Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 1142-1146
Received: 05-07-2017
Accepted: 06-08-2017

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Genotypic performance of F_5 segregating population of wheat (*Triticum aestivum* L. Em. Thell.)

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Abstract
In order to develop and identify superior genotypes, a set of 19 genotypes and 1 check were evaluated in randomized block design with three replications having 22.5 x 5 cm crop geometry during *Rabi*-2016 at field experimentation centre, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad. The data were recorded for thirteen quantitative characters to study genetic variability, heritability and correlation coefficient analysis. Analysis of variance among 19 wheat genotypes showed highly significant differences for all the characters indicated the presence of substantial amount of genetic variability. On the basis of mean performance, the highest grain yield per plant was observed for the genotypes HUW 213 x NW 2086 followed by HUW 231 x K 712 and HUW 234 × K 212-1. An estimate of GCV and PCV revealed that phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicate presence of environment effect on expression on character studied. Higher difference between GCV and PCV were depicted for flag leaf width, flag leaf length, number of tillers per plant, spike length, harvest index and grain yield per plant. The heritability estimates were high for number of grains per spike followed by test weight, plant height and days to 50% flowering. High heritability coupled with high genetic advance in the present set of hybrids was recorded for grains per spike, indicating predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters. Correlation study revealed that grain yield per hill at genotypic and phenotypic level was positively correlated with biological yield per plant, grains per spike and test weight and at phenotypic level was positively correlated with biological yield per plant, grains per spike, harvest index, number of tillers per plant and test weight.

Keywords: Wheat, genetic variability, heritability, correlation coefficient analysis.

Introduction
Wheat (*Triticum aestivum* L.) is the 2nd most important cereal in India after rice and improvement in the productivity has played a key role in making India self-sufficient in the food production (Mahaptara *et al*., 2008) [12]. The production level of wheat in India had a quantum jump from 6.46 million tons from an area of 9.75 million ha in 1950-51 to more than 101.2 million tons from an area of about 32 million hectares during 2015-16. (Directorate of Economics & Statistics, 2016) [5]. Development of high yielding varieties mainly depends on the magnitude of genetic variability present in the base material for desired characters. Genetic variability is of greatest interest to the plant breeder as it plays a vital role in forming successful breeding programme. The extent of genetic variability is of paramount importance for the improvement of a crop as greater is the genetic variability in the existing germplasm better would be the chances of the selection superior genotypes. Heritability and genetic advance are other important selection parameters the estimates of heritability which help the plant breeder in determining the character for which selection would be done. Heritability is classified as low (< 30%), medium (30-60%) and high (>60%). Correlation coefficient is an essential statistical method which can help wheat breeders in selection for higher yield. The use of correlation coefficient is to establish the extent of association between yield and yield component characters, which are having decisive role in influencing the yield (Singh, 2009) [15]. Keeping in view the above perspectives, the present investigation was taken up to identify promising lines for yield and yield components of wheat.

Material and Methods
The present investing was undertaken during *Rabi*-2016 at the Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Allahabad, U.P. The experiment comprised of 19 wheat genotypes including one check. Seeds were sowed in 5 x 2 m^2 plot in randomized block design with three replications. Spacing was maintained at 22.5 x 5 cm between the plants and rows respectively.

Standard agronomic package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Observation were recorded on ten randomly taken plants from each replication on 13 quantitative traits *viz*., days to 50% flowering, plant height, number of productive tillers per plant, spike length, flag leaf length, flag leaf width, days to maturity, grain filling period, number of grains per spike, biological yield, harvest index, test weight and grain yield per plant. The data were analysed for variability as per procedure given by Panse and Sukhatme (1985), genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) by Burton and De Vane (1953) [4], heritability and genetic advance by (Johnson *et al*., 1955) [9] and correlation coefficient analysis (Al Jibouri *et al.,* 1958).

Results and Discussion

The magnitude of genetic variability present in wheat genotypes is of paramount importance to a plant breeder for starting a judicious breeding programme. The analysis of variance revealed the existence of highly significant differences among the genotypes and therefore, selection would be effective. The result of analysis of variance is present in the Table 1. Similar results were reported earlier in wheat by Ranjana *et al.* (2013) [14] and Singh *et al.* (2016) [16].

