

Correlation and path analysis in barley (*Hordeum vulgare* L.) for yield and contributing traits under varied conditions

Neha Manhas and Subhash Chander Kashyap

Division of Plant Breeding and Genetics, Sher-e-Kashmir University of Agricultural Sciences and Technology, Main Campus, Chatha, Jammu 180009

Article history:

Received: 28 Jun., 2023

Revised: 25 Nov., 2023

Accepted: 23 Dec., 2023

Citation:

Manhas N and SC Kashyap. 2023. Correlation and Path analysis in Barley (*Hordeum vulgare* L.) for yield and contributing traits under varied conditions. *Journal of Cereal Research* 15 (3): 357-364. <http://doi.org/10.25174/2582-2675/2024/138618>

*Corresponding author:

E-mail: sc241274@outlook.com

Abstract

The present experiment was carried out for evaluation of seventeen barley (*Hordeum vulgare* L.) genotypes for grain yield and its contributing characters in four environments. The experiment was conducted at two locations viz., Advance Centre for Rainfed Agriculture SKUAST-Jammu, Dhiansar (under rainfed condition) and Research Farm Chatha, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (under irrigated condition) during Rabi 2019-20 and 2020-21, in Randomized Block Design with three replications. The data was recorded on characters viz. days to 50 per cent flowering, plant height (cm), chlorophyll content of leaf (SPAD values), flag leaf length (cm), flag leaf width (cm), number of tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike, biological yield/plant (g), grain yield/plant (g), test weight (g) and harvest index (%). Significant and positive correlation of grain yield per plant was observed with harvest index, number of grains per spike, plant height and flag leaf width at both genotypic and phenotypic levels. Positive and direct effect on grain yield was observed through harvest index, number of tillers per plant, plant height, SPAD values, days to 50% flowering at both genotypic and phenotypic levels in pooled environment. This experiment concluded that the characters, harvest index, number of tillers per plant, plant height, SPAD values, days to 50% flowering revealed true relationship between these characters and grain yield per plant, thus direct selection would be considered for grain yield improvement for these traits.

Key words: Correlation, path analysis, barley (*Hordeum vulgare* L.).

© Society for Advancement of Wheat and Barley Research

1. Introduction:

Barley (*Hordeum vulgare* L. 2n=2x=14) belongs to the family *Poaceae*. It is the fourth most important cereal crop of the world after rice, wheat and maize with a share of about 7% of global cereal production. In India total area occupied by barley is 600 thousand hectares with a total production of 1.69 million tons (Anonymous 2021). In J&K, barley occupies an area of about six thousand hectares with production of 4.4 thousand tonnes and

average productivity of 5.76q/ha which is significantly very low as compared to national production and productivity (Singh, 2018). Barley is also known as poor man's crop because it needs low inputs and possess better adaptability to dry and marginal lands. Barley grains are used as a protein and energy source in mulching cattle diets although it is most commonly used as malt source for alcoholic beverages in beer industries and is commonly



used in bread, soups, stews and health products (Badea and Wijekoon 2021). Despite being a crucial crop rich in proteins, minerals and carbohydrates, barley has been neglected in most of the area because of dominance of wheat, rice, and other cash crops, as a result of which its area, production and productivity is decreasing year after year. Development of new barley cultivars with tolerance to abiotic and biotic stresses and improved yield is a prime objective of any breeding programme. To make this possible, a good knowledge of variability present in the available germplasm, wild and cultivated barley is pre-requisite. The rate of success, however, will depend on the occurrence of desirable genetic variation and the availability of precise methods of identification, selection and, transfer of superior genes (Ellis. *et al.*, 2000). The identification of important traits and their correlation with yield will be very useful for the advancement of an effective breeding method for the development of better genotypes. In most of the breeding programme, yield is the prime objective, therefore the information on association of characters with yield and among themselves can be useful for planning a successful breeding programme.

