

Genetic diversity based on PCA for Grain Yield and its Components in Wheat (*Triticum aestivum* L.) genotypes in Punjab Region

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Abstract

Genetic diversity was evaluated for 68 wheat genotypes for sixteen traits. Four components among seventeen contributed 82.93% variation out of total variation for the traits under study. Principal component 1, 2, 3 and 4 having values 42.74%, 27.31%, 7.27% and 5.60% made up the major share of the entire variation. PC1 possessing highest variability was majorly associated with days to 50% heading (1.61), days to maturity (0.53), plant height (0.42). The result of present investigation could provide a roadmap for outlining and beheading future breeding programme in wheat.

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

Introduction

Wheat is the segmental allohexaploid ($2n=6x=42$) member of Poaceae family. 90% of the global wheat production is covered by tetraploid and hexaploid wheat ie. T. Durum and T. Aestivum. “King of cereals” is the depiction given to the wheat crop solely due to the area occupied followed by the productivity and in addition to this the nutritional value it possesses. (Verma *et al.*, 2019). Wheat is the main food crop for people over the entire world, occupying commanding position in Indian Agriculture, which occupies 28% area under cereals and contributing 33% of the total food grain production in the country (Rangare *et al.*, 2010). It has relatively high content of niacin and thiamine which are principally concerned in providing the special protein called ‘Gluten’ which provides the framework of spongy cellular texture of bread and baked products (Bhushan *et al.*, 2013).

Prime objective for any wheat breeding programme is to produce the varieties which are high yielding, exhibit good adaptability and possess resistance against insect-pest, pathogens and other environmental factors. For achieving this objective, sufficient genetic divergence should be present among the genotypes.(Janmohammadi *et al.*, 2014).Principal component analysis (PCA) helps in determining selection criteria and selection of superior lines in a diverse breeding population. It is a useful technique for plant traits contributing maximum toward economic yield and in clarifying the relationships among traits in complex multi-trait system such as the growth characters, quality traits and yield contributing characters. PCA explains the relationship of the eigen-vectors and eigen-values with

economic yield and helps in identification of principal components of yield in diverse breeding population. Appropriate selection of the parents is essential to be used in crossing nurseries to enhance the genetic recombination for potential yield increase (Islam, 2004). Some appropriate methods, cluster analysis, PCA and factor analysis, for genetic diversity identification, parental selection, tracing the pathway to evolution of crops, centre of origin and diversity, and study interaction between the environment are currently available (Eivazi *et al.*, 2007). The present study was undertaken to find out putative genotypes and important characters using PCA (Principal Component Analysis) in some bread wheat genotypes for its utilization in further wheat breeding programs.

Materials and Methods

Experiment Location: The experiment was conducted at Agriculture Research Farm, Department of Plant Breeding and Genetics, Lovely Professional University, Phagwara (Punjab).

Methodology and details: 68 diverse genotypes of wheat were evaluated using RBD during 2018-19 *rabi* season. Sowing was performed with the help of dibbler in rows with row to row distance 22.5 cm, plant to plant distance 3 cm, row length is 2 m. All genotypes were sown in 5 lines each. All the suggested intercultural practices were followed.

Data recorded: Taken out five random plants from each entry of genotype of replications and tagged for data recording. Data was recorded on whole plot basis for Days to 50% heading, Days to maturity and canopy temperature whereas plant height (cm), peduncle length (cm), number of productive tillers plant⁻¹, number of spikelets ear⁻¹, ear length (cm), ear weight (g), number of ears plant⁻¹, number of grains ear⁻¹, 1000-grain weight (g), biological yield plant⁻¹(g), grain yield plant⁻¹ (g), harvest index (%) and chlorophyll content from individual tagged plant.

Results and Discussion

In present study PCA was executed for both quantitative and qualitative traits. Four principal components among the total seventeen showed Eigen value greater than 1. (Table:1) i.e. PC1 (33.00), PC2 (21.08), PC3 (5.61) and PC4 (4.32) contributing about 82.93% of the total variation. The PC1 had 42.74%, PC2 showed 27.31%, PC3 exhibited 7.27% and PC4 showed 5.60% variation.

Table: 1 Eigen values, % variance and cumulative variance of bread wheat genotypes

PCs	Eigen value	Variation (%)	C. variance (%)
PC1	33.00	42.74	42.74
PC2	21.08	27.31	70.05
PC3	5.61	7.27	77.32
PC4	4.32	5.60	82.93

The yield and its contributing characters were laden in each component as indicated in the rotated component matrix (Table 2,3). Days to 50% heading (1.61), days to maturity (0.53) and plant height (0.42) were the traits associated with first principal component showing highest variability. The second principal component was more related to days to

50% heading (3.91), protein content (1.41), days to maturity (1.06), plant height (0.83), peduncle length (0.45) and ear weight (0.41). The third principal component was more related to days to 50% heading (0.67), No. of grains per ear (0.52) and chlorophyll content (0.42). The fourth principal component was associated with number of grains per ear (1.49), number of spikelets per ear (1.03) and ear length (0.44). Based on the analysis, it was conferred that PC4 retained the major yield and yield contributing traits and on considering all the first three principal components days to 50 % heading possessed highest value.

