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Genetic Analysis for Economic Traits in Wheat under Timely and Very Late Sown Conditions

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ABSTRACT

Forty F_1's generated by cross of ten genetically diverse promising genotypes with well adapted 4 testers in a line x tester mating design, were evaluated in randomized complete block with 3 replications and two dates of sowing i.e. 2^{nd} week of November (timely sown) and 1^{st} week of January (very late sown). Moderate GCV values were recorded for three characters viz., harvest index, ear weight and number of productive tillers plant^{-1} under timely sown condition. While higher GCV values exhibited by ear weight and harvest index under very late sown condition. The estimates of heritability for all the traits revealed that heritability estimates increased with delay in sowing time except for harvest index. Economically important traits like grain yield plant^{-1}, biological yield plant^{-1} and 1000-grain weight which exhibited high estimates for expected genetic advance accompanied with high heritability estimate can be improved by hybridization followed by selection. The study conclude that, correlated response obtained with grain yield plant^{-1} as a result of selection for different yield contributing traits viz; biological yield plant^{-1}, number of productive tillers plant^{-1}, ear weight exerted maximum response to grain yield followed by number of spikelets ear^{-1} and harvest index. Therefore, selection for grain yield plant^{-1} can be done through biological yield plant^{-1}, number of productive tillers plant^{-1}, number of spikelets ear^{-1} and harvest index.

Key words: *Coefficients of variation, heritability, genetic advance, correlation*

INTRODUCTION

Wheat is the second most important food crop in India after rice in terms of both area and production, with 12 per cent contribution in world wheat pool. Wheat is best adopted to cool growing conditions, while studies conducted under controlled environments have revealed that long hours of exposure to moderately high temperature as well as short exposure to very high temperature reduces wheat yield. Such situations arise when the crop is exposed to high temperature before anthesis, reduction in grain number occurs via reduction in spike per square meter and grains per spike, while reduction in grain weight results from reduction in grain filling duration and rate.

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Grain yield is the principal character of a cereal crop. This is a complex quantitative character, which is influenced by a number of yield contributing characters. So, the selection for desirable types should not only be based on yield, the other yield components should also be considered. It is, therefore, necessary to know the correlation of various component characters with yield and among themselves. The success of a breeding program depends largely upon the amount of genetic variability present in the population and the extent to which the desired traits are heritable. Therefore, an attempt was undertaken to estimate genetic variability, association among desired traits and their direct and indirect effects towards grain yield under timely and very late sown conditions.

MATERIALS AND METHODS

The research work was carried out in the experimental area of the Department of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P). The present investigation was undertaken to study the experimental material consisting of 40 F_1's generated by cross of ten genetically diverse promising genotypes viz., GW-273, GW-322, GW-366, JW-1201, JW-1202, JW-1203, LOK-1, HD-2864, HD-2932 and HI-1544 with well adapted 4 testers, i.e. JW-3336, JW-3288, MP-3269 and JW-3211 of wheat (*Triticum aestivum* L.) in a line x tester mating design during *rabi* 2013-14. The seeds of F_1's hybrids and their parents were sown in a randomized complete block design with three replications during *rabi* 2014-15. The sowing was done on 13/11/2014 (normal sown condition) and 05/01/2015 (very late sown condition) by dibbing of seeds in row. Normal agronomic and cultural practices were applied to the experiment throughout the growing season. Observations were recorded on nine different yield and yield contributing traits viz., number of productive tillers plant^{-1}, number of spikelets ear^{-1}, ear length, ear weight, number of grains ear^{-1}, 1000-grain weight, biological yield plant^{-1}, harvest index and grain yield plant^{-1}.

The genetic parameters of variability, estimation of heritability and genetic advance were computed according to the method suggested by Johnson *et al*[5]. The character association was estimated from variance and covariance components as given[1,4].