2. Materials and Methods:

The experimental material for the present study comprising of 17 genotypes of barley genotypes obtained from Rajasthan Agricultural Research Institute (RARI), Durgapura, and some maintained in the Division of PBG, SKUAST- Jammu. The experiment was carried out at two rabi locations *viz.*, Advance Centre for Rainfed Agriculture SKUAST-J, Dhiansar, and Research Farm Chatha, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during 2019-20 and 2020-21 making four environments and was laid out in Randomized Block Design with three replications under different dates of sowing with plot size of 2m² (2m×1m) and row to row spacing of 25cm. The data was recorded on the basis of randomly selected five plants for thirteen characters *viz.* days to 50 per cent flowering, plant height (cm), chlorophyll content of leaf (SPAD values), flag leaf length, flag leaf width, number of tillers/ plant, spike length, number of spikelets per spike, number of grains per spike, biological yield per plant, grain yield per plant, test weight and harvest index. The genotypic and phenotypic correlations between all the characters under study were estimated according to the method given by Searle (1961)

whereas, path coefficient analysis was worked out using phenotypic and genotypic correlation values of yield components on yield as suggested by Wright (1921) and illustrated by Dewey and Lu (1959).

3. Results and Discussions:

The estimates of correlation coefficients among different characters are presented in Table 1. Correlation studies among yield contributing characters plays a crucial role in developing more effective genotypes with increased yield. The value of genotypic correlation was higher than the value of phenotypic correlation. In pooled environment, positive and significant association of grain yield per plant was found with days to 50% flowering our results are in consonance with Shahinnia *et al.*, (2005). Likewise, positive and significant correlation of grain yield was observed with plant height, SPAD values, flag leaf width, number of tillers per plant, number of grains per spike, harvest index similar findings were also reported by Al- Tabbal *et al.*, (2012), Mehmet *et al.*, (2011), Dere and Yildirim (2006), Blum *et al.*, (1989), Sharief *et al.*, (2011), Singh *et al.*, (2014), Srivastava *et al.*, (2012), Bhutta *et al.*, (2005), Ahmad *et al.*, (2005), Rajbir & Kaul (1989). Whereas, grain yield showed negative and significant association with spike length and negative non-significant association with number of spikelets per spike while negative non-significant association with test weight similar results were reported by Haile *et al.*, (2015), Kumar *et al.*, (2018).

Days to 50% flowering exhibited significant and positive association with plant height, SPAD values, number of tillers per plant, number of spikelets per spike, test weight, similar findings were obtained by Shahinnia, *et al.*, (2005), Vinesh *et al.*, (2018). Negative association of days to 50% flowering with harvest index was found similar with findings of Yadav *et al.*, (2014).

Similarly, plant height showed positive and significant association with biological yield per plant similar results were reported by Ayer *et al.*, (2017). The negative and significant association of plant height was recorded with number of tillers per plant, spike length and test weight, whereas, negative and non-significant association was recorded for plant height with harvest index, similar findings were also obtained by Pilania and Dhaka (2014). SPAD values had positive and significant association with test weight, harvest index, similar results were also shown by Ayer *et al.*, (2017). Likewise, it showed negative



Table 1. Phenotypic (P) and Genotypic (G) correlation coefficient analysis of grain yield per plant with other characters of pooled environment

