Indian Res. J. Genet. & Biotech 7(1) : 22 – 26 (2015)

Correlation and path analysis in advanced lines of wheat (*Triticum aestivum* L. em. Thell)

Jagatpal Singh[1], Veena Chawla[2], Pankaj Garg[3], Mamta Gupta[4] and L. K. Chugh[5]

Department of Genetics and Plant Breeding, CCS Haryana Agricultural University,Hisar-125 004 (Haryana),India

(Received: November 2014; Revised: December 2015; Accepted: January 2015)

Abstract

Thirty advance lines of bread wheat and their parents were evaluated at wheat research area of CCS HAU, Hisar, for morphological and quality traits to identify the most promising wheat lines. Correlation studies provide information of the nature and extent of association between any two pairs of metric characters. Moreover, understanding of the interaction of characters among themselves and with the environment has been of great use in enhancing the performance of a genotype. There was a positive correlation of the flag leaf with plant height, 100-grain weight, hectoliter weight and protein content whereas, negative correlation was observed with gluten content. Plant height also exhibited positive correlation with hectoliter weight and tiller per plant showed positive correlation with yield per plant. The path coefficient analysis takes into account the cause and effect relationship between the variables which is unique in partitioning the associations into direct and indirect effects through other dependent variables. Among the traits studied, days to 50 per cent flowering showed negative effect on grain yield. Tillers per plant and days to maturity exhibited positive direct effect on yield. The path analysis helps to resolve these correlations further and provide a clear picture in which component traits contribute towards dependent variable. So these traits can be used for effective selection of genotypes for grain yield.

Key words: Wheat, genotypic and phenotypic correlation, grain yield, path analysis

Introduction

Wheat (*Triticum aestivum* L. em. Thell) is an important cereal crop of cool climates, and plays a key role in the food and nutritional security of India. In India, 86 per cent of the cultivated area under wheat represents hexaploid spring type belonging to *Triticum aestivum* (Singh *et al*., 2008) more commonly called bread wheat. Wheat is widely grown the world-over and stands first among the cereals both in area and production. Most of the agronomic characters in crop plants are quantitative in nature. Yield is a complex quantitative trait, considerably affected by environment. Therefore, selection of genotypes based on yield is not effective. Selection has to be made for the components of yield. Bhatt (1972) reported that only correlation studies not clearly reveal such sort of information and inadequate knowledge interrelationships of heritable traits may lead to negative results. On the other hand, path coefficient analysis measures the direct and indirect effect for one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effect (Dewey and Lu, 1959). The genotypic association is important in determining the degree to which various traits are associated with grain yield per plant (Ali *et al*., 2009). Since the correlation coefficients generally show linear relationships among independent variables that may not sufficiently describe the association when a clear cause-result relationship is required between the variables. Therefore, the direct and indirect effects between yield and yield components should be known in breeding programs (Albayrak *et al*., 2003). Path coefficient analysis partitions the correlation coefficient into direct and indirect effects on yield. It is a reliable statistical technique which provides means not only to quantify the inter relationships of different yield component but also indicate whether the influence is directly reflected in the yield or takes some other path way for ultimate effects. Therefore, this technique provides a critical examination of specific factors producing a given correlation and can be successfully employed in formulating a selection strategy. Hence, the knowledge of correlations combined with path analysis for the morphological characters along with the grain yield provides a rational approach for planning more efficient improvement programme.

Materials and methods

In order to evaluate morphological and quality traits of wheat advanced lines by correlation and path analysis, this work was conducted during *Rabi*, 2011 at the experimental area of Department of Genetics and Plant breeding, CCS HAU, Hisar. Thirty advance lines (L_1 to L_{30}) of bread wheat (*Triticum aestivum* L.) along with their parents were grown in 3 replications in randomized

Corresponding authors- e-mail: *czarpankaj@gmail.com*
Published by the Indian Society of Genetics, Biotechnology Research and Development
Biotech Bhawan 5 E Nikhil Estate, DPS Road, Shastripuram, Agra 282007
Online management by www.isgbrd.co.in

block design. Observations were recorded on five randomly selected plants from each genotype as per DUS guideline in each replication for morphology and quality traits. Data were subjected to analysis of variance using online Staistical Analysis Package (OPSTAT, Computer Section, CCS Haryana Agricultural University, Hisar, India). Correlation and regression were also calculated. Path analysis was calculated following the procedure developed by Wright (1921) and applied by Dewey and Lu (1959).

