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Correlation coefficient Analysis in Bread Wheat (*Triticum aestivum* L.) Genotypes under Heat Stress Conditions

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ABSTRACT: Forty bread wheat genotypes were evaluated in two replicated trials under late sown irrigated conditions during 2020-21 and 2021-22. The Experiment assessed the effects of different traits on grain yield and their association under late-sown conditions in bread wheat. The character, grain yield per plot exhibited a highly significant and positive correlation under heat stress conditions with the number of tillers per meter, biological yield per plot, grain weight per spike, harvest index, 1000-grain weight, number of spikelets per spike, spike length, number of grains per spike, while it also manifested the highly significant and negative correlation with days to maturity and days to anthesis. The yield components exhibited varying trends of association among themselves. Thus, the most important traits revealed under heat stress conditions were the number of tillers per meter, harvest index, biological yield per plot and grain weight per spike, which may contribute considerably towards higher grain yield.

Keywords: Bread wheat, correlation coefficient, heat tolerance.

INTRODUCTION

Bread Wheat (*Triticum aestivum*) is one of the most important cereal food crops after rice, originated in southwestern Asia. It is one of the earliest domesticated cereals which is widely grown and consumed globally. It belongs to the true grass family Poaceae of the genus *Triticum* (Mollasadeghi and Shahryari 2011). It is an allohexaploid (AABBDD) having a chromosome number of 2n=6x=42 with a genome size of approximately 17 GB. The wheat crop is grown in a wide range of climatic conditions ranging from tropical high-rainfall areas to temperate, irrigated to drought-stressed areas and from warm-humid circumstances to cold-arid regions (Acevedo *et al*., 2002).

In India, the wheat crop is widely cultivated in different agro-climatic conditions ranging from northern to southern hills and Gujarat to Assam. Wheat cultivation in India has traditionally been dominated by the country's North Western Plains Zones (NWPZ) which comprises Punjab, Haryana, Delhi, adjoining parts of Rajasthan, western Uttar Pradesh, some parts of Jammu & Kashmir and Himachal Pradesh.

Several biotic and abiotic stresses tend to decrease crop productivity globally. Abiotic stresses, which include low or high temperature, inadequate or excessive water, salinity and metal toxicity are also responsible for substantial yield loss (Dhakal *et al.,* 2021). The wheat crop is adapted to cooler climatic conditions and therefore, its cultivation is being undertaken in the winter season in subtropical and tropical environments. Temperature is one of the main natural factors influencing crop growth and development rate at various stages. Wheat crop is highly sensitive to heat stress, particularly at the reproductive stage. In general, heat stress affects several plant development phases like anthesis, grain filling, and ripening (Vignjevic *et al.,* 2015).

Heat tolerance is a complex phenomenon and difficult to measure. Improvement of a particular trait cannot only be accomplished, through direct selection for the targeted trait but also by indirect selection via other traits that are more heritable and easy to select. Coefficients of correlation can be used to quantify the relationship between these traits. In Correlation coefficient analysis, grain yield is considered the dependent variable and the remaining morphological traits are considered as independent variables (Singh *et al.,* 2014). Therefore, the present study was to evaluate the correlation between grain yield and its component traits in bread wheat under heat stress conditions.

MATERIAL AND METHODS

The experiment was conducted at the Wheat & Barley Section research farm area, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University Hisar. The experiment was conducted for two consecutive years 2020-21 and 2021-2022 during Rabi season. Geographically, the experimental farms of CCS HAU, Hisar are situated at a latitude of 29.09°N, longitude of 75.43°E, at an altitude of 215.2 m above the sea level in the sub-tropical region of the North Western Plain Zone (NWPZ) of India. The forty bread wheat genotypes were sown with hand plough in a randomized complete block design (RBD) including a check variety as treatments and two replications. The details of forty bread wheat genotypes and their pedigree are given in Table 1. Each plot comprised three rows of 2.5 m in length with row-to-row spacing of 20 cm and all the standard agricultural practices were followed for general cultivation and maintenance of the healthy crop. Data were recorded based on five randomly selected plants from each genotype plot. The observed data were subjected to statistical analysis. Correlation and path coefficient analysis were carried out over pooled data between grain yield and its attributing traits, by using the formula suggested by Pearson (1948).

Table 1: Details of 40 bread wheat genotypes along with their pedigree.

