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Assessment of Heritability, Genetic Advance and Correlation Coefficient in Wheat (*Triticum aestivum* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present research investigation was conducted at Instructional farm of AKS University, Satna, Madhya Pradesh during *rabi* Season of 2022. The experimental material for the present research trial comprised of 20 diverse genotypes of wheat collected from different sources through the help from Department of Genetics & Plant Breeding, Faculty of Agriculture Science, AKS University, Satna (M. P.). This experiment was conducted by using Randomized Block Design with three replications. Five plants were chosen aimlessly from every genotype in each replication. Data were recorded for 12 yield and its contributing traits viz. days to 50 % flowering, number of productive tillers per plant, peduncle length (cm), plant height (cm), spike length (cm), number of spikelets per spike, number of grains per spike, days to maturity, 1000 seed weight (g), biological yield (g), harvest index (%) and grain yield per plant (g) to estimate the heritability, genetic advance and correlation coefficient among various yield and its contributing characters of wheat (*Triticum aestivum* L.). The results revealed highly significant difference for all the characters which

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expressed huge amount of diversity among 20 genotypes of wheat. The maximum value of heritability was shown by number of grains per spike (97.75), number of spikelets per spike (97.16), spike length (cm) (90.68), plant height (cm) (87.68), 1000 seed weight (g) (87.37), days to maturity (86.59), number of productive tillers per plant (84.77), days to 50 % flowering (84.24), grain yield per plant (g) (81.25) and peduncle length (cm) (78.23). Characters 1000 seed weight (g) (47.0977) followed by Spike length (cm) (41.0351), Number of grains per spike (39.9853), Number of productive tillers per plant (37.6517) and Number of spikelets per spike (30.6568) showed higher estimates of genetic advance in per cent of mean. The characters number of productive tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike and 1000 seed weight (g) exhibited great coupling in heritability and genetic advance. The characters number of spikelets per spike (0.8524**), number of grains per spike (0.8411**), biological yield (g) (0.8279**), spike length (cm) (0.7737**), days to maturity (0.7252**),1000 seed weight (g) (0.6038**) and plant height (cm) (0.4648*) exhibited positive significant correlation with grain yield per plant so maximum weightage should be given to these traits for further crop improvement program.

Keywords: Wheat, heritability; genetic advance; correlation coefficient.

1. INTRODUCTION

"Wheat (*Triticum aestivum* L.) is a self pollinated crop belongs to family Gramineae. It is widely grown all over the world as food crop. Wheat is third most produced cereal in the world after rice and maize. China is the world's largest producer of wheat which produces more than 2.4 billion tonnes of wheat in the last 20 years, around 17% of the total wheat production. Russia is the largest exporter of wheat in the world, which exported more than 7.3 billion tonnes of wheat in 2021" [1]. "The top 10 wheat producing countries in the world are China, India, Russia, United States, France, Canada, Germany, Pakistan, Australia and Ukraine" [2]. In India, wheat is extensively cultivated in North West India, Eastern part, Central plain to some extent Southern peninsular zone. The top wheat producing states in the India are Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, Rajasthan, Bihar, Gujarat, Maharashtra, West Bengal, Uttarakhand.

"The knowledge about genetic variability of yield contributing characters, inter relationship among them and their relation with yield are necessary for an effective crop improvement program" [3]. "Knowledge about heritability helps the breeders to predict the nature of the succeeding generation, to make an appropriate selection and to assess the magnitude of genetic improvement through selection" [4]. "In addition, high genetic advance coupled with high heritability offers the most effective condition for selection for a perticular trait" [5]. Heritability estimates provide the information on the proportion of variation that is transmissible to the progenies in subsequent generations. Genetic advance provides information on expected genetic gain resulting from selection of superior individuals. Yield is very complex character and gains by selecting for yield alone are difficult to achieve, Grafius [6,7,8]. has put forth emphasis on the basis of geometrical logic against the selection for yield itself. The maximum gain in yield, as has been proved, may be attained through the increase in components. Therefore, the knowledge of correlation among components of economic worth between such and other traits and their direct and indirect effects on each other will not only help in understanding their inter-relationships and their apparent significance and contributions, but will definitely improve the efficiency of selection by making possible, the use of suitable combinations and in laying greater stress on important ones while making selection. Keeping these things in the view, the present investigation was conducted to assess available germplasm of wheat with the objectives: to estimate the heritability, genetic advance and correlation coefficient among various yield and its contributing characters of wheat (*Triticum aestivum* L.).

2. MATERIALS AND METHODS

The present research investigation was conducted at Instructional farm of AKS University, Satna, Madhya Pradesh during *rabi* Season of 2022. The altitude of Satna is 317 meters above mean sea level and the latitude of Satna, Madhya Pradesh, India is 24.579716, and the longitude is 80.832176. The experimental material for the present research trial comprised of 20 diverse genotypes of wheat collected from different sources through the help from Department of Genetics & Plant Breeding,

Faculty of Agriculture Science, AKS University, Satna (M. P.). This experiment was conducted by using Randomized Block Design with three replications. Five plants were chosen aimlessly from every genotype in each replication. The arbitrarily chosen plants were labeled for recording perceptions on different yield contributing characters viz. days to 50 % flowering, number of productive tillers per plant, peduncle length (cm), plant height (cm), spike length (cm), number of spikelets per spike, number of grains per spike, days to maturity, 1000 seed weight (g), biological yield (g), harvest index (%) and grain yield per plant (g).