RESULT AND DISCUSSION

The analysis of variance (Table 1) revealed that the treatments were highly significant for all the characters and highest value was estimated for biological yield plant^{-1} followed by harvest index, grain yield plant^{-1}, number of grains ear^{-1} while, 1000-grain weight was lowest in timely sown condition whereas, biological yield plant^{-1} had highest value followed by harvest index, number of grains ear^{-1}, 1000-grain weight while, grain yield plant^{-1} was lowest in very late sown condition. This suggested that the genotypes selected were genetically variable and considerable amount of variability existed among them.

Variability: Moderate GCV values were recorded for three characters viz., harvest index, ear weight and number of productive tillers plant^{-1} under timely sown condition. While higher GCV values exhibited by ear weight and harvest index under very late sown condition. For characters, biological yield plant^{-1} and grain yield plant^{-1} phenotypic and genotypic coefficients of variation were high, almost similar and indicative for presence of very low environmental effects (Table 2). The results indicate that the above traits offer a better opportunity for improvement through selection. Similar findings were reported by Tripathi *et al*[10]., and Bhushan *et al*[2]. These values alone are not helpful in determining the heritable portion of variation.

Heritability: The proportion of genetic variability which is transmitted from parents to all spring is reflected by heritability[6]. The heritability estimates was minimum for number of productive tillers plant^{-1} (52.3%) and maximum for grain yield plant^{-1} (85.4%) under timely sown condition. Similarly, estimates were minimum for harvest index (37.0%) and maximum for 1000-grain weight (93.6%) under very late sown condition (Table

2). High value indicates that heritability may be due to higher contribution of genotypic components. The results reported by Monpara[7] for grain yield, Bhushan *et al*[2]., for biological yield and grain yield, Nukasani *et al*[8]., for grain yield are in support of the present findings. The comparison of heritability for all the traits was done under timely and very late sown condition indicated that heritability estimates increased with delay in sowing time except for harvest index. This may be due to influence of environment on genotypes under temperature stress environment.

Heritability estimates provide information about genetic gain if accompanied with estimates of genetic advance. The expected genetic advance as per cent of mean was minimum for ear length (11.86%) and maximum for grain yield plant^{-1} (46.16%) under timely sown condition while, minimum for harvest index (4.84%) and maximum for number of productive tillers plant^{-1} (25.37%) under very late sown condition. Higher estimates of genetic advance as per cent over mean were also recorded for biological yield plant^{-1} under timely and 1000-grain weight under very late sown, which is indicative of the fact that these traits are likely to show promise of improvement through selection (Table 2). The importance of these traits in wheat has also been studied by Bhushan *et al*[2]., Chavan *et al*[3]., Nukasani *et al*[8]. Therefore it can be said that economically important traits like grain yield plant^{-1}, biological yield plant^{-1} and 1000-grain weight which exhibited high estimates for expected genetic advance accompanied with high heritability estimate can be improved by hybridization followed by selection. Panse[9] reported that high heritability accompanied with high expected genetic advance is indicative of additive gene action which can be fixed by simple selection.

Correlation analysis: The estimates of genotypic and phenotypic correlation coefficient between grain yield and its components are presented in Table 3 and 4. Grain yield plant^{-1} showed significant positive correlation with number of productive tillers plant^{-1}, number of spikelets ear^{-1}, ear length, ear weight, number of grains ear^{-1}, biological yield plant^{-1} and harvest index at both genotypic and phenotypic level under both sowing conditions. These characters can be effectively used as selection criteria for grain yield under high temperature regime. The present findings are in conformity with the results reported by Bhushan *et al*[2]., Chavan *et al*[3]., Nukasani *et al*[8].