Characters		Plant height (cm)	SPAD values	Flag leaf length (cm)	Flag leaf width (cm)	No. of tiller/plant	Spike length (cm)	No. of Spikelet/spike	No. of Grains/spike	Biological yield/plant (g)	Test weight (g)	Harvest Index (%)	Grain yield/plant (g)
Days to 50% flowering	G	0.311**	0.513**	0.081	0.622**	0.383**	0.049	0.262**	0.466**	0.131	0.296**	0.021	0.425**
	P	0.224**	0.174*	0.051	0.288**	0.293**	0.019	0.177*	0.107	0.086	0.169*	-0.016	0.250**
Plant height(cm)	G		0.003	-0.476**	0.092	-0.170*	-0.423**	-0.128	0.203**	0.495**	-0.318**	-0.090	0.660**
	P		0.116	-0.319**	0.030	-0.157*	-0.294**	-0.079	0.104	0.396**	-0.233**	-0.068	0.520**
SPAD values	G			0.444**	0.453**	0.461**	0.102	0.408**	0.480**	-0.194**	0.527**	0.224**	0.273**
	P			0.177**	0.095	0.238**	-0.018	0.122	0.082	-0.102	0.287**	0.148*	0.177*
Flag leaf length(cm)	G				0.602**	0.389**	0.734**	0.712**	0.319**	-0.742**	0.818**	0.525**	-0.289**
	P				0.377**	0.311**	0.408**	0.387**	0.126	-0.633**	0.649**	0.447**	-0.246**
Flag leaf width(cm)	G					0.319**	0.578**	0.679**	0.463**	-0.406**	0.510**	0.451**	0.179*
	P					0.176**	0.237**	0.334**	0.215**	-0.255**	0.303**	0.290**	0.149*
No. of tillers/plant	G			0.144*			0.144*	0.133	0.072	-0.147*	0.408**	0.177*	0.243**
	P			0.118				0.111	0.019	-0.150*	0.340**	0.152*	0.172*
Spike length(cm)	G							0.725**	0.359**	-0.341**	0.439**	0.165*	-0.358**
	P							0.277**	0.105	-0.222**	0.322**	0.075	-0.267**
No. of Spikelet/spike	G								0.586**	-0.390**	0.638**	0.413**	-0.034
	P								0.470**	-0.251**	0.358**	0.251**	-0.005
No. of Grains/spike	G									-0.091	0.398**	0.365**	0.400**
	P									-0.057	0.141*	0.187**	0.205**
Biological yield/plant(g)	G										-0.588**	-0.819**	0.084
	P										-0.544**	-0.797**	0.097
Test weight(g)	G											0.479**	-0.010
	P											0.435**	-0.019
Harvest index (%)	G												0.382**
	P												0.385**

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

Table 2. Phenotypic(P) and Genotypic(G) path coefficient analysis of grain yield/plant with other characters in pooled environment

Characters	Days to 50% flowering	Plant height (cm)	SPAD values	Flag leaf length (cm)	Flag leaf width (cm)	No. of tillers/plant	Spike length (cm)	No. of spikelets/spike	No. of grains/spike	Biological yield (g)	Test weight (g)	Harvest Index (%)	Correlation coefficient with Grain yield/plant (g)
Days to 50% Flowering	G 0.453 P 0.080	0.554 0.050	0.520 0.007	-0.321 -0.016	-1.006 0.022	0.302 0.056	0.138 -0.001	-0.004 -0.010	-0.167 0.007	-0.342 0.057	0.299 0.015	0.001 -0.016	0.425** 0.250**
Plant height (cm)	G 0.141 P 0.018	1.781 0.222	0.003 0.004	0.038 0.097	-0.148 0.002	-0.134 -0.030	-1.187 0.018	0.002 0.005	-0.074 0.007	-1.290 0.262	-0.322 -0.020	-0.004 -0.067	0.660** 0.520**
SPAD values	G 0.232 P 0.014	0.005 0.026	1.013 0.038	-1.764 -0.055	-0.733 0.007	0.363 0.045	0.287 0.001	-0.007 -0.007	-0.172 0.005	0.506 -0.068	0.534 0.025	0.009 0.145	0.273** 0.177*
Flag leaf length (cm)	G 0.037 P 0.004	-0.848 -0.071	0.450 0.007	-3.973 -0.309	-0.974 0.029	0.306 0.059	2.058 -0.025	-0.011 -0.023	-0.114 0.008	1.932 -0.419	0.828 0.056	0.020 0.437	-0.289** -0.246**
Flag leaf width (cm)	G 0.282 P 0.023	0.163 0.007	0.459 0.004	-2.392 -0.117	-1.618 0.077	0.251 0.034	1.621 -0.015	-0.011 -0.019	-0.166 0.014	1.057 -0.168	0.516 0.026	0.017 0.284	0.179* 0.149*
No. of tillers/plant	G 0.173 P 0.024	-0.304 -0.035	0.467 0.009	-1.545 -0.096	-0.516 0.014	0.787 0.191	0.405 -0.007	-0.002 -0.007	-0.026 0.001	0.383 -0.099	0.414 0.029	0.007 0.149	0.243** 0.172*
Spike length (cm)	G 0.023 P 0.002	-0.753 -0.065	0.104 -0.001	-2.915 -0.126	-0.935 0.018	0.114 0.022	2.806 -0.062	-0.012 -0.016	-0.129 0.007	0.889 -0.147	0.445 0.028	0.006 0.073	-0.358** -0.267**
No. of spikelet/spike	G 0.119 P 0.014	-0.227 -0.018	0.414 0.005	-2.829 -0.120	-1.099 0.026	0.105 0.022	2.033 -0.017	-0.016 -0.058	-0.210 0.031	1.015 -0.166	0.646 0.031	0.016 0.246	-0.034 -0.005
No. of grains/spike	G 0.211 P 0.009	0.366 0.023	0.487 0.003	-1.266 -0.039	-0.749 0.016	0.057 0.004	1.007 -0.006	-0.009 -0.027	-0.359 0.066	0.238 -0.038	0.404 0.012	0.014 0.183	0.400** 0.205**
Biological yield (g)	G 0.060 P 0.007	0.882 0.088	-0.197 -0.004	2.948 0.196	0.657 -0.020	-0.116 -0.029	-0.957 0.014	0.006 0.015	0.033 -0.004	-2.604 0.562	-0.595 -0.047	-0.031 -0.780	0.084 0.097
Test weight (g)	G 0.134 P 0.014	-0.566 -0.052	0.534 0.011	-3.250 -0.201	-0.825 0.023	0.321 0.065	1.231 -0.020	-0.010 -0.021	-0.143 0.009	1.531 -0.360	1.013 0.086	0.018 0.426	-0.010 -0.019
Harvest index (%)	G 0.009 P -0.001	-0.161 -0.015	0.227 0.006	-2.084 -0.138	-0.730 0.022	0.139 0.029	0.463 -0.005	-0.007 -0.015	-0.131 0.012	2.132 -0.527	0.486 0.038	1.891 0.979	0.382** 0.385**

