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Principal Component Analysis for Yield and Yield Attributing Traits in Bread Wheat (Triticum aestivum L.) Genotypes under Normal Sown Condition

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ABSTRACT

Assessment of genetic divergence using principal component analysis was conducted in 47 bread wheat genotypes. Only first five principal components, out of the thirteen components exhibited more than 1.00 eigen value. The total variation of the five principal component was accounted to be 75.15%. The highest variation was recorded by the first principal component (22.140%) followed by second component (20.192%), third component (13.679%), fourth component (11.097%) and fifth component (8.044%). The first principal component showed highest variability (22.140%) for days to 50% heading, plant height (cm), number of productive tillers plant^{-1}, ear length (cm), ear weight plant^{-1} (g), ears plant^{-1} and grain yield plant^{-1} (g). In second PC positive component was related with traits such as days to 50% heading number of productive tillers plant^{-1}, number of spikelets ear^{-1}, ear weight plant^{-1} (g), ears plant^{-1}, grains ear^{-1}, Test weight (g), biological yield per plant (g) and grain yield plant^{-1} (g). The characters such as plant height (cm), number of productive tillers plant^{-1}, ears plant^{-1} , Test weight (g), biological yield plant^{-1} (g), grain yield plant^{-1} (g), grains ear^{-1}, ear weight plant^{-1} (g) and ear length (cm) are more important yield contributing traits based on PCA analysis.

***Key words :** Bread wheat, PCA, genetic diversity and eigen value*

INTRODUCTION

Bread wheat is a natural allohexaploid with chromosome number of 2n=6x=42 of Poaceae family. Being the largest cereal crop it is known as the “king of cereals” as it dominates the food grain trade globally. For fulfilling the requirements of the increasing population all over the world, increase in production has become a major priority over the years. Grain yield plays a major role which leads to higher production and so it is considered to be one of the most important trait. Successful hybridization programmes needs to be implemented to produce high yielding varieties. So, it is mandatory to identify genetically diversified lines for future wheat breeding. Modern agriculture confide on producing high yielding varieties and for attaining this objective desirable parents are to be selected for a crossing programme. Genetically diverse parents act as a boon for producing progenies exhibiting high extent of heterosis. PCA is of prime significance in deciding major agronomic

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traits contributing towards yield which are to be emphasized in the breeding program. PCA has an edge over cluster analysis as it designates each genotype solitary in each group. The main objective of this study is to determine genetic diversity within 47 wheat genotypes based on PCA.

Material and method

The experimental material consisted of 47 wheat genotypes *viz*. DPW-621-50, PBW-625, DBW- 14, WH- 1105, DBW- 17, PBW- 723, JW- 3211, PBW- 550 , DBW- 71 , DBW-39, CBW- 38, DBW- 16, HD- 2967, HD- 3086, DBW-107, RUJ-4037, DBW-110, DBW- 93, WH- 703, PBW- 677, DBW- 90, DBW- 88, PBW- 343, MP- 3336, MP- 3382, HD- 2932, HI- 1500, JWS- 17, LOK- 4, C- 360, MP- 3288, HI- 8627, GW- 322, HI- 1544, HI- 8713, GW-273, MP-3020, MP-4010, MP-1203, HI-8498, HI-1531, HW-2004, GW-3366, MP-3173, LOK-1, HD-3987 and HI-1418. The present experiment was carried out under field condition in the Agricultural Research Field, Department of Genetics and Plant Breeding, SAGR, Lovely Professional University, Phagwara, Punjab-144411 during *Rabi* season (2017-18). The genotypes were sown in RBD using three replications. The plot size was maintained by taking 3m row length, distance between the rows was 20cm and plant to plant was 4-6cm. Data for days to 50% heading and days to maturity was recorded on whole plot basis. At maturity five randomly selected plants in every replication were used for recording the plant height (cm), number of productive tillers plant^{-1}, number of spikelet's ear^{-1}, ear length(cm), ear weight plant^{-1}(g), number of ears plant^{-1}, number of grains ear^{-1}, test weight(g), biological yield plant^{-1}(g), grain yield plant^{-1} (g) and harvest index (%). Principal Component Analysis for the genetic diversity was performed using software.