Under timely sown, number of spikelets ear^{-1} possessed significant positive correlation with ear length, ear weight, number of grains ear^{-1} and biological yield plant^{-1}; ear length showed positive correlation with ear weight, number of grains ear^{-1} and biological yield plant^{-1}; ear weight positively correlated with number of grains ear^{-1} at both phenotypic and genotypic level whereas, number of grains ear^{-1} possessed positive correlation with biological yield plant^{-1} at phenotypic level and harvest index at genotypic level. Similarly under very late sown conditions number of productive tillers plant^{-1} possessed significant positive correlation with number of spikelets ear^{-1}, ear length, number of grains ear^{-1} and biological yield plant^{-1}; number of spikelets ear^{-1} possessed significant positive correlation with ear length, ear weight, number of grains ear^{-1} and biological yield plant^{-1}; ear length showed positive correlation with ear weight, number of grains ear^{-1} and biological yield plant^{-1}; ear weight positively correlated with number of grains ear^{-1}, 1000-grain weight, biological yield plant^{-1} and harvest index at both phenotypic and genotypic level.

From the study it was concluded that correlated response obtained in a grain yield plant^{-1} as a result of selection for different yield contributing traits *viz;* biological yield plant^{-1}, number of productive tillers plant^{-1}, ear weight exerted maximum response to grain yield followed by number of spikelets ear^{-1} and harvest index. Therefore, selection for grain yield yield^{-1} can be done through biological yield plant^{-1}, number of productive tillers plant^{-1}, number of spikelets ear^{-1} and harvest index.

Table 1: Analysis of variance for yield and its components

Source of variation		D.F	Number of productive tillers plant-1	Number of spikelets ear-1	Ear length	Ear weight	Number of grains ear-1	1000-grain weight	Biological yield plant-1	Grain yield plant-1	Harvest index
Replications	**Timely sown**	2	5.73	3.20	0.58	0.06	21.80	5.05	35.84	0.27	12.72
	Very late sown		1.76	1.72	0.69	0.23	14.87	0.91	64.20	9.19	34.93
Genotypes	**Timely sown**	53	8.79**	10.69**	2.29**	0.63**	90.11**	41.99**	729.46**	95.62**	99.74**
	Very late sown		7.27**	8.09**	2.02**	0.53**	64.58**	40.57**	301.43**	31.64**	70.39**
Error	**Timely sown**	106	2.04	1.62	0.42	0.11	13.78	3.18	48.20	5.16	16.00
	Very late sown		1.07	0.57	0.30	0.07	5.29	0.90	22.85	3.73	25.48

*, ** indicate level of significance at 5% and 1%, respectively.

Table 2: Various genetic parameters for nine metric traits in wheat

Character	Timely sown						Very late sown					
	Range	**Mean**	**GCV**	**PCV**	**h2**	**GA**	**Range**	**Mean**	**GCV**	**PCV**	**h2**	**GA**
Number of productive tillers plant-1	6.00-14.06	10.30	14.55	20.11	52.3	21.69	6.56 -13.93	9.46	15.19	18.72	65.8	25.37
Number of spikelets ear-1	14.13-22.13	18.11	9.59	11.89	65.1	15.95	14.13 - 21.60	18.09	8.74	9.69	81.4	16.26
Ear length	8.24-12.27	10.57	7.47	9.68	59.5	11.86	8.14 - 11.98	10.35	7.32	9.06	65.4	12.20
Ear weight	1.80-4.00	3.14	13.17	17.07	59.5	20.92	1.73 - 3.80	2.65	14.63	17.95	66.4	24.55
Number of grains ear-1	40.60-64.66	52.50	9.60	11.93	64.9	15.93	40.06 - 61.26	51.48	8.63	9.72	78.9	15.79
1000-grain weight	33.00-50.66	39.96	9.00	10.04	80.2	16.60	26.00 - 44.00	34.33	10.58	10.94	93.6	21.10
Biological yield plant-1	43.43-111.83	67.68	22.26	24.51	82.5	41.65	24.13 - 59.93	41.09	23.45	26.17	80.2	17.78
Grain yield plant-1	12.42-41.21	22.64	24.25	26.25	85.4	46.16	7.20 - 20.62	12.93	23.57	27.91	71.3	5.30
Harvest index	15.69-56.55	33.99	15.54	19.49	63.6	25.52	23.14 - 44.65	31.76	12.18	20.02	37.0	4.84

