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STUDY OF GENETIC VARIATION IN SPRING WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES

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ABSTRACT

The study was aimed to estimate the genetic variation in different genotypes of spring wheat (*Triticum aestivum* L.). The trial was conducted during 2019-20 in Randomized Complete Block Design with three replications at experimental farm, Nuclear Institute of Agriculture (NIA), Tandojam. Twelve commercial varieties were used in the experiment namely: Kiran-95, Sarsabz, NIA-Amber, NIA-Sunhari, NIA-Sarang, Khirman, TJ-83, TD-1, Imdad-05, Sindhu-16, Benazir-13 and SKD-1. Recorded growth parameters: spike length (cm), spikelets spike^{-1}, grains spike^{-1}, biological yield plot^{-1} (kg), grain yield plot^{-1} (kg), harvest index (%). Kiran-95: highest grain yield plot^{-1}. Khirman: highest biological yield plot^{-1}. Variety NIA-Sarang: maximal spikelets spike^{-1}, grains spike^{-1}, harvest index (%). The correlation studies revealed a positive and significant association between grain yield and biological yield plot^{-1}, while the remaining traits exhibited non-significant relationships with grain yield plot^{-1}. The highest variation in grain yield plot^{-1} was due to per unit variation in biological yield plot^{-1}. The varieties Kiran-95, NIA-Sarang and TD-1 proved to be potential genotypes that can be used as higher yield producing genotypes.

Key words: *Triticum aestivum* L, genetic variation, spring wheat, correlation and regression

INTRODUCTION

Pakistan stands as a significant global contributor to wheat production, ranking within the top ten nations in terms of both cultivated area and wheat yield. Wheat is the third most-produced cereal after rice and maize and the second most produced for human consumption (World Economic Forum, 2022). Wheat contribution is 7.8 % in agriculture and 1.8 % in Pakistan's GDP during 2021-22. Experiencing a decrease of 3.9%, the wheat production dwindled to 26.394 million tonnes from the previous year's output of 27.464 million tonnes, as reported in the Economic Survey of Pakistan, 2022. Plant breeding plays a vital role in increasing the productivity of crop species by developing high yielding varieties with desirable traits and genetic variation required for sustainable yield**.** Analysis of correlation and regression between genetic features can be commonly used in breeding for the development of high yielding varieties (Pushkarev *et al*., 2018). The study of genetic variation within the registered varieties advised for general cultivation is crucial for the improvement of future wheat varieties by providing a basis for selection of superior parental combinations and predictions of progeny performance. It provides information about the extent of genetic diversity of the improved varieties obtained for developing appropriate breeding strategies and broadening the genetic base of wheat varieties for development in breeding programs (Haile *et al*., 2013).

MATERIALS AND METHODS

The experiment was conducted at the experimental farm of the Nuclear Institute of Agriculture (NIA), Tandojam, in Randomized Complete Block Design (RCBD) with three replications. Twelve commercial varieties (Kiran-95, Sarsabz, NIA-Amber, NIA-Sunhari, NIA-Sarang, Khirman, TJ-83, TD-1, Imdad-05, Sindhu-16, Benazir-13 and SKD-1) were included in the experiment to estimate the genetic variation among them. Each variety was sown in four rows of 5 m length and row to row distance was 30 cm. Sowing was done before 15th November by hand drill. The crop was fertilized at the recommended dose of N P K @ of 120, 80 and 60 Kg / ha, in the form of Urea, DAP and SOP fertilizer. Nitrogen was applied in two doses i.e., 1st at the time of sowing and 2nd at the time of 1st irrigation. Five irrigations were given and all the necessary agronomical

operations (weeding, hoeing, cleaning etc.) were performed regularly. At maturity, the crop was harvested, and the subsequent agronomic measurements encompassed spike length (cm), spikelets per spike, grains per spike, biological yield per plot (kg), grain yield per plot (kg), and harvest index percentage.

Spike length (cm)

From the main tillers, the measurement of spike length was taken in centimeters, extending from the last node to the top of the spikelets excluding awns.

