Study of stability and adaptation on yield components of Bread Wheat (Triticum aestivum L. em Thell.)

Pre-Dissertation

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Department of genetics and Plant Breeding

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MASTER OF SCIENCE

In

Genetics and Plant Breeding

By

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CERTIFICATE

This is to certified that this synopsis entitled "**Study of stability and adaptation on yield components of Bread Wheat (Triticum aestivum L. em Thell.)**" submitted in partial fulfilment of requirements for degree – Master of Science in Genetics and Plant Breeding by **Ankita Bhakri**, Registration no. **11707971** to Department of Genetics and Plan0t Breeding, School of Agriculture, Lovely Professional University, has been formulated and finalized by the student himself on the subject.

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DECLARATION

I hereby declare that the project work entitled **—** “**Study of stability and adaptation on yield components of Bread Wheat (Triticum aestivum L. em Thell.)**” is an authentic record of my work carried 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

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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 al over the world and stands 1st among the cereals both in area and production. Globally, it is cultivated on an area of 221.61 million hectare and production of 728.96 million tonnes with an average yield of 3289 kg per hectare In India, wheat is the 2nd most important food crop after rice.

Wheat is the largest cereal crop extensively grown as staple food sources in world (Mollasadeghi et al 2012). Wheat was grown on an area of 302.27 lakh hectare with the total production of 93.50 million tonnes in India in year 2016-17. However, in Punjab it was grown on a total area of 35.06 lakh hectare having production of 160.08 lakh tonnes. It is predominantly grown in state Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar and Gujarat. The most popular varieties of wheat that are extensively cultivated in India are as follows: VL-832,VL-804, HS-365, HS-240 , HD2687,WH-147, WH-542, PBW-343, WH-896(d), PDW-233(d), UP-2338, PBW-502, Shresth (HD 2687), Aditya (HD 2781), HW-2044, HW-1085, NP-200(di), HW-741. Unnat PBW 343, Unnat PBW 1 Zn, Unnat PBW 550 are the 3 recent varieties which were release by PAU, Ludhiana.

For a successful breeding programme, the presence of genetic variability plays a vital role. It is true that the more diverse plant, the greater chance of exploiting high heterotic crosses. The principal objective of breeding is to develop varities of good quality. If GE interaction causes a change in yield,then the work of plant breeders becomes increasingly significant in terms of the effectiveness of selection of cultivars for different regions. However, in order to analysis the correlation and path analysis between yield and contributing characters is effective only when desired genetic variability is present in the genetic stock. Genotypic and phenotypic correlations are important in determining the degree to which various yield contributing characters are associated. Many researcher have reported the positive correlation of grain yield with number of grain per spike, plant height and 1000 grain weight. Moreover, environmental conditions are known to have significant influence on yield of wheat. Methods available for estimating the magnitude of G x E interaction involve an analysis of variance (Ebehart and Russell 1966).

Objectives of investigation:

1. To assess the genetic variability for yield and yield contributing traits.
2. To estimate pattern of character association among the traits under study.
3. To estimate direct and indirect effects using path analysis.
4. Screening of stable wheat genotypes suitable for different environment.

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 variability
2.2 Genetic stability
2.3 Correlation coefficient and path analysis

2.1 Genetic variability

It is observed that genotype within the species exhibit variations with respect to metric traits and components of yield. Genetic variation between the species is a key for the success of any breeding programme. Plant breeders are able to determine and distinguish between genetic and environmental variances.

Tewodros et. al., (2014) reported that fourteen bread wheat genotypes were tested at eight environments namely Adet, Motta, Debre Tabor and Finote Selam in 2008 and 2009 to determine genetic variations, heritability and diversity of bread wheat genotypes, to determine genotypes with high yielder and form homogenous grouping of environments and genotypes. The result of combined analysis of variance for the grain yield, days to heading, days to maturity, plant height, Septoria, thousand seed weight and hector liter weight showed highly significant difference among the genotypes.

Nusrat et. al., (2013) revealed that considerable variability among the genotypes for 13 quantitative characters. High genotypic coefficient of variation (GCV) was observed for number of tillers per running meter followed by grain yield per plant biomass yield and thousand seed weight while as medium to low GCV was observed for other characters. High estimates of broad sense heritability were observed for number of tillers followed by 1000 seed weight harvest index, plant height days to maturity and biomass yield, while as other character showed moderate to low broad sense heritability.