A wide range of variability was exhibited by most of the traits under study (Table 2). Phenotypic variance was higher than the genotypic variances for all the characters indicated the influences of environmental factors on these traits. The magnitude of PCV was higher than GCV for all the characters which may due to higher degree of interaction of genotypes with the environment (Majumder *et al.,* 2008) [13]. Higher magnitude of genotypic coefficient of variation was recorded for grains per spike. Similar results reported earlier in wheat by Jan and Kashyap (2016) and Singh *et al.* (2016) [16] for grains per spike.

Heritability acts as predictive instrument in expressing the reliability of phenotypic value. Therefore, high heritability helps in effective selection for a particular character. The heritability estimates were high for number of grains per spike followed by test weight, plant height, days to 50% flowering, biological yield per plant, days to maturity, grain yield per plant, spike length, grain filling period and flag leaf length. Heritability estimates were moderate for tillers per plant and harvest index, low heritability shows for flag leaf width. The above results were also reported by Khan *et al.* (2013) [10] for plant height and Ajmal *et al.* (2009) and Bhusan *et al.* (2012) for grain yield per plant and plant height.

High heritability estimates along with high genetic advance are more helpful in predicting the gain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al.,* 1955) [9]. High heritability coupled with high genetic advance in the present set of genotypes was recorded for grains per spike, indicating predominance of additive gene effects and the possibilities of effective selection for the improvement of these characters. Similar results were also reported by Gurjar *et al.* (2015) [7].

High heritability coupled with moderate genetic advance for plant height and biological yield suggesting that greater role of non-additive gene action in their inheritance. Heterosis breeding could be used to improve these characters. Similar results were also reported by Gurjar *et al.* (2015) [7] for grain yield and plant height

The difference between PCV and GCV were slightly high for most of traits, showing little influence of environment on the expression of most of the characters, which is also indicative from high values of heritability for most of the characters. High heritability with high genetic advance was recorded for grains per spike. Therefore, selection can be exercised upon these traits for yield improvement of wheat.

Grain yield per plant showed the positive significant genotypic association with number of biological yield per plant, grains per spike and test weight at genotypic level. Similar results were also reported by Baloch *et al.* (2014) [2] for positive significant correlation of number of grains per spike with grain yield per plant. Dutamo *et al.* (2014) observed positive correlation of biological yield per plant with grain yield per plant. Singh *et al.* (2016) [16] and Kumar *et al.* (2013) [3-11-14] observed positive correlation of test weight with grain yield per plant.

Grain yield per plant showed the positive significant association with biological yield per plant, grains per spike, harvest index, number of tillers per plant and test weight at phenotypic level. Similar results were also reported by Kumar *et al.* (2013) [3-11-14] observed positive correlation of grain yield per plant with number of tillers per plant and test weight.

Table 1: Analysis of variance for thirteen quantitative characters in wheat

Sources	d.f	Days to 50% flowering	Plant height	Tillers/ plant	Spike length	Flag leaf length	Flag leaf width	Days to maturity	Grain filling period	Grains per spike	Test weight	Biological yield/ plant	Harvest index	Grain yield/ plant
Replications	2	0.15	5.34	0.35	0.13	1.88	0.02	0.75	1.35	1.55	0.36	17.23	13.88	1.51
Treatments	18	32.91**	222.76**	1.12**	3.30**	28.93**	0.03*	19.63**	14.27**	410.18**	54.45**	96.84**	22.13**	15.63**
Errors	36	1.00	5.91	0.20	0.33	4.26	0.01	1.14	1.92	1.59	0.84	5.98	6.61	1.35

