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Genetic variability, correlation and path analysis for yield and its components in f_5 generation of bread wheat (*Triticum aestivum* L.)

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Abstract
The present investigation was undertaken with nineteen genotypes of wheat, (including one check) during *Rabi* 2015-2016 in a randomized block design with three replications at Field Experimentation Center of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, determine the magnitude of genetic variability Correlation and Path analysis for yield and its component traits in bread wheat (*Triticum aestivum*. L. Emm. Thell). Seventeen traits were studied in this investigation. Variability was measured by estimating genotypic and phenotypic variance (GCV and PCV), heritability (h^2_{bs}) and genetic advance for different quantitative traits. The mean sum of squares showed significant differences among all the characters. The maximum genotypic coefficient of variation (GCV) was observed for Biological yield per plant, followed by seed yield per plant, Grain filling periods, thousand grains weight, No of grain per spike, peduncle length, number of productive tiller per plant, plant height, and flag leaf width. Whereas, maximum phenotypic coefficient of variation (PCV) was exhibited for Biological yield per plant, followed by Seed yield per plant, Grain filling periods, Number of productive tiller per plant, thousand grains weight, Main spike weight, No of grains per spike peduncle length, Flag leaf width, Flag leaf length, Number of grains per spike, Spike length and plant height. High heritability (h^2_{bs}) was recorded for no of grains per spike, Plant height, thousand grains weight, Biological yield, Grain filling periods, Days to 50% heading, Days to 50% flowering, Peduncle length, Spike length and Seed yield per plant. High genetic advance was recorded for plant height. Seed yield exhibited positive significant correlation with biological yield, Main spike weight, Spikelets per spike at genotypic level, while biological yield per plant showed positive significant association at both genotypic and phenotypic level. Plant height, Days to 50% flowering, Spike length, Peduncle length, Biological yield, Harvest index and Main spike weight displayed positive direct effects on Grain yield per plant at both genotypic and phenotypic level. The above mention traits should be given due emphasis for future bread wheat genetic improvement because they possess high genetic variance, heritability (h^2_{bs}) coupled with high genetic correlation among themselves which may yield high genetic advance under proper selection pressure in a breeding program.

Keywords: Bread wheat, Genetic variability, Correlation coefficient and path analysis

Introduction
Wheat is the world's most widely cultivated food crop. It is eaten in various forms by more than one thousand million human beings in the world. In India it is second important staple food crop next to rice. Wheat, a cereal grass of the Gramineae (Poaceae) family and of the genus (*Triticum aestivum.* Emm. L) is the world's largest cereal crop. It has been described as the 'King of Cereals' because of the acreage it occupies, high productivity and the prominent position. It holds in the international food grain trade.

Wheat (*Triticuma aestivum* L.) is a hexaploid (2n = 6x = 42 = AABBDD genomes), annual and self-pollinated cereal which is grown worldwide. It belongs to tribe "Triticeae" of the family "Gramineae". As stated by (Mergoum, *et al.*, 2009) wheat is a monoecious plant with perfect flowers, reproducing sexually as an autogamous crop although limited (3%) cross pollination is possible. Similar to many crops of the Old World, wheat was one of the first domesticated food crops which was evolved in the Fertile Crescent of the Middle East and has become a basic staple food of the present day human population. Studies indicated, the first cultivation of wheat occurred about 10,000 years ago, which is considered as part of the 'Neolithic Revolution'. These earliest cultivated forms were diploid (genome AA) einkorn and tetraploid (genome AABB) emmer wheat and their genetic relationships indicate that they originated from the south-eastern part of Turkey (Dubcovsky and Dvorak, 2007).

Wheat is considered as the earliest domesticated cereal crop and the most important agricultural product of the world.

Today, wheat is grouped among the big three cereal crops of the world with its high tones of grain yield being harvested annually (Shewry, 2009). The wheat is cultivated in about 120 countries of the world. The major wheat producing countries are China, India, USA, Russian Federation, Canada, Australia, etc. The China has emerged as the largest producer of wheat and accounted for 15.7% share followed by India, which shared 12.06% in world production of wheat during the years 2001-2003.