Said et. al., (2014) reported that highly significant ($P \leq 0.01$) differences were found for all the traits studied indicating the scope of improvement through simple selection for high mean values of these traits. Maximum genotypic differences were observed for all the studied parameters except chlorophyll concentration index and number of spikelet per spike indicating considerable amount of variation among the accessions for each trait. Highest heritability estimates and expected genetic advance were found for all the traits except chlorophyll concentration index, spike length and number of -1spikelet spike which exhibited moderate heritability.

Fikre et. al., (2015) showed that high heritability values were observed for days to heading, days to maturity, grain filling period, 1000 kernel weight, number of spikelet spike-1, spike length and plant height. Moderate PCV and GCV were recorded for 1000 kernel weight, grain yield, harvest index, number of grains per spike and number of productive tiller. Among the characters 1000 kernel weight showed high values of genetic gain whereas days to maturity, grain yield, harvest index, productive tillers and number of grains plant-1 had moderate values of genetic advance.

2.2 Genetic stability

Improved varieties have to be evaluated in different environments to test their performance. Information about stability is useful for the selection of crop varieties as well as for breeding programmes because yield performance of a genotype is a result of the interaction between genotype and environment.

Ayalneh et. al., (2017) said that the success of crop improvement and production activities can be enhanced with scientific information generated frorm genotype-environment interactions. Highly significant (P<0.01) variation were observed in environment and genotype-environment interaction, while significant (p<0.05) variations noted in genotypes. Significance of GEI is an indication for inconsistency of genotypes in response to changing environments due to genotype-environment interaction.

Ulcer et. al., (2006) reported that there were significant differences and interactions among genotypes, locations and years. The regression coefficient (b) values of the 11 genotypes used in this study ranged from 0.46 to 1.73; deviation from regression ranged from 69.9 to 2896.7. According to estimates of the two stability parameters, none of the genotypes were stable for grain yield.

Rashid et. al., (2015) showed that a highly significant GEI was accompanied by highly significant genotype and environment main effects. Most of the stability models (7 out of 12) did not identify stable and unstable genotypes in similar fashion. Three out of twelve stability statistics identified four genotypes G1, G20, G2 and G7 as the most stable and high yielding and three genotypes G11, G14 and G8 as unstable with low yielding performance.

Khatoon et. al.,(2016) showed that the genotypes which have more thermostable and that hold optimum relative water content and more stomatal size and frequency were more biological yield as compared to other genotypes. So the Saleem-2000 was the best genotype followed by Wafaq-2001 according to these water related parameters.

2.3 Correlation and path analysis

For effective selection, it is important to measure the mutual relationship between various plant characters. The study of path analysis is important to measure the degree of effect between the two characters.

Akram et. al., (2008) revealed positive correlation in case of number of spikelets per spike, number of grains per spike and 1000 grain weight with grain yield at both genotypic and phenotypic levels. However, number of tillers per m2 and spike length contributed negatively towards grain yield at both levels. Plant height was positively correlated with grain yield at genotypic level, whereas negatively correlated at phenotypic levels.

Bhutto et. al., (2016) found that significant differences among the genotypes for plant height, tillers per plant, spike length, spikelet's per spike, grains per spike, seed index and grain yield per plant. The phenotypic correlations revealed that tillers per plant and grains per spike were highly positively associated; hence these yield components can be used as reliable selection criteria to improve grain yield in wheat.

Khaliq et. al., (2004) reported phenotypic correlation between yield and plant height, tillers per plant, spike length, spikelets per spike and 1000-grain weight while positive and significant genotypic correlation was significant between these characters and grain yield per plant. Among these characters, spike length reflected the highest direct effect of (4.43) towards grain yield; while minimum direct effect was indicated by spikelets per spike.

Bhushan et. al,. (2009) found high direct genotypic and phenotypic correlations for the test weight, biological yield, spikelets per spike and grain filling period. While, days to heading, plant height and days to maturity showed direct negative correlation with grain yield. Path analysis showed that harvest index had highest direct positive effect on grain yield followed by biological yield, productive tillers per plant, spikelets per spike.

