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CHARACTER ASSOCIATION AND PATH ANALYSIS IN WHEAT (T*RITICUM AESTIVUM* L. EM THELL) UNDER TEMPERATE CONDITIONS OF KASHMIR, INDIA

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Abstract

An experiment was conducted in field conditions in the Department of Plant Breeding and Genetics of Mountain Research Centre for Field Crops, SKUAST-Kashmir, Khudwani to study Correlation and Path analysis in thirteen quantitative and qualitative characters. Twenty genetically diverse genotypes of wheat (*T. aestivum*) were used in the present study. There was a significant variation for all the traits studied among the genotypes. Correlation coefficient analysis revealed that biomass yield (0.86, 0.72), no. of tillers per running meter (0.43, 0.38) exhibited significant positive correlation with grain yield at both genotypic and phenotypic levels. While as days to 50% flowering (0.07, 0.09) exhibited non-significant positive correlation with grain yield at both genotypic and phenotypic levels. Path coefficient analysis revealed that biomass yield had highest positive direct effect on grain yield at both genotypic (0.83) and phenotypic levels (0.84). Flag leaf area showed direct negative effect (-0.61) on grain yield at genotypic level while as number of grains per spike (-0.15) showed direct negative effect with grain yield at phenotypic level. Results showed that more stress be given on the selection of genotypes with high biomass yield alongwith flag leaf area which directly affected the photosynthetic product to add to grain yield. The derived information would be very useful to select potentially breeding lines for future wheat improvement program

Key words : Correlation coefficient, path coefficient, *Triticum aestivum*.

Intoduction

Grain yield, being a quantitative trait is a complex character of any crop. Various morphological and physiological plant characters contribute to yield. These yield contributing components are interrelated with each other showing a complex chain of relationship and also highly influenced by the environmental conditions (Prasad *et al*., 2001). Wheat (*Triticum aestivum* L.) is an important cereal crop of the world. The grain yield in the wheat is a complex character that can be determined by several components, which reflect positive or negative effects upon this trait (Singh and Chaudhary, 2006). Understanding of interrelationship of component characters helps in determining the priorities of characters at the time of selection when improvement of the related complex character is desired. Correlation coefficient is a statistical measure, which is used to find out the degree and diversion of relationship between two or more variables. Correlation coefficient analysis measure the nature relationship between various plant characters and determines components in economically important characters. However, simple correlation does not provide the adequate information about the contribution of each factor towards yield. Therefore, the techniques of path coefficient analysis are utilized to have an idea of direct and indirect contribution of a trait towards the yield, the end product (Nandan *et al*., 2010). Although, determination of correlation coefficients between the characters has a considerable importance in selecting breeding materials (Afroz *et al*., 2004), but path coefficient analysis has been found to give more specific information on the direct and indirect influence of each of the component characters on grain yield. Therefore, the present study was undertaken to find out relationship between yield and its component characters and the causes of such relations.

Materials and Methods

The present experiment was conducted during the year 2011-2012 at Mountain Research Centre for Field Crops, Khudwani (34^0 N latitude and 74^0longitude) of

