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Genetic Improvement through Variability, Heritability and Genetic Advance for Grain Yield and its contributing traits in Wheat (*Triticum aestivum* L. em Thell)

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ABSTRACT

At global level India ranks as second largest wheat producing country, contributing about one-tenth of the global wheat production. Introduction, evaluation and identification of potentially useful germ plasm forms the first and foremost step in a crop improvement programme. Genetic variability existing in nature or created through crop breeding is of immense value for crop improvement programmes. Genetic variability in a population can be partitioned into heritable and non-heritable variation with the aid of genetic parameters such as variance, genotypic coefficient of variation, heritability and genetic advance, which serve as a basis for selection of some outstanding genotypes from existing ones Heritability is the ratio of genetic variance to total variance for a plant trait and is related with progress from selection It expresses the extent to which phenotypes are determined by the genes transmitted from parents. Similarly Knowledge of the association of quantitative characters specifically for yield and its attributes is of immense practical value during selection. The selection of one character will lead to indirect change(s) of other character(s) if the two are correlated. Therefore, the knowledge of phenotypic and genotypic correlation and path analysis is important for a plant breeder. Path coefficient analysis measures the direct and indirect effects of various characters. High estimates of genetic advance in per cent of over mean were found for productive tiller per plant, biological yield per plant and flag leaf area. Grain yield per plant, plant height exhibited moderate (GA) The low estimates of genetic advance were observed for harvest index ,50% flowering, yield per spike, day to maturity, spikelet's, ear length, number of grains per spike, peduncle length were observed our study.

Key words: *Wheat, Heritability, Variability, Genetic Advance.*

INTRODUCTION

Wheat is the world's largest famous energy rich cereal crop. It has been described as the "King of Cereals" because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. The ultimate goal of most of the breeding programmes is to increase the production per unit area in per unit time.

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Genetic improvement for quantitative traits depends upon the nature and amount of variability present in the genetic stock and the extent to which the desirable traits are heritable. Our mentioned genotype identified as statistically equal to best genotype for economic yield. The genotype showing very high mean performance for various characters may be utilized as donor for improving those characters in a component breeding approach. For effective selection of superior genotype in the germplasm lines, knowledge on genetically parameters such as variability, heritability and genetic advance is very much essential. Enhance the present yield level and overcome yield stagnation, it essential to reshuffle the gene through hybridization in suitable parent. For this it is necessary to identify thegene action involve in the expression of various yield contributing characters and also the combining ability of the parent and resulting crosses. The present study was, therefore, undertaken to estimate combining ability effects for grain yield and its related traits inbreed wheat.

MATERIAL AND METHODS

The field experiment under present investigation was conducted during rabi2016-17 at agriculture research farm of B.R.D.G. P.G. College Campus, Deoria, U.P., India. The site of experiments located at 26.5 degree north latitude, 83.79 degree east longitude and 68 meter (223 feet) above the sea level. The climate of district deoria is semi-arid with hot summer and cold winter. The experiment with 72 genotype with 3 checks variety of wheat in augmented block design. A test genotype was present only one block while the three checks were replicated in all the 9blocks. Each plot considered of two rows 2.5 meters length with spacing of 5 cm. within the rows and 25 cm. between the rows. Heritability (Board Sense), genetic advance (GA) and genetic advance as a percent over mean (GAM) were worked by following the method suggested by Hanson, W.D.[13] and Johnson *et al*.[19].

Breeding through component traits for grain yield in wheat has recently been getting the attention of plant breeders. The grain yield of a crop is a complex character and is the final product of actions and interactions of various characters[26]. Since no independent gene system is present for grain yield, a complete understanding of the relationships among yield and its components merits more attention[12].

Phenotypic and genotypic variability Genetic variability in a population can be partitioned into heritable and non-heritable variation with the aid of genetic parameters such as variance, genotypic coefficient of variation, heritability and genetic advance, which serve as a basis for selection of some outstanding genotypes from existing ones[22,8] also indicates the three ways of assessing the existence of variability in breeding population; (1) by using simple measures of variability, such as range, mean, variance, standard deviation, coefficient of variability and standard error (2) by estimating the various components of variance.