Cultivation spread to the Near East by about 9000 years ago when hexaploid bread wheat made its first appearance (Feldman, 2001).

Materials and Methods

The investigation entitled "Genotypic and phenotypic variability and correlation analysis of wheat (*Triticum aestivum.* L. Emm. Thell) for yield and its components in late sown" was conducted during *Rabi* 2015-2016 at Field Experimentation Center of Department of Genetics and Plant Breeding, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad – 211 007, Uttar Pradesh, INDIA.

Experimental materials

The experimental materials consisted of 19 genotypes (including one check) of wheat, which were obtained from Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad, U.P. These were selected on the basis of their diverse geographical origin, wide variation and their adaptability for different agro- climatic zones of India.

Analysis of Variance

The mean sum of squares for the characters studied revealed that the mean sum of squares due to genotypes were significant for all the characters. This suggests that the genotypes selected were genetically variable and considerable amount of variability existed among them. Thus ample scope for selection for different quantitative traits for bread wheat improvement. Similar findings in wheat has also been reported by Bergale *et al*.,(2002), Dwivedi *et al.*,(2002), Asif *et al.*(2004) [3], Ali *et al.* (2008) [1], Mukher Jee *et al.,* (2008).

Estimation of Genetic parameters

Variability plays an important role in crop breeding. The development of an effective plant breeding programme depends on genetic variability. The efficiency of selection largely depends on the magnitude of genetic variability present in plant population. The success of genetic improvement in any character depends on the nature of variability present in gene pool for the component characters. Hence assessment of existing variability for any character present in the gene pool of a species is of almost importance to a plant breeder for starting judicious plant breeding. An insight into the magnitude of variability present in crop species is of all most important as it provides the basis for selection. The total variation present in a population arises due to genotypic and environmental effect presence of genetic variability in the breeding materials is essential for a successful plant breeding programme. Variability was measured by estimation of mean, coefficient of variation (genotypic and phenotypic), heritability, genetic advance and genetic gain. Environment plays an important role in the expression of phenotype and genotype facts, which are inferred, form phenotypic observations. Hence, variability can be observed through biometric parameters like genotypic coefficient of variation, heritability (broad sense) and genetic advance. This would be of great help to breeder in evolving a selection programme for gene. The estimate of variance (genotypic and phenotypic) coefficient of variation, heritability and genetic advance for all the seventeen characters studied have been presented.

Estimates of phenotypic variance and genotypic variance

Estimation of phenotypic variance (σ^2p) and genotypic variance (σ^2g) were obtained for different characters (Table 4.3). A wide range of variance was observed for all the characters. The highest genotypic variability (VG) was recorded for plant height (39.02), while moderate values were observed for Number of grain per spike (32.09), whereas Weight of 1000 seeds (23.01), Grain filling periods (17.89), Days to 50% heading (5.18), Days to 50% flowering (6.44), Flag leaf length/cm (1.09), Biological Yield (16.18), Days to Maturity (1.88), Total seed yield per plant/g (1.60), Harvest Index(9.94), Spike length with awn / cm(0.47), No of spikelet per spike (0.54), number of productive tillers per plant (0.17), Main spike weight (0.02) and Flag leaf width/cm (0.01) showed low variance.

The highest phenotypic variability (VP) was recorded for Plant height (44.40) while, moderate values were observed for no of Grain per spike (35.80), whereas Weight of 1000 seeds (26.68), Grain filling period(22.57), Biological Yield (19.99), Harvest Index (17.79) Peduncle length (14.53), Spikelets per spike (0.66), Days to 50% heading(6.99), Days to 50% flowering (8.76), Days to Maturity(4.72), Flag leaf length/cm(4.27), Total yield per plant/g-(2.45), Spike length with awn/cm(0.66), Number of productive tillers per plant (0.74), Main spike Weight (0.07) and Flag leaf width/cm (0.08) showed low variance.