Genotypic Residual effect = -0.32978 Phenotypic Residual effect = 0.26815

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



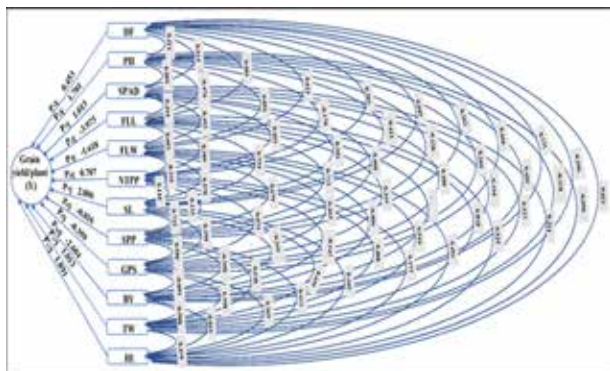


Figure 4.1 Genotypic path diagram for grain yield per plant

association with biological yield per plant, similar findings were also obtained by Perween *et al.* (2020). Similarly, flag leaf length and flag leaf width showed positive association with number of tillers per plant, grains per spike and test weight similar results were also reported by Singh *et al.*, (2015). Number of tillers per plant had positive and significant association with spike length, test weight and harvest index similar findings were also reported by Najeeb and Wani (2004), Drikvand *et al.* (2011), Shahinnia *et al.* (2005), Pal *et al.* (2010). Spike length had positive and significant association with spikelet per spike, grains per spike, test weight and harvest index, similar findings were also obtained by Srivastava *et al.*, (2012), Lodhi R. *et al.*, (2015), Najeeb and Wani (2004). Number of spikelets per spike showed positive and significant association with number of grains per spike, test weight and harvest index, similar findings were obtained by Tas and Celik (2011), Dyulgerova (2012), Gocheva (2014) and Doneva *et al.*, (2015). Number of grains per spike showed positive and significant association with test weight and harvest index. Negative association was shown by Number of grains per spike with biological yield per plant and similar findings were obtained by Doneva *et al.*, (2015), Tabassum *et al.*, (2018). Biological yield per plant showed negative significant association with test weight and harvest index and similar findings were also shown by Tabassum *et al.*, (2018), Pilania and Dhaka (2014), Srivastava *et al.*, (2012). Test weight showed positive and significant association with harvest index, similar results were also reported by Ayer *et al.*, (2017), Dubey, *et al.*, (2018).

