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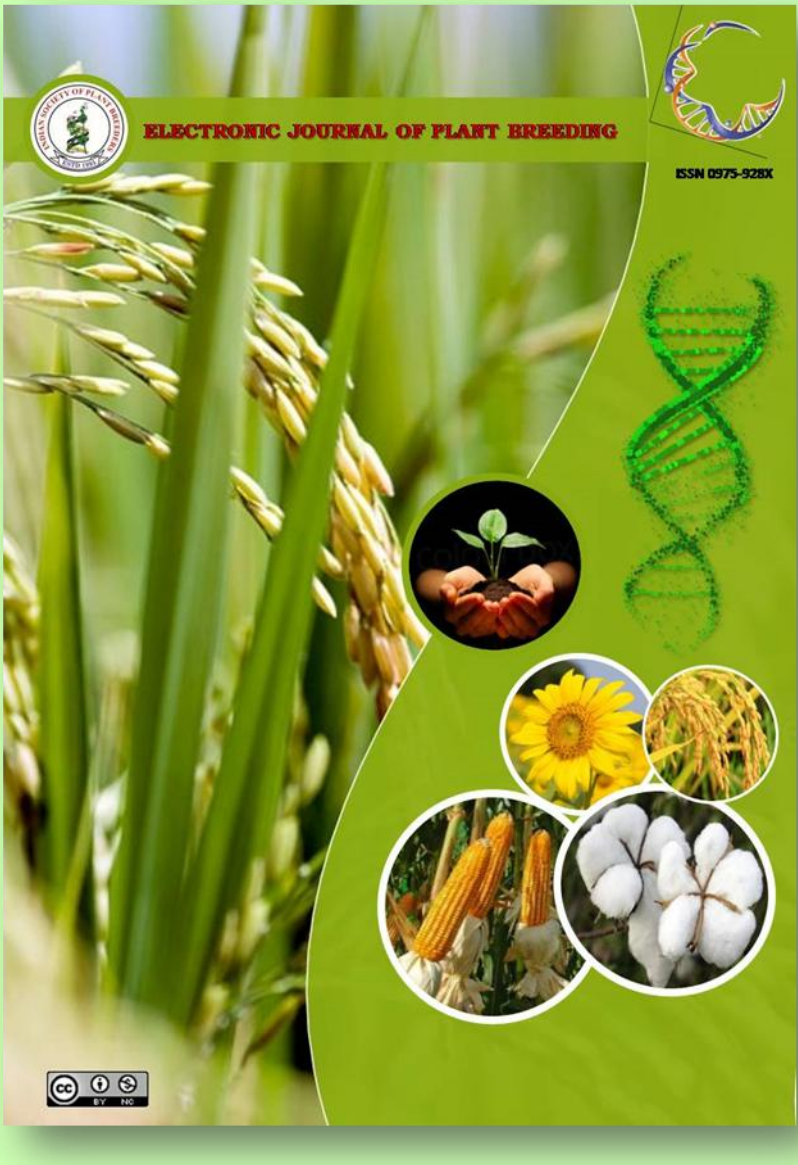

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Research Article

Genetic evaluation of different genotypes of wheat (*Triticum aestivum* L.) in normal sowing condition in Punjab

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Abstract
Study was carried out with 25 wheat genotypes at Agricultural Research Farm, School of Agriculture, Lovely Professional University, Phagwara, Punjab (India) during *Rabi* 2017-18 to study genetic variability for 11 traits. The genotypes exhibited broad range of diversity, which means that existence of enough genetic variability in the genotypes under study. High heritability combined with high genetic advance was recorded for harvest index (27.77%) and number of grains per plant (26.31%), which means that this traits were covered by additive gene action and can be effectively used for genetic advancement programme The correlation coefficients estimate exhibit high genotypic and phenotypic correlation for harvest index, number of grains spike^{-1} and effective tillers plant^{-1} with grain yield. Outcome of path analysis confirmed that harvest index and grain yield plant^{-1} should be taken into consideration during wheat improvement programmes. In D^2 analysis 25 wheat genotypes were arranged into 6 groups. The genotypes included in group II were recorded minimum days to maturity and days to 50% flowering. Group IV shown high harvest index and grain yield^{-1} which appeals that the genotypes present in these groups could adequately used for the wheat advancement programmes.