Sr. No.	Genotypes	Pedigree
1.	BRW 3806	NI5439/MACS2496
2.	C 306	REGENT1974/3*CHZ//*2C591/3/P19/C281
3.	DBW 14	RAJ3765/PBW-343
4.	DBW 71	PRINIA/UP2425
5.	DBW 74	WBLLI*/BRAMBLING
6.	DBW 110	KIRITATI/4/2*SERI1B*2/3/KAUZ*2/BOW//KAUZ
7.	DBW 296	SOKOLL/3/PASTOR//HXL7573/2*BAU/4/MASSIV/PPR47.89C
8.	DBW 299	WAXWING*2/KRONSTADF2004*2//BECARD
9.	DBW 303	WBLL1*2/BRAMBLING/4/BABAX/LR42//BABAX*2/3/SHAMA*2/5/PBW343
10.	DPW 621-50	KAUZ//ALTAR84/AOS/3/MILAN/KAUZ/4/HUITES
11.	GW 477	GW366/BOW898
12.	HD 3059	KAUZ//ALTAR84/AOS/3/MILAN/KAUZ/4/HUITES
13.	HD 3086	DBW14/HD2733//HUW468
14.	HD 3226	GRACKLE/HD2894
15.	HD 3237	HD3016/HD2967
16.	HD 3293	HD2967/DBW46
17.	HD 3298	CL1449/PBW343//CL882/HD2009
18.	HI 1621	W15.92/4/PASTOR//HXL7573/2*BAU/3/WBLL1
19.	HI 1655	MACS2496/HI1531
20.	K 1317	K0307/K9162
21.	LOK 54	Raj3777/WH671
22.	MP 3288	DOVE/BUC/DL788-2
23.	NIAW 3170	SKOLL/ROLF07
24.	NIAW 3624	DL 1022 X NIAW 1415
25.	NIAW 3643	RAJ 4083 X NIAW 1275
26.	QST 1910	HD2967/WH1080
27.	RAJ 3765	HD2402/VL639
28.	RAJ 4480	WR989/PBW587
29.	RW 5	RAJ4014/WH730
30.	RWP-2018-31	HD3108/DPW621-50
31.	RWP-2018-32	HD3131/DBW90
32.	PBW 773	FRANCOLIN#1*2/KIRITATI
33.	HI 1653	NADI/COPIO/NADI
34.	WH 711	S308/CHR//KAL
35.	WH 730	CPAN2092/ImprovedLok-1
36.	WH 1021	NYOT95/SONAK
37.	WH 1063	BARBET1Selection
38.	WH 1105	MILAN/S87230//BABAX
39.	WH 1124	MUNIA/CHTO//AMSEL
40.	WH 1202	D67.2/PARANA66.270//AE.SQ.(320)/3/CUNNINGHAM

RESULTS AND DISCUSSION

Correlation coefficient analysis provides information on the nature and extent of association between any two characters. Correlation occurs between different characters either due to linkage or pleiotropic effects. The results of correlation coefficients between grain yield and its attributing traits are given in Table 2.

The results indicated a strong association between grain yield and other morphological traits. A positive correlation between desirable characters may lead to simultaneous improvement in both of the associated characters through appropriate methods of plant breeding.

Grain yield per plot was significantly and positively correlated with number of tillers per meter (0.675^{**}), biological yield per plot (0.613^{**}), grain weight per spike (0.602^{**}), harvest index (0.577^{**}), 1000-grain weight (0.500^{**}), number of spikelets per spike (0.389^{**}), spike length (0.376^{**}), number of grains per spike (0.224^{**}). These results agreed with the findings of Devi *et al.* (2023); Paras *et al.* (2022); Baye *et al.* (2020); Mecha *et al.* (2017); Mohanty *et al.* (2016). A highly negative and significant correlation was observed for days to maturity (-0.269**) and days to anthesis (-0.265**). Similar findings were also reported by Neeru *et al*. (2017); Bhushan *et al.* (2013).