Path-coefficient analysis

Path-coefficient analysis is an important statistical measure to partition the observed correlation coefficients into direct and indirect effects of component traits on grain

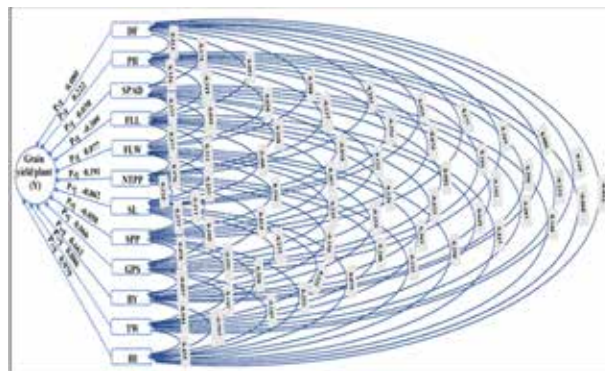


Figure 4.2 Phenotypic path diagram for grain yield per plant

yield. Partitioning of genotypic correlations between grain yield per plant and its component characters indicated that the direct effects showed higher magnitude than that of indirect effects for most of the characters. In the present investigation, path coefficient analysis of pooled environment was carried out taking grain yield per plant as a dependent variable and other twelve characters as independent variables (table 2). Out of twelve characters days to fifty percent flowering, plant height, number of tillers per plant, test weight and harvest index directly affected the grain yield per plant in positive direction. Harvest index showed highest positive direct effect on grain yield, similar results were also shown by Kara (2008), Najeeb and Wani (2004), Mittal *et al.* (2009), Eshghi *et al.* (2011) and Zaefizadeh *et al.* (2011). Likewise, SPAD values also showed positive direct effect with grain yield per plant similar findings were also reported by Blackmer and Schepers, (1995), Ramesh *et al.*, (2002) and Boggs *et al.*, (2003). Flag leaf width had negative direct effect on grain yield. Number of grains per spike have negative direct effect on grain yield per plant though it had a positive and significant correlation with grain yield, similar results were also reported by Singh *et al.*, (2015) and Pilania and Dhaka, (2014).

Conclusions:

From this study it has been concluded that the yield contributing traits like days to fifty percent flowering, plant height, number of tillers per plant, test weight and harvest index were found to be important components which effects grain yield.

Residual effect factor *i.e.*, G(-0.32978), P(0.26815) in pooled environment indicated that the yield contributing traits were also responsible for considerable variability in



the grain yield and hence while selection for yield these characters should be given due consideration.

Author Contributions

NM and SCK prepared the manuscript and preparing the final version of the manuscript and correspond to the journal.

Ethical Approval

This article does not contain any studies involving human or animal participants performed by any of the authors.

Conflicts of Interest:

The authors declare no conflict of interest.

References:

