects on the dependent variable (grain yield) (Agarwal and Ahmad, 1982, Aycicek and Yildirim 2006).

Through path analysis, its assumed there are causal and linear relationship between cause and result, the path analysis was aimed to related traits into direct and indirect effects and there are relationship among variables (Aycicek and Yildirim 2006., Mohammadi *et al*, 2016, Walter, 1975). Its depended on the strong relationship among studied traits (Hanson *et al*, 1956).

A complex quantitative characters, which are influenced by a number of yield contributing characters. Hence, the selection for desirable genotypes should not only be based on yield alone, and the other yield components should also be considered (Storck *et al*, 2016).

The path analysis is limitation of causal relationship among variables in one direction or in interactive relationship and this is very complex and difficult and explains the effects of independent variable in dependent variable as direct and indirect effects (Walter, 1975). Wheat yield is the complex trait, depending on genetic and environmental factors and their interaction. (Agarwal and Ahmad, 1982).

The grain yield and yield components of wheat are affected very much by the genotype and the environment. Therefore, as new cultivars are being produced by breeding, the relationships between yield and its components are studied by the breeders. To increase the yield, study of direct and indirect effects of yield components provides the basis for its successful breeding programmer and hence the problem of yield increase can be more effectively tackled on the basis of performance of yield components and selection for closely related characters (Bornhofen *et al*, 2017, Haddad *et al*, 2017).

The aim of this study was to determine the correlations and path analysis of yield and yield components in bread wheat and evaluate their suitability in a breeding program.

Therefore, the current study was carried out to estimate the magnitude of correlation between grain yield and yield contributing characters, and to partition the correlation coefficients of yield with its related traits into direct and indirect effects through path analysis, and eventually focus on one dependent variable which is economically yield.

Materials and methods

A field experiment was carried out in three different locations (Kut, Diwaniyah and Nasiriyah), for estimating of the nine varieties of bread wheat (Tamoz 1, Tamoz 2, Miskibak, Sabah, eba 95, Latifia, eba 99, Abu Ghraib and Shamm 6).

The seeds of bread wheat were obtained from the Field crops Department, College of Wasit University, Wasit, Iraq. The experiment was applied according to RCBD with three replicates.

Planting seed by 120kg/h in-November 2015 in three different locations (Kut, Diwaniyah and Nasiriyah) in the lines between 20cm. Superphosphate was added by 200kg/h in the tillage. The urea fertilizer was added 46% nitrogen by 200kg/h in two batches after 30 days of planting and at the spiking stage. The experimental unit area was $5x4m^2$. The characters of plant height (cm), number of tiller, length of spike (cm), number of grains in spike, and weight of 1000 grains (g) and yield grains T/h were studied. The direct and indirect effects and total of the genetic parameters were estimated by the path analysis according to the reciprocal model. Environmental correlation, genetic and phenotypic were estimated among the pairs of studied characters according to Walter (1975).

The data were analyzed statistically according to the variation analysis method (ANOVA) for R.C.B.D, the sequencing of splinter panels and the use of the last significant difference test (L.S.D) to compare arithmetic means of treatment at a level of probability (5%).

Results and discussion

The Kut Location: Path factor of genetic parameter

The results of Table 1 indicate that the path coefficients of the direct effects were higher than the indirect effects of the variance of the yield grain of the variety studied. The height of the plant achieved the highest path factor (0.73). This means that the increase of the plant height of one unit increases the grain yield by 0.73 units, while the weight of 1000 grain less direct impact in the grain yield was(-0.18), which means that the increase one unit grain decrease at a rate of 0.18 units.

This means that the height of the plant is one of the most important character that explain the difference in the grain yield. 70% of the variance of the grain yield among cultivars. Following number of taller, which explain for 29% of the differences in grain yield and the length of the spike, which explain for 25.7% while number of grain was explain 15.5%, the weight of 1000 grain give less of character to explain the difference of the studied varieties (-17%). As for the indirect effects, all were positive except for the weight of 1000 grain which had a negative effect on grain yield variation.

The height of the plant achieved the highest path coefficient of indirect effect in the grain yield (0.42) that mean as high plant increase with increase grain yield (0.42) per unit added, and gave the weight of 1000 grain less path factor (-0.15), which means that by increasing the average weight of this character one unit decreases the grain yield by 0.15 units.

Table 1. Direct and indirect coefficient path analysis of the genetic parameters of grain yield of varieties of bread wheat Kut location.

