Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 258-262
Received: 06-05-2017
Accepted: 07-06-2017

Shahidullah Sapi
Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Shailesh Marker
Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Indranil Bhattacharjee
Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correspondence
Shahidullah Sapi
Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correlation and path coefficient analysis of some quantitative traits in bread wheat

Shahidullah Sapi, Shailesh Marker and Indranil Bhattacharjee

Abstract
One hundred five wheat genotypes and three checks varieties were studied for correlation and path coefficient analysis for some quantitative and physiological traits related to terminal heat tolerance at the Experimentation Centre of Department of Genetics and Plant Breeding, NAI, SHUATS, Allahabad (U.P.). Generally, the estimates of genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients for all the character combinations. Seed yield was significantly and positively associated with spike weight, grains per spike, test weight, chlorophyll content, harvest index and biological yield per plant. But it showed significant negative association with days to heading, days to flowering, plant height and days to maturity at genotypic level. Path coefficient analysis revealed that the magnitude of positive direct effect on grain yield per plant was highest through biological yield, followed by harvest index and test weight, whereas chlorophyll content followed by days to flowering revealed negative direct effect on grain yield per plant.

Keywords: correlation coefficient, path coefficient, direct and indirect effect on grain yield

1. Introduction
Wheat (*Triticum aestivum* L.) is the main staple food crop for a large number of world populations. The area under wheat cultivation in the world being 222 mha, while production is 714.74 million tons with a productivity of 2.99 Mt/ha (CIMMYT, 2016) [4]. It is the main winter cereal in India followed by rice. India had a remarkable achievement during Green revolution in wheat production and could increase productivity to the extent that it could bring itself out from insufficiency to a present self-sufficient status. This is certainly a significant and comforting outcome. The area under wheat in India is 28.42 mha, with a production of 84.20 million tons and a resultant productivity of 2.6 Mt/ha. However in Uttar Pradesh state, it occupies an area of 10.42 mha, with production of 29.32 million tons and productivity of 2.8 Mt/ha (DWR, 2016) [7]. Wheat will continue to attract substantial research attentions in the face of a daunting challenge of feeding a predictable population of 9 billion by 2050. Yield increases are essential to meet this demand, as expanding the wheat area is not practically possible (Rajaram and Braun, 2008) [15]. (Gill *et al.*, 2004) [8] Therefore, yield component concept in breeding has got much importance in improving yield potential. Selection on the basis of performance of yield alone, a polygenic complex trait is usually not very efficient **(**Singh and Singh 1973 [19] and Sastri 1974 [16]). Therefore, selection based on yield components was suggested to be more effective rather than yield alone (Shamsuddin and Ali 1998) [18]**.** Initiating a breeding program based on yield component requires knowledge of relationship between yield and its component characters. In this context, determination of correlation coefficient has considerable importance in selecting breeding materials **(**Afroz *et al.*, 1989) [1]. On the other hand, path coefficient analysis gives more specific information on the direct and indirect influence of each of the component characters upon grain yield. Therefore, the present study was embarked on to find out the relationship between yield and its component characters and the cause-effect relation was further analyzed.

2. Materials and Methods
A study was conducted taking 108 diverse genotypes which included three checks (Halna, K-8962, and HD-2733). The experiment was planted during *Rabi* 2014-15 and *Rabi* 2015-16 at the Experimentation Centre of Department of Genetics and Plant Breeding, NAI, SHUATS, Allahabad (U.P.), which is located at 25^0 24' 42" N latitude, 81^0 50' 56" E longitude, at an altitude of 98 m above the mean sea level. The experimental material was grown in a Randomized Block Design (RBD) replicated thrice.

Each genotype was grown in one row plot of 5 meters with 25 centimeter distance between the rows. The recommended cultural practices were adopted to raise a good crop. Data were recorded on five randomly selected competitive plants from each plot on sixteen quantitative characters namely, days to 50 % heading, days to 50 % flowering, plant height (cm), spike length (cm), spike weight (cm), number of productive tillers per plant, grain filling period, grains per spike, test weight (g), chlorophyll content (%), membrane thermo-stability (%), harvest index, canopy temperature depression, days to 50 % maturity, biological yield per plant (g), and grain yield per plant (g). The data were analyzed using the procedure given by (Panse and Sukhatme 1961) [14] for estimation of variance and coefficient of variances. Genotypic correlations were computed using variance and co-variances as suggested by (Dhonde *et al.* (1955) [6]. Path coefficient analysis was performed as suggested by (Dewey and Lu 1959) [5].