1. Ahmad Z. 2005. Genetic diversity for morpho-genetic traits and hordein seed protein in barley germplasm. Department of Plant Breeding and Genetics. Faculty of Crop and Food Science. Arid Agriculture University.
2. Al-Tabbal, JA and AH Al-Fraihat. 2012. Genetic variation, heritability, phenotypic, and genotypic, correlation studies for yield and yield components in promising barley genotypes. *Journal of Agricultural Science*, 4(3): 193-210.
3. Anonymous. 2021. Ministry of Agriculture and Farmers Welfare Department of Agriculture, Cooperation and Farmers Welfare First Advance Estimates of Production of Foodgrains for 2020-21 Directorate of Economics and Statistics. (<https://agricoop.nic.in>)
4. Ayer DK, A Sharma, BR Ojha, A Paudel and K Dhakal. 2017. Correlation and path coefficient analysis in advanced wheat genotypes. *SAARC Journal of Agriculture*, 15(1): 1-12.
5. Badea A. and C Wijekoon. 2021. Benefits of Barley Grain in Animal and Human Diets. *Cereal Grains*. Vol: 1.
6. Bhutta WM, T Barley and M Ibrahim. 2005. Path-coefficient analysis of some quantitative characters in husked barley. *Caderno de Pesquisa Serie Biologia Santa Cruz do Sul*, 17(1): 65-70.
7. Blackmer TM and JS Schepers. 1995. Use of a chlorophyll meter to monitor nitrogen status and schedule fertigation for corn. *Journal of Production Agriculture* 8(1): 11.
8. Blum A, G Golan, J Mayer, B Sinmena, L Shpiler and J Burra. 1989. The drought response of landraces of wheat from the northern Negev desert in Israel. *Euphytica*, 4, 87-96.
9. Boggs JL, TD Tsegaye, TL Coleman, KC Reddy and A Fashi. 2003. Relationship between hyperspectral reflectance, soil nitrate-nitrogen, cotton leaf chlorophyll and cotton yield: A step toward precision agriculture. *Journal of Sustainable Agriculture*, 22: 5-16.
10. Dere S and MB Yildirim. 2006. Inheritance of grain yield per plant, flag leaf width, and length in an 8 x 8 diallel cross population of bread wheat (*T. aestivum* L.). *Turkish Journal of Agriculture and Forestry*, 30, 339-345.
11. Dewey DR and KH Lu. 1959. A correlation and path coefficient analysis of components of crested wheat grass and seed production. *Agronomy Journal*, 52: 515-7.
12. Doneva MD, B Dyulgerova, D Dimova and D Valcheva. 2015. Correlation and path analysis between yield and yield components in winter barley. 2nd International Balkan Agriculture Congress: 302-308.
13. Drikvand R, K Samiei and T Hossinpur. 2011. Path coefficient analysis in hullless barley under rainfed condition. *Australian Journal of Basic and Applied Science* 5: 12-27.
14. Dubey V, DK Dwivedi, A Singh, Rampreet and Chhavi. 2018. Correlation and path coefficient analysis of yield components in rice under drought condition. *International Journal of Current Microbiology and Applied Sciences* 7: 4116-4122.
15. Dyulgerova B. 2012. Correlations between grain yield and yield related traits in barley mutant line. *Agricultural science and technology*, 4(3): 208 - 210.
16. Ellis RP, BP Foster, D Robinson, LL Handley, DC Gordon, JR Russell, Powell and W. 2000. Wild barley: a source of genes for crop improvement in the 21st century. *Journal of Experimental Botany*, 51: 9-17.