Key words
Cluster, Correlation, Heritability, Wheat, Yield

Introduction

Wheat (*Triticum aestivum* L.) is cultivated extensively in all over the world after maize. India is the 2nd largest producer of wheat in the globe after China. Wheat is the most largely grown crop among cereals occupies 17% of the agricultural land and provides food for 40% of world's population. Wheat is consumed in a variety of ways such as flour, porridge, chapatti, bread, chapatti etc (Bharat *et al.*, 2013). During 2017-18 India's wheat production reduced by 1.42% (govt. of India) wheat production is predicted to drop by 1.40 MT. In 2016-17, wheat production was 98.51 MT and in 2017-18 it was 97.11 MT. Today as the population increases day by day, because of that it is important for the breeders to develop both grain yield and quality cultivars in cultivated genotypes of wheat (Rudra *et al.*, 2015). Evaluation of genotypic and phenotypic coefficient of variations is helpful for selection of promising genotypes. Heritability combine with genetic advance helpful for anticipate the performance of genotypes in the future generations (Kumar *et al.,* 2014). Correlation studies give us information about relationship among different traits. This information helpful for breeders in choosing genotypes with desired characters (Ali 2012). D^2 statistics help in the estimation of genetic diversification in plant breeding. Higher the distance among the clusters, higher diversity and heterosis in offspring's can be obtained (Joshi and Dhawan 1966). The present investigation was conducted with 25 wheat genotypes to appraise the level of genetic variations exists in the genotypes with respect to yield and yield contributing characters in wheat for utilization in selection programmes aimed at productivity increase of future genotypes.

Materials and Methods

The current research was conducted during *Rabi* 2017-2018 at Agricultural Experimental Farm of School of Agriculture, Lovely Professional University, Phagwara, Punjab (India). Total twenty five wheat genotypes were grown by using randomized block design with three replications. It is located at 31.22 latitude and 75.77 longitudes and it is situated at elevation of 246 meters above sea level. Each genotype was sown in 3 rows of 3 meter length with a spacing of 10 cm for plant to plant and 30 cm for row to row. Observation were recorded for 11 characters *viz.*, plant height (cm), spike length (cm), effective tillers per plant, seed yield per plant, biological yield, harvest index, grains per spike, days to maturity, days to 50% flowering, awn length (cm) and 1000 grain weight. The obtained information includes genotypic ($\sigma^2 g$) and phenotypic variance ($\sigma^2 p$) which was evaluated using the formula given by (Singh and Chaudhary 1985). Whereas genetic advance as percent of mean estimated by using the method (Johnson *et al.,* 1955) the method suggested by (Singh and Chaudhary, 1985) was used for estimation of correlation coefficients Correlation. Path analysis was done by using procedure given by Dewey and Lu (1959). The D2 statistics was estimated by the method given by (Mahalanobis 1936). Tochers method of Rao (1952) was used for grouping of the 25 genotypes into 6 clusters.

Results and Discussion

Total 25 wheat genotypes exhibited significant differences for all 11 characters under study, recommended that the genotypes were genetically divergent (Table 1). These results implied that this population of wheat genotypes would respond positively to selection for wheat improvement. Biol ogical yield per plant ranged from 100.66 to 171.0 gm and mean was calculated to be 134.23 gm. Plant height ranged from 90.33 cm to 143.93 cm. and the mean value was 116.80 cm. Days to maturity varied from 105.33 to 137.33 days, the average being 115.60 days. Days to 50% flowering ranged from 79 to 105.66 days with an overall mean performance of 85.70 days. Thus these results indicate the existence of wide range of genetic variability in the material (Table 2).

For all 11 traits observed PCV > GCV were recorded, which means that expression of traits were influenced by environment and also reported by (Palve and Raghavaiah 2002), (Kumar *et al.*, 2003), (Chandra *et al.*, 2010) and (Binod *et al.*, 2013). Genotypic coefficient of variation (GCV) ranged from 6.1% to 15.07% and phenotypic coefficient variation (PCV) from 7.4% to 18.71%. Harvest index and grain yield per plant exhibited highest genotypic coefficient of variation of 15.07% and 14.53% and highest phenotypic coefficient of variation showed in effective tillers per plant 18.71% and harvest index 16.84% the high PCV and GCV noticed are evident from their high variability which helps in favorable range of selection.(Table 2).