Results and Discussion

Principal component analysis reduces the complexity of a data set into a simplified structure. In the present study PCA was conducted on thirteen characters of wheat genotypes. The PCA analysis have extracted thirteen components from the total traits studied. However the components exhibiting more than one Eigen values are considered. PCA for the first six principle component are listed in table 1. Only five principalcomponent PC1 to PC5 out of the thirteen components exhibit more than 1.00 Eigen values accounting to 75.15% variability among the traits studied. Similar findings was recorded by Mecha *et al.,* (2017).The highest variation was recorded by the first PC1 (22.140%) followed by PC2 (20.192%), third component PC3 (13.679%), fourth component PC4 (11.097%) and fifth component PC5 (8.044%). The total variation of the five principalcomponent was accounted to be 75.15%. Related conclusions were concluded by Saini *et al.,* (2018) and Kumar *et al.,* (2016).

First principal component which showed the highest variability (22.140%) consisted of high positive component was related with plant height (cm), number of productive tillers plant^{-1} and ears plant^{-1}. In second PC positive component was related with traits such as biological yield plant^{-1} (g) and grain yield plant^{-1} (g). In third PC positive component was associated alongwith traits such as ear length (cm) and grains ear^{-1}. In fourth PC the trait

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1000-grain weight (g) was more related. The fifth principal component was more related to ear weight plant^{-1}. Similar results were reported by Getachew *et al.,* (2017), Ali *et al.,* (2018) and Qaseem *et al.,* (2017).

The principal scores for all the thirteen traits of the 47 genotypes were divided in the five principal components (Table 2). High values for the traits in a genotype can be indicated using the principal score scored by that genotype in a particular component. In the first principal component C-306 (8.879) has the highest score followed by MP-3020 (8.654),HI-1500 (8.614), HW-2004 (8.532), MP-3288 (8.468), JAWS-17 (8.179) and HI-1531 (8.174) indicating that they have high value for plant height (cm),number of productive tillers plant^{-1}and ears plant^{-1}. In the fourth principal component MP-4010(8.573) has the highest score followed by DBW-93(8.328), DBW-16 (8.165), PBW-343(7.854), JAWS-17(7.808), HD-3086(7.802) and C-306 (7.707)) indicating that they have high value for 1000-grain weight (g). C-306 and JAWS-17 was found in both PC1 and PC4. Based on the top PC scores in principal component 1 and principal component 4, two genotypes C-306 and MP-4010 are selected. These results are in relevance with the results quoted by Pooja *et al.,* (2018), Poudel*et al.,* (2017), Singh *et al.,* (2018) and Panotra *et al.,* (2018).

Conclusion

The characters plant height (cm), number of productive tillers plant^{-1}, ears plant^{-1} , test weight (g), biological yield plant^{-1} (g), grain yield plant^{-1} (g), grains ear^{-1}, ear weight plant^{-1} (g) and ear length (cm) are the imperative yield attributing characters on the basis of PCA.

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Traits	PC1	PC2	PC3	PC4	PC5	PC6
Days to 50% heading	0.218	0.132	0.225	0.113	0.251	0.734
Days to maturity	-0.093	-0.340	-0.146	0.128	-0.329	0.442
Plant height (cm)	**0.427**	-0.185	-0.371	-0.113	0.145	0.048
No. of productive tillers plant^{-1}	**0.500**	0.142	-0.004	-0.085	-0.329	0.063
No. of spikelets ear^{-1}	-0.305	0.196	-0.170	-0.498	0.035	0.300
Ear length (cm)	0.260	-0.313	**0.344**	-0.176	0.128	-0.252
Ear weight plant^{-1} (g)	0.130	0.180	-0.153	-0.603	**0.312**	-0.039
Ears plant^{-1}	**0.430**	0.288	0.068	0.194	-0.194	0.063
Grains ear^{-1}	-0.347	0.274	**0.400**	0.039	-0.091	0.045
1000-grain weight (g)	-0.081	0.044	-0.520	**0.441**	0.252	-0.139
Biological yield plant^{-1} (g)	-0.053	**0.453**	-0.357	0.068	-0.043	0.068
Grain yield plant^{-1} (g)	0.086	**0.449**	0.031	-0.036	-0.362	-0.263
Harvest Index (%)	-0.093	-0.271	-0.231	-0.258	-0.582	0.054
Eigen values	2.878	2.624	1.778	1.442	1.045	0.979
% Variation	22.140	20.192	13.679	11.097	8.044	7.533
Cumulative %	22.140	42.332	56.011	67.109	75.153	82.686

