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Genetic variability and correlation studies for grain yield and its components traits in wheat (*Triticum aestivum* L.) genotypes

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ABSTRACT

The present investigation was carried out using nine bread wheat genotypes at Regional Agricultural Research Station, Chintapalle, Acharya N G Ranga Agricultural University during *rabi*, 2020-21 in Randomized Block Design with three replications. Sagarika has proved well in terms of high mean yield among nine genotypes. High genotypic and phenotypic coefficient of variation, heritability values coupled with high genetic advance were recorded for grain yield per plot. Correlation between yield and two characters, *viz*., days to maturity and plant height were found positive and significant and therefore selection for these characters can directly be considered for yield improvement. While path coefficient analysis revealed that spikelet length showed the highest positive direct effect on grain yield (kg/ha), but the correlation is positive non-significant so focusing on the indirect effects through 1000 grain weight, grain yield per plot would be rewarding for yield improvement.

Keywords: : *Correlation coefficient,Genetic advance, Heritability, Wheat and Variability*

Wheat(*Triticum aestivum* L.) is the most important cereal crop in northern states of India. Wheat belongs to the family Poaceae, is one of the most important staple food amongst major cereals of the world. India occupies second position in the world with 107.59 million tons production in total area of 30.55 million hectares. In India Uttar Pradesh has highest production with 32.59 million tons followed by Madhya Pradesh 19.61 million tons (Directorate of Economics & Statistics, DAC&FW, 2019-20).Grain yield in wheat is a complex character and its performance is depending on its component traits. For genetic manipulation of grain yield, quality and other characters, there is a need to examine the nature of genetic variability for the yield related attributes and quality traits in Wheat. It is very important to partition the observed variability into heritable and non-heritable components measured as genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability H^2(bs)%, genetic advance (GA) and genetic advance expressed as percent mean (GAM%). Estimation of variability with the help of suitable parameters such as PCV, GCV, heritability estimates, and GA are very necessary to start an efficient breeding program. Heritability associated with genetic advance as per cent of mean (GAM) is more effective and reliable in predicting the resultant effect of selection. Correlation expresses the degree of inter-relationship between various traits while path analysis provides a better understanding of the type of effect (Sabit *et al*., 2017). The existing interrelationship between components is expressed through correlations coefficients and those coefficients can be separated in to direct and indirect effects by path analysis (Saif-ur-rasheed *et al*., 2014).The prejent study aims to compare results of genotypic and phenotypic correlations and path coefficient analysis of wheat and helps in the effective selection of genotypes for improving yield in a wheat breeding program.

Keeping above objectives, the present investigation was made to estimate the variability, heritability, genetic advance, correlation and path analysis for yield and yield components traits in wheat.

MATERIAL AND METHODS

The experimental plant material comprised of nine wheat genotypes were taken from ICAR-IARI, Regional station, Indore. These nine varieties were tested during *rabi*, 2020-21 at Regional Agricultural Research Station, Chintapalle, Alluri Seetharamarju district, Andhra Pradesh. Chintapalle is located at latitude of 17°67Œ§ North and longitude of 82°34Œ§ East and at an elevation of 839 meters above mean sea level. Soil texture of research field was sandy loam with pH 6.3. The experiment was laid out in Randomized Block Design (RBD) with 3 replications and each genotype sown in ten rows of three-meter length spaced at 25 cm from row to row and 10 cm from plant to plant. The recommended package of practices was adopted for raising the healthy crop. Five randomly selected plants of each entry in each replication are taken into consideration for recording data of all observations except for days to 50 per cent flowering, days to maturity and grain yield per plot were recorded on plot basis.