Heritability assessment along with genetic advance are usually beneficial in anticipate the gain under selection than selecting best individual based on heritability alone (Johnson *et al.*, 1955). High heritability along with high genetic advance (GA) were reported in harvest index and plant height (cm), which in fact exhibit that existence of additive genes effect, indicating effectiveness of selection for the improvement of traits. Similar findings reported by (Rudra *et al.*, 2015). The value of heritability estimates were very high for plant height (90.9%), followed by days to maturity (85.9%), 1000 grain weight (85.5%), days to 50% flowering (84.8%), harvest index (80.0%) and number of grains per plant (77.2%). The highest estimates of genetic advance was recorded for harvest index (27.77%) followed by grains per plant (26.31%), plant height (22.57%) and biological yield per plant (21.39%) presented in (Table 2).

Genotypic and phenotypic correlations selection index determined with the help of phenotypic correlation coefficients and genotypic correlations gives the measure of close association between the characters and indicates the use of characters in overall improvement of crop. Grain yield plant^{-1} had high significant positive correlation with harvest index at phenotypic (r_p) and genotypic (r_g) levels. Identical results were recorded by (Kara and Akram 2007). These results recommended that harvest index and effective tillers per plant should be given prime importance regarding its improvement to yield in wheat. At phenotypic (r_p) and genotypic (r_g) levels effective tillers plant^{-1} and days to 50% flowering shown strong positive significant association with biological yield and days to maturity. Days to 50% flowering exhibited strong negative significant correlation with harvest index and grain yield plant^{-1}.Effective tillers plant^{-1} had shown strong negative significant correlation with spike length and harvest index respectively at genotypic (r_g) level. (Table 3).

Path analysis of different characters contributing towards seed yield^{-1} exhibited that harvest index (0.95) had highest positive direct effect followed by biological yield per plant (0.86) this is similar to the findings of (Dharmendra and Singh 2010) (Tripathi *et al.*, 2011) and (Kumar *et al.*, 2014), whereas days to 50% flowering (-0.084), effective tillers plant^{-1} (-0.030) and plant height (-0.024) had the highest negative direct effect on seed yield plant^{-1}. Highest positive indirect effect shown by biological yield plant^{-1} through effective tillers plant^{-1} (0.45). Harvest index exhibited highest negative indirect effect through biological yield plant^{-1}(-0.42). Hence for developing high yielding varieties in wheat, these traits should give more weightage in breeding or selection program (Table 4).

In present investigation 25 genotypes were grouped into six different clusters by using Mahalanobis D^2 analysis. Cluster II and IV had maximum number of (8) genotypes while, cluster II and V had only one genotype. The genotypes included in cluster IV recorded minimum for days to 50% flowering (82.29), whereas, days to maturity was recorded minimum in cluster II (111.50) (Table 5-7) and Fig.1. High grain yield per plant was recorded in cluster IV (39.34). The plant height was high for cluster II (125.18) which appeals that the genotypes present in these clusters could adequately used for the wheat advancement programmes. Found similar findings by (Khare *et al.*, 2015).

The overall results obtained from 25 wheat genotypes shown that there is existence of significant amount of diversity which are useful for crop improvement programmes. Knowledge about genetic parameters such as, coefficient of variation, heritability, genetic advance, correlation, path, D^2 analysis can benefit the researcher to develop appropriate cultivars within a short duration. In D^2 analysis the genotypes included in cluster IV recorded minimum days to flowering, days to maturity was recorded minimum in cluster II. High grain yield per plant was recorded in cluster IV which means that these clusters can adequately used for wheat advancement programmes.

References

Ali, I. H. and Shakor, E. F. (2012). Heritability, variability, genetic correlation and path analysis forquantitativetraits in durum and bread wheat under dry farming conditions. *Mesoptamia J. Agri.*,**40**: 27 39.

Binod, K., Chandra, M. S. and Kundan, K. J. (2013). Genetic variability, association and diversity studies in bread wheat *(Triticum aestivum* L.).*An International Quarterly Journal of LifeSciences,* **8**(1): 143-147.

Bharat, B., Sonu, B., Ashish, O., Manoj, P. and Shailendra, S. G., Bhudeva, S.T and Gyanendra, S. (2013). Genetic variability, correlation coefficient and path analysis of some quantitative traits in bread wheat. *J. Wheat Res.,* **51**(9): 21-26.