The analysis of variance for the design of the experiment was carried out according to the procedure outlined by Panse and Sukhatme [9]. Heritability in broad sense (h^2) was calculated using the formula suggested by Burton and de Vane [10]. Genetic advance was calculated by the method suggested by Johnson *et al.* [11]. The simple correlation between different characters at genotypic and phenotypic levels were worked out between characters as suggested by Al-Jibouri *et al*. [12]. All the statistical analysis done by statistical software developed by Popat *et al*. [13].

3. RESULTS AND DISCUSSION

Analysis of variance for the design of experiment has presented in Table 1. The results revealed highly significant difference for all the characters which expressed huge amount of diversity among 20 genotypes of wheat. Non significant difference due to replications were observed for days to 50 % flowering, plant height (cm), days to maturity and grain yield per plant (g). These results are in confirmity with Bhushan *et. a.l.* [14] Seyoum and Sisay [15] Khinchi et al. [16] and Ahmad and Gupta [17].

Heritability in broad sense was computed for all the character under study and has been presented in Table 2. The heritability values ranged from 38.1 to 97.75 %. Out of 12 characters ten showed higher estimates of broad sence heritability viz. number of grains per spike (97.75), number of spikelets per spike (97.16), spike length (cm) (90.68), plant height (cm) (87.68), 1000 seed weight (g) (87.37), days to maturity (86.59), number of productive tillers per plant (84.77), days to 50 % flowering (84.24), grain yield per plant (g) (81.25) and peduncle length (cm) (78.23). Two character viz. biological yield (g) (56.37) and harvest index (%) (38.1) showed moderate heritability. Genetic advance for all the traits under study estimated and presented in Table 3. The expected genetic advance in per cent of means ranged from 6.8165 for plant height (cm) to 47.0977 for 1000 seed weight (g). High estimates of genetic advance in per cent of means were observed for 1000 seed weight (g) (47.0977) followed by spike length (cm) (41.0351), number of grains per spike (39.9853), number of productive tillers per plant (37.6517) and number of spikelets per spike (30.6568). “High heritability coupled with high genetic advance were observed for the characters number of productive tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike and 1000 seed weight (g) which indicated that above characters were governed by additive gene action and direct selection may be useful for further improvement

Table 1. Analysis of variance for 12 characters in 20 genotypes of wheat

Sr. No.	Characters	Mean sum of squares		
		Replications d.f. = 2	Treatment d.f. = 19	Error d.f. = 38
1	Days to 50 % flowering	4.717	34.635***	2.032
2	Number of productive tillers per plant	0.9272*	4.2416***	0.2396
3	Peduncle length (cm)	24.1508***	22.6183***	1.9197
4	Plant height (cm)	1.072	44.992***	2.013
5	Spike length (cm)	0.9707*	7.3519***	0.2436
6	Number of spikelets per spike	70.792***	146.880***	1.416
7	Number of grains per spike	15.308***	146.572***	1.116
8	Days to maturity	4.517	67.343***	3.306
9	1000 seed weight (g)	1.8580**	5.9865***	0.2753
10	Biological yield (g)	236.022***	113.807***	23.341
11	Harvest index (%)	162.931***	38.278**	13.448
12	Grain yield per plant (g)	0.0498	14.9331***	1.0665

*Signifcant. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1*

Table 2. Estimation of heritability and genetic advance 12 characters in 20 genotypes of wheat

Sr. No.	Characters	Heritability (%) (h2)	Genetic advance (GA)	Genetic Advance as % means
1	Days to 50 % flowering	84.24	6.2331	7.2115
2	Number of productive tillers per plant	84.77	2.1907	37.6517
3	Peduncle length (cm)	78.23	4.7860	16.8201
4	Plant height (cm)	87.68	7.3010	6.8165
5	Spike length (cm)	90.68	3.0195	41.0351
6	Number of spikelets per spike	97.16	14.1396	30.6568
7	Number of grains per spike	97.75	14.1818	39.9853
8	Days to maturity	86.59	8.8563	6.8538
9	1000 seed weight (g)	87.37	2.6567	47.0977
10	Biological yield (g)	56.37	8.4932	18.4659
11	Harvest index (%)	38.10	3.6581	11.2160
12	Grain yield per plant (g)	81.25	3.9922	26.9886

program". Ullah *et al.* [18] Khinchi et al. [16] and Ahmad and Gupta [17].