Statistical analysis is done to test the difference among the genotypes, the analysis of variance was worked out separately for each character as per method suggested by Fisher (1954). Genotypic and phenotypic variances, genotypic and phenotypic coefficient of variability, broad sense heritability and correlation coefficients were computed according to the method suggested by Singh and Chaudhary (1985). Genetic advance in terms of percentage of means was estimated as described by Brim *et al*., (1959). The methodology proposed by Dewey and Lu (1959) was used to perform the path analysis for grain yield and its components keeping grain yield as resultant variable and its components as causal variables.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) revealed significant differences for the characters studied indicating presence of considerable variation among the genotypes and scope for the genetic improvement of yield attributing traits. Among nine genotypes, Sagarika recorded high mean grain yield (5,169 kg/ha) followed by PBW-723(4,668 kg/ha) (Table 1). The knowledge of genetic variability present in a given crop species for the character is of paramount importance for the success of any plant breeding programme. Information on coefficient of variation is useful in measuring the range of variability present in the characters. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone.

Variability, Heritability and Genetic advance:

The observed estimates of GCV (Table-2) are high for grain yield per plot (38.77 %) followed by grain yield (kg/ha) (38.66 %), panicle length (10.97 %) and lower values were recorded for days to maturity (0.87 %), days to 50 % flowering (3.15 %), plant height (5.03 %), 1000 seed weight (5.11 %), number of productive tillers per plant (5.67%). Similarly, higher PCV is recorded for grain yield(kg/ha) (44.11 %) followed by grain yield per plot (43.93 %), number of productive tillers per plant (18.33 %), panicle length (16.62%), 1000 seed weight (16.00%), plant height (9.20 %), days to 50 % flowering (3.55 %) and days to maturity (1.49%). Jagdish Prasad *et al.,* (2020) observed similar results for GCV and PCV for plant height, days to 50% flowering, days to maturity, panicle length, grain yield. The PCV values were reported higher than GCV values for all the traits which prove the influence of environment on the expression of traits. Estimates of PCV were slightly higher than the corresponding GCV estimates for characters days to 50% flowering, Grain yield indicating that the characters were less influenced by the environment and selection on the basis of phenotype alone can be effective for the improvement of these traits. The characters viz., plant height, days to maturity, spikelet length enhibited moderate differences while number of productive tillers per plant and 1000 seed weight showed high magnitude of difference indicating more environment influence on these characters and selection based on these traits would be less effective comparatively.

The estimates of heritability are very essential towards knowing reliability of phenotypic value. In the present scenario high heritability was observed in days to 50 % flowering (78%) followed by grain yield per plot (77 %), grain yield (kg/ha) (76 %) and moderate heritability observed for panicle length (43 %), days to maturity (34%) and lowest heritability found for characters *viz.,* plant height (29%), number of productive tillers per plant (9.6 %) and 1000 seed weight (10 %). These results were in accordance with Nukasani *et al.,* (2013) and Barman *et al.,* (2020). Therefore, characters having high heritability found to be effective for selection as they are least influenced by the environmental effects. Nevertheless, the characters coupled with high heritability along with high genetic advance as per cent of mean are more effective towards selection when compared to heritability estimates alone.

In the present investigation, high heritability coupled with high genetic advance as per

Table.1 Performance of wheat genotypes for grain yield and yield attributing characters

S.No	Genotype	Plant height (cm)	Days to 50 % flowering	Days to maturity	No. of productive tillers per plant	Panicle length (cm)	Grain yield (kg/ha)
1	PBW-725	69.6	52	90	5.9	7.7	2583
2	PBW-660	77.2	52	90	6.4	8.9	4481
3	PBW-723	71.1	51	90	8.7	6.2	4668
4	SAGARIKA	82.1	53	92	7.1	8.3	5169**
5	PBW-761	69	52	89	7.4	7.1	2110
6	DWL-3504	68.6	55	90	6.8	8.4	2246
7	HD-3886	77	55	91	7	8.6	4239
8	PBW-3086	69.7	55	90	7.5	7.7	1254
9	WH-1105	78.2	50	92	6.3	9.8	4312
	GM	73.6	53	90	7	8.1	3451.2
	C.D.	8.25	2.002	1.464	1.349	1.77	1244.3
	SE(m)	2.728	0.662	0.484	0.446	0.585	411.5
	SE(d)	3.858	0.936	0.685	0.631	0.828	581.9
	C.V.	6.418	2.167	0.927	11.014	12.531	20.65

Table.2 Genetic variability parameters for yield and its contributing traits in wheat