Chandra, D., Sharma, R., Rani, S., Singh, D. K., Sharma, R. and Sharma, S. K. (2010). Genetic variability for quantitative traits in wheat (*Triticum aestivum* L. em. Thell). *Plant Archives.* **10**(2): 871-874

Dewey, R. D. and Lu, K. H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomy Journal,* **52**: 515–518

Dharmendra, S. and Singh, K. N. (2010). Variability analysis for yield and yield attributes of bread wheat under salt affected condition. *Wheat Information Service*, **110**: 35-39.

Hindustan times (2018). India's wheat harvest drops by 1.42% in 2017-18: Govt. estimate. https://www.hindustantimes.com/business-news/govt-estimates-foodgrain-output-will-touch-a-new record-of-277-mt-in-2017-18/story-0T599sTmSfkvbbMpdyxWlN.html

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955). Estimation of genetic and environmental variability in soybean. *Agronomy Journal* **47**: 314-318.

Joshi, A. B. and Dhawan, N. L. (1966). Genetic improvement of yield with special reference to self fertilizing crops. *Indian J. Genet.*, **26**A: 101-113.

Rudra, N., Suma, S. Biradar, A. Y., Desai, A. and Veeresha B. A (2015). Study of genetic variabilityparameters in bread wheat (*Triticum aestivum* L.). *Research Journal of Agricultural Sciences*, **6**(1): 123-125.

Rao, C. R. (1952). Advanced statistical method in biometrical research. Ed. 1st Wiley and sons Inc., New York.

Kara, B. and Z. Akman (2007). Correlation and path coefficient analysis in the local wheat ecotypes. (Turkish) *Suleyman Demirel,* **3**: 219-224.

Kumar, Y., Lamba, R. A. S. and Saharan, R. P. (2014). Genetic variability for different biometric traits in wheat (*Triticum aestivum* L.) under medium fertility conditions. *Electronic Journal of Plant Breeding,* **5**: 71-76.

Kumar, S., Dwivedi, V. K., and Tyagi, N. K. (2003). Genetic variability in some metric traits and its contribution to yield in wheat (*Triticum aestivum* L.). *Progressive Agriculture,* **3**(1/2): 152-153.

Kumar, N., Markar, S. and Kumar, V. (2014).Studies on heritability and genetic advance estimates in timely sown bread wheat (*Triticum aestivum* L.). *Bioscience Discovery,* **5**(1): 64-69.

Khare, M., Rangare, N. R., and Singh, R. P. (2015). Evaluation of genetic diversity in Mexican wheat (*Triticum aestivum* L.) genotypes for qualitative and quantitative traits. *Internat. J. Plant Protec.*,
8 (1):77-80.

Mahalanobis, P. C. (1936). On generalized distance in statistics. *Proceedings of national institute of science*, **2**: 49-55.

Palve, S. M. and Raghavaiah, P. (2002). Genetic variation and interrelationship of agronomic traits in interspecific derivatives of durum wheat (*Triticum durum* Desf.). *Annals of Agricultural Research*, **23**(4): 602-607.

Singh, R. K. and Chaudhary, B. D. (1985). Biometrical methods in quantitative genetic analysis. *Kalyani Publishers*, New Delhi. pp 318.

Tripathi, S. N., Shailesh, M.,Praveen, P., Jaiswal, K. K. and Tiwari, D. K. (2011). Relationship between some morphological and physiological traits with grain yield in bread wheat (*Triticum aestivum* L.em.Thell.). *Trends in Applied Science Research*, **6**(9): 1037-1045.

Table 1. Analysis of variance for 11 morphological traits in 25 wheat genotypes.

Source of variation	d.f	Days to50% flowering	Days to maturity	Plant height (cm)	Effective tillers /plant	Spike length (cm)	Awn length (cm)	Grains per spike	1000 grain weight	Harvest index	Grain yield per plant (g)	Biological yield
Replication	2	16.65	15.88	25.04	9.08	1.55	0.84	5.48	6.33	0.36	2.68	2.89
Treatment	24	122.25***	202.08***	559.03***	27.71***	2.44*	0.90***	132.34***	61.80***	55.21***	73.10***	964.38***
Error	48	6.87	10.50	18.09	8.01	1.11	0.27	11.86	3.30	4.24	18.02	123.76

*Significant at 5%, ***Significant at 1%

Table 2. Mean variation, heritability and genetic advance for yield and yield contributing traits in 25 wheat genotypes.