Genetic parameter effect	Direct effect of path analysis				
	High plant	Number of taller	Spike length	No. of grain/ spike	Wight of 1000 grain
	0.733	0.294	0.257	0.155	-0.176
	indirect effect of path analysis				
High plant		0.134	0.422	0.108	0.287
No. of taller	0.054		0.201	0.097	0.212
Spike length	0.148	0.175		0.129	0.216
No. of grain/spike	0.023	0.051	0.077		0.124
Wight of 1000 grain	-0.069	-0.126	-0.147	-0.141	
Totally effect	0.889	0.528	0.810	0.348	0.662
Residual effect			0.221		

The spike length recorded the highest indirect effect in grain yield with a coefficient of 0.15. This confirms that the height of the plant was one of the most genetic parameters that directly affect the variability of plant yield, explain for 42% of the difference in the product of the grains of the studied varieties. The total effect values, it is noted that the height of the plant is one of the most significant genetic factors in the variation of the components of wheat grain content, with a coefficient of 0.88, ie, explained 88% of the variance of grain yield while number of grain explain 38% from grain yield different among studied verities to give less value for path coefficient (0.35), there are non-noted effected explain 22% of variance variety.

The Diwaniyah location: the path of the genetic parameters

Table (2) shows that the highest path coefficient for direct effects (0.736) was achieved by the number of taller and the lowest coefficient of direct effect was recorded at 1000 weight grain reached 0.002. This means that the number of taller is responsible for the explain of 74% of the yield grain of the studied varieties. Increasing by 0.74 as the number of taller increased.

Plant height gave the highest path coefficient of indirect effects (0.544) with a weight of 1000 grains. The height of the plant had no significant effect on the number of grains (0.00) for values above the diameter. The height of the plant with spike length achieved the highest indirect effect (0.437), while the weight of 1000 grains achieved negative values with all the genetic parameters and the lowest path coefficient was with the number of grains with spike (-0.652) for the values under the diameter. The number of spike grains recorded the highest total effect of grain yield, with 66% of the grain yield variance, while the plant height was lower the total path coefficient (0.264).

Table 2. The direct, indirect and total effect of the genetic parameters of bread wheat varieties in Diwaniyah location.

Genetic parameter effect	Direct effect of path analysis				
	High plant	No. of taller	Spike length	No. of grain/ spike	Wight of 1000 grains
	0.01	0.736	0.63	0.54	0.002
	indirect effect of path analysis				
High plant		0.001	0.003	0.000	0.544
No. of taller	0.099		0.317	0.469	0.376
Spike length	0.437	0.272		0.233	0.427
No. of grain /spike	0.003	0.341	0.198		0.530
Wight of 1000 grain	-0.279	-0.605	-0.488	-0.652	
Totally effect	0.264	0.745	0.661	0.585	0.392
Residual effect	0.392				

The Nasraya location Path analysis of the genetic parameters

Table (3) shows that the highest path coefficient for direct effects was achieved by the number of taller of the plant (0.865). The weight of 1000 grain was less than the path factor of the direct effect of -0.429, the number of tellers was the main reason and responsible for explain 86% from grain yield variance, the grain yields increase by up to 0.86 with an increase in the number of taller per unit area. The length of the spike achieved the highest path coefficient for indirect effects (0.559) with the height of the plant, while the weight of 1000 negative values with the length of the spike (-0.168) recorded the lowest path coefficient with the number of grains with spike (-0.335). The number of taller in the unit area recorded the highest total effects of grain yield (0.722), that explained 72% of the variation of grain yield, while the number of grains with spike was less the total path coefficient (0.459).

Table 3. The direct, indirect and total effect coefficient of grain yield on the genetic characteristics of bread wheat varieties in Nasraya location.

Genetic parameter effect	Direct effect of path analysis				
	High plant	No. of taller	Spike length	No. of grain/ spike	Wight of 1000 grains
	0.763	0.865	-0.308	0.417	-0.429
	indirect effect of path analysis				
High plant		0.038	0.559	0.274	0.123
No. of taller	0.045		0.319	0.547	0.422
Spike length	-0.234	-0.113		-0.204	-0.168
No. of grain/spike	0.070	0.204	0.228		-0.335
Wight of 1000 grain	-0.160	-0.271	-0.285	0.326	
Totally effect	0.457	0.722	0.514	0.459	0.513
Residual effect	0.475				

Correlation coefficient of Kut location

The correlation coefficients among the genetic parameters studied in Table (4) indicate that the highest correlation coefficient was 0.525, which the positive relationship between plant height and number of taller, the number of taller increased with plant height. A significant correlation was found between plant height and grain yield (0.918). The highest correlation coefficient was 0.889 due to the positive relationship between plant height and grain yield. This confirms the importance of plant height in grain yield through a positive relationship between these two properties, possibly because they are responsible for the plant's biological yield (Anwar *et al*, 2009).

Correlation coefficient of Diwaniyah location

The results of Table (5) reviled that the environmental correlation coefficient reached the highest value of 0.531 due to the positive correlation between plant height and number of spike grains. Also, The environmental correlation coefficients of plant height were negatively correlated with plant yield and spike length (-0.102 and -0.92) With a weight of 1000 grain with a lower environmental correlation value (-0.210). The number of grains with spike recorded the highest genetic correlative value with the weight of the grain (0.802).

The lowest correlation coefficient (0.003) was due to the low correlation between plant height and number of grains with spike. The phenotype correlation coefficient between the number of grains with spike and the weight of 1000 grain (0.797) was higher, while the value of the phenotypic correlation coefficient between plant height and number of grains with spike decreased (0.005).