Jain and Aulakh6 reported high coefficients of phenotypic and genotypic variation for productive tillers per plant and 1000-grain weight and high genetic advance for most of the traits. The highest coefficient of variation was shown by grain yield per plant followed by grains per spike; spikelets per spike, spike length and germination percent[17,7,15] reported high estimates of phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance which indicates scope for improvement through simple selection for grain weight per spike, grain yield per plot, grains per spike, 1000- grain weight and tillers per plant. Uddin *et al*.[25] observed the highest coefficient of variation for grains per spike followed by 1000- grain weight and grain yield per plant. Bergale *et al*.[3] reported high phenotypic and genotypic coefficients of variation for the number of spikes per plant, grain yield plant, plant height, flag leaf area and 1000-grain weight. Jedynski et al.[18] explained the correlation and path coefficient for grain yield and its components in wheat. He also reported heritability estimates as very

high for plant height, high for 1000-grain weight, intermediate for number of grains per spike and very low for grain yield per plant. Pramod *et al*.24 reported highest genotypic coefficient of variation for number of effective tillers per plant and kernel yield[1]. Genetic variability was measured and subjected to statistical analysis as suggested by Federer, W.T.[10].

RESULT AND DISCUSSION

In their study of seventy Two local and exotic wheat genotypes found that the estimates of GCV were high for yield plant-1, number of productive tillers plant-1 and number of grains spike-1. The remaining traits recorded moderate to low GCV estimates. The PCV values were higher than GCV values for all the traits which reflect the influence of environment on the expression of these traits. Kalim-Ullah *et al*.[20] reported that the estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were highly significant ($P \leq 0.05$) for spike length, days to 50% flowering and plant height given in table 1.

Heritability is the ratio of genetic variance to total variance for a plant trait and is related with progress from selection It expresses the extent to which phenotypes are determined by the genes transmitted from parents. In other words, it expresses the magnitude of genotypic variance in the population, which is mainly responsible for changing the genetic composition of a population through selection[8]. It indicates the effectiveness with which selection of genotypes can be based on phenotypic performance. The broad-sense heritability is useful if the target is in relative importance of genotype and environment in determination of phenotypic value. But, it does not indicate the progress that might be made through selection within a particular population[5]. As for many field crops, the studies regarding the new cultivars for wheat are being conducted and the selection continues to be the basic method. The efficacy of the selections of both yield (a quantitative character) and the yield components depend on the genetic variation and percentage of heritability. It is necessary to identify the components that create the phenol typical difference in order to calculate the genetic variability and heritability based on that variation. Yield performance continues to be of importance in wheat breeding, though it will be necessary to improve traits involved in yield stability, if further yield increases are to be achieved. Das and Rehman[6] studied 8 quantitative traits in 9 varieties of wheat and observed a wide genotypic and phenotypic variability for plant height with a high value of heritability. Low values of heritability for grain weight spike-1 have been obtained in the studies conducted by Pawas *et al*.[23] and AlMarakby *et al*.[2] Contrary to this, Chaturvedi and Gupta[4] have obtained middle values. Ghimiaray and Sarkar[11] estimated heritability (broad sense) and genetic advance in wheat. High heritability coupled with high genetic advance were recorded for number of tillers plant-1. High heritability estimates were reported for days to 50% heading, grains spike1, 1000-grain weight, spikelets spike-1, spike length, tillers plant-1 and days to maturity. Also low estimates were observed for germination per cent and grain yield plant-1 Imbrahim *et al*.[14] Jedynsky[18] reported high heritability estimates for plant height and 1000- grain weight, intermediate for number of grains spike-1 and very low for grain yield plant-1 (Kumar *et al*.) reported high heritability coupled with high genetic advance for plant height, number of spikelets spike-1, 1000- grain weight and number of days to 50% heading in wheat. Kashan and Khaliq[21] reported moderate to very high broad sense heritability for all morphological characters except fertile tillers plant-1. Heritability and genetic advance are important selection parameters. Heritability estimates Along with genetic advance are normally more helpful in predicting the grain under selection than heritability estimates alone. the estimate of heritability can be utilized for the prediction of genetic gain, which indicates the genetic improvement that would result from the selection of best individual hence estimate of

heritability is an essential per – requisite for formation of an effective selection method for genetic improvement .

Genetic advance is the improvement in the mean genotypic value of selected individual over the parental population. High heritability accompanied with high genetic advance indicated that the heritability is due to additive genetic effect and selection may be effective while high heritability coupled with low genetic advance indicates pre-dominance of non additive gene action while low heritability is exhibited due to influence of environmental interaction rather than genotypic selection for such characters may not be rewarding.

The estimates of broad sense heritability (h^2) and genetic advance in per cent over mean (GA) for different characters are given in Table 2.