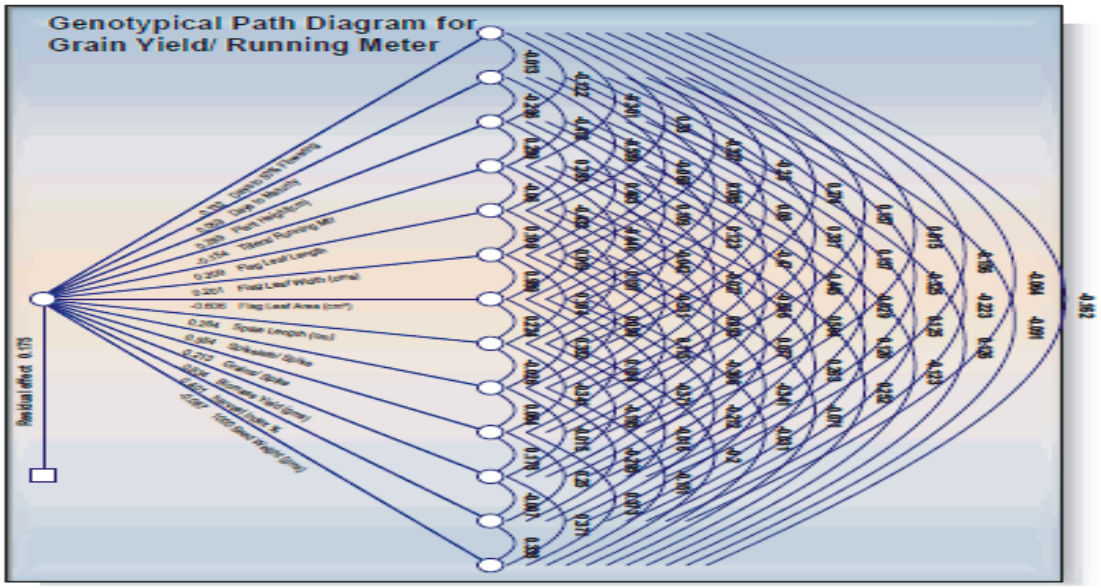

Fig. 1 : Genotypic path diagram for grain yield/ Running Meter.

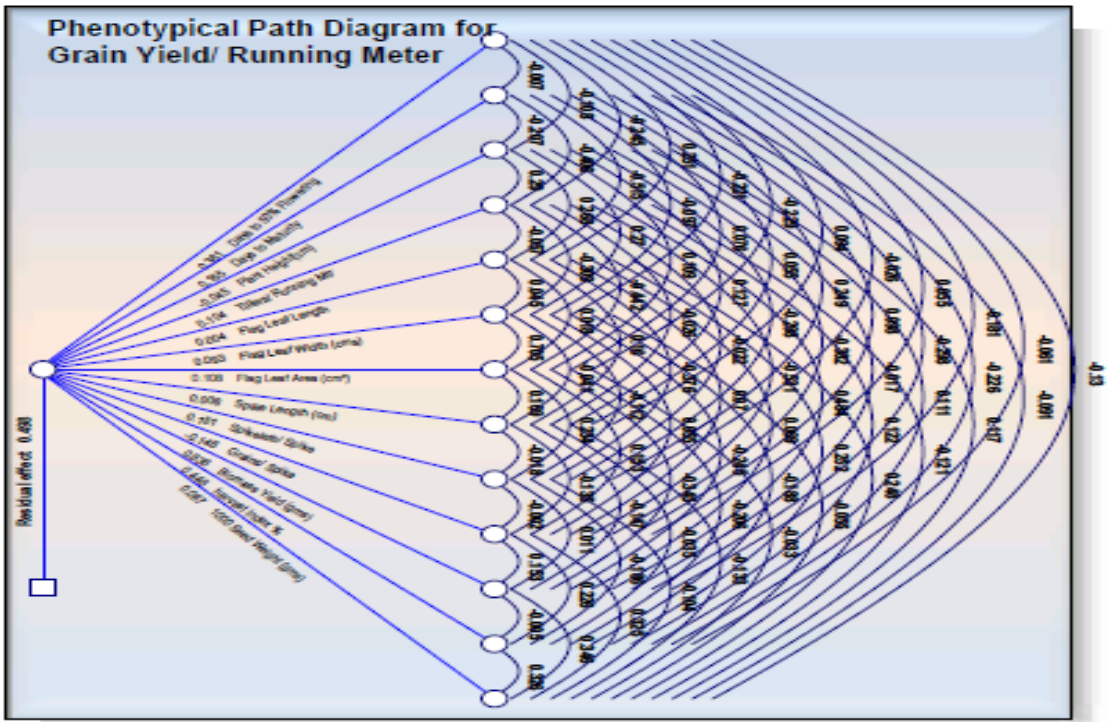

Fig. 2 : Phenotypic path diagram for grain yield/ Running Meter.