Phenotypic variance was higher than genotypic variance for all the yield and yield contributing characters indicates the influence of environmental factors on these traits. Similar findings were reported by Arya *et al.* (2005) [2], Mishra *et al.*, (2013) [7].

Heritability (in broad sense)

The estimates of heritability ranged from 23.23% productive tiller per plant to 89.63% no of grains per spike. High heritability(above 70%) was observed for traits like No. of grains per spike (89.63%), Plant height (87.87%), 1000 Grains weight (86.26%), Biological yield per plant (80.95%), Grain filling periods (79.25%), Days to 50 % heading (74.15%), Days to 50% flowering (73.55%), Peduncle length (71.52%) and Spike length (70.65%) whereas Seed weight per plant (65.28%), Harvest Index (55.85%) and Days to maturity (39.84%) showed moderate heritability. The low estimates of heritability were recorded for No of productive tillers per plant (23.23%) and Main spike weight per plant (24.05%). Knowledge of heritability of a character is important as it indicates the possibility and extent to which improvement is possible through selection. It is a measure of relationship between parent and progeny and has been widely used to assess the degree to which a character may be transmitted from parent to offspring. It also indicates the relative importance of heritability and environment in the expression of characters. In the present study traits like No of grains per spike, Plant height, 1000 grains weight, Biological yield, Days to 50% heading, Days to 50% flowering and Peduncle length depicted high estimates of heritability (broad sense). Therefore selection from these traits will be worth full for

further improvement. Similar findings were reported by Khan and Hassan (2017) [5] and Wahidy *et al*., (2016) [9].

Estimates of phenotypic and genotypic correlation coefficients between each pair of characters

The results showed that, in general, the genotypic correlation coefficients (rg) were higher than the phenotypic correlation coefficients (rp) which indicated that association among these characters was under genetic control and indicating the preponderance of genetic variance in expression of characters. It might be due to depressing effect of environment on character association as reported earlier for wheat crop. In the present investigation the genotypic and phenotypic correlation coefficient of different character with seed yield per plant and their relationship among themselves are presented in table 4.4 and are discussed here under following points.

Path analysis

This technique was first used for plant selection .The path coefficient analysis is the simply a standardized partial regression coefficient which split the correlation coefficient into the measure of direct and indirect effects.

Plant height (0.01752), Peduncle length (0.02425), Spike length (0.05295), Flag leaf length (0.00508), Flag leaf width(0.03134), Days to flowering (0.02378), Grain filling periods(0.03651), Main spike weight (0.02903), Biological yield(1.0004) and Harvest index(0.60077) had positive direct effect on grain yield per plant at genotypic level.

The present experimental results were concluded on the basis of mean performance the genotype SHUATS-BW102 (10.43 gr) was recorded highest for seed yield per plant and genotype SHUATS-BW113 (61) was found best in No of grains per spike.

The present investigation the difference between PCV and GCV was very less for character s such as No of productive tiller per plant followed by Days to 50% heading, Days to 50% flowering, Spikelets per spike, Flag leaf length, Flag leaf width and Days to maturity indicating the lesser role of environment on the expression of various quantitative or metric traits whereas magnitudinal differences between GCV and PCV were relatively higher for Biological yield, Seed yield per plant, Grain filling periods, 1000 grains weight, No of grains per spike, Peduncle length and No of productive tillers per plant suggested greater influence of the environment in the expression of these characters .

The high heritability observed in most of the traits and coupled with high genetic advance was recorded for Plant height followed by No of grain per spike, 1000 grains weight, Grain filling period, Biological yield, Peduncle length, Days to 50% flowering and Harvest index suggesting that there was preponderance of additive gene action for the expression of these traits.