S.No.	Characters	Means	Range		GCV%	PCV%	H^2(bs)(%)	Genetic Advance	GAM
			Min.	Max.					
1	Plant height (cm)	73.6	69	82.1	5.03	9.2	29	5.66	4.16
2	Days to 50 % flowering	53	50	55	3.15	3.55	78	3.04	5.76
3	Days to maturity	90	90	92	0.87	1.49	34	0.96	1.06
4	No.of productive tillers per plant	7	5.9	8.7	5.67	18.33	9.6	0.25	3.61
5	Panicle length (cm)	8.1	6.2	9.8	10.97	16.62	43	1.2	14.92
6	1000 seed weight (g)	48.3	41.6	54.5	5.11	16	10	1.62	3.36
7	Grain yield (kg/ha)	3451.2	1254	5169	38.66	44.11	76	2409.32	69.8

cent of mean was observed for grain yield per plot . Thus, these traits are predominantly under the control of additive gene action and hence these characters can be very effective in selection and can be fixable in the population. Moderate heritability with moderate genetic advance was recorded for panicle length which appears to be under the control of both additive and non-additive gene actions.

Correlation and Path analysis

Correlation and path analysis estimates the nature of relationships among the traits and plays an important role during the selection of desirable parents for hybridization programme. In the present study of correlation (Table 3) days to maturity (r_g= 0.4954**; r_p=0.4176*) has positive significant correlation with grain yield at both levels indicating medium to late maturing entries are more promising in yield when compared to early maturing entries followed by plant height (r_p=0.5070*) at phenotypic level only which indicates tall types are preferred. Similar results were reported by Kumar *et al.,* (2014), Reza *et al.,* (2014) and Devesh *et al.,* (2018), for plant height. Characters *viz*., panicle length (r_g= 0.3623; r_p=0.1344), Grain yield plot should not be taken as independent valuable keep it the grain yield /plot(or) grain yield (kg/ha) in the artical and number of productive tillers per plant (r_p=0.1408) has shown positive non-significant contribution towards grain yield at phenotypic level and negative non-significant (r_g= -0.0335) at genotypic level. Sokoto *et al.,*(2012) and Abderrahmane *et al.,* (2013) observed similar results for spikelet length. Characters *viz*., 1000 seed weight, days to 50 % flowering has shown negative non-significant contribution towards grain yield. This implies that early flowering ones are desirable, and similore results were reported by Ayer *et al*., (2017) and Ojha *et al*., (2018). The result for 1000 seed weight is deviating from the proceedings of Akram *et al*. (2008). Characters namely, 1000 seed weight (r_g= 0.9521**; r_p=0.4532*) and grain yield per plot (r_g= 0.4959*; r_p=0.4175*), enhibited positive correlation with days to maturity. Other characters like Spikelet length(r_g= 0.7378**) has shown positive significant contribution to 1000 seed weight and plant height (r_g= -0.7307**) showed negative significant association with number of productive tillers per plant at genotypic level.

Path coefficient analysis is an important tool for partitioning the correlation coefficients into the direct and indirect effects of independent variables on a dependent variable. In this analysis, grain yield (kg/ha) was taken as dependent variable and the rest of the characters were considered as independent variables. The path analysis (Table 4) revealed that grain yield per plot (0.0190) showed the highest positive direct effect on grain yield followed by number of productive tillers per plant(0.0177), panicle length (0.0162), and 1000 seed weight(0.0075)indicating that, direct selection through these traits will be effective for yield improvement. Similar observations was found by Khan (2014) for panicle length. Plant height (-0.0143)showed negative direct effect on Grain yield (kg/ha) , which was similarly observed by Ojha *et al.,*(2018).

The indirect effects of days to maturity showed positive through 1000 seed weight, days to 50 % flowering and grain yield per plot at both phenotypic and genotypic levels while for indirect effects of plant height showed positive through panicle length, grain yield per plot at both levels and negative through number of productive tillers per plant. The character number of productive tillers per plant showed positive indirect effect through 1000 seed weight, grain yield per plot at phenotypic level and negative indirect effect at genotypic level, while for panicle length it showed negative indirect effects at both levels. Aycicek and Yildirim (2006) also reported positive but small direct effects of 1000 grain weight on grain yield in wheat.