3. Result and Discussion

Genotypic and phenotypic correlation coefficient provides a quantitative evaluation of the effect of environment on a particular character (Khaliq *et al.*, 2004) [9]. The association of grain yield per plant with other characters was estimated by genotypic and phenotypic correlation coefficient (Table 1). Highly significant and positive genotypic and phenotypic correlation were found between grain yield and spike weight (r_g =0.40, r_{ph} = 0.26), test weight (r_g = 0.62, r_{ph} =0.33), chlorophyll content (r_g =0.50, r_{ph} =0.34), harvest index (r_g =0.47, r_{ph} =0.54), biological yield (r_g =0.73, r_{ph} =0.47), number of grain per spike ((r_g =0.24, r_{ph} =0.17) these results are in agreement with the results obtained by (Khaliq *et al.*, 2004) [9],(Uddin *et al.*, 1997) [20], (Narwal *et al.*, 1999) [12], (Ashfaq *et al.*, 2003) [2], (Nayeem *et al.*, 2003) [13]**.** Days to heading and days to flowering had negative but significant correlation with grain yield at a phenotypic and genotypic level. Days to heading also had positive and significant correlation (r_g =0.90, r_{ph} =0.81) with days to flowering, while it revealed a negative significant correlation (r_g = -0.36, r_{ph} =-0.30) with grain filling period. Plant height had negative significant correlation r_g = -0.12) at genotypic level. Spike weight depicted strongly positive correlation (r_g =0.65, r_{ph} =0.52) with grains per spike and test weight (r_g = 0.40, r_{ph} =0.28). It also had positive significant correlation with chlorophyll content and biological yield at both genotypic and phenotypic level. Grain filling period revealed a positive significant correlation (r_g =0.55, r_{ph} =0.52) with days to maturity. Test weight showed highly positive significant correlation (r_g =0.93, r_{ph} =0.81) with chlorophyll content. It also revealed positive significant correlation (r_g =0.51, r_{ph} =0.41) with biological yield which was in agreement with the study carried out by (Khaliq *et al*., 2004 [9], Zevic *et al*., 2004 [21], and Bhatt 1973 [3]).

Positive correlation appeared between test weight and grain yield per plant. This result confirms with the findings of (Khan *et al.*, 2005 [10], Khaliq *et al.*, 2004 [9] and Shahid *et al*., 2002 [17]).

3.1. Path coefficient analysis

Path coefficient analysis helps us to determine the contribution of various components of yield to overall grain yield in the genotypes under study. It provides an effective way of finding out direct and indirect sources of cause-effect relationship. (Khan *et al.*, 2005 [10], Khaliq *et al*., 2004 [9], Mohsin *et al.*, 2009 [11]). Our result showed that biological yield per plant had the greatest positive direct effect (0.96), on grain yield per plant, followed by harvest index (0.73), and test weight (0.14), (Table 3). The effect of other traits were in negative direction thus reducing the yield. Especially chlorophyll content, which had a conspicuous effect on grain yield per plant in negative direction with (-0.18).

Test weight had a positive indirect effect via chlorophyll content (0.13). Harvest index had positive indirect effect through number of grains per spike (0.16), and test weight (0.18), while negative effect was seen through days to heading (-0.19) and plant height (-0.15) on grain yield per plant. Biological yield per plant had positive indirect effect (0.49) through test weight, chlorophyll content (0.44) and spike weight (0.33), while negative effect appeared through harvest index (-0.26) and grain filling duration (-0.14) on grain yield per plant.

The path coefficient analysis gave a slightly different picture from what the simple correlation analysis did. The genotypic correlation analysis indicated that spike weight and chlorophyll content as important positive influence on grain yield per plant. The direct negative effects of spike weight and chlorophyll content on the grain yield were masked from the positive indirect effect of these characters through biological yield per plant.

Table 1: Genotypic Correlation Matrix (Pooled)

Character	**Days to 50 % Heading**	**Days to 50 % Flowering**	**Plant Height**	**Spike Length**	**Spike Weight**	**Tillers/ Plant**	**Grain Filling Period**	**Grains /Spike**	**Test Weight**	**Chlorophyll Content**	**Membrane Thermo-stability**	**Harvest Index**	**Canopy Temperature Depression**	**Days to 50% Maturity**	**Biological Yield/ Plant**
Days to 50 % Heading	1.00														
Days to 50 % Flowering	0.91**	1.00													
Plant Height	-0.01	-0.08*	1.00												
Spike Length	0.24**	0.26**	0.24**	1.00											
Spike Weight	0.11**	0.13**	0.15**	0.07	1.00										
Tillers/ Plant	0.01	0.04	-0.07	-0.02	-0.03	1.00									
Grain Filling Period	-0.36**	-0.49**	-0.08*	-0.38	0.08*	0.16**	1.00								