Results and discussion

The analysis of variance revealed significant differences among the parents and advance lines for all the morphological and quality characters studied (Table 1). All the lines exhibited significant differences due to genotypes for all the traits. The existence of substantial variation for all the characters indicated the prevalence of adequate genetic variability in the material for not only the analysis of genetic variability, divergence, character association but also for besides selecting potential advance lines for wheat breeding and selection pursuits for tangible wheat improvement. Many earlier workers including Pawar *et al.* (1988), Kamat (1996), Kamboj *et al.* (2000), Naghavi *et al.* (2009), Riaz-ud-Din *et al*. (2010) and Kaushik *et al*. (2013) reported high variability for different traits in wheat. The genetic diversity present in the gene pool has also earlier been exploited for further improvement by Tanskley and McCouch (1997) and Fernie *et al*. (2006) in wheat.

Correlation studies provide information of the nature and extent of association between any two pairs of metric characters. In general, genotypic correlation coefficient indicated the inherent association among the various traits studied. At genotypic level, Days to 50 per cent flowering exhibited significant positive correlation with days to maturity (0.46**) and negative correlation with flag leaf length, plant height, 100-grain weight, sedimentation value and protein content (Table 2). Days to maturity exhibited positive correlation with yield per plant (0.20*) and negative correlation with 100-grain weight (-0.27*). Almost similar results were recorded by Jadhav (1994). Positive correlations of the flag leaf with plant height, 100-grain weight, hectoliter weight and protein content were observed whereas, negative correlation was observed with gluten content. Plant height exhibited positive correlation with hectoliter weight. Tiller per plant showed positive correlation with yield per plant (0.79*). Earlier Akbar *et al*. (1995), Mahmood *et al*. (2006), Jamali and Jamali (2006) and Ali *et al*. (2008) have recorded almost similar patterns of positive correlations. Contrary to this, tillers per plant were reported to have negative association with grain yield by Iftikhar *et al.* (2012). 100-grain weight was found to be positively correlated with sedimentation value and protein content. Gluten content exhibited positive correlation with sedimentation value and protein content. Sedimentation value exhibited positive correlation with protein content and negative correlation with yield per plant. Almost similar results were recorded earlier by Shah and Deora (2002) and Saxena *et al.* (2007). Correlation between different characters of plant could arise due to linkage, pleiotrophy and developmentally influenced relationships. In the present investigations, the genotypic correlation coefficient values were higher than the phenotypic values as earlier reported by Subhashchandra *et al*. (2009); Riaz-ud-din *et al*., (2010) and Iftikhar *et al.,* (2012).This indicated the strong intrinsic and inherent associations were somewhat masked at phenotypic level due to environmental effects. The correlation coefficient indicates only linear relationship existing between pair of characters. But, a dependent character is an interaction of product of many component characters and change in any one component will disturb whole network.

The path coefficient analysis takes into account the cause and effect relationship between the variables which is unique in partitioning the associations into direct and indirect effects through other dependent variables. Among the traits studied (Table 3), days to 50 per cent flowering showed negative effect (-0.55) on grain yield. It contributed to grain yield indirectly *via* 100-grain weight (0.38) and flag leaf length (0.34). No. of tillers per plant and days to maturity exhibited positive direct effect on yield. So direct selection of genotypes for grain yield through these traits may be effective. Similar results have been reported by Lad *et al*. (2003), Ali *et al.* (2008) and Subhashchandra *et al*. (2009). Plant height exhibited negative direct effects on grain yield per plant hence, dwarf varieties are preferred, as they could withstand in lodging conditions, this association could be used advantageous for development of dwarf varieties. Fossati *et al.* (2010) reported that protein content and yield were negatively correlated. In the present study protein content showed negative direct effect on yield per plant, it means yield loss occurred, during the selection of a variety for high protein content.

Five promising lines were selected on the basis of their performance for different characters. These lines were L_2 (Aldan x WH 542 F_7), L_3 (Aldan x WH 542 BC_5F_3), L_6 (Aldan x WH 542 BC_5F_3), L_{26} (HD 29 x WH 711 BC_5F_3) and L_{28} (HD 29 x WH 711 BC_5F_3).These lines were good for both yield and quality characters. Line L_2 exhibited desirable features like early flowering (87.00), long flag leaf (27.59 cm), high no. of tillers per plant (13.00), high 100-grain weight (5.29 g) and medium protein content (10.47%). High yield per plant (13.33 g), high 100-grain weight (4.56 g) and medium protein content (11.12%) were also recorded in L_3. High yield per plant (14.08 g) and high protein content (14.15%) were recorded in L_6. High yield per plant and high 100-grain weight were found in other two lines L_{26} and L_{28}.

