Department of Genetics and Plant Breeding
School of Agriculture

Principle component analysis and genetic diversity in bread wheat (*Triticum aestivum* L. emThell.)

Synopsis for Research Project of

M.Sc Agri. (Genetics and Plant Breeding) On

Pre Dissertation (GPB 596)

Submitted To
Lovely Professional University
Department of Genetics and Plant Breeding

In partial fulfillment of the requirement

wabanginla Ozukum
Uni. Regd. No. 11719060

Title:

Principle component analysis and genetic diversity in bread wheat (*Triticum aestivum* L. emThell.)

Name of Student	:	Wabanginla ozukum
Major Subject	:	Genetics & Plant Breeding
Name of Supervisor	:	Dr. Harshal Ashok Avinashe
Name of co-Supervisor	:	Dr. Nidhi Dubey
Place/Station of Research	:	LPU ,Phagwara, India
University Reg.No.	:	11719060
Year of Passing B.Sc.(Agri)	:	May 2017
Year of Admission in M.Sc.Agri	:	August 2017
Period of Research	:	2017-2019

CERTIFICATE

This is certified that this synopsis entitled "**Principle component analysis and genetic diversity in bread wheat (*Triticum aestivum* L. emThell.)**" submitted in partial fulfilment of requirements for degree – **Master of Science in Genetics and Plant Breeding** by **wabanginla ozukum, Registration no. 11719060** to **Department of Genetics and Plant Breeding, School of Agriculture, Lovely Professional University**, has been formulated and finalized by the student herself on the subject.

(Signature of Student) **(Signature of Supervisor)**

Wabanginla ozukum **Dr.Harshal Ashok Avinashe**

Reg No: 11719060 **UID: 19844**

(Signature of co supervisor)

Dr.Nidhi Dubey

UID: 19843

Members of Committee

Dr. Madakemohekar Anant Hanumant **Sneha Choudhary**

UID: 19767 **UID:21894**

DECLARATION

I hereby declare that the project work entitled **— "Principle component analysis and genetic diversity in bread wheat (*Triticum aestivum* L. emThell.)"** is an authentic record of my work carried out at **Lovely Professional University** as requirements of Project work for the award of degree -**Master of Science in Genetics and Plant Breeding**, under the guidance of **Dr. Harshal Ashok Avinashe, Assistant Professor, School of Agriculture, Lovely Professional University, Phagwara, Punjab.**

Wabanginla ozukum

(Registration No. 11719060)

Content

1. INTRODUCTION

Bread wheat (*Triticum aestivum* L. em Thell. 2n = 6x = 42) is a self-pollinating annual plant in the true grass family. It is cereal crop belong to Poaceae Family. It is the world's largest cereal crop. It has been described as the "king of cereals" because of the area it occupy, due to high productivity and prominent position it holds in the international food grain trade. It is an important cereal crop of cool climate and plays an important role in food nutritional security of world.

Wheat is widely grown all over the world and stands 1st among the cereals both in area and production with an estimated 211 mmt & ranks third when it comes to the total production volume with an estimated value of 749mmt (2017-2018). In India it is the second most important grain crop after rice & the estimated production volume is 92.08mmt. In india, bread wheat is the most common grown variety. India's Wheat production has increased in the last 10 years at Compound Annual Growth Rate(CAGR) of 2.46% & Area under Wheat cultivation has also increased by 0.77%. The main increase in the productivity of wheat in India has been observed in Haryana, Punjab. MP & UP. Punjab produces 17% of India's total Wheat & ranks second in production after UP. It produces approx 15783 tonnnes every year.

In the context of improvement in wheat crops & sustainable agriculture, the genetic variability in Bread Wheat is very important. Wheat is a self- pollinating polyploid crop that has been bred for its broad range of quality traits & various other adaptive traits. Improvement in wheat productivity in any breeding program mainly depends on the availability of genetic diversity in wheat material. Wheat breeding through techniques like hybridization also requires the selection of diverse genotypes, irrespective of whether the end product is a pure line or a hybrid variety (Prasad et el., 2000).In analyzing genetic diversity of a crop species it's important to distinguish and understand relationship between different traits, this is where Principal component analyses(PCA) comes into play. PCA is a multivariate analysis method that aims to explain the correlation between a large set of variables in terms of a small number of underlying independent factors. Through PCA a given set of Correlated traits or variables are transformed into a new set of variables which are not correlated at all. The new obtained traits can be used for further evaluation. Briggs and Shebeski (1972) reported change in number of factors and its related characters by the genotype by environment interaction. Four components(flag leaf area, photosynthetic, yield & spike density) were found to explain the 98.4% of variability between traits (Walton, 1971).