Grains /Spike	0.03	0.04	-0.08*	-0.03	0.65**	0.09*	0.16**	1.00							
Test Weight	0.04	-0.01	0.17**	0.03	0.40**	-0.03	0.02	0.07	1.00						
Chlorophyll Content	0.03	0.01	0.18**	0.07	0.37**	-0.09*	0.00	0.00	0.93**	1.00					
Membrane Thermo-stability	0.05	-0.01	0.06	-0.11	-0.08*	-0.21**	0.08*	-0.11**	-0.01	0.02	1.00				
Harvest Index	-0.26**	-0.18**	-0.21**	-0.06	0.18**	0.02	0.12	0.22**	0.24**	0.17**	-0.05	1.00			
Canopy Temperature Depression	-0.16**	-0.10*	0.01	-0.07	0.05	0.00	-0.06	0.04	-0.04	-0.01	-0.05	0.14**	1.00		
Days to 50% Maturity	0.54**	0.47**	-0.17**	-0.14	0.21**	0.22**	0.55**	0.20**	0.02	0.01	0.09*	-0.02	-0.13**	1.00	
Biological Yield/ Plant	0.10*	0.08*	0.05	-0.05	0.34**	-0.01	-0.15**	0.10	0.51**	0.45**	0.01	-0.27**	-0.14**	-0.04	1.00
Grain Yield/ Plant (g)	-0.14*	-0.11**	-0.12*	-0.03	0.40**	0.00	-0.08	0.24**	0.62**	0.50**	-0.03	0.47**	-0.04	-0.13**	0.73**

Table 2: Phenotypic Correlation Matrix (Pooled)

Character	Days to 50 % Heading	Days to 50 % Flowering	Plant Height	Spike Length	Spike Weight	Tillers/ Plant	Grain Filling Period	Grains /Spike	Test Weight	Chlorophyll Content	Membrane Thermo-stability	Harvest Index	Canopy Temperature Depression	Days to 50% Maturity	Biological Yield/ Plant
Days to 50 % Heading	1.00														
Days to 50 % Flowering	0.81**	1.00													
Plant Height	0.00	-0.07	1.00												
Spike Length	0.21*	0.23**	0.20**	1.00											
Spike Weight	0.10	0.10	0.10	0.05	1.00										
Tillers/ Plant	0.03	0.02	-0.05	-0.02	0.02	1.00									
Grain Filling Period	-0.30	-0.49**	-0.07	-0.30**	0.08	0.11	1.00								
Grains /Spike	0.02	0.04	-0.07	-0.03	0.52**	0.07	0.13	1.00							
Test Weight	0.05	0.01	0.14	0.02	0.29**	-0.02	-0.01	0.05	1.00						
Chlorophyll Content	0.03	0.01	0.17	0.06	0.31**	-0.05	0.00	0.00	0.81**	1.00					
Membrane Thermo-stability	0.05	0.00	0.06	-0.09	-0.06	-0.15	0.07	-0.10	0.00	0.02	1.00				
Harvest Index	-0.14	-0.09	-0.12	-0.02	0.09	0.02	0.05	0.13	0.12	0.09	-0.04	1.00			
Canopy Temperature Depression	-0.14	-0.08	0.01	-0.03	0.04	0.01	-0.06	0.04	-0.04	-0.01	-0.03	0.07	1.00		
Days to 50% Maturity	0.41**	0.36**	-0.14	-0.09	0.14	0.14	0.52**	0.16	0.01	0.01	0.06	-0.03	-0.09	1.00	
Biological Yield/ Plant	0.08	0.07	0.05	-0.05	0.24**	-0.01	-0.13	0.09	0.41**	0.40**	0.00	-0.24*	-0.12	-0.04	1.00
Grain Yield/ Plant (g)	-0.10	-0.08	-0.07	-0.02	0.26**	0.01	-0.02	0.17	0.33**	0.34**	-0.04	0.54**	-0.05	-0.09	0.47**

Table 3: Genotypic PATH matrix of Grain Yield/ Plant (Pooled)

Character	Days to 50 % Heading	Days to 50 % Flowering	Plant Height	Spike Length	Spike Weight	Tillers/ Plant	Grain Filling Period	Grains /Spike	Test Weight	Chlorophyll Content	Membrane Thermo-stability	Harvest Index	Canopy Temperature Depression	Days to 50% Maturity	Biological Yield/ Plant
Days to 50 % Heading	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Days to 50 % Flowering	-	-	0.00	-	-	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.01	-	0.00