At genotypic level the characters number of spikelets per spike (0.8524**), number of grains per spike (0.8411**), biological yield (g) (0.8279**), spike length (cm) (0.7737**), days to maturity (0.7252**),1000 seed weight (g) (0.6038**) and plant height (cm) (0.4648*) exhibited positive significant correlation with grain yield per plant. Days to 50 % flowering (-0.4424), harvest index (%) (-0.426) and peduncle length (cm) (-0.384) showed negative and non-significant correlation with yield altributes. Similarly Baye et al (2020) and Jaiswal et al (2022) also reported from their investigation. At phenotypic level the characters number of grains per spike (0.77**), number of spikelets per spike (0.7448**), biological yield (g) (0.7165**), spike length (cm) (0.7012**), days to maturity (0.5509**),1000 seed weight (g) (0.4907**) and plant height (cm) (0.4241**) showed strong positive significant association with grain yield per plant. Three characters viz. harvest index (%) (-0.4032 **), days to 50 % flowering (-0.3896 **) and peduncle length (cm) (-0.3393 **) exhibited highly negative significant with grain yield. Similar results of significant and positive association of seed yield per plant with yield contributing characters were also observed by Kashif and khaliq [19] Hama et al. [20] Sharma et al. [21] and Jaiswal et al [22].

Days to 50 % flowering showed negative significant correlation with number of productive tillers per plant (-0.808 **) followed by plant height (cm) (-0.7577**), spike length (cm) (-0.5995**) and days to maturity (-0.4939*). Days to 50 % flowering showed positive but non-significant association with peduncle length (cm) (0.3769) and harvest index (%) (0.3592). Number of productive tillers per plant showed positive significant correlation with plant height (cm) (0.7154**) followed by spike length (cm) (0.5456*). The correlation coefficient of this trait was found negative but non-significant with peduncle length (cm) (-0.3511) and harvest index (-0.3134). Peduncle length exhibited negative significant correlation with only one character i. e. spike length (-0.4932*). Correlation of peduncle length With harvest index (0.3703) was found positively non significant. Plant height (cm) showed positive significant association with days to maturity (0.5385*) whereas, negative significant association with harvest index (-0.4864*). Spike length showed positive significant association with biological yield (0.9157**), number of spikelets per spike (0.8487**), number of grains per spike (0.8443**) 1000 seed weight (0.5276*) and days to maturity (0.5151*). Number of spikelets per spike exhibited positive significant relation with number of grains per spike (0.9671**) followed by biological yield (0.9345**) and 1000 seed weight (0.7914**). This trait showed negative and non-significant relation with harvest index (-0.224). Number of grains per spike showed positive significant association with biological yield (0.9301**) and 1000 seed weight (0.7721**). Days to maturity showed positive significant association with biological yield (0.4666*). Days to maturity exhibited negative and non-significant association with 2 characters viz. harvest index (-0.324) and 1000 seed weight (-0.11). 1000 seed weight (g) showed positive significant correlation with biological yield (0.6488**) whereas, negative non-significant correlation with harvest index (-0.306). Biological yield (g) showed negative non significant association with harvest index (-0.202). Similar findings have also been reported by Baye et al. [23] and Jaiswal et al. [22].

Table 3. Correlation coefficient of different yield component with grain yield per plant in wheat

Traits	Number of productive tillers per plant	Peduncle length (cm)	Plant height (cm)	Spike length (cm)	Number of spikelets per spike	Number of grains per spike	Days to maturity	1000 seed weight (g)	Biological yield (g)	Harvest index (%)	Grain yield per plant (g)
Days to 50 % flowering	-0.808 **	0.3769	-0.7577**	-0.5995**	-0.4115	-0.4066	-0.4939*	-0.0679	-0.3655	0.3592	-0.4424
Number of productive tillers per plant		-0.3511	0.7154**	0.5456*	0.2655	0.2617	0.2573	0.0736	0.236	-0.3134	0.2291
Peduncle length (cm)			-0.3809	-0.4932*	-0.3881	-0.3929	-0.3974	-0.1238	-0.4403	0.3703	-0.384
Plant height (cm)				0.3591	0.3099	0.3142	0.5385*	0.0804	0.2159	-0.4864*	0.4648*
Spike length (cm)					0.8487 **	0.8443**	0.5151*	0.5276*	0.9157**	-0.31	0.7737**
Number of spikelets per spike						0.9671**	0.4063	0.7914**	0.9345**	-0.2237	0.8524**
Number of grains per spike							0.4041	0.7721**	0.9301**	-0.2231	0.8411**
Days to maturity								-0.1097	0.4666*	-0.3243	0.7252**
1000 seed weight (g)									0.6488**	-0.3056	0.6038**
Biological yield (g)										-0.2018	0.8279**
Harvest index (%)											-0.426

*Signifcant. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

4. CONCLUSIONS AND SUGGESTIONS

Direct selection may be adopted for improving the traits number of productive tillers per plant, spike length (cm), number of spikelets per spike, number of grains per spike and 1000 seed weight (g) which exhibited great coupling in heritability and genetic advance. On the basis of correlation coefficient analysis it could be concluded that, maximum weightage should be given to number of spikelets per spike, number of grains per spike, spike length, plant height, 1000 seed weight, biological yield and harvest index (%) as these traits showed highly significant correlation with grain yield per plant.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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