SKUAST-K, Khudwani, Anantnag, Kashmir, India. Climate of the area is cold temperate. The maximum temperature is 34^{0}C and minimum temperature 20^{0}C. The experimental material of the study comprised of twenty genetically diverse genotypes of wheat maintained at the Department of Plant Breeding and Genetics, SKUAST-Kashmir, Khudwani, Anantnag. The experiment was laid out in randomized block design with three replication. In each replication each genotype was sown in a plot comprising three rows of two meters length, and row to row spacing was maintained at 23 cm. Observations on the thirteen quantitative and qualitative traits *viz*. days to 50 per cent flowering, days to maturity, plant height (cm), number of productive tillers per running meter, flag leaf length (cm), flag leaf width (cm), spike length (cm), number of spikelets per spike, number of grains per spike, biomass yield (g), harvest index (%), thousand grain weight (test weight) and grain yield per running meter.

Correlation coefficients were computed at genotypic and phenotypic levels between pair of characters adopting the procedure of Johnson *et al*. (1955). The path

Table 1 : Estimates of genotypic correlation between different agro-morphological traits in wheat.

S. no.	Character	Days to 50% flower-ing	Days to to mat-urity	Plant height (cm)	Tillers/ running meter	Flag leaf length	Flag leaf width (cm)	Flag leaf area (cm^2)	Spike length (cm)	No. of spike-lets /spike	Grains/ spike	Biomass yield (gms)	Harvest index %	1000 seed weight (gms)	Grain yield/ running Meter
1.	Days to 50% flowering	**1.00**	-0.01	-0.12	-0.30	0.33	-0.33	-0.28	0.27	0.16	0.02	-0.16	-0.06	-0.16	0.07
2.	Days to maturity		**1.00**	-0.24	-0.42	-0.54	-0.07	0.09	0.08	0.34	0.14	-0.32	-0.22	-0.09	-0.24
3.	Plant height(cm)			**1.00**	0.30	0.29	0.40	0.11	0.12	-0.47	-0.45	-0.03	0.12	0.13	0.01
4.	No. of tillers/running meter				**1.00**	-0.06	-0.43	-0.45	-0.04	-0.03	-0.66	0.50	0.13	-0.12	0.43
5.	Flag leaf length					**1.00**	0.11	0.02	0.20	-0.53	0.09	0.08	0.26	0.25	0.16
6.	Flag leaf width (cms)						**1.00**	0.99	0.10	0.10	0.12	-0.37	-0.34	-0.07	-0.48
7.	Flag leaf area (cm^2)							**1.00**	0.22	0.33	0.18	-0.37	-0.21	-0.03	-0.37
8.	Spike length (cm)								**1.00**	-0.03	-0.34	-0.20	-0.02	-0.20	-0.04
9.	No. of spikelets/ spike									**1.00**	0.06	-0.01	-0.29	-0.15	0.02
10.	No. of grains/ spike										**1.00**	0.18	0.25	0.37	0.28
11.	Biomass yield (gms)											**1.00**	-0.01	0.37	0.86
12.	Harvest index %												**1.00**	0.34	0.38
13.	1000 seed weight (gms)													**1.00**	**0.43**

Table 2 : Estimates of phenotypic correlation between different agro-morphological traits in wheat.

S. no.	Character	Days to 50% flower-ing	Days to to mat-urity	Plant height (cm)	Tillers/ running meter	Flag leaf length	Flag leaf width (cm)	Flag leaf area (cm^2)	Spike length (cm)	No. of spike-lets /spike	Grains/ spike	Biomass yield (gms)	Harvest index %	1000 seed weight (gms)	Grain yield/ running Meter
1.	Days to 50% flowering	**1.00**	-0.01	-0.11	-0.24	0.25	-0.22	-0.23	0.09	-0.03	0.06	-0.18	-0.06	-0.13	0.09
2.	Days to maturity		**1.00**	-0.21	-0.41	-0.51	-0.10	0.08	0.05	0.25	0.10	-0.30	-0.23	-0.09	-0.21
3.	Plant height(cm)			**1.00**	0.29	0.27	0.27	0.11	0.13	-0.30	-0.38	-0.02	0.11	0.12	0.01
4.	No. of tillers/running meter				**1.00**	-0.06	-0.31	-0.44	-0.03	-0.02	-0.53	0.48	0.12	-0.12	0.38
5.	Flag leaf length					**1.00**	0.05	0.02	0.16	-0.38	0.07	0.07	0.25	0.25	0.12
6.	Flag leaf width (cms)						**1.00**	0.71	-0.04	-0.11	0.06	-0.25	-0.19	-0.05	-0.29
7.	Flag leaf area (cm^2)							**1.00**	0.17	0.23	0.15	-0.35	-0.21	-0.03	-0.32
8.	Spike length (cm)								**1.00**	-0.02	-0.13	-0.15	-0.03	-0.13	-0.08
9.	No. of spikelets/ spike									**1.00**	0.00	0.01	-0.19	-0.10	0.12
10.	No. of grains/ spike										**1.00**	0.15	0.23	0.32	0.13
11.	Biomass yield (gms)											**1.00**	0.00	0.35	0.72
12.	harvest index %												**1.00**	0.33	0.32
13.	1000 seed weight (gms)													**1.00**	0.37