Table 3: Phenotypic and genotypic correlation coefficient between grain yield and its components in wheat (Timely sown)

		Number of productive tillers plant-1	Number of spikelets ear-1	Ear length	Ear weight	Number of grains ear-1	1000-grain weight	Biological yield plant-1	Harvest index	Grain yield plant-1
Number of productive tillers plant-1	**P**	**1.000**	0.086	0.141	0.051	0.072	-0.040	0.523**	-0.203	0.329**
	G	**1.000**	-0.019	0.164	0.085	-0.052	0.006	0.623**	-0.270**	0.367**
Number of spikelets ear-1	**P**		**1.000**	0.674**	0.510**	0.987**	-0.256*	0.267**	0.125	0.345**
	G		**1.000**	0.671**	0.583**	0.993**	-0.363**	0.298**	0.266**	0.441**
Ear length	**P**			**1.0000**	0.577**	0.685**	-0.192	0.422**	0.011	0.410**
	G			**1.000**	0.644**	0.687**	-0.267**	0.515**	0.135	0.562**
Ear weight	**P**				**1.000**	0.498**	0.012	0.377**	0.125	0.459**
	G				**1.000**	0.549**	0.057	0.473**	0.196	0.585**
Number of grains ear-1	**P**					**1.000**	-0.272**	0.243*	0.121	0.322**
	G					**1.000**	-0.374**	0.251*	0.278**	0.409**
1000-grain weight	**P**						**1.000**	-0.006	0.041	0.043
	G						**1.000**	0.012	0.062	0.069
Biological yield plant-1	**P**							**1.000**	-0.340**	0.657**
	G							**1.000**	-0.264*	0.705**
Harvest index	**P**								**1.000**	0.469**
	G								**1.000**	0.494**

*, ** indicate level of significance at 5% and 1%, respectively.

Table 4: Phenotypic and genotypic correlation coefficient between grain yield and its components in wheat (Very late sown)

		Number of productive tillers plant^{-1}	Number of spikelets ear^{-1}	Ear length	Ear weight	Number of grains ear^{-1}	1000-grain weight	Biological yield plant^{-1}	Harvest index	Grain yield plant^{-1}
Number of productive tillers plant^{-1}	**P**	**1.000**	0.257*	0.243*	0.117	0.241*	-0.254*	0.774**	-0.091	0.696**
	G	**1.000**	0.278**	0.265*	0.157	0.279**	-0.279**	0.832**	-0.128	0.761**
Number of spikelets ear^{-1}	**P**		**1.000**	0.783**	0.554**	0.987**	0.044	0.439**	0.130	0.501**
	G		**1.000**	0.824**	0.591**	1.011**	0.043	0.455**	0.201	0.551**
Ear length	**P**			**1.000**	0.693**	0.749**	-0.027	0.451**	0.106	0.498**
	G			**1.000**	0.780**	0.777**	-0.037	0.468**	0.197	0.555**
Ear weight	**P**				**1.000**	0.526**	0.225*	0.382**	0.249*	0.508**
	G				**1.000**	0.557**	0.255**	0.427**	0.351**	0.592**
Number of grains ear^{-1}	**P**					**1.000**	0.043	0.432**	0.131	0.497**
	G					**1.000**	0.045	0.441**	0.198	0.540**
1000-grain weight	**P**						**1.000**	-0.088	0.107	-0.020
	G						**1.000**	-0.099	0.142	-0.027
Biological yield plant^{-1}	**P**							**1.000**	-0.248*	0.835**
	G							**1.000**	-0.209*	0.907**
Harvest index	**P**								**1.000**	0.311**
	G								**1.000**	0.220*

*, ** indicate level of significance at 5% and 1%, respectively.

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