Keeping in view the aforesaid problems, the present investigation has been planned with the following objectives:

OBJECTIVES OF INVESTIGATION:

1. To study the genetic diversity among wheat genotypes
2. To evaluate the different morphological traits among wheat germplasm for selection of superior genotypes
3. To study principle component analysis among the wheat genotypes

2. REVIEW OF LITERATURE

The success of any plant improvement programme mainly relies on the right selection of material and its proficient management. It is only feasible when we possess knowledge of previous work done in the field of genetics and breeding. In wheat, significant contribution has been made in concerned field in the recent years. The literature pertaining to the various aspects of the study discussed under the following headings:

2.1 Genetic diversity
2.2 Principle component analysis

2.1 GENETIC DIVERSITY

There is a wide diversity in the genotypes of different species based on their morphological traits and genetic constitution. The study of the diversity is a key for the success of any breeding programme.

Poudel et al., (2017). Conducted a study using 50 bread wheat to assess the identification as well as selection of superior genotypes using multivariate method. Observations were taken from flag leaf senescence, thousand kernel weight, grain filling duration, grain weight per spike etc. Selection of genotypes from cluster 2 (GautamandSOKOLL/3/PASTOR//HXL7573/2*BAU/5/CROC_1/AE.SQUARROSA(205)// BORL95/3/PRL/SARS//TSI/VEE#5/4/FRET2) would lead to selection of superior genotypes and can be used in breeding programme

Dutamo et al., (2015). Conducted a study on sixty eight germplasm of bread wheat to study the extent of genetic divergent and association among grain yield and yield related traits. The D^2 analysis showed the 68 germplasm clustered into six clusters. It was indicated that the tested bread wheat germplasm were moderately divergent.

Singh et al., (2014). Evaluated a study using 13 bread wheat genotypes to study the genetic diversity. The genetic divergence among the wheat were calculated by canonical and non-hierarchical Elucidean methods of divergence estimation. The result obtained from different method of divergence study were slightly different from each other. Among 13 wheat genotypes highest diversity was reflected between PBW 343and HS 375 while minimum was recorded between RSP564 and RSP561.

Degewione et al., (2013). Studied twenty six bread wheat (*Triticum aestivum* L.) genotypes to assess the extent of genetic diversity among bread wheat genotypes in three cropping seasons under irrigation. The D^2 analysis showed the 68 germplasm clustered into six clusters. Maximum average intra cluster D^2 (differences among

the germplasm within the same cluster) was shown by cluster I (31.14) followed by cluster III (27.51**)** and IV (24.03). The lowest inter cluster distance was noticed between clusters I and III (44.83) followed by that between clusters II and IV.

Gupta et al., (1998). Conducted a study using 300 genotypes of bread and durum wheat for 10 yield trials. Five characters namely grain and biological yield, tiller number, grain weight/ear and grains/ear exhibited high variability. Based on the genetic divergence and mean performance five diverse and superior genotypes namely MUW 109, CPAN 3064, CPAN 1556, MUW 104 and CPAN 1998 were selected

2.3 PRINCIPLE COMPONENT ANALYSIS

Mecha et al., (2017). Conducted a study using sixty four wheat genotypes to access the genetic diversity of the genotypes using multivariate analysis (cluster and principle component analysis). The principal component analysis revealed that five principal components (PC1-C5) exhibited eigen value higher than one, with values 3.36, 2.46, 1.43, 1.19 and 1.03, respectively, have accounted for 72.78% of the total variation

Dutamo et al., (2015). Conducted a study on sixty eight germplasm of bread wheat to study the extent of genetic variation and association among grain yield and yield related traits. Principal components (PC1 to PC3) considered eigenvalue greater than one (significant), accounted nearly 63.2% of the total variation. It was noted that principal component first contributed 33.7%, Principal component second 16.7% and Principal Component third 12.8% of the total genetic variability for all the germplasm.

Beheshtizadeh et al., (2013). Studied 18 cultivar of bread wheat to determine principal component analysis. Principal component analysis indicated the four important component accounted for 76 percent of total variation among the traits. The first component assigned 38 percent of total variation and was related to spike yield. The other component accounted for 15, 12 and 11 percent and was related to tillering, seed weight and seed yield.