Table 3 : Direct (diagonal) and indirect effects of component traits on yield in wheat at genotypic level.

S. no.	Character	Days to 50% flower-ing	Days to mat-urity	Plant height (cm)	Tillers/ running meter	Flag leaf length	Flag leaf width (cm)	Flag leaf area (cm^2)	Spike length (cm)	No. of spike-lets /spike	Grains/ spike	Biomass yield (gms)	Harvest index %	1000 seed weight (gms)	Grain yield/ running Meter
1.	Days to 50% flowering	**-0.13**	0.00	0.02	0.04	-0.04	0.04	0.04	-0.04	-0.02	0.00	0.02	0.01	0.02	0.07
2.	Days to maturity	0.00	**0.06**	-0.01	-0.02	-0.03	0.00	0.01	0.00	0.02	0.01	-0.02	-0.01	-0.01	-0.24
3.	Plant height(cm)	-0.04	-0.07	**0.29**	0.09	0.08	0.12	0.03	0.04	-0.14	-0.13	-0.01	0.04	0.04	0.01
4.	No. of tillers/ running Meter	0.05	0.06	-0.05	**-0.15**	0.01	0.07	0.07	0.01	0.00	0.10	-0.08	-0.02	0.02	0.43
5.	Flag leaf length	0.07	-0.11	0.06	-0.01	**0.21**	0.02	0.00	0.04	-0.11	0.02	0.02	0.05	0.05	0.16
6.	Flag leaf width (cms)	-0.07	-0.01	0.08	-0.09	0.02	**0.20**	0.20	0.02	0.02	0.02	-0.07	-0.07	-0.01	-0.48
7.	Flag leaf area (cm^2)	0.17	-0.05	-0.07	0.27	-0.01	-0.60	**-0.61**	-0.14	-0.20	-0.11	0.22	0.13	0.02	-0.37
8.	Spike length (cm)	0.07	0.02	0.03	-0.01	0.05	0.03	0.06	**0.26**	-0.01	-0.09	-0.05	0.00	-0.05	-0.04
9.	No. of spikelets/ spike	0.09	0.19	-0.26	-0.01	-0.29	0.05	0.18	-0.01	**0.55**	0.04	-0.01	-0.16	-0.08	0.02
10.	No. of grains/ spike	0.00	0.03	-0.09	-0.14	0.02	0.02	0.04	-0.07	0.01	**0.21**	0.04	0.05	0.08	0.28
11.	Biomass yield (gms)	-0.13	-0.27	-0.02	0.42	0.06	-0.31	-0.31	-0.16	-0.01	0.15	**0.83**	-0.01	0.31	0.86
12.	harvest index %	-0.03	-0.09	0.05	0.05	0.11	-0.14	-0.09	-0.01	-0.12	0.10	0.00	**0.40**	0.14	0.38
13.	1000 seed weight (gms)	0.01	0.01	-0.01	0.01	-0.02	0.01	0.00	0.02	0.01	-0.03	-0.03	-0.03	**-0.09**	**0.43**

Table 4 : Direct (diagonal) and indirect effects of component traits on yield in wheat at phenotypic level.