Table 1: Principal component analysis for 47 genotypes on 13 characters in wheat

Table 2: PCA scores of wheat genotypes

Genotypes	PC1	PC2	PC3	PC 4	PC5
DPW-621-50	4.529	-22.688	-8.837	6.923	-1.919
JW-3211	4.780	-22.920	-8.486	6.276	-1.631
DBW-14	3.825	-23.361	-7.724	5.808	-1.749
WH-1105	4.377	-23.463	-9.314	6.485	-2.190
DBW-17	4.340	-22.687	**-7.156**	6.380	-2.876
PBW-723	4.551	-23.149	-9.417	6.879	**-1.499**
PBW-725	5.199	-22.933	-9.359	5.993	**-0.988**
8PBW-550	4.730	-23.038	-8.083	5.987	-2.501
DBW-71	5.363	-24.059	-8.385	7.386	-2.415
DBW-39	6.559	-23.220	-8.886	6.332	**-1.629**
CBW-38	6.493	-22.457	-8.053	6.391	-3.427
DBW-16	5.507	-23.320	-7.511	**8.165**	-3.029
HD-2967	5.166	-22.250	-9.414	6.436	-3.146
HD-3086	5.942	-24.367	-7.608	**7.802**	**-1.409**
DBW-107	5.721	-22.728	-7.824	7.025	-2.850
RUJ-4037	6.035	-24.673	**-7.436**	7.654	-2.048
DBW-110	6.497	-22.326	-8.245	7.005	-3.050
DBW-93	4.082	-22.896	-7.643	**8.328**	-2.247
WH-703	4.813	-24.036	**-7.265**	6.673	**-1.539**
PBW-677	6.042	-23.144	-9.100	6.907	-1.939

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DBW-90	5.570	-23.722	**-7.160**	7.053	-4.259
DBW-88	5.015	-22.379	-9.768	6.298	-3.071
PBW-343	5.296	-23.460	-7.569	**7.854**	-1.779
MP-3336	4.956	-23.214	-7.565	7.566	-4.079
MP-3382	5.318	-22.311	-8.802	6.003	-1.631
HD-2932	5.976	-22.562	-7.856	7.107	-4.449
HI-1500	**8.614**	-24.512	-9.892	6.756	**-1.190**
JAWS-17	**8.179**	-23.970	-8.203	**7.808**	-1.812
LOK-4	7.197	-21.677	-9.495	6.945	-3.168
C-306	**8.879**	-23.541	-10.281	**7.707**	**-1.040**
MP-3288	**8.468**	-23.775	**-6.842**	7.512	-2.593
HI-8627	6.985	**-17.437**	-10.021	7.460	-3.640
GW-322	8.107	**-21.180**	**-6.646**	7.191	-3.496
HI-1544	7.004	-22.312	-8.062	7.039	-2.277
HI-8713	6.651	**-19.166**	-8.794	7.081	-4.038
GW-273	8.014	-21.409	-7.522	4.176	-3.371
MP-3020	**8.654**	-23.519	-8.310	2.960	-2.227
MP-1203	6.193	**-20.621**	-7.823	5.137	-2.590
MP-4010	6.811	**-20.954**	-7.914	**8.573**	-4.084
HI-8498	5.438	-21.392	-10.082	7.079	-3.284
HI-1531	**8.174**	-24.272	-10.871	6.970	-3.773
HW-2004	**8.532**	-24.598	-10.760	5.368	-1.703
GW-3366	6.685	-21.606	-7.754	6.394	-2.564
MP-3173	6.943	-25.412	-8.152	6.385	-3.640
LOK-1	7.201	**-21.355**	-8.332	6.480	-2.885
HD-3987	6.911	**-21.159**	-7.475	6.267	-3.461
HI-1418	7.544	-22.115	**-7.020**	4.915	-2.280