Table: 2 Principal Component values of rotation component matrix

Characters	Principal components			
	PC1	PC2	PC3	PC4
Days to 50% heading	1.61	3.91	0.67	0.05
Days to maturity	0.53	1.06	-0.88	-0.03
Plant height (cm)	0.42	0.83	-1.75	0.38
Peduncle length (cm)	0.22	0.45	-0.38	0.13
No. of productive tillers per plant	-0.05	-0.38	0.30	-0.20
No. of spikelets per ear	-0.18	0.35	0.21	1.03
Ear length (cm)	0.22	-0.84	-0.34	0.44
Ear weight (g)	0.21	0.41	0.22	0.21
No. of ears per plant	0.17	0.11	-0.25	0.07
No. of grains per ear	-0.57	-0.48	0.52	1.49
1000-grain weight (g)	-0.03	-0.27	-0.05	-0.26
Biological yield plant (g)	-0.05	-0.17	-0.36	0.08
Harvest index (%)	0.01	-0.34	-0.16	-0.16
Chlorophyll content	-0.15	0.02	0.42	-0.00
Canopy temperature	0.09	0.27	0.03	-0.42
Protein content (%)	-5.38	1.41	-0.16	-0.06
Grain yield per plant (g)	-0.55	-0.12	0.32	-0.51

Values in bold represents more related traits in each principal component

Table: 3 Interpretation of rotated matrix for the traits having values $n > 0.4$ in each PCs

PC1	PC2	PC3	PC4
Days to 50% heading	Days to 50% heading	Days to 50% heading	No. of spikelets per ear
Days to maturity	Days to maturity	No. of grains per ear	Ear length
Plant height	Plant height	Chlorophyll content	No. of grains per ear
-	Peduncle length	-	-
-	Ear weight	-	-
-	Protein content	-	-

In PC1 grouping of characters is decided by the traits having value near to 1 rather than traits having value near to zero.(Chahal and Gosal, 2001).Accordingly in the current investigation, grouping of genotypes in distinct clusters is due to some characters which contributed on large scale as compared to the contribution done by each character. Maximum

variability was recorded for PC1 & PC2 whereas minimum variability was recorded for PC4 within the genotypes for the characters under investigation.

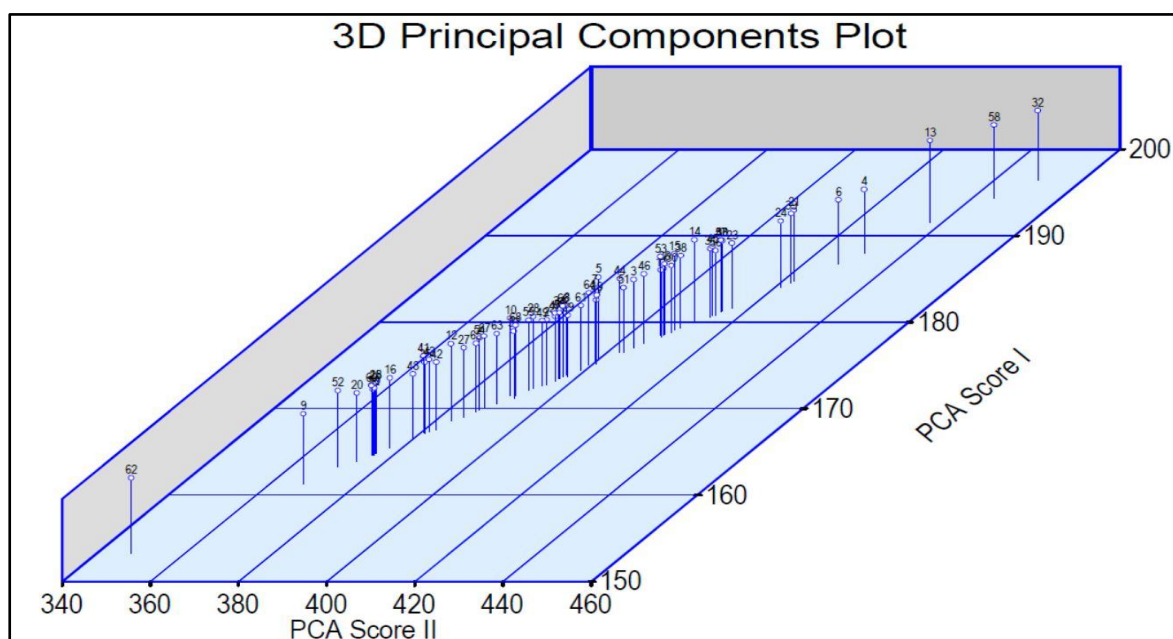
Emphasis should be given for the characters associated with PC1, PC2, PC3 and PC4 majorly contributing to the total variability as indicated in the rotated component matrix as they are the most divergent traits grouped into distinct clusters.

Related results were recorded by Rymuza *et al.* (2012) found 3 PCs are significant in his investigation and total variance is 79.64% and associated characters are Grain yield, mass of 1000 grains, grain number. Beheshtizadeh *et al.* (2013) reported 4 PCs are significant in his investigation and total variance is 76% and associated characters are No. of spikes, spike weight, spike length, No. of seeds/spike and spike yield. Mecha *et al.* (2017) reported 5 PCs are significant in his investigation and total variance is 72.78% and associated characters are Days to heading, days to maturity, grain filling period, plant height, number of spikelet's per spike, 1000 kernels weight, harvest index and hectoliter weight.

Conclusion

It can be concluded that traits should be selected from PC1 to PC4 as they contributed to the total genetic variation for overall improvement of the wheat genotypes.

Fig:1 Principal component analyses score of 68 Wheat genotypes



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