S. no.	Character	Days to 50% flower-ing	Days to mat-urity	Plant height (cm)	Tillers/ running meter	Flag leaf length	Flag leaf width (cm)	Flag leaf area (cm^2)	Spike length (cm)	No. of spike-lets /spike	Grains/ spike	Biomass yield (gms)	Harvest index %	1000 seed weight (gms)	Grain yield/ running Meter
1.	Days to 50% flowering	**0.36**	0.00	-0.04	-0.09	0.09	-0.08	-0.08	0.03	-0.01	0.02	-0.07	-0.02	-0.05	**0.09**
2.	Days to maturity	0.00	**0.16**	-0.03	-0.07	-0.08	-0.02	0.01	0.01	0.04	0.02	-0.05	-0.04	-0.02	**-0.21**
3.	Plant height(cm)	0.00	0.01	**-0.05**	-0.01	-0.01	-0.01	0.00	-0.01	0.01	0.02	0.00	-0.01	-0.01	**0.01**
4.	No. of tillers/ running Meter	-0.03	-0.04	0.03	**0.10**	-0.01	-0.03	-0.05	0.00	0.00	-0.06	0.05	0.01	-0.01	**0.38**
5.	Flag leaf length	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	**0.12**
6.	Flag leaf width (cms)	-0.02	-0.01	0.03	-0.03	0.00	**0.09**	0.07	0.00	-0.01	0.01	-0.02	-0.02	-0.01	**-0.29**
7.	Flag leaf area (cm^2)	-0.02	0.01	0.01	-0.05	0.00	0.08	**0.11**	0.02	0.03	0.02	-0.04	-0.02	0.00	**-0.32**
8.	Spike length (cm)	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	**-0.08**
9.	No. of spikelets/ spike	0.00	0.04	-0.04	0.00	-0.06	-0.02	0.04	0.00	**0.15**	0.00	0.00	-0.03	-0.02	**0.12**
10.	No. of grains/ spike	-0.01	-0.01	0.06	0.08	-0.01	-0.01	-0.02	0.02	0.00	**-0.15**	-0.02	-0.03	-0.05	**0.13**
11.	Biomass yield (gms)	-0.15	-0.25	-0.01	0.40	0.06	-0.20	-0.29	-0.12	0.01	0.13	**0.84**	0.00	0.29	**0.72**
12.	harvest index %	-0.03	-0.10	0.05	0.05	0.11	-0.08	-0.09	-0.02	-0.08	0.10	0.00	**0.45**	0.15	**0.32**
13.	1000 seed weight (gms)	-0.01	-0.01	0.01	-0.01	0.02	0.00	0.00	-0.01	-0.01	0.03	0.03	0.03	**0.09**	**0.37**

coefficient analysis is simply the standardized partial regression coefficient, which splits the correlation coefficient into the measures of direct and indirect effects of independent variables on the dependent variables**.** Path analysis was worked out by using the estimates of correlation coefficient in all possible combinations among the dependent variables by using the procedure of Dewey and Lu (1959).

Results and Discussion

Genotypic and phenotypic correlation coefficient analysis

Correlation is a statistical measure, which is used to find out the degree and diversion of relationship between the grain yield with other characters. The correlation coefficients was estimated at both genotypic and phenotypic level (tables 1 and 2). Genotypic correlation coefficient analysis revealed that grain yield per running meter showed positive significant association with biomass yield (0.86), number of productive tillers per running meter (0.43), thousand seed weight (0.43), harvest index (0.38), number of grains per spike (0.28) and flag leaf length (0.16cm). Whereas, positive non significant association was observed with days to 50% flowering (0.07), number of spikelets per spike (0.02), plant height (0.01). The character like flag leaf width (-0.48) and flag leaf area (-0.37) showed negative significant association. These results are in agreement with those of Choudhary *et al*. (1991), Nabi *et al*. (1998), Uddin *et al*. (1997). Phenotypic correlation coefficient analysis revealed that grain yield per running meter showed positive significant association with biomass yield (0.72), number of productive tillers per running meter (0.38), thousand seed weight (0.37), harvest index (0.32), number of grains per spike (0.13), number of spikelets per spike (0.12) and flag leaf length (0.12). While positive non significant association was observed with days to 50% flowering (0.09) and plant height (0.01). The characters like flag leaf area (-0.32), flag leaf width (-0.29), days to maturity (-0.21) showed negative significant association. Similar results were also been reported by Mikheev (1992) and Narwal *et al*. (1999).