17. Eshghi RJ, Ojaghi and S Salayeva. 2011. Genetic gain through selection indices in hulless barley. *International Journal of Agriculture and Biology*. **13** (2): 191-197.
18. Gocheva M. 2014. Study of the productivity elements of spring barley using correlation and pathcoefficient analysis. Agribalkan congres, Edirne, Turkey, *Turkish Journal of Agricultural and Natural Sciences*, 1638-1641.
19. Haile J, H Legesse, CP Rao. 2015. Genetic variability, character association and genetic divergence in barley (*Hordeum vulgare* L.) genotypes grown at Horo district, Western Ethiopia. *Science Technology and Arts Research Journal*, **4**(2): 01-09.
20. Kara B. 2008. Effects of different tillage practices on the trait association in barley. *Turkish Journal of Field Crops*. **13**(1): 32-43.
21. Kumar Y, N Kumar, OP Bishnoi and S Devi. 2018. Estimation of genetic parameters and character association in Barley (*Hordeum vulgare* L.) under irrigated condition. *Forage Research*, **44** (1): 56-59 (2018).
22. Mehmet, Yildirim, Kilic, Hasan, Kendal, Enver, Karahan and Turan 2011. Applicability of chlorophyll meter readings as yield predictor in durum wheat. *Journal of plant nutrition*, **34**(2): 151-164.
23. Mittal VP, KS Brar, Paramjit Singh. 2009. Interrelationships and path coefficient analysis for yield and component characters in barley (*Hordeum vulgare* L.). *International Journal of Agricultural Sciences*, **5**(1): 151-153.
24. Najeeb S and Wani SA. 2004. Correlation and path analysis studies in barley (*Hordeum vulgare* L.). *National Journal of Plant Improvement*, **6**: 124-125.
25. Pal S, T Singh and B Ramesh. 2010. Estimation of genetic parameters in barley (*Hordeum vulgare* L.). *Crop Improvement*. **37**(1): 52-56.
26. Perween S, A Kumar, F Adan, J Kumar, P Raj and A Kumar. 2020. Correlation and path analysis of yield components in rice (*Oryza sativa* L.) under irrigated and reproductive stage drought stress condition. *Current Journal of Applied Science and Technology*, **39**(8): 60-68.
27. Pilania DS and RPS Dhaka. 2007. Stability analysis for grain yield and quality parameters in barley (*Hordeum vulgare* L.) germplasm in National Bureau of Plant Genetic Resources, Pusa Campus, NEW DELHI. *International Journal of Agricultural Sciences*, **3**(1): 49-52.
28. Ramesh K, B Chandrasekaran, TN Balasubramanian, U Bangarusamy, R Sivasamy and N Sankaran. 2002. Chlorophyll dynamics in rice (*Oryza sativa*) before and after flowering based on SPAD (chlorophyll) meter monitoring and its relation with grain yield. *Journal of Agronomy and Crop Science*, **188**: 102-105.
29. Rajbir S and MLH Kaul. 1989 Agronomic performance and correlations in elite barley. *Archiv fur. Zuchtungsforschung*, **19**(2), 119-132.
30. Searle SA. 1961. Phenotypic, genotypic and environmental correlations. *Biometrics*. **17**(3): 474-480.
31. Shahinnia, F., Rezai, AM. and Tabatabaei, BES. 2005. Variation and path coefficient analysis of important agronomic traits in two- and six-rowed recombinant inbred lines of barley (*Hordeum vulgare* L.). *Czech Journal of Genetics and Plant Breeding* **41**: 246-250.
32. Sharief AE, AN Attia, M Saied, AA El-Sayed & A EI-Hag. 2011. Agronomic studies on barley: yield analysis. *Crop & Environment*, **2**(1), 11-18.
33. Singh J, LC Prasad, AH Madakemohekar and SS Bornare. 2014. Genetic variability and character association in diverse genotypes of barley (*Hordeum vulgare* L.). *The Bioscan*. **9**(2): 759-761.
34. Singh S, AH Madakemohekar, LC Prasad and L Prasad. 2015. Genetic variability and correlation analysis and its contributing traits in barley (*Hordeum vulgare* L.) for drought tolerance. *Indian Research Journal of Genetics and Biotechnology* **7**(1): 103-108.
35. Singh GP. 2018. ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana, India. 94.
36. Srivastava S, A Sirohi, S Kumar. 2012. Correlation and path coefficient studies for yield and yield contributing traits in malt barley (*Hordeum vulgare* L.) International Conference on Agriculture, Science and Engineering (ICASE2012), 3-7 September 2012, Port Harcourt-Nigeria, **2**: 1-7.



37. A Tabassum Kumar, D Pandey and B Prasad. 2018. Correlation and path analysis for yield and its attributing traits in bread wheat (*Triticum aestivum* L. em Thell). *Journal of Applied and Natural Science* 10(4): 1078-1084.
38. Tas B. and N Celik. 2011. Determination of seed yield and some yield components through path and correlation analyses in many six-rowed barley (*H. vulgare* conv. *hexastichon*). *African Journal of Agricultural Research*, vol. 6(21), 4902 - 4905.
39. Vinesh B. LC Prasad and R Prasad. 2018. Character association and partitioning of correlations of yield and its attributing traits in late sown barley (*Hordeum vulgare* L.). *International Journal Current Microbiology Applied Sciences*, 7(7): 2020-2026.
40. Wright S, 1921. Correlation and causation. *Journal of Agricultural Research*, 20: 557-85.
41. Yadav SK, KK Pawar, SS Baghel, M Jarmanand and AK Singh. 2014. Genetic analysis for grain yield and its components in barley (*Hordeum vulgare* L.). *Journal of Wheat Research* 6(2):163-166.
42. Zaefizadeh M, M Ghasemi, J Azimi, M Khayatnezhad and B Ahadzadeh. 2011. Correlation analysis and path analysis for yield and its components in hullless barley. *Advances in Environment Biology*, 5(1): 123-126.