Biological yield per plant, Spikelets per spike and Main spike weight per plant showed positive and significant correlation at genotypic level with Seed yield per plant hence selection for these traits could be helpful for the improvement of bread wheat genotypes. Plant height, peduncle length, Days to 50% flowering, Grain filling periods, Biological yield, Harvest index, Flag leaf length and Spike length displayed positive direct effect on grain yield. This justifies that the presence of true relationship between these characters and grain yield, there by direct selection through these characters would result reasonable effect on grain yield while, No of productive tiller per plant, Spikelets per spike, Days to 50% heading, Days to 50% maturity and Flag leaf width depicted negative direct effect on grain yield. The present study showed the presence of considerable variability among the tested wheat genotypes and the possibility of improving yield and other desirable characters through selection. The study also revealed the importance of considering other characters in the process of selection of genotypes for yield. However, this study was conducted at one location of the wheat growing area for one growing season, therefore, it may not be sufficient to make strong conclusion and recommendation. This indicates the need to conduct further study by considering many wheat growing areas of Allahabad district for more than one cropping season.

Table 4.1: Analysis of variance for 17 quantitative and physiological characters among bread wheat 19 genotypes

Characters	Mean sum of squares		
	Replications	Treatments	Error
	df = 2	df = 18	df = 36
Plant height	0.123	122.435**	5.387
Tillers per plant	0.127	1.087*	0.570
Peduncle length	1.997	35.313**	4.139
Spikelets per spike	0.537	3.272*	1.653
Spike length	0.425	1.589**	0.193
Leaf length	2.162	6.454*	3.180
Leaf width	0.013	0.036**	0.018
Days to heading	1.032	17.354**	1.806
Days to flowering	1.309	21.642**	2.317
Days to maturity	1.740	8.482**	2.840
Grain filling periods	0.676	19.447**	4.684
Main spike weight	0.049	0.108*	0.055
No 0f grains per spike	0.727	99.974**	3.711
1000 grain weight	4.297	72.702**	3.666
Biological yield	0.469	52.358**	3.809
Harvest index	5.366	37.668**	7.856
Seed weight per plant	0.018	5.657**	0.852

Table 4.3 Estimation of components of variance and genetic parameters for 17 quantitative characters in 19 Bread wheat genotypes

Characters	Vg	Vp	GCV	PCV	HERTI	GA	GA AS %
Plant height	39.02	44.40	6.56	7.00	87.87	12.06	12.67
Tillers per plant	0.17	0.74	7.76	16.10	23.23	0.41	7.70
Peduncle length	10.39	14.53	8.83	10.44	71.52	5.62	15.38
Spikelets per spike	0.54	2.19	4.20	8.47	24.63	0.75	4.30
Spike length	0.47	0.66	6.72	7.99	70.65	1.18	11.63
Leaf length	1.09	4.27	4.57	9.03	25.55	1.09	4.75
Leaf width	0.01	0.02	5.00	10.04	24.84	0.08	5.13
Days to heading	5.18	6.99	2.99	3.48	74.15	4.04	5.31
Days to flowering	6.44	8.76	3.16	3.68	73.55	4.48	5.57
Days to maturity	1.88	4.72	1.26	1.99	39.84	1.78	1.63
Grain filling periods	17.89	22.57	14.71	16.53	79.25	7.76	26.98
Main spike weight	0.02	0.07	6.44	13.13	24.05	0.13	6.50
No 0f grains per spike	32.09	35.80	11.89	12.56	89.63	11.05	23.19
1000 grain weight	23.01	26.68	13.73	14.79	86.26	9.18	26.27
Biological yield	16.18	19.99	20.46	22.74	80.95	7.46	37.92
Harvest index	9.94	17.79	7.75	10.37	55.85	4.85	11.93
Seed weight per plant	1.60	2.45	16.21	20.06	65.28	2.11	26.98

Table 4.4.1: Estimates of genotypic correlation between yield and its components with grain yield per plant in 19 bread wheat genotypes