Degewione et al., (2013). Studied twenty six bread wheat (Triticum aestivum L.) genotypes to determine principal component Principal component analysis showed that the first six principal components explained about 91.87% of the total variation. In principal component 1 (PC1) variation was chiefly attributed due to number of kernel per spike, grain yield, thousand kernel weight and spike length. In 2^{nd} (PC2) the variation was due to days to heading, days to maturity, plant height and spike length. Whereas in principal component 3 variations was chiefly originated from plant height, number of effective tillers per plant, grain yield, biomass yield per plot and harvest index.

3. MATERIALS AND METHOD

3.1 STUDY AREA:

The present investigation was carried out under field condition in the "Agricultural Research Field, School of Agriculture, Lovely Professional University, Phagwara, Punjab -144411. The Genotypes were tested at Breeding field, Department of Genetics and Plant Breeding, Lovely Professional University Phagwara, (Punjab) in cropping season of 2017 to 2018.It has a humid subtropical climate with hot summer and cool winters with an annual average

rainfall of 70-100 cm. The annual average temperature in the summer vary from highs of around 48^0 C to average lows of around 25^0 C. Winters vary with maximum temperature of around 19^0 C to minimum temperature of around 50^0C.The soil type is of sandy loam with good drainage.

3.2 PLANT MATERIALS

The experimental material consisted of 47 germplasm of Bread Wheat (*Triticum aestivum* L.emThell.*)*.

The names of the genotypes used are mentioned below:

Sr. No.	Genotypes	Pedigree/parentage/source
1	DPW-621-50	KAUZ//ALTAR84/(AOS)AWNEDONAS/3/MILAN/KAUZ/4/HUITES(436)
2	PBW- 625	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
3	DBW- 14	RAJ 3765/PBW 343
4	WH- 1105	MILAN/S87230//BABAX
5	DBW- 17	CMH79A.95/3*CNO 79//RAJ3777
6	PBW- 723	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
7	JW- 3211	SKAuZ/2/FCT
8	PBW- 550	WH 594/RAJ 3858//W 485
9	DBW- 71	PRINIA/UP-2425(4361)
10	DBW- 39	ATTILA/HUI
11	CBW- 38	CNDO/R143/ENTE/MEXI_2/3/Ae.SQUARROSA (TAUS)/4/WEAVER/5/2*PASTOR
12	DBW- 16	RAJ 3765/WR 484//HUW 468
13	HD- 2967	ALD/COC//URES/HD2160M/HD2278
14	HD- 3086	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
15	DBW-107	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
16	RUJ-4037	DL 788-2/RAJ 3717
17	DBW-110	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
18	DBW- 93	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
19	WH- 703	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
20	PBW- 677	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
21	DBW- 90	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
22	DBW- 88	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
23	PBW- 343	ND/VG9144//KAL/BB/3/YCO"S" /4/VEE#S "S"
24	MP- 3336	HD2402/GW173
25	MP- 3382	INDIAN INSTITUTE OF WHEAT AND BARLEY RESEARCH KARNAL
26	HD- 2932	KAUZ/STAR//HD 2643
27	HI- 1500	HW 2002*2//STREMPALLI/PNC 5
28	JWS- 17	SELCTION FROM HUW 334
29	LOK- 4	JNKVV, JABALPUR
30	C- 360	JNKVV, JABALPUR
31	MP- 3288	DOVE/BUC/DL 788-2
32	HI- 8627	HD 4672 / PDW 233
33	GW- 322	GW 173/GW 196
34	HI- 1544	HINDI 62/BOBWHITE/CPAN 2099
35	HI- 8713	HD 4672 / PDW 233

36	GW- 273	CPAN 2084/VW 205
37	MP- 3020	JNKVV, JABALPUR
38	MP- 1203	FASN/28TEPOKA/3/CHEN/A.SQUARROSA/TA
39	MP- 4010	ANGOSTURA 88
40	HI- 8498	CR "S"-GS"S" /A-9-30-1//RAJ911
41	HI- 1531	HI 1182/CPAN 1990
42	HW- 2004	C 306 *7 //TR 380-14 #7 /3 AG14
43	GW- 3366	JNKVV, JABALPUR
44	MP- 3173	HI 1011/WH 965-1
45	LOK- 1	S308 / S331
46	HD- 3987	JNKVV, JABALPUR
47	HI- 1418	HI 999/HI 601