Spikelets spike^{-1}

For each selected spike and replication, spikelets per spike were individually counted.

Grains spike^{-1}

Carefully counting the grains from labeled plants, the results were recorded.

Biological yield plot $^{-1}$ (kg)

The biological yield per plot in kilograms was recorded by measuring the plot yield and subsequently weighing it using an electric balance under laboratory conditions.

Grain yield plot $^{-1}$ (kg)

The grain yield per plot in kilogram was noted after harvesting and seed and weighing them on electric balance in laboratory.

Harvest index %

The harvest index ratio between biological weight and grain as calculated following the procedure proposed by Donald and Hamblin (1976), given by the formula: Harvest index (%) = Grain yield / Biological yield × 100.

Statistical analysis

The collected data was subjected to the statistical analysis of variance adopted by Gomez and Gomez (1984). While the correlation and regression analyses were determined following the procedures of Raghavrao (1983).

RESULTS

The data analyzed statistically for analysis of variance (ANOVA) mean square, for grain yield and yield contributing parameters is presented in Table 1. The growth parameters i.e., spike length (cm), spikelets spike^{-1}, grains spike^{-1}, biological yield plot^{-1} (kg), grain yield plot^{-1} (kg), harvest index % are highly significant at $p > 0.01$ probability within the genotypes.

The mean performance of tested wheat varieties for grain yield and their components are presented in Table-2, which revealed that the parameter spike length, which is an important criterion to affect the growth performance also showed variation between the genotypes. In this regard maximum spike length was produced by TJ-83 i.e., 13.66 cm, followed by Khirman, NIA-Sunhari and NIA-Sarang. The maximum spikelets spike^{-1} (26.66) produced by NIA-Sarang followed by Khirman. The maximum grains per spike (84.33) produced by NIA-Sarang followed by TJ-83. In the case of the biological yield plot (kg)$^{-1}$ the maximum biological yield plot (kg)$^{-1}$ (9.20) produced by Khirman followed by NIA-Amber. The maximum grain yield plot (kg)$^{-1}$ (4.066) produced by Kiran-95 followed by Imdad-05. In the case of harvest index the maximum harvest index (49.53) produced by NIA-Sarang followed by SKD-1.

DISCUSSION

The data for mean square (ANOVA) for yield and yield components revealed that genotypes were highly significant at $p > 0.01$ probability for spike length (cm), number of spikelets per spike, number of grains per spike, biological yield per plot (kg), grain yield per plot (kg), harvest index %. Bhutto *et al.* (2016) reported that significant differences between the genotypes used in their research. Whereas Rahman *et al*. (2016) observed significant variation in yield characters and explained that presence of variation in traits which helps in selections of genotypes for further evaluation and using in breeding programs. The mean performance of twelve varieties for yield of grain and their components showed that the observations with value to the maximum spikelets per spike (26.66) produced by NIA-Sarang. The observations with value to the maximum grains per

spike (84.33) higher produced by NIA-Sarang. In the case of the biological yield per plot the maximum biological yield per plot (9.20) is produced by Khirman. The observations with value to the maximum grain yield per plot (4.066) produced by Kiran-95. In the case of the harvest index the maximum harvest index (49.53) is produced by NIA-Sarang. The earlier researcher like Rahman *et al*. (2016) reported that significant variation between the genotypes use in their research. Ayer *et al.* (2017) reported that significant variations between the genotypes for all characters. Whereas Ali *et al*. (2017) calculated six yield parameters and their results displayed significant differences ($P \leq 0.01$) for all studied character. Noorka *et al*. (2018) used diverse genotypes and reported that genotypes have much yield potential. Zhang *et al.* (2019) reported that exact evaluation of morphological and physiological characters significant for variety of wheat (*Triticum aestivum* L.) cultivars exhibiting high yield, which is stable over different growing conditions.

Table 1. Mean squares (ANOVA) for grain yield and its associated traits of wheat Genotypes.