Characters	Plant height	Tillers per plant	Peduncle length	Spikelets per spike	Spike length	Leaf length	Leaf width	Days to heading	Days to flowering	Days to maturity	Grain filling periods	Main spike weight	No 0f grains per spike	1000 grain weight	Biological yield	Harvest index	Seed weight per plant
Plant height	1.00	-0.060	0.195	-0.031	-0.322*	0.473**	0.010	-0.396**	-0.414**	-0.021	0.461**	0.462**	-0.176	0.300*	0.110	0.048	0.206
Tillers per plant		1.00	-0.183	0.268*	-0.191	0.680**	-0.476**	-0.140	-0.230	-0.273*	0.094	-0.066	0.209	-0.336*	-0.045	0.016	-0.111
Peduncle length			1.00	-0.142	-0.147	0.323*	0.151	-0.398**	-0.320*	-0.173	0.259	-0.100	-0.589**	0.315*	0.075	0.246	0.256
Spikelets per spike				1.00	0.873**	0.159	1.014**	0.549**	0.501**	-0.341**	-0.784**	0.917**	0.621**	0.388**	0.062	0.320*	0.303*
Spike length					1.00	-0.327*	0.162	0.459**	0.453**	-0.100	-0.580**	0.293*	0.076	0.362**	-0.221	0.455**	0.003
Leaf length						1.00	0.325*	-0.117	-0.117	0.485**	0.434**	0.906**	-0.166	0.408**	-0.067	-0.311*	-0.334*
Leaf width							1.00	0.624**	0.692**	0.468**	-0.502**	0.406**	0.405**	0.114	0.098	-0.360**	-0.042
Days to heading								1.00	0.979**	0.482**	-0.822**	0.605**	0.147	0.295*	0.092	0.058	0.148
Days to flowering									1.00	0.489**	-0.842**	0.559**	0.101	0.276*	0.173	-0.007	0.226
Days to maturity										1.00	0.059	0.069	0.210	-0.198	-0.013	-.483**	-0.314*

Grain filling periods											1.00	-0.597**	0.015	-0.438**	-0.206	-0.290*	-0.452**
Main spike weight												1.00	0.263*	0.797**	0.251	0.089	0.369**
No 0f grains per spike													1.00	-0.487**	0.166	-0.458**	-0.061
1000 grain weight														1.00	-0.049	0.484**	0.246
Biological yield															1.00	-0.699**	0.875**
Harvest index																1.00	-0.261
Seed weight per plant																	1.00

**Significant at 1% level of significance, * Significant at 5% level of significance respectively

Table4. 4. 2: Estimates of Phenotypic correlation between yield and its components with grain yield per plant in 19 bread wheat genotypes

Characters	**Plant height**	**Tillers per plant**	**Peduncle length**	**Spikelets per spike**	**Spike length**	**Leaf length**	**Leaf width**	**Days to heading**	**Days to flowering**	**Days to maturity**	**Grain filling periods**	**Main spike weight**	**No 0f grains per spike**	**1000 grain weight**	**Biological yield**	**Harvest index**	**Seed weight per plant**
Plant height	1.00	-0.066	0.117	-0.091	-0.273*	0.173	0.057	-0.333*	-0.341**	-0.076	0.273*	0.210	-0.109	0.312*	0.111	0.068	0.191
Tillers per plant		1.00	-0.118	-0.071	-0.179	0.227	0.015	-0.009	-0.097	-0.228	-0.068	0.199	0.158	-0.134	0.104	-0.058	0.069
Peduncle length			1.00	-0.080	-0.108	0.175	-0.062	-0.297*	-0.222	-0.122	0.126	-0.040	-0.499**	0.272*	0.082	0.043	0.148
Spikelets per spike				1.00	0.317*	-0.086	0.197	0.133	0.173	-0.075	-0.218	0.342**	0.235	0.180	-0.029	0.099	0.036
Spike length					1.00	-0.083	0.033	0.392**	0.407**	0.052	-0.352**	0.185	0.042	0.233	-0.163	0.229	-0.013
Leaf length						1.00	-0.005	-0.144	-0.177	0.172	0.290*	0.161	-0.115	0.210	-0.014	-0.149	-0.098
Leaf width							1.00	0.138	0.215	0.231	-0.043	0.409**	0.222	0.126	0.145	-0.183	0.086
Days to heading								1.00	0.932**	0.237	-0.724**	0.288*	0.157	0.194	0.049	-0.028	0.024
Days to flowering									1.00	0.301*	-0.744**	0.263*	0.119	0.186	0.159	-0.087	0.118
Days to maturity										1.00	0.413**	-0.015	0.150	-0.204	-0.004	-0.258	-0.173
Grain filling											1.00	-0.261*	-0.009	-0.321*	-0.154	-0.098	-0.234