3.3 EXPERIMENTAL DETAILS:

Crop	:	Wheat
Design	:	RBD (Randomized Block Design)
Replication	:	Three
Genotypes	:	Forty seven
Plot size	:	47m length x 11m width
Row to row distance	:	20 cm
Net area of experimental field	:	517 sq. metre
Season	:	*Rabi* (2017-18)

3.4 STATISTICAL ANALYSIS:

1. Analysis of variance (Panse and Sukhatme, 1961)
2. D^2 analysis (Mahalanobis, 1936)
3. PCA (Ingebriston and Lyon, 1985)

3.5 OBSERVATIONS:

A	Quantitative Traits	B	Quality Traits
1	Days to 50% heading	14	Protein content (%)
2	Days to maturity		
3	Plant height (cm)		
4	No. of productive tillers plant^{-1}		
5	No. of spikelets ear^{-1}		
6	Ear length (cm)		
7	Ear weight (g)		
8	No. of ears plant^{-1}		
9	No. of grains ear^{-1}		
10	1000-grain weight (g)		
11	Biological yield plant^{-1} (g)		
12	Grain yield plant^{-1} (g)		
13	Harvest index (%)		

4. REFERENCE

Beheshtizadeh, H.; Rezaie, A.; Rezaie, A. and Ghandi, A. (2013). Principal component analysis and determination of the selection criteria in bread wheat *(Triticum aestivum* L.) genotypes. *International Journal of Agriculture and Crop Sciences*. IJACS/2013/5 -18/2024-2027.

Birhanu, M., Sentayehu, A.; Assefa, A.; Assefa, E. and Dutamo, D. (2017). Genetic Diversity Based on Multivariate analysis for Yield and it's Contributing Characters in Bread Wheat (Triticum aestivum L.) Genotypes. *Agri Res & Tech: Open Access Journal* 10.19080/ARTOAJ.2017.08.555748

Briggs, K. G. and Shebeski, L.H. (1972). An application of factor analysis to some bread making quality data. Crop Sci. 12: 44-46.

Degewione, A. and Alamerew, S. (2013). Genetic Diversity in Bread Wheat (*Triticum aestivum* L.) Genotypes. *Pakistan Journal of Biological Science.,* 16 (21): 1330-1335.

Dutamo, D.; Alamerew, S.; Eticha, A. and Assefa, E. (2015). Genetic Variability in Bread Wheat (Triticum aestivum L.) Germplasm for Yield and Yield Component Traits. *Journal of Biology, Agriculture and Healthcare,* 5(17): 2224-3208.

Ingebriston, S. E. and Lyon, R. J. P. (1985). Principal components analysis of multi-temporal image pairs: *Ind. J. of Remote Sensing,* 6: 687-696.

Leilah, A.A and Al-Khateeb, S.A. (2005). Statistical analysis of wheat yield under drought conditions. J. Arid. Environments. 61: 483-496.

Mahalanobis, P. C. (1936). On the generalized distance in statistics", proceeding of the national institute of sciences of India. 2 (1), 49-55.

Panse, V. G. and Sukhatme, P. V. (1961). Statistical methods for agricultural workers, ICAR, New Delhi

Poudel, A.; Thapa, D.B. and Sapkota, M. (2017). Assessment of genetic diversity of bread wheat (*Triticum aestivum* l.) genotypes through cluster and principal component analysis. *International Journal of Experimental Research and Review*, 11: 1-9

Prasad, M. and Varshney, R.K. (2000). The use of microsatellite for detecting DNA polymorphism, genotype identification and genetic diversity in wheat. *Theoritical and applied genetics.*, 100: 584-592.

Sharma, P. K.; Gupta, P. K. and H. S. Balyan(1998).Genetic diversity in a large collection of wheats(*Triticum aestivum* L.). *Indian* J. *Genet.*, 58(3): 271-278.

Singh, P.; Singh, A. K.; Shama, M. and Salgotra, S. K. (2014). Genetic divergence study in improved bread wheat varieties *(Triticum aestivum*). *African Journal of Agricultural Research* 10.5897/AJAR2013.7588.

Walton, P.D. (1971). The use of factor analysis in determining characters for yield selection in wheat. Euphytica. 20: 416-421.