	0.05	0.05		0.01	0.01									0.03	
Plant Height	0.00	0.00	-0.03	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.01	0.00	0.00	0.00
Spike Length	0.02	0.02	0.02	0.09	0.01	0.00	-0.03	0.00	0.00	0.01	-0.01	-0.01	-0.01	-0.01	0.00
Spike Weight	0.00	-0.01	-0.01	0.00	-0.04	0.00	0.00	-0.03	-0.02	-0.01	0.00	-0.01	0.00	-0.01	-0.01
Tillers/ Plant	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grain Filling Period	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Grains /Spike	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Test Weight	0.01	0.00	0.02	0.00	0.06	0.00	0.00	0.01	0.14	0.13	0.00	0.03	-0.01	0.00	0.07
Chlorophyll Content	-0.01	0.00	-0.03	-0.01	-0.07	0.02	0.00	0.00	-0.17	-0.18	0.00	-0.03	0.00	0.00	-0.08
Membrane Thermo-stability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
harvest Index	-0.19	-0.13	-0.15	-0.05	0.13	0.02	0.08	0.16	0.18	0.12	-0.04	0.73	0.10	-0.02	-0.20
Canopy Temperature Depression	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Days to 50% Maturity	-0.02	-0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.01	0.00	0.00	0.00	0.00	0.00	-0.04	0.00
Biological Yield/ Plant	0.10	0.07	0.05	-0.04	0.33	-0.01	-0.14	0.10	0.49	0.44	0.01	-0.26	-0.13	-0.04	0.96
Grain Yield/ Plant	-0.14	-0.11	-0.12	-0.03	0.40	0.00	-0.08	0.24	0.62	0.50	-0.03	0.47	-0.04	-0.13	0.73
Partial R^2	0.00	0.01	0.00	0.00	-0.02	0.00	0.00	0.00	0.09	-0.09	0.00	0.34	0.00	0.00	0.71

R Square = 1.0408 Residual Effect =Sqrt (1- 1.0408)

Table 4: Phenotypic PATH matrix of Grain Yield/ Plant (g) (Pooled)

Character	Days to 50 % Heading	Days to 50 % Flowering	Plant Height	Spike Length	Spike Weight	Tillers/ Plant	Grain Filling Period	Grains /Spike	Test Weight	Chlorophyll Content)	Membrane Thermo-stability	harvest Index	Canopy Temperature Depression	Days to 50% Maturity	Biological Yield/ Plant
Days to 50 % Heading	0.03	0.02	0.00	0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Days to 50 % Flowering	-0.09	-0.11	0.01	-0.02	-0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.01	0.01	-0.04	-0.01
Plant Height	0.00	0.00	-0.05	-0.01	-0.01	0.00	0.00	0.00	-0.01	-0.01	0.00	0.01	0.00	0.01	0.00
Spike Length	0.01	0.01	0.01	0.04	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spike Weight	0.01	0.01	0.01	0.00	0.06	0.00	0.00	0.03	0.02	0.02	0.00	0.01	0.00	0.01	0.01
Tillers/ Plant	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grain Filling Period	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grains /Spike	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Test Weight	-0.01	0.00	-0.01	0.00	-0.03	0.00	0.00	-0.01	-0.10	-0.08	0.00	-0.01	0.00	0.00	-0.04
Chlorophyll Content	0.00	0.00	0.02	0.01	0.03	-0.01	0.00	0.00	0.08	0.10	0.00	0.01	0.00	0.00	0.04
Membrane Thermo-stability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harvest Index	-0.10	-0.06	-0.08	-0.02	0.06	0.01	0.04	0.09	0.08	0.06	-0.03	0.68	0.05	-0.02	-0.16
Canopy Temperature Depression	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	0.00	0.00
Days to 50% Maturity	-0.01	-0.01	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.03	0.00
Biological Yield/ Plant	0.05	0.05	0.03	-0.03	0.15	-0.01	-0.08	0.05	0.26	0.25	0.00	-0.15	-0.08	-0.02	0.63
Grain Yield/ Plant (g)	-0.10	-0.08	-0.07	-0.02	0.26	0.01	-0.02	0.17	0.33	0.34	-0.04	0.54	-0.05	-0.09	0.47
Partial R^2	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	-0.03	0.03	0.00	0.37	0.00	0.00	0.30

R Square = 0.6948 Residual Effect = 0.5524

Conclusion

Seed yield was significant and positively associated with spike weight, grains per spike, test weight, chlorophyll content, harvest index and biological yield per plant at genotypic and phenotypic level. But it showed significant negative association with days to heading, days to flowering, plant height and days to maturity at genotypic level. Path coefficient analysis revealed that the magnitude of positive direct effect on grain yield per plant was highest through biological yield, followed by harvest index and test weight, whereas chlorophyll content followed by days
to flowering revealed negative direct effect on grain yield per plant. Therefore, the characters *viz.*, biological yield per plant, harvest index and test weight can be used as a selection criteria to increase grain yield in bread wheat.