Sr. No.	Characters	Range		Mean	GCV (%)	PCV (%)	h^2 (bs) (%)	GAPM
		Min	Max					
1	DTF	79.000	105.666	85.706	7.236	7.856	0.848	13.196
2	PH	90.333	143.933	116.806	11.496	12.059	0.909	22.575
3	SL	8.866	13.100	10.820	6.147	11.528	0.284	6.751
4	AL	5.233	7.433	6.500	7.075	10.679	0.439	9.656
5	DTM	105.333	137.333	115.600	6.913	7.460	0.859	13.196
6	GYPP	28.066	46.200	36.313	11.800	16.612	0.505	17.265
7	BYP	100.666	171.00	134.232	12.471	14.973	0.694	21.395
8	ETPP	14.400	26.800	20.408	12.556	18.711	0.450	17.355
9	GPP	32.866	64.400	43.592	14.538	16.546	0.772	26.312
10	1000GW	38.666	56.666	47.546	9.287	10.044	0.855	17.630
11	HI	20.453	38.358	27.351	15.071	16.847	0.800	27.773

GCV (%) = genotypic coefficient of variation, PCV (%) =phenotypic coefficient of variation, h2b.s (%) = Broad sense heritability, GAPM = genetic advance in % of mean

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Table 3. Phenotypic (r_p) and genotypic (r_g) correlation coefficient for 11 traits in 25 wheat genotypes.

Character		Days to 50 % Flowering	Days to Maturity	Plant Height (cm)	Effective Tillers/ Plant	Spike Length (cm)	Awn Length (cm)	Grains Per Spike	1000 Grain Weight (g)	Harvest Index	Grain Yield Per Plant (g)	Biological Yield
Days to 50 % Flowering	r_p	1.00	0.86***	0.03	-0.06	-0.02	-0.02	0.09	-0.29*	-0.40***	-0.35**	0.08
	r_g	1.00	0.91***	0.02	-0.12	0.05	-0.09	0.09	-0.33	-0.53***	-0.59***	0.10
Days to Maturity	r_p		1.00	0.07	-0.00	-0.02	-0.03	0.24*	-0.25*	-0.37***	-0.24*	0.12
	r_g		1.00	0.09	0.06	0.01	-0.12	0.28	-0.35	-0.49***	-0.40***	0.21
Plant Height (cm)	r_p			1.00	0.43***	0.08	0.24*	-0.01	0.20	-0.17	0.06	0.27*
	r_g			1.00	0.59	0.04	0.27*	-0.00	0.2	-0.24*	-0.00	0.30**
Effective Tillers/ Plant	r_p				1.00	-0.23*	0.07	-0.15	0.13	-0.11	0.36**	0.52***
	r_g				1.00	-0.51***	0.25*	-0.15	0.37	-0.32***	0.23*	0.61***
Spike Length (cm)	r_p					1.00	0.23*	0.06	-0.11	0.06	0.03	-0.05
	r_g					1.00	0.30	0.23*	-0.24*	0.06	-0.08	-0.24*
Awn Length (cm)	r_p						1.00	-0.22	0.22	0.09	0.10	0.04
	r_g						1.00	-0.48***	0.28*	-0.02	0.21	0.27*
Grains Per Spike	r_p							1.00	-0.11	0.04	0.10	0.03
	r_g							1.00	-0.14	0.11	0.27*	0.09
1000 Grain Weight (g)	r_p								1.00	0.12	0.06	-0.04
	r_g								1.00	0.14	0.15	0.01
Harvest Index	r_p									1.00	0.57***	-0.45***
	r_g									1.00	0.58	-0.62***
Grain Yield Per Plant (g)	r_p										1.00	0.45***
	r_g										1.00	0.24
Biological Yield	r_p											1.00
	r_g											1.00

*significant at P = 0.05 level of significance
**Significant at P = 0.01 level of significance
***Significance at P = 0.001 level of significances

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Table 4. Direct and indirect effect of different traits on grain yield per plant in 25 wheat genotypes.