Table 1: ANOVA for various characters in advance lines of bread wheat

Source of variation	df	Mean squares										
		Days to 50% flowering	Days to maturity	Flag leaf length	Plant height	No. of tillers per plant	100-grain weight	Gluten content	Hectoliter weight	Sedimentation value	Protein content	Yield per plant
Replication	22	3.65	24.72	0.48	33.80	6.01**	0.58**	2.94**	1.79	14.86	0.27**	9.05**
Treatment	33	111.12**	32.61**	29.38**	643.78**	7.71**	1.32**	100.55**	54.67**	85.27**	7.84**	27.60**
Error	66	7.61	9.74	1.66	8.89	2.55	0.11	0.54	3.11	20.81	0.09	4.55
CD		4.49	5.08	2.03	4.85	2.59	0.55	1.20	2.87	7.43	0.49	2.69

**significant at 1% level, *significant at 5% level

Table 2: Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients in various characters in advance lines of bread wheat

Traits	Days to 50% flowering	Days to maturity	Flag leaf length	Plant height	No. of Tillers per plant	100-grain weight	Gluten content	Hect-oliter weight	Sedime-ntation value	Protein content	Yield Per plant
Days to 50% flowering	1	0.46**	-0.54**	-0.41**	0.09	-0.61**	-0.06	-0.16	-0.34**	-0.21*	0.11
Days to maturity	0.67	1	-0.15	-0.18	0.06	-0.27**	-0.063	-0.07	-0.18	-0.18	0.20*
Flag leaf length	-0.61	-0.21	1	0.25*	0.02	0.45**	-0.26**	0.22*	0.13	0.21*	-0.06
Plant height	-0.46	-0.3	0.26	1	0.19	0.32	0.04	0.29**	0.15	0.06	0.09
No. of tillers per plant	0.19	0.16	-0.06	0.36	1	-0.01	-0.1	0.1	-0.13	0.01	0.79**
100-grain weight	-0.7	-0.6	0.52	0.36	-0.11	1	-0.06	0.18	0.25**	0.27**	-0.09
Gluten content	-0.08	-0.1	-0.29	0.04	-0.16	-0.06	1	0.09	0.42**	0.42*	-0.05
Hecto-litre weight	-0.18	-0.08	0.28	0.33	0.16	0.25	0.03	1	0.01	0.13	0.09
Sedimentation value	-0.48	-0.3	0.23	0.22	-0.19	0.36	0.6	0.05	1	0.46**	-0.25*
Protein content	-0.25	-0.29	0.24	0.06	0.01	0.3	0.43	0.16	0.62	1	-0.19
Yield per plant	0.22	0.41	-0.22	0.21	0.75	-0.25	-0.08	0.17	-0.32	-0.32	1

Table 3: Path coefficient analysis of grain yield per plant with its component characters in advance lines of bread wheat

Traits	Days to 50% flowering	Days to maturity	Flag leaf length	Plant height	No. of tillers per plant	100 seed weight	Gluten content	Hectoliter weight	Sedimentation	Protein content	Yield per plant
Days to 50% flowering	-0.55	-0.37	0.34	0.26	-0.11	0.38	0.04	0.10	0.27	0.14	0.50
Days to maturity	0.31	0.47	-0.10	-0.14	0.08	-0.28	-0.05	-0.04	-0.16	-0.14	-0.05
Flag leaf length	0.18	0.06	-0.30	-0.08	0.02	-0.16	0.09	-0.08	-0.07	-0.07	-0.41
Plant height	0.07	0.04	-0.04	-0.14	-0.05	-0.05	-0.01	-0.05	-0.03	-0.01	-0.27
No. of tillers per plant	0.15	0.13	-0.05	0.29	0.80	-0.09	-0.13	0.12	-0.15	0.01	1.08
100-grain weight	-0.03	-0.03	0.02	0.02	-0.01	0.05	0.00	0.01	0.02	0.01	0.06
Gluten content	-0.01	-0.02	-0.05	0.01	-0.03	-0.01	0.16	0.00	0.10	0.07	0.22
Hectoliter weight	-0.03	-0.01	0.04	0.05	0.02	0.04	0.00	0.15	0.01	0.02	0.29
Sedimentation Value	0.06	0.04	-0.03	-0.03	0.02	-0.04	-0.07	-0.01	-0.12	-0.07	-0.25
Protein content	0.07	0.08	-0.07	-0.02	0.00	-0.08	-0.12	-0.05	-0.17	-0.28	-0.64

Conclusion

The analysis of variance revealed highly significant genotypic differences for all characters which indicated the presence of adequate genetic variability in the material for further genetic analysis. Correlation coefficient at the genotypic level showed similar trends at the phenotypic level. Tillers per plant showed positive correlation with yield per plant (0.79**). 100-grain weight with sedimentation value (0.25**) and protein content (0.27**). Gluten content showed positive correlation with protein content (0.42*) and sedimentation value (0.42**). The high direct effects, in positive direction of the dependent variable i.e grain yield per plant was recorded for tillers per plant followed by days to maturity. The negative direct effect was observed of days to 50% flowering. In general, the indirect effects of the characters towards grain yield per plant were low.