periods																
Main spike weight												1.00	0.166	0.438**	0.246	-0.124	0.240
No 0f grains per spike													1.00	-0.422**	0.149	-0.363**	-0.057
1000 grain weight														1.00	0.008	0.323*	0.231
Biological yield															1.00	-0.515**	0.836**
Harvest index																1.00	0.019
Seed weight per plant																	1.00

**Significant at 1% level of significant and *Significant at 5% level of significant respectively

Table 4.5.1: Genotypic Path coefficient of yield attributing traits with grain yield per plant

Characters	Plant height	Tillers per plant	Peduncle length	Spikelets per spike	Spike length	Leaf length	Leaf width	Days to heading	Days to flowering	Days to maturity	Grain filling periods	Main spike weight	No 0f grains per spike	1000 grain weight	Biological yield	Harvest index
Plant height	0.01752	0.00111	0.00283	0.00136	-0.01445	0.00088	0.00178	0.00481	-0.00811	0.00351	0.00995	0.0061	0.00024	-0.00423	0.12671	0.04092
Tillers per plant	-0.00116	-0.01681	-0.00285	0.00106	-0.0095	0.00116	0.00046	0.00012	-0.0023	0.01055	-0.00247	0.00579	-0.00035	0.00181	0.11843	-0.03478
Peduncle length	0.00204	0.00198	0.02425	0.0012	-0.0057	0.00089	-0.00196	0.00429	-0.00527	0.00563	0.00461	-0.00115	0.00111	-0.00369	0.09345	0.02584
Spikelets per spike	-0.0016	0.00119	-0.00194	-0.01497	0.01678	-0.00044	0.00617	-0.00193	0.00412	0.00346	-0.00796	0.00992	-0.00052	-0.00244	-0.03338	0.05918
Spike length	-0.00478	0.00301	-0.00261	-0.00474	0.05295	-0.00042	0.00104	-0.00566	0.00967	-0.00242	-0.01284	0.00537	-0.00009	-0.00316	-0.18625	0.13782
Leaf length	0.00303	-0.00382	0.00425	0.00129	-0.00438	0.00508	-0.00016	0.00209	-0.0042	-0.00796	0.01057	0.00467	0.00025	-0.00285	-0.01652	-0.08945
Leaf width	0.001	-0.00025	-0.00151	-0.00295	0.00176	-0.00003	0.03134	-0.00199	0.00511	-0.01068	-0.00157	0.01188	-0.00049	-0.00171	0.16614	-0.10998
Days to heading	-0.00584	0.00015	-0.0072	-0.002	0.02078	-0.00073	0.00433	-0.01443	0.02216	-0.01095	-0.02642	0.00837	-0.00035	-0.00263	0.05607	-0.01685
Days to flowering	-0.00598	0.00163	-0.00538	-0.00259	0.02154	-0.0009	0.00673	-0.01345	0.02378	-0.01392	-0.02715	0.00763	-0.00026	-0.00253	0.1815	-0.05219
Days to maturity	-0.00133	0.00384	-0.00295	0.00112	0.00277	0.00087	0.00724	-0.00342	0.00716	-0.0462	0.01509	-0.00042	-0.00033	0.00276	-0.00406	-0.1552
Grain filling periods	0.00477	0.00114	0.00307	0.00326	-0.01862	0.00147	-0.00135	0.01045	-0.01769	-0.0191	0.03651	-0.00758	0.00002	0.00435	-0.17616	-0.05897
Main spike weight	0.00368	-0.00335	-0.00096	-0.00512	0.0098	0.00082	0.01283	-0.00416	0.00625	0.00067	-0.00953	0.02903	-0.00037	-0.00595	0.28067	-0.07465