Character	Days to 50 % Flowering	Days to Maturity	Plant Height (cm)	Effective Tillers/ Plant	Spike Length (cm)	Awn Length (cm)	Grains Per Spike	1000 Grain Weight (g)	Harvest Index	Biological Yield
Days to 50 % Flowering	**-0.084**	-0.0729	-0.002	0.005	0.002	0.002	-0.008	0.025	0.0344	-0.0073
Days to Maturity	0.0371	**0.0430**	0.0030	0.0000	-0.0009	-0.0017	0.0105	-0.0111	-0.0162	0.0053
Plant Height (cm)	-0.0008	-0.0017	**-0.0244**	-0.0106	-0.0021	-0.0059	0.0004	-0.0051	0.0042	-0.0067
Effective Tillers/ Plant	-0.0024	0.0000	0.0163	**0.0375**	-0.0088	0.0029	-0.0057	0.0051	-0.0043	0.0197
Spike Length (cm)	-0.0008	-0.0006	0.0021	-0.0060	**0.0255**	0.0061	0.0017	-0.0029	0.0017	-0.0013
Awn Length (cm)	0.0004	0.0005	-0.0032	-0.0010	-0.0032	**-0.0133**	0.0030	-0.0030	-0.0012	-0.0006
Grains Per Spike	0.0023	0.0057	-0.0004	-0.0035	0.0016	-0.0053	**0.0234**	-0.0026	0.0011	0.0008
1000 Grain Weight (g)	0.0089	0.0077	-0.0062	-0.0041	0.0034	-0.0068	0.0034	**-0.0301**	-0.0039	0.0012
Harvest Index (%)	-0.3868	-0.3591	-0.1638	-0.1081	0.0640	0.0887	0.0433	0.1222	**0.9516**	-0.4293
Biological Yield	0.0754	0.1070	0.2395	0.4571	-0.0458	0.0389	0.0289	-0.0355	-0.3924	**0.8696**

R square = 0.9699 residual effect = 0.1734

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Table 5. Mean values of clusters and contribution of different characters towards genetic divergence in 25 wheat genotypes

	Days to 50% Flowering	Days to maturity	Plant height (cm)	Effective Tillers /Plants	Spike Length (cm)	Awn Length (cm)	Grains/Spike	1000 grain weight (g)	Harvest index (%)	Grain yield/Plant (g)	Biological yield (g)
Cluster1	88.60	120.13	123.52	20.01	11.52	6.60	40.77	44.20	24.51	32.33	132.05
Cluster2	82.29	111.50	125.18	22.20	10.60	6.50	42.63	52.17	27.56	36.77	133.68
Cluster3	105.67	137.33	114.47	18.00	10.88	6.47	43.07	41.00	21.64	28.07	129.33
Cluster4	83.25	111.71	102.92	18.98	10.76	6.43	44.34	45.25	31.20	39.34	127.38
Cluster5	85.33	123.00	115.57	16.47	11.50	6.23	64.40	50.00	27.55	37.67	137.00
Cluster6	92.17	121.67	123.90	23.10	9.82	6.68	41.37	48.67	21.01	35.82	170.40

Table 6. Intra and inter cluster values among 6 clusters for 25 genotypes of wheat

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Cluster 1	13.86 (3.72)	31.68 (5.62)	27.93 (5.28)	43.19 (6.57)	34.63 (5.88)	37.12 (6.09)
Cluster 2		20.23 (4.49)	77.10 (8.78)	46.70 (6.83)	34.86 (5.90)	52.98 (7.27)
Cluster 3			0.00	72.78 (8.53)	64.42 (8.02)	44.17 (6.64)
Cluster 4				25.66 (5.06)	43.34 (6.58)	67.52 (8.21)
Cluster 5					0.00	62.12 (7.8)
Cluster 6						16.65 (4.08)

Table 7. Distributing 25 genotypes of wheat into six clusters based on D^2 statistic

Cluster group	No. of genotypes	Name of genotypes
Cluster 1	5	HUW-434,NI-DW-15,HUW-343,NI-5439,UP-262
Cluster 2	8	K-68,CMH-771-917,K-8962,HUW-478,HUW-21,HYB-65,HD-2285,RW-3371
Cluster 3	1	HS-284
Cluster 4	8	HP-1744,UP-2338,KNS-57,KBW-2,HUW-516,HI-1454,HUW-309,HS-375
Cluster 5	1	HUW-666
Cluster 6	2	NP-852, DL-153-2

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Diagram 1: Inter cluster values among 6 clusters for 25 genotypes of wheat