Harvest index exhibited highly significant and positive correlation with the number of tillers per meter (0.469**), 1000-grain weight (0.360**), and grain weight per spike (0.282**), Whereas, it had a highly negative and significant correlation with the traits *viz.,* biological yield per plot (0.284**) and days to anthesis (-0.248**), Results are agreed with the findings of Mecha *et al.* (2017); Mohammad *et al*. (2005). Biological yield per plot had a significant and positive correlation with grain weight per spike (0.440**), number of tillers per meter (0.350**), spike length (0.346**), number of spikelets per spike (0.291*), 1000-grain weight (0.247**) and number of grains per spike (0.119**). However, a highly significant and negative correlation was observed for days to maturity (-0.318**) by Abd-Allah *et al.* (2018). The number of tillers per meter showed a highly significant and positive correlation with grain weight per spike (0.687**), spike length (0.491**), and number of spikelets per spike (0.439**) whereas, it showed a significant and negative association with days to anthesis (-0.370**), days to heading (-0.309**) and days to maturity (-0.247*).

Thousand-grain weight data about correlation analysis showed that the 1000-grain weight had a highly significant and positive correlation with the number of tillers per meter (0.628**), grain weight per spike (0.499**), spike length (0.488**), number of spikelets per spike (0.402**). These results were similar to those of Islam *et al.* (2017). It had a highly negative and significant correlation with the traits *viz*., days to anthesis (-0.318**) and number of grains per spike (-0.139**). Similar findings were also reported by Wolde *et al.* (2016). Grain weight per spike was significantly and positively correlated with the number of spikelets per spike (0.690**), spike length (0.516**) and number of grains per spike (0.145**) Whereas, it had highly negative and significant correlation with the traits *viz*., days to anthesis (-0.255**) and days to maturity (-0.246*). Spikelets per spike was significantly and positively correlated with spike length (0.495**). The present finding was supported by Bhutto *et al.* (2016) ; Kumar *et al.* (2014).

Table 2: Pooled correlation-coefficient analysis among grain yield and yield-attributing traits under heat stress conditions.

	DH	DA	DM	T/M	SL	S/S	GR/S	GW/S	TGW	BY/P	HI
DH	1										
DA	0.797**	1									
DM	0.070	0.140	1								
T/M	-0.309**	-0.370**	-0.247*	1							
SL	0.054	-0.089	-0.139	0.491**	1						
S/S	-0.042	-0.103	-0.259*	0.439**	0.495**	1					
GR/S	0.003	0.114	0.033NS	0.045	0.124	0.111	1				
GW/S	-0.132	-0.255*	-0.246*	0.687**	0.516**	0.690**	0.145**	1			
TGW	-0.202	-0.318**	-0.215	0.628**	0.488**	0.402**	-0.139**	0.499**	1		
BY/P	0.049	-0.089	-0.318**	0.350**	0.346**	0.291**	0.119**	0.440**	0.247*	1	
HI	-0.203	-0.248**	0.006	0.469**	0.101	0.162	0.135	0.282**	0.360**	-0.284**	1
GY/P	-0.113	-0.265*	-0.269*	0.675**	0.376**	0.389**	0.224*	0.602**	0.500**	0.613**	0.577**

*** Significant at p=0.05, **Significant at p=0.01**

DH: Days to heading, **DA:** Days to anthesis, **DM:** Days to maturity, **T/M:** Number of tillers per meter, **SL:** Spike length (cm), **S/S:** Number of spikelets per spike, **GR/S:** Number of grains per spike, **GW/S:** Grain weight per spike(gm), **TGW:** 1000-grain weight(gm), **BY/P:** Biological yield per plot (gm), **HI:** Harvest index(%), **GY/P:** Grain yield per plot (gm).

SUMMARY AND CONCLUSION

For a successful breeding program, it is very important to have a piece of scientific information about the interrelationship between yield and yield-attributing traits. It is plausible to conclude that the strategic selection of genotypes using correlation analysis permits the concurrent augmentation of many traits contributing to grain production in bread wheat based on such data regarding the connections among grain yield and its component traits. In this study correlation coefficients between grain yield and component traits under heat stress conditions need attention for such imperative traits which possess positive and highly significant correlation with the grain yield are very important. The character, grain yield per plot under heat stress conditions exhibited a highly significant and positive correlation with the number of tillers per meter, biological yield per plot, grain weight per spike, harvest index, 1000-grain weight, number of spikelets per spike, spike length, number of grains per spike. Whereas, a highly negative and significant correlation was observed between grain yield per plot with days to maturity and days to anthesis was also observed. The yield component traits exhibited varying trends of association among themselves. Thus, revealed that under heat stress conditions such traits were the most important and may contribute considerably towards higher grain yield.

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Conflict of Interest. None.

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