Genotypic and phenotypic path coefficient analysis

As the number of independent variables influencing a particular dependent variable increases the amount of interdependence of variable also increase such that indirect association becomes more complex and important. Under such as situation, correlation is not sufficient to explain the true association for effective manipulation of characters. It does not also indicate the cause and effect relationship and independent one may not be able to know which of the independent characters has the most direct effect on yield (tables 3 and 4). Genotypic path coefficient analysis revealed that biomass yield (0.83) had highest positive direct effect on grain yield per running meter followed by number of spikelets per spike (0.55), harvest index (0.40), plant height (0.29), spike length (0.26), flag leaf length (0.21), flag leaf width (0.20). While as flag leaf area (-0.61) showed direct negative effect with grain yield per running meter. Phenotypic path coefficient analysis revealed that biomass yield (0.84) had highest positive direct effect on grain yield per running meter followed by harvest index (0.45), days to 50% flowering (0.36), number of spikelets per spike (0.15), days to maturity (0.16), flag leaf area (0.11), number of productive tillers running meter (0.10). While as number of grains per spike (-0.15) showed direct negative effect with grain yield per running meter. These result were in agreement with the findings of Akhtar *et al.* (1992).

Conclusion

Correlation and path analysis revealed that Biomass yield, thousand seed weight, number of spikelets per spike and harvest index are the most important component characters that could be used as selection indices for further improvement in grain yield under temperate Kashmir conditions.

References

Afroz, R., M. S. H. Sharif and L. Rahman (2004). Genetic variability, correlation and path analysis in mustard and rape (Brassica spp.). *Bangladesh J. P1. Breed. Genet.*, **17(1)** : 59-63.

Akhtar, M., K. Alam and M. A. Chowdhry (1992). Genotypic and phenotypic correlation studies of yield and other morphological characters in *Triticum aestivum* L. *J. Agric. Res.,* **30** : 301–05.

Dewey, D. R. and K. H. Lu (1959). Genetic variability, correlation and path coefficient analysis of components of crested wheat grass seed production. *Agro. J*., **51** : 515-518.

Johnson, H. W., H. F. Robinson and R. E. Comstock (1955). Genotypic and phenotypic correlation in soybean and their implications in selections. *J. Agro*., 477-483.

Mikheev, L. A. (1992). Correlation of grain weight per ear with yield components in wheat hybrids. *Selektisys; Semenovodstvo* (Moskva), **2/3** : 17–21.

Nabi, T. G., M. A. Chowdhry, K. Aziz and W. M. Bhutta (1998). Interrelatinship among some polygenic traits in hexaploid spring wheat (*Triticum aestivum* L.). *Pakistan J. Biol. Sci*., : 299–302.

Nandan, R., Sweta and S. K. Singh (2010). Characters association and analysis in rice (*Oryza sativa* L.) genotypes. *World J.*

of Agric. Sci., **6(2)** : 201-206.

Narwal, N. K., P. K. Verma and M. S. Narwal (1999). Genetic variability, correlation and path coefficient analysis in bread wheat in two climatic zones of Haryana. *Agri. Sci. Digest Karnal*, **19** : 73–6.

Prasad, B., A. K. Patwary and P. S. Biswas (2001). Genetic variability and selection criteria in fine rice (*Oryza sativa* L.). *Pakistan J. Biol. Sci.*, **4** : 1188-1190.

Singh, G. and H. Chaudhary (2006). Selection parameters and yield enhancement of wheat (*Triticum aestivum* L.) under different moisture stress condition. *Asian J. Plant Sci.*, **5** : 894-898.

Uddin, M. J., B. Mitra, M. A. Z. Chowdhry and B. Mitra (1997). Genetic parameters, correlation, path-coefficient and selection indices in wheat. *Bangladesh J. Sci. Industrial Res.,* **32** : 528–38.