The estimates of heritability in broad sense ranged from 99.45% (Flag leaf area) to 39.15 (Days of maturity). High estimates of heritability (>75%) were observed for Flag leaf area ,Grain yield per spike Harvest index, Grains per spike, Grain yield per plant, Biological yield per plant, 1000 Grains weight, Spike length, Peduncle length, No. of spikelet's per spike, Plant height, Days to 50% flowering, where as Days to50% flowering, Grain yield per plant recorded moderate heritability (50-75%). Rest of characters were characterized with low estimates of h^2 (<50%).

High estimates of genetic advance in per cent of over mean were found for productive tiller per plant, biological yield per plant and flag leaf area. Grain yield per plant, plant height exhibited moderate (GA) The low estimates of genetic advance were observed for harvest index, 50% flowering, yield per spike, day to maturity, spikelet's, ear length, number of grains per spike, peduncle length were observed our study.

Table 1: Estimates of correlation coefficients computed between 14 character indigenous and exotic lines of wheat Geno typical Correlation Matrix

No	Character	Days to 50% Flowering	Plant Height cm	Peduncle Length (cm	Flag Leaf Area cm²	Ear Length cm	Productive Tillers/ Plant	Spikelets /Spike	Days to Maturity	Biological Yield/ Plant(g)	Yield/ Spike(g)	Grains/ Spike	1000 Grains Weight(g)	Harvest Index%
	Days to 50% Flowering	1.0000	-0.1005	-0.1319	-0.0327	-0.2288	0.1674	0.0170	1.0108	0.1407	-0.0281	-0.0364	-0.0864	-0.0542
	Plant Height cm	-0.1005	1.0000	0.4594	-0.0930	0.3610	0.0891	0.3845	0.1692	0.3323	0.0500	0.0286	-0.0828	-0.3914
	Peduncle Length (cm	-0.1319	0.4594	1.0000	-0.0480	0.5499	0.0981	0.0511	0.3701	0.2853	0.0702	0.0699	0.0132	-0.1307
	Flag Leaf Area cm²	-0.0327	-0.0930	-0.0480	1.0000	-0.1251	0.2124	-0.1527	0.0726	-0.1211	-0.0443	-0.1247	-0.0796	0.2121
	Ear Length cm	-0.2288	0.3610	0.5499	-0.1251	1.0000	-0.0208	0.3645	-0.1810	0.4243	0.0628	0.2863	0.1091	-0.1791
	Productive Tillers/ Plant	0.1674	0.0891	0.0981	0.2124	-0.0208	1.0000	-0.0009	-0.1919	0.5568	0.2433	0.0134	0.0103	-0.3958
	Spikelets /Spike	0.0170	0.3845	0.0511	-0.1527	0.3645	-0.0009	1.0000	0.2104	0.4748	0.3414	0.4773	0.3432	-0.1009
	Days to Maturity	1.0108	0.1692	0.3701	0.0726	-0.1810	-0.1919	0.2104	1.0000	0.0477	-0.0026	-0.0420	0.0125	-0.1027
	Biological Yield/ Plant(g)	0.1407	0.3323	0.2853	-0.1211	0.4243	0.5568	0.4748	0.0477	1.0000	0.4114	0.3382	0.1517	-0.4687
	Yield/ Spike(g)	-0.0281	0.0500	0.0702	-0.0443	0.0628	0.2433	0.3414	-0.0026	0.4114	1.0000	0.6068	0.0693	0.1396
	Grains/ Spike	-0.0364	0.0286	0.0699	-0.1247	0.2863	0.0134	0.4773	-0.0420	0.3382	0.6068	1.0000	0.0809	0.0989
	1000 Grains Weight(g)	-0.0864	-0.0828	0.0132	-0.0796	0.1091	0.0103	0.3432	0.0125	0.1517	0.0693	0.0809	1.0000	0.1356
	Harvest Index%	-0.0542	-0.3914	-0.1307	0.2121	-0.1791	-0.3958	-0.1009	-0.1027	-0.4687	0.1396	0.0989	0.1356	1.0000
	Grain Yield/ Plant (g)	0.0722	-0.0997	0.0475	0.1340	0.0881	0.0722	0.2469	0.0295	0.2905	0.5184	0.4014	0.2520	0.6962

