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Research article

CHARACTER ASSOCIATION AND HERITABILITY ANALYSIS IN PAKISTANI ELITE BREAD WHEAT CULTIVARS

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ABSTRACT: An investigation was done on correlation and heritability analysis for 09 characters on 20 advance bread wheat cultivars which were grown in randomized complete block design with three replications during rabi, 2012-13. The trait grain yield per plant made positive and significant association with productive tillers per plant, spike length, spikelets per spike, grains per spike, seed index, total biomass and harvest index. Indicating a thorough selection for these traits will automatically improve seed yield in wheat because the five yield contributing traits are associated among themselves, selection in one of the traits will wholly result in the improvement of the other traits. Significant and negative correlation was revealed by plant height with productive tillers per plant, spike length, spikelets per spike and seed index, suggesting that dwarf wheat genotypes are by and large good yielders. High heritability estimates were observed for seed index, total biomass, grains per spike and plant height, indicating that these traits were predominantly controlled by additive gene effects and direct selection may be effective for these traits.

Key words: Bread wheat, Elite cultivars, Correlation, Heritability

INTRODUCTION

Wheat (*Triticum aestivum* L.) has been used as a staple food of the major civilizations since old ages. It is the most extensively grown cereal crop in the world, engaging 17% of crop acreage world over, giving food about 40% of world population and supplying 20% of the total food calories and protein in human diet (Gupta *et al.,* 2005). Wheat grain yield varies widely as a consequence of its interaction with a variety of environmental factors since it is a complex quantitative genetic parameter and is the result of numerous contributing factors affecting grain yield directly or indirectly. Wheat grain production can be improved through the development of productive varieties which better adjust in diverse agro-climatic conditions and also resist all types of biotic and abiotic stresses. Selection and improvement in respect to grain yield can only be efficient if adequate genetic variability is exit in the breeding materials (Ali *et al.,* 2008). Correlation coefficient is an important statistical technique which can assist wheat breeders in selection crop plants for higher yields. Therefore, knowledge of interrelationships between grain yield and its contributing factors will improve the effectiveness of breeding programs through the use of suitable selection indices (Mohammadi *et al.,* 2003). The creation and selection of genetic variation for crop improvement is one of the key integral tasks for plant breeders. The selection depends not only on the estimation of genetic variation among genotypes, but also upon a proportion of heritable variation and expected genetic gain that could be obtained (Falconer and Mackay, 1996; Singh, 2000). An attempt was made in the present research study to assess the heritability of some quantitative traits and understand the relationship between these traits and their contribution to yield in a set of advance cultivars.

MATERIAL AND METHODS

The present study was carried out during rabi season, 2012-13 at Botanical Garden, Department of Plant Breeding and Genetics, Faculty of Crop Production, Sindh Agriculture University Tando jam. The experimental materials consisted of twenty elite bread wheat cultivars viz, TD-1, TJ-83, SKD-1, Imdad-05, Kiran-95, Marvi-2002, Khirman, Sindh-81, Mehran-89, Soughat-91, Johar, Sarsabz, Amber, Sonhari, Moomal, Abadgar, Anmol, Sundar, Sasuee and Sahar.

The experimental materials were sown in randomized complete block design (RCBD) with three replications. The sowing was done by dibbling, keeping 20 centimeters space between plants and 30 cm between rows. Ten plants were randomly selected and tagged from each replication. After collecting necessary data under field conditions, further observations were recorded at the laboratory. The traits studied were plant height (cm), productive tillers per plant, spike length (cm), spikelets per spike, grains per spike, grain yield per plant (g), seed index (1000 grain weight g), total biomass (g) and harvest index (%). The analysis of variance (ANOVA) was determined after Gomez and Gomez (1984); correlation coefficient was calculated according to Dewey and Lu (1959), while heritability estimates were determined according to Allard (1960).

RESULTS AND DISCUSSION

The amount of genetic variability in base population and relationship of different characters towards grains yield is the key of any breeding efforts. In the current study, the analysis of variation depicted highly significant differences among the cultivars for all the studied traits, indicating the existence of substantial genetic variation in the studied experimental materials.