References

1. **Akbar, M., Khan, N. I. and Chowdhry, M. H.** 1995. Variation and interraltionships between some biometric characters in wheat (*Triticum aestivum* L.). *J. Agric. Res*. **33**: 247-54.
2. **Bhatt, G. M.,** 1972. Significance of path coefficient analysis in determining the nature of character association. *Euphtica*. **22**: 38-43.
3. **Dewey, D. R. and K. H. Lu,** 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J*. **51**: 515-518.
4. **Albayrak, S., Sevimay, C. S. and Tongel, M. O.** 2003. Determination of characters regarding to seed yield using correlation and path analysis in inoculated and non-inoculated common vetch. *Turk. J. Field Crops.* **8**(2): 76-84.
5. **Ali, M. A., Nawab, N., Abbas, A., Zulkiffal, M. and Sajjad, M.** 2009. Evaluation of selection criteria in *Cicer arietinum* L. using correlation coefficients and path analysis. *Aus. J. Crop Sci*. **3**(2): 65-70.
6. **Ali, Y., Atta, B. M., Akhtar, J., Monnevux, P. and Lateef, Z.** 2008. Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. *Pak. J. Bot.* **40**(5): 2087-2097.
7. **Fossati, D., Brabant, C. and Kleijer, G.** 2010. Yield, protein content, bread making qualityand market requirements of wheat. *Tagung der Vereinigung der P fl anzenzüchter und Saatgutkau fleute* Österreichs. **6**: 179-182.
8. **Iftikhar R., Khaliq I., Ijaz M. and Rashid, M. A. R.** 2012. Association Analysis of Grain Yield and its Components in Spring Wheat (*Triticum aestivum* L.). *American-Eurasian J. Agric. & Environ. Sci*. **12**(3): 389-392.
9. **Jadhav, A. S.** 1994. Correlation studies in wheat. *Madras Agric. J.* **81**(5): 274.
10. **Jamali, R. and Jamali. K. D.** 2006. Correlation and Regression studies in semi-dwarf spring wheat (*Triticum aestivum* L.). *Pak. J. Bot*. **38**(2): 417-424.
11. **Lad, D. B., Bangar, N. D., Bhor, T. J., Mukherkar, G. D. and Biradar, A. B.** 2003. Correlation and path coefficient analysis in wheat. *J. Maharashtra Agric. Univ*. **28**(1): 23-25.
12. **Mahmood, Q. Wu, D. Lei, A. S. Qureshi, M. R. Khan, Y. Hayat, G. Jilani, I. H. Shamsi, M. A. Tajammal and Khan, M. I.** 2006. Heterosis, Correlation and Path Analysis of Morphological and Biochemical Characters in Wheat. *Agric. J*. **1**(3): 180-185.
13. **Moore,G., Devos, K. M., Wang, Z. and Gale, M. D.** 1995. Cereal genome evolution. *Curr. Biol*. **5**: 737-739.
14. **Riaz-ud-Din, Subhani, G. M., Ahmad, N., Hussain, M. and Rehman, A. U.** 2010. Effect of temperature on development and grain formation in spring wheat. *Pak. J. Bot*. **42**(2): 896-899.
15. **Saxena, P., Rawat, R. S., Verma, J. S. and Meena, B. K.** 2007. Variability and association analysis for yield and quality traits in wheat. *Pantnagar J. Res. (India).* **5**(2): 85-92.
16. **Shah, M. A and Deora, V. S.** 2002. Genetic variability and association studies in wheat for grain yield andtemperature tolerance parameters. *Indian J. Agric. Res.* **36**(3): 172-176.
17. **Subhashchandra, B., Lohithaswa, H. C., Desai, S. A., Hanchinal, R. R., Kalappanavar, I. K., Math, K. K. and Salimath, P. M.** 2009. Assessment of genetic variability and relationship between genetic diversity and transgressive segregation in tetraploid wheat. *Karnataka J. Agric. Sci.* **22**(1): 36-38.
18. **Singh, G., Khan, M. H. and Bhan, S. K.** 2008. Genetic divergence in wheat (*Triticum aestivum* L.). *New Botanist.* **35**(1-4):65-69.
19. **Wright, S.** 1921. Correlation and causation. *J. Agril. Res*. **20**: 557-585.