Table 4. The environmental, genetic and descriptive correlation coefficient of the genetic parameters of bread wheat varieties in Kut location.

Character	Correlation	Yield plant	Wight 1000 grain	No. grain spike	Lange spike	No. taller
Yield plant	Environmental correlation coefficient	-0.006	0.460	0.211	-0.411	0.525
	Genetic cor. coefficient	0.918	0.391	0.147	0.601	0.178
	Phenotype cor. coefficient	0.889	0.391	0.148	0.576	0.183
No. taller	Environmental correlation coefficient	0.015	0.384	-0.200	-0.241	
	Genetic cor. coefficient	0.556	0.741	0.346	0.739	
	Phenotype cor. coefficient	0.523	0.720	0.330	0.682	
Long spike	Environmental correlation coefficient	0.115	0.073	0.177		
	Genetic cor. coefficient	0.848	0.860	0.512		
	Phenotype cor. coefficient	0.810	0.838	0.500		
No. grain spike	Environmental correlation coefficient	-0.189	0.046			
	Genetic cor. coefficient	0.362	0.804			
	Phenotype cor. coefficient	0.348	0.801			
Wight 1000 grain	Environmental correlation coefficient	0.204				
	Genetic cor. coefficient	0.679				
	Phenotype cor. coefficient	0.662				

r 0.01=0.623 & r 0.05=0.497.

Correlation coefficient for Nasraya location

The results of Table (6) indicate that the correlation coefficients of the spike length with the grain yield were significantly higher (0.470). The correlation between the number of taller and the number of grains in spike was low and negative. There was a strong and positive correlation between plant height and spike length, which was higher in the correlation coefficients (0.856). The strength of the relationship between plant height and number of taller decreased and gave the lowest correlation coefficient (0.054). The highest coefficient of correlation was achieved between the number of grains with spike and weight of 1000 grain with a positive correlation between them was 0.781, while the relation between plant height and number of taller decreased by giving a less strong correlation of (0.052).

Table 5. The environmental, genetic and descriptive correlation coefficient of the genetic parameters of bread wheat varieties in Diwaniyah location.

Character	Correlation	Yield plant	Wight 1000 grain	No. grain spike	Lange spike	No. taller
Yield plant	Environmental correlation coefficient	-0.102	0.309	0.531	-0.092	0.507
	Genetic cor. coefficient	0.271	0.342	0.003	0.753	0.128
	Phenotype cor. coefficient	0.264	0.341	0.005	0.693	0.134
No. taller	Environmental correlation coefficient	0.302	0.006	0.447	0.441	
	Genetic cor. coefficient	0.765	0.763	0.649	0.436	
	Phenotype cor. coefficient	0.745	0.739	0.637	0.431	
Long spike	Environmental correlation coefficient	0.099	-0.210	0.080		
	Genetic cor. coefficient	0.718	0.655	0.397		
	Phenotype cor. coefficient	0.661	0.596	0.369		
No. grain spike	Environmental correlation coefficient	0.014	0.062			
	Genetic cor. coefficient	0.595	0.802			
	Phenotype cor. coefficient	0.585	0.797			
Wight 1000 grain	Environmental correlation coefficient	0.352				
	Genetic cor. coefficient	0.535				
	Phenotype cor. coefficient	0.530				

r 0.05=0.497 & r 0.01=0.623.

Table 6. The environmental, genetic and descriptive correlation coefficient of the genetic parameters of bread wheat varieties in Nasraya location.

Character	Correlation	Yield plant	Wight 1000 grain	No. grain spike	Lange spike	No. taller
Yield plant	Environmental correlation coefficient	-0.151	-0.065	-0.209	0.195	-0.024
	Genetic cor. coefficient	0.462	0.374	0.169	0.856	0.054
	Phenotype cor. coefficient	0.457	0.372	0.167	0.760	0.052
No. taller	Environmental correlation coefficient	0.159	-0.312	-0.267	0.057	
	Genetic cor. coefficient	0.744	0.657	0.507	0.423	
	Phenotype cor. coefficient	0.722	0.632	0.488	0.369	
Long spike	Environmental correlation coefficient	0.470	-0.007	0.304		
	Genetic cor. coefficient	0.555	0.754	0.611		
	Phenotype cor. coefficient	0.514	0.663	0.546		
No. grain spike	Environmental correlation coefficient	-0.155	0.078			
	Genetic cor. coefficient	0.465	0.783			
	Phenotype cor. coefficient	0.459	0.781			
Wight 1000 grain	Environmental correlation coefficient	-0.062				
	Genetic cor. coefficient	0.519				
	Phenotype cor. coefficient	0.513				

r 0.05=0.497 & r 0.01=0.623.

Conclusion

We conclude that the direct effects values are higher than the indirect effects values and all the genetic parameters.

The most variable explanation for the variance is the height of the plant, which has the highest direct effect on grain yield variation in Kut location, while the correlation coefficient was higher than the environmental and phenotypic factors in all environmental locations.

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