No 0f grains per spike	-0.0019	-0.00266	-0.0121	-0.00352	0.00222	-0.00058	0.00695	-0.00227	0.00283	-0.00692	-0.00031	0.00482	-0.00222	0.00573	0.17058	-0.21801
1000 grain weight	0.00546	0.00225	0.00659	-0.00269	0.01234	0.00106	0.00395	-0.00279	0.00443	0.0094	-0.0117	0.01272	0.00094	-0.01357	0.00862	0.19404
Biological yield	0.00194	-0.00174	0.00198	0.00044	-0.00863	-0.00007	0.00456	-0.00071	0.00378	0.00016	-0.00563	0.00713	-0.00033	-0.0001	1.14284	-0.30926
Harvest index	0.00119	0.00097	0.00104	-0.00147	0.01215	-0.00076	-0.00574	0.0004	-0.00207	0.01194	-0.00358	-0.00361	0.00081	-0.00438	-0.58831	0.60077

Table 4.5.2: Phenotypic Path coefficient of yield attributing traits with grain yield per plant

Characters	**Plant height**	**Tillers per plant**	**Peduncle length**	**Spikelets per spike**	**Spike length**	**Leaf length**	**Leaf width**	**Days to heading**	**Days to flowering**	**Days to maturity**	**Grain filling periods**	**Main spike weight**	**No 0f grains per spike**	**1000 grain weight**	**Biological yield**	**Harvest index**
Plant height	0.068	-0.091	0.047	-0.02	0.002	-0.009	-0.026	-0.236	0.191	-0.014	-0.112	0.119	0.007	-0.182	1.236	0.639
Tillers per plant	-0.00408	-0.09063	-0.00867	-0.0054	-0.00046	-0.00625	0.01236	0.03312	-0.04395	0.00377	-0.01049	-0.00787	0.00147	0.0612	-0.05541	0.01029
Peduncle length	0.01327	0.01657	0.04741	0.00286	-0.00035	-0.00297	-0.00392	0.09402	-0.06122	0.00239	-0.02893	-0.01195	-0.00414	-0.0574	0.09259	0.15738
Spikelets per spike	-0.0021	-0.02428	-0.00673	-0.02014	0.0021	-0.00146	-0.02635	-0.12954	0.09579	0.0047	0.08745	0.10934	0.00437	-0.07083	0.07642	0.20451
Spike length	-0.0219	0.01732	-0.00695	-0.01758	0.00241	0.003	-0.00421	-0.1083	0.08661	0.00138	0.06471	0.03496	0.00054	-0.06594	-0.27335	0.29077
Leaf length	0.0322	-0.06167	0.01531	-0.00321	-0.00079	-0.00919	-0.00845	0.02772	-0.02241	-0.00669	-0.04839	0.10807	-0.00117	-0.07433	-0.08251	-0.19863
Leaf width	0.0007	0.04313	0.00715	-0.02043	0.00039	-0.00299	-0.02598	-0.14725	0.13235	-0.00646	0.05606	0.04841	0.00285	-0.02073	0.12106	-0.23041
Days to heading	-0.02692	0.01271	-0.01888	-0.01105	0.0011	0.00108	-0.0162	-0.23612	0.18723	-0.00665	0.09176	0.07211	0.00104	-0.05387	0.11371	0.03705
Days to flowering	-0.02818	0.02083	-0.01518	-0.01009	0.00109	0.00108	-0.01797	-0.23113	0.19128	-0.00675	0.09398	0.06674	0.00071	-0.05025	0.21401	-0.00467
Days to maturity	-0.0014	0.02476	-0.00821	0.00686	-0.00024	-0.00445	-0.01216	-0.11374	0.09347	-0.01381	-0.0066	0.00828	0.00147	0.03617	-0.01575	-0.30877
Grain filling periods	0.03137	-0.00852	0.01229	0.01578	-0.0014	-0.00398	0.01305	0.19412	-0.16107	-0.00082	-0.11161	-0.07124	0.0001	0.07986	-0.2546	-0.18554
Main spike weight	0.03146	0.00598	-0.00475	-0.01846	0.00071	-0.00832	-0.01054	-0.14274	0.10701	-1E-03	0.06666	0.11929	0.00185	-0.14528	0.31002	0.05661