3. Material and methods

This heading consist of the details about the materials and methods adopted during the period of investigation of objectives under consideration entitled “Study of stability and adaptation on yield components of Bread Wheat” which was carried out in winter season.

3.1 Description of Experimental Area

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 5^0 C. with the soil type classified as sandy loam with good drainage.

3.2 Experimental materials

The experimental material is consisted of 25 germplasm of Bread Wheat (Triticum aestivum L. em Thell.).

3.2.1 Details of genotypes used in the study

Sr. No.	Genotype	Pedigree/Sources
1.	DPW-621-50	KAUZ//ALTAR84/(AOS)AWNEDONAS/3/MILAN/KAUZ/4/HUITES{436
2.	PBW- 625	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
3.	DBW- 14	RAJ376/PBW343
4.	WH- 1105	MILAN/S-87230//BABAX[389]
5.	JW-3211	SKAuZ/2/FCT
6.	PBW- 723	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
7.	DBW- 17	CMH79A.95/3*CNO79//RAJ3777
8.	PBW- 550	WH 594/RAJ3858//W 485
9.	DBW- 71	PRINIA/UP-2425[4361]
10.	DBW- 39	ATTILA/HUI
11.	CBW- 38	CNDO/R143/ENTE/MEXI2/3/Ae.SQUARROSA(TAUS)/4/WEAVER
12.	DBW- 16	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
13.	HD- 2967	ALD/COC//URES/HD2160M/HD2278
14.	HD- 3086	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
15.	DBW- 107	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
16.	RUJ- 4037	DL7882/RAJ3717
17.	DBW-110	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
18.	DBW-93	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
19.	WH- 703	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
20.	PBW- 677	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
21.	DBW- 90	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, KARNAL
22.	DBW- 88	INDIAN INSTITUTE OF WHEAT AND BARLEY RESESRCH, 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 RESESRCH, KARNAL

3.2.2 Experimental details

The experiment was conducted in randomized block design (RBD) with 25 treatments in 3 replications. The experimental details are as follows:-

Design	:	RBD (Randomized Block Design)
Genotypes	:	Twenty five
Plot size	:	25 x 11 sq. metre
Row to row distance	:	20 cm
Net area of experimental field	:	275 sq. metre
Crop	:	Wheat
Season	:	*Rabi*

Sowing of wheat based on three different environments

Environment 1	:	20th November 2017
Environment 2	:	10th December 2017
Environment 3	:	21st December 2017

3.2.3 Field preparation and layout

3.2.4 Sowing

In order to get good tilth of the soil one cross cultivation was done by tractor drawn cultivar followed by one harrowing and one ploughing before sowing of seed.

3.2.5 Irrigation

Light irrigation was given just 2 days after sowing**.**

3.2.6 Intercultural operations

The experimental plots were kept weed free. Hand deweeding and hoeing was done when needed.

3.2.7 Plant protection

Spray of insecticide was given at a regular interval of time

3.2.8 Fertilizer application

Application of 11.5 kg of N, 16.5 kg of P, 2.12 kg of K was given at a regular interval of time.

Observations to be recorded

A.	**Phenological parameters**	**B.**	**Quality parameters**
1	Days to 50% heading	16	Sedimentation value (mm)
2	Days to maturity	17	Hectolitre (g/litre)
3	Plant height (cm)	18	Protein content (%)
4	Number of tillers per plant	19	Wet gluten content (%)
5	Number of productive tillers per plant	20	Starch (%)
6	Number of spikelets per ear		
7	Ear length (cm)		
8	Ear weight (g)		
9	Number of ears per plant		
10	Spike legth (cm)		
11	1000 grain weight (g)		
12	Grain yield per plant (g)		
13	Number of grains per ear		
14	Biological yield per plant		
15	Harvest index (%)		

Statistical methodology

1. Analysis of variance (Panse and Sukhatme, 1952)
2. Heritability and Genetic advance (Hanson et. al., 1956 and Johnson et. al., 1955)
3. Correlation coefficient analysis (Miller et. al., 1958)
4. Path coefficient analysis (Dewey and Lu, 1959)
5. Stability analysis (Eberhart and Russell, 1966)

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