Phenotypical Correlation Matrix

No	Character	Days to 50% Flowering	Plant Height cm	Peduncle Length (cm	Flag Leaf Area cm²	Ear Length cm	Productive Tillers/ Plant	Spikelets /Spike	Days to Maturity	Biological Yield/ Plant(g)	Yield/ Spike(g)	Grains/ Spike	1000 Grains Weight(g)	Harvest Index%
	Days to 50% Flowering	1.0000	-0.0649	-0.0984	-0.0377	-0.2275	0.1496	0.0037	0.4571	0.1188	-0.0408	-0.0481	-0.0448	-0.0662
	Plant Height cm	-0.0649	1.0000	0.4119	-0.0880	0.3431	0.0912	0.2867	0.1294	0.3149	0.0431	0.0185	-0.0585	-0.3460
	Peduncle Length (cm	-0.0984	0.4119	1.0000	-0.0414	0.5198	0.0707	0.0675	0.1066	0.2774	0.0615	0.0528	0.0218	-0.1371
	Flag Leaf Area cm²	-0.0377	-0.0880	-0.0414	1.0000	-0.1233	0.1984	-0.1350	0.0263	-0.1157	-0.0450	-0.1246	-0.0797	0.2087
	Ear Length cm	-0.2275	0.3431	0.5198	-0.1233	1.0000	-0.0138	0.3409	-0.0840	0.4170	0.0681	0.2816	0.1006	-0.1701
	Productive Tillers/ Plant	0.1496	0.0912	0.0707	0.1984	-0.0138	1.0000	-0.0198	-0.0283	0.5398	0.2397	0.0192	0.0089	-0.3710
	Spikelets /Spike	0.0037	0.2867	0.0675	-0.1350	0.3409	-0.0198	1.0000	0.0625	0.4421	0.3198	0.4577	0.3198	-0.1128
	Days to Maturity	0.4571	0.1294	0.1066	0.0263	-0.0840	-0.0283	0.0625	1.0000	-0.0048	0.0103	0.0204	-0.0205	-0.0263
	Biological Yield/ Plant(g)	0.1188	0.3149	0.2774	-0.1157	0.4170	0.5398	0.4421	-0.0048	1.0000	0.4084	0.3269	0.1529	-0.4563
	Yield/ Spike(g)	-0.0408	0.0431	0.0615	-0.0450	0.0681	0.2397	0.3198	0.0103	0.4084	1.0000	0.6046	0.0612	0.1411
	Grains/ Spike	-0.0481	0.0185	0.0528	-0.1246	0.2816	0.0192	0.4577	0.0204	0.3269	0.6046	1.0000	0.0746	0.0996
	1000 Grains Weight(g)	-0.0448	-0.0585	0.0218	-0.0797	0.1006	0.0089	0.3198	-0.0205	0.1529	0.0612	0.0746	1.0000	0.1343
	Harvest Index%	-0.0662	-0.3460	-0.1371	0.2087	-0.1701	-0.3710	-0.1128	-0.0263	-0.4563	0.1411	0.0996	0.1343	1.0000
	Grain Yield/ Plant (g)	0.0670	-0.1087	0.0560	0.1326	0.0930	0.0647	0.2438	0.0066	0.2885	0.5127	0.3949	0.2527	0.6851

Table 2: Estimates of Heritability and Genetic Advance in 72 germplasm lines of wheat

	Range					
Characters	**Min**	**Max**	**Mean**	**h^2 (bs) (%)**	**GA (%)**	**GA% Over mean**
Days to 50% flowering	71.0833	91.0833	79.6433	83.25	7.0318	8.8358
Flag leaf area (cm^2)	80.2321	100.842	89.3289	99.45	10.1969	31.9654
Plant height (cm)	36.9567	55.0100	45.3240	88.13	7.5780	8.4657
Days to maturity	22.1671	47.1204	31.7492	39.15	2.0448	1.6746
Spike length (cm)	8.5758	13.1258	10.7628	96.62	1.5829	14.6728
No.of spikelet's per spike	3.8400	5.9267	5.1127	91.89	1.6942	9.4672
No. of effective fillers per Plants	15.8200	20.0133	17.9160	94.25	0.6610	12.9154
Peduncle length	115.7917	127.125	122.231	94.40	6.2712	13.7908
Grains per Spike	12.1213	31.6213	18.9547	98.94	16.1648	29.6859
1000 Grain weight (g)	1.0663	3.9063	2.3288	97.65	8.8805	24.1009
Biological yield per Plant (g)	34.3988	76.1421	54.6012	97.88	5.8179	30.6855
Grain yield per Plant (g)	1.0575	3.7975	2.0898	98.81	0.7680	36.7791
Grain yield per Spike (g)	25.0417	58.0417	36.8550	99.39	1.0810	46.3531
Harvest Index (%)	6.1783	18.0850	11.2331	98.99	4.4947	40.0271

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