Panicle length showed positive indirect effect through 1000 seed weight and grain yield per plot and negative effect through plant height and number of productive tillers per plant. 1000 seed weight has shown positive indirect effect through spikelet length at both levels and negative indirect effect through grain yield per plot at both levels and days to 50 % flowering, plant height, number of productive tillers per plant at genotypic level only. Grain yield per plot has shown positive indirect effect through panicle length at both levels.

In the present study, correlation between yield and two characters, *viz*.,Days to maturity and plant height were found positive and significant, therefore selection for these characters can directly be considered for yield improvement. While path coefficient analysis revealed that panicle length

Table.3 Genotypic and Phenotypic correlation for yield and its contributing traits in wheat

S.no	Character	Days to 50 % flowering	Days to maturity	Plant height (cm)	No. of productive tillers per plant	Panicle length (cm)	1000 seed weight (g)	Grain yield (kg/ha)
1	Days to 50 % flowering	1	0.0001	-0.3045	0.2404	-0.0111	-0.3193	-0.4798*
		1	-0.0164	-0.0807	0.0479	-0.0123	-0.0928	-0.4098
2	Days to maturity		1	0.5402**	-0.7958**	0.0677	0.9521**	0.4954**
			1	0.1449	0.0432	0.2335	0.4532*	0.4176*
3	Plant height (cm)			1	-0.7307**	0.7065	0.1004	0.2541
				1	-0.0289	0.4961**	-0.1601	0.5070**
4	No. of productive tillers per plant				1	-1.0288	-1.3127	-0.0335
					1	-0.6920**	0.0076	0.1408
5	Panicle length (cm)					1	0.7378**	0.3623
						1	0.0651	0.1344
6	1000 seed weight (g)						1	-0.2529
							1	-0.0398
7	Grain yield per plot (g)							0.0034
								0.0053

**Significance at P<0.01, *Significance at P<0.05,

Table.4 Path coefficient analysis for yield and its contributing traits in wheat

S.no	Character	Days to 50 % flowering	Days to maturity	Plant height (cm)	No. of productive tillers per plant	Panicle length (cm)	1000 seed weight (g)	Grain yield (kg/ha)
1	Days to 50 % flowering	**0.0049**	0.0001	0.0043	0.0043	-0.0002	-0.0024	-0.4798
		-0.0011	0.0002	0.0019	0.0004	-0.0002	-0.0012	-0.4098
2	Days to maturity	0.0001	**0.0017**	-0.0219	-0.0141	0.0173	0.0072	0.4954
		0.0001	**-0.0098**	-0.0034	0.0004	0.0038	0.0059	0.4176
3	Plant height (cm)	-0.0015	0.0026	**-0.0143**	-0.013	0.0115	0.0083	0.2541
		0.0001	-0.0014	**-0.0236**	-0.0003	0.0081	-0.0021	0.4918
4	No. of productive tillers per plant	0.0012	-0.0013	0.0104	**0.0177**	-0.0167	-0.0099	-0.0335
		-0.0001	-0.0004	0.0007	**0.0087**	-0.0113	0.0001	0.1408
5	Panicle length (cm)	-0.0001	0.0018	-0.0101	-0.0182	**0.0162**	0.0056	0.3623
		0.0001	-0.0023	-0.0117	-0.006	**0.0163**	0.0009	0.1344
6	1000 seed weight (g)	-0.0016	0.0016	-0.0157	-0.0233	0.012	**0.0075**	-0.2529
		0.0001	-0.0044	0.0038	0.0001	0.0011	**0.0131**	-0.0398
7	Grain yield per plot (g)	-0.0024	0.0008	-0.0176	-0.0006	0.0059	-0.0017	0.0034
		0.0004	-0.0041	-0.012	0.0012	0.0022	-0.0007	0.0053

showed the highest positive direct effect on grain yield, but the correlation is positive non-significant so focusing on the indirect effects through 1000 grain wight, grain yield per plot would be rewarding for yield improvement.

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