No 0f grains per spike	-0.01198	-0.01896	-0.02791	-0.01251	0.00018	0.00153	-0.01053	-0.03481	0.01923	-0.00289	-0.00162	0.03134	0.00703	0.08889	0.2049	-0.29262
1000 grain weight	0.02045	0.03042	0.01492	-0.00782	0.00087	-0.00375	-0.00295	-0.06976	0.05271	0.00274	0.04888	0.09504	-0.00343	-0.18236	-0.05996	0.30954
Biological yield	0.00745	0.00406	0.00355	-0.00125	-0.00053	0.00061	-0.00254	-0.02172	0.03311	0.00018	0.02299	0.02992	0.00117	0.00885	1.23621	-0.44668
Harvest index	0.00328	-0.00146	0.01167	-0.00644	0.0011	0.00285	0.00936	-0.01368	-0.0014	0.00667	0.03239	0.01056	-0.00322	-0.08828	-0.86359	0.63941

References

1. Ali Y, Barbar MA, Javed A, Philippe M, Zahid L. Genetic variability, Association and diversity Studies in Wheat (*Triticum aestivum* L.) Germplasm. Pakistan Journal of Botany. 2008; 40(5):2087-2097.
2. Arya VD, Pawar IS, Lamba RAS. Genetic variability, correlation and path coefficient for yield and quality traits in bread wheat. Haryana Agricultural University Journal of Research. 2005; 35(1):59-63.
3. Asif M, Mujahid MY, Kisana SS, Mustafa SZ, Ahmad I. Heritability, genetic variability and path coefficient of some traits in spring wheat. Sarhad Journal of Agriculture. 2004; 20(1):87-91.
4. Bergale S, Billere Mridulla, Holakar AS, Ruwali KN, Prasad SVS, Mridulla B. Genetic variability traits with grains yield in bread wheat (*Triticum aestivum* L.) Madras Journal of Agriculture. 2001; 88(7/9):457-461.
5. Khan SA, Hassan G. Heritability and Correlation Studies of Yield and Yield Related Traits in Bread Wheat. Sarhad Journal of Agriculture. 2017; 33(1):103-107.
6. Kumar S, Dwivedi VK, Tyagi NK. Genetic variability in some metric trait and its contribution to yield in wheat (*Triticum aestivum*. L. Emm. Thell) Progressive Agriculture. 2003; 3(1-2):152-153.
7. Santosh, Arya, Mishra DK, Bornare SS. Screening genetic variability in advance lines for drought tolerance of bread wheat (*Triticum aestivum* L.). The Bioscan. 2013; 8(4):1193-1196.
8. Shankarrao BS, Mukherjee S, Pal AK, De DK. Estimation of variability for yield parameters in Bread Wheat (*Triticum aestivum* L.) grown in Genetics West Bengal. Electronic Journal of Plant Breeding. 2010; 1(4):764-768.
9. Wahidy S, Lavanya GR. Genetic variability for seed yield and its component characters in wheat (*Triticum aestivum* L.) International Journal of Multidisciplinary Research and Development. 2016; 3(7):21-23.