*and** Significant at 5% and 1% level of significance respectively

Table 2: Genetic parameters for 13 quantitative characters in wheat genotypes

S. No.	Characters	Vg	Vp	Coefficient of variation		h^2% (bs)	GA	GA as % of mean
				GCV	PCV			
1.	Days to 50% flowering	10.63	11.64	4.31	4.51	91	6.42	8.48
2.	Plant height	72.28	78.20	8.80	9.16	92	16.84	17.44
3.	Number of tillers per plant	0.31	0.51	8.39	10.84	60	0.88	13.37
4.	Spike length	0.99	1.33	10.04	11.63	75	1.77	17.86
5.	Flag leaf length	8.22	12.49	12.56	15.47	66	4.80	21.00
6.	Flag leaf width	0.01	0.03	5.97	12.15	24	0.08	6.05
7.	Days to maturity	6.16	7.31	1.97	2.15	84	4.70	3.73
8.	Grain filling period	4.12	6.04	4.04	4.90	68	3.45	6.87
9.	Number of grains per spike	136.20	137.80	22.71	22.84	99	23.90	46.50
10.	Biological yield	30.29	36.27	14.01	15.33	84	10.36	26.37
11.	Harvest index	5.17	11.79	6.47	9.76	44	3.10	8.82
12.	Test weight	17.87	18.72	10.88	11.14	95	8.51	21.90
13.	Grain yield per plant	4.76	6.12	15.80	17.91	78	3.97	28.72

σ^2g = Genotypic variance. σ^2p = Phenotypic variance. h^2 = Heritability (broad sense), GCV = Genotypic coefficient of variation. PCV = Phenotypic coefficient of variation.

Table 3: Correlation coefficient between yield and its related traits in 19 wheat genotypes at genotypic level.

Characters	Plant height	No of tillers /plant	Spike length	Flag leaf length	Flag leaf width	Days to maturity	Grain filling period	Number of grains per spike	Test weight	Biological yield /plant	Harvest index	Grain yield/plant
Days to 50% flowering	0.20	0.14	0.62**	0.29	0.57*	0.74**	-0.64**	0.37**	-0.68	0.05	-0.12	0.0005
Plant height		-0.11	0.48**	0.48**	0.71*	0.12	-0.21	0.19	-0.12	0.12	-0.003	0.10
No. of tillers per plant			0.08	0.17	0.20	0.21	0.20	-0.18	0.005	0.13	0.63**	0.34
Spike length				0.70**	0.72**	0.43**	-0.41**	0.06	-0.62**	-0.22	-0.31	-0.30
Flag leaf length					0.59**	0.38*	0.06	-0.28	-0.12	-0.30	0.07	-0.21
Flag leaf width						0.44*	-0.33	-0.05	-0.79*	-0.40	-0.17	-0.41
Days to maturity							0.05	0.36*	-0.47**	0.17	-0.08	0.13
Grain filling period								-0.23	0.46**	0.10	0.07	0.13
No. of grains per spike									-0.25	0.78**	-0.14	**0.64****
Test weight										0.18	0.38*	**0.31***

Biological yield / plant											0.10	**0.93****
Harvest index												0.49

** & * @ 1% & 5% level of significance

Table 4: Correlation coefficient between yield and its related traits in 19 wheat genotypes at phenotypic level.

Characters	Plant height	No of tillers/plant	Spike length	Flag leaf length	Flag leaf width	Days to maturity	Grain filling period	Number of grains per spike	Test weight	Biological yield / plant	Harvest index	Grain yield / plant
Days to 50% flowering	0.17	0.07	0.54**	0.24	0.30*	0.71**	-0.56**	0.35**	-0.62**	0.03	-0.06	0.002
Plant height		-0.11	0.35**	0.35**	0.33*	0.10	-0.16	0.18	-0.10	0.10	0.02	0.06
No. of tillers per plant			0.05	-0.04	-0.01	0.05	0.04	-0.15	0.03	0.16	0.39**	**0.40****
Spike length				0.58**	0.54**	0.34**	-0.36**	0.05	-0.52**	-0.13	-0.16	-0.19
Flag leaf length					0.38**	0.33*	0.07	-0.22	-0.13	-0.22	-0.11	-0.26
Flag leaf width						0.31*	-0.08	-0.04	-0.34*	-0.21	-0.05	-0.20
Days to maturity							0.12	0.34*	-0.41**	0.14	-0.10	0.07
Grain filling period								-0.18	0.34**	0.07	-0.02	0.05
No. of grains per spike									-0.25	0.72**	-0.09	0.56**
Test weight										0.18	0.30*	0.30*
Biological yield / plant											-0.04	0.82**
Harvest index												0.50**

** &* 1% and 5% level of significance

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