5. Acknowledgements

The authors are thankful to Head, Department of Genetics and Plant Breeding, Sam Higgin- bottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh (India) for the facilities provided during the experiment.

6. References

1. Afroz R, Sharif MSH, Rahman L. Genetic variability, correlation and path analysis in mustard and rape (*Brassica* spp.). Bangladesh Journal of Plant Breeding Genet. 2004; 17(1):59-63.
2. Ashfaq M, Khan AS, Ali Z. Association of morphological traits with grain yield in wheat. Journal of Agriculture and Biology. 2003; 5:262-264.
3. Bhatt GM. Significance of path coefficient analysis in determining the nature of character association. Euphytica, 1973; 22:338-343.
4. CIMMYT. Wheat-Global Alliance for Improving Food Security and the Livelihoods of the Resources-Poor in the Developing World. 2016.
5. Dewey DR, Lu KH. A Correlation and path coefficient analysis of component of crested wheat grass seed production. Agronomy Journal. 1959; 51:515-518.
6. Dhonde SR, Kute NS, Kanawade, Johnson HW, Robinson HF, Comstock RE. Genotypic and phenotypic correlations and their implication in selection. Agronomy Journal. 1955; 47:477-483.
7. DWR. Proceedings, Recommendations & Plan of Work (2011-12). In: 49th All India Wheat and Barley Research Workers' Meet, 2016.
8. Gill B, Appels RA, Botha-Oberholster C, Buell J, Bennetzen BC. Workshop report on wheat genome sequencing: International genome research on wheat consortium. Genetics. 2004; 168:1087-1096.
9. Khaliq I, Parveen N, Chowdhry MA. Correlation and path coefficient analysis in breed wheat. International Journal of Agriculture and Biology. 2004; 6(4):633-635.
10. Khan AJ, Azam F, Ali A, Tariq M, Amin M. Inter-relationship and path coefficient analysis for biometric traits in drought tolerance wheat (*Triticum aestivum* L.) Asian Journal of Plant Science. 2005; 4(5):540-543.
11. Mohsin T, Khan N. Nagve FN. Heritibility phenotypic correlation and path coefficient studies for some agronomic characters in synthetic elite lines of wheat. Journal of Food and Agriculture and Environment. 2009; 7(3-4):278-282.
12. Narwal NK, Verma PK, Narval MS. Genetic variability, correlation and path coefficient analysis in bread wheat in two climate zone of Haryana. Agriculture Science Digest Karnal. 1999; 19:73-76
13. Nayeem KA, Baig KS. Correlation study in durum wheat. Journal Research ANGRAU. 2003; 31:116-121.
14. Panse VG Sukhatme PV. Statistical methods for agricultural workers, ICAR Publication, New Delhi (IInd edition) 1967, 381.
15. Rajaram S, Braun H. Wheat yield potential International Symposium on Wheat Yield Potential: Challenges to International Wheat Breeding. CIMMYT, Mexico. 2008, D103-107.
16. Sastri AB. Path analysis of yield components in tobacco. Indian Journal Genetics. 1974; 1974(34):57-58.
17. Shahid F, Mohammad F, Tariq M. Path coefficient analysis in wheat. Sarhad Journal of Agriculture. 2002; 18:383-388.
18. Shamsuddin AKM, Ali MM. Genotypic and phenotypic correlation and path analysis in spring wheat. Bangladesh Journal of Agricultural Sciences. 1989; 16(1):75-78.
19. Singh TP, Singh KB. Association of grain yield and its components in segregating populations of green gram. Indian Journal Genetics. 1973; 33:112-117.
20. Uddin MJ, Mitro B, Chowdhry MAZ. Genetic parameters, correlation path coefficient and selection indices in wheat. Bangladesh Journal of Sciences and Industry. 1979; 32:528-538.
21. Zevic V, Knezevic D, Mecanovic D. Genetic correlation and path coefficient analysis of yield and quality component in wheat (*Triticum astivum* L.) Gentica. 2004; 36(1):13-21.