Grain yield is the end product of interactions of many factors known as contributing components hence it is a complex trait. Understanding of the interaction of characters among themselves and with the environment has been of great interest in the plant breeding. The present study showed significant ($P<0.05$) and positive correlation such as spike length v/s grain yield per plant(r=0.6012**), productive tillers per plant v/s yield per plant (r= 0.5065*), spike length v/s spikelets per spike (r= 0.6142**), spike length v/s grains per spike (r =0.7771**), spike length v/s seed index (r =0.5013*), spike length v/s grain yield per plant (r =0.6691**), spikelets per spike v/s grains per spike (r=0.6180**), spikelets per spike v/s grain yield per plant (r = 0.6229**), grains per spike v/s grain yield per plant (r =0.8324**) and seed index v/s grain yield per plant (r = 0.7601**). Similarly, significant positive correlation of grain yield with grains per spike (Hussain *et al.*, 2014), productive tillers per plant (Hannachi *et al.*, 2013), 1000 kernel weight (Ajmal *et al.*, 2013) and harvest index (Sokoto *et al.*, 2012) were reported in their respective studies. Overall, an intensive selection for spike length, productive tillers per plant, spikelets per spike, seed index and grain yield per plant will automatically improve seed yield in wheat since these five traits are correlated among themselves; selection in one of the traits will implicitly result in the improvement of the other traits. Significant ($P<0.05$) and negative correlation was observed for plant height v/s productive tillers per plant, (r= -0.5568*); spike length (r= -0.6099**); spikelets per spike(r= -0.6358**) and seed index (r= -0.6048**). The plant height had shown significant negative association with yield contributing components. This suggested that dwarf varieties are preferred as they could withstand lodging and hence these could be used to the advantage in direct selection for grain yield.

Heritability estimates are useful in deciding the characters to be considered while making selection. In the present study, heritability (h^2) estimates were low for grain yield per plant (h^2=0.344), spikelets per spike (h^2=0.501) and harvest index (h^2=0.668). This shows that these traits are highly influenced by environmental factors. High heritability estimates were observed for seed index (h^2=0.954), total biomass (h^2=0.903), grains per spike (h^2=0.894) and plant height (h^2=0.88). High heritability values for these traits indicated that the variation observed was mainly under genetic control and was less influenced by environment. Heritability estimates were moderate for spike length (h^2=0.717) and productive tillers per plant (h^2=0.714).

Table 1. Mean squares from analysis of variances for various traits in wheat cultivars.

Source of variation	Degrees of Freedom	Characters								
		Plant Height	Productive tillers per plant	Spike length	Spikelets per spike	Grains per spike	Grains yield per plant	Seed index	Total Biomass	Harvest Index
Replications	2	1.500	0.45	0.88	0.50	4.54	0.12	7.54	0.37	0.31
Cultivars	19	162.64**	4.87**	4.03**	14.07**	42.47**	40.51**	61.23**	122.32**	6.16**
Errors	38	10.35	0.81	0.65	2.78	2.35	19.75	1.44	6.04	2.03

** = Significant at 1% probability level.

Table 2. Correlation (r) coefficients among various traits in bread wheat cultivars.

Characters	PH	PTP	SL	SS	GS	GY	SI	TB
Plant Height (PH)	1							
Productive tillers per plant (PTP)	-0.5568*	1.0000						
Spike length (SL)	-0.6099**	-0.4431^{ns}	1.0000					
Spikelets per spike (SS)	0.6358**	0.4881^{ns}	0.6142**	1.0000				
Grains per spike (GS)	0.2272^{ns}	-0.1504^{ns}	0.7771**	0.6180**	1.0000			
Grain yield per plant (GY)	-0.6012**	0.5065*	0.6691**	0.6229**	0.8324**	1.0000		
Seed index (SI)	-0.6048**	-0.1611^{ns}	0.5013*	0.4929^{ns}	-0.1324^{ns}	0.7601**	1.0000	
Total biomass (TB)	0.0750^{ns}	-0.1365^{ns}	-0.1152^{ns}	-0.1775^{ns}	-0.3860^{ns}	0.6095**	-0.0929^{ns}	1.0000
Harvest index (HI)	-0.6584**	0.7757**	0.5665*	0.5616*	-0.1824^{ns}	0.7792**	0.3890^{ns}	0.2094^{ns}

**= Significant at 1% probability level; *= Significant at 5% probability level; ns= Non-significant

Table 3. Heritability estimates in broad sense for various quantitative traits in bread wheat.

Characters	Genotypic variance	Phenotypic variance	Coefficient of heritability (h^2)	Heritability in percentage
Plant height	50.76	57.66	0.880	88.00
Productive tillers per plant	1.35	1.89	0.714	71.42
Spike length	1.12	1.56	0.717	71.70
Spikelets per spike	3.75	5.61	0.668	66.80
Grains per spike	13.37	14.94	0.894	89.40
Grain yield per plant	6.92	20.06	0.344	34.40
Seed index	19.93	20.89	0.954	95.40
Total biomass	38.65	42.78	0.903	90.30
Harvest index	1.37	2.73	0.501	50.10

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