Source of variation	Mean square						
	D.F	Spike length	Spikelets spike^{-1}	Grains spike^{-1}	Biological yield plot^{-1}	Grain yield plot^{-1}	Harvest index
Replications	2	1.75	3.08	127.08	0.003	0.02	3.59
Genotypes	11	5.03**	13.78**	466.57**	1.09**	0.10**	26.51**
Error	22	0.78	3.05	51.93	0.01	0.03	6.92
Total	35						

**** = Highly significant @ 0.01 probability**

Table 2. Mean performance of grain yield and its components in twelve wheat varieties.

Varieties	Spike length (cm)	Spikelets spike^{-1}	Grains spike^{-1}	Biological yield plot^{-1} (kg)	Grain yield plot^{-1} (kg)	Harvest index %
Kiran-95	13.00	22.00	45.33	8.43	4.066	48.20
Khirman	13.33	23.33	77.00	9.20	3.66	39.80
Sarsabz	11.33	19.66	52.33	7.70	3.50	45.43
NIA-Ambar	11.33	21.66	52.00	8.70	3.93	45.16
NIA-Sunhari	13.33	22.00	59.00	8.30	3.50	42.10
NIA-Sarang	13.33	26.66	84.33	7.40	3.66	49.53
TJ-83	13.66	23.00	78.33	7.50	3.60	47.96
TD-1	10.66	20.33	55.00	7.30	3.53	48.33
Imdad-05	12.33	21.00	61.33	8.10	3.86	47.73
Sindhu-16	10.33	19.66	61.00	7.30	3.50	47.90
Benazir-13	10.33	19.33	49.66	7.70	3.70	48.03
SKD-1	11.00	19.31	54.66	7.80	3.83	49.10
LSD 5 %	2.62	5.18	21.39	0.41	0.58	7.81

Correlation studies

Spike length (cm)

Spike length had highly significant and positive association with grain spike^{-1} (r=0.580**) and negative but highly significant with harvest index (r = -0.471**) and significant but positive with spikelets spike^{-1} (r = 0.441*) and biological yield plot^{-1} (r=0.388*) and while non-significant and negative with grain yield plot^{-1} (r = -0.023 ^{NS}). The results of this research are consistent with Bhutto *et al.* (2016), who reported significant

differences among the genotypes for spike length, number of spikelets per spike, number of grains per spike, and grain yield per plant. They also found highly positive correlations between these variables.

Spikelets spike^{-1}

Spikelets spike^{-1} had highly significant and positive (r = 0.724**) association with grains spike^{-1} and positive but non-significant with biological yield plot^{-1} (r = 0.029 ^{NS}) and grain yield plot^{-1} (r=0.032 ^{NS}) and positive but non-significant (r = 0.021 ^{NS}) with harvest index. Safi *et al.* (2017) reported that agronomic traits for analysis of variance for plant height, numbers of spikelets per spike, grains per spike and grain yield. Which revealed that significant variation higher yielding varieties.

Table 3. Phenotypic correlation coefficient analysis for yield and its components in wheat.

Traits	Spike length	Spikelets spike^{-1}	Grains spike^{-1}	Biological yield plot^{-1}	Grain yield plot^{-1}
Spikelets spike^{-1}	0.441*				
Grains spike^{-1}	0.580**	0.724**			
Biological yield plot^{-1}	0.388*	0.029ns	-0.116ns		
Grain yield plot^{-1}	-0.023ns	0.032ns	-0.181ns	0.567**	
Harvest index	-0.471**	0.021ns	0.008ns	-0.680**	0.216ns

** = Significant at 1% probability level. NS = non-significant, * = Significant @ 5% probability

Grains spike^{-1}

Grains spike^{-1} had negative and non-significant (r = -0.116 ^{NS}) association with biological yield plot^{-1} and non-significant but negative with grain yield plot^{-1} (r = -0.181 ^{NS}) and positive but non-significant (r=0.008 ^{NS}) with harvest index. The previous worker Rahman *et al*. (2016) reported in their results grains per spike exhibited negative association with grain yield.

Biological yield plot $^{-1}$ (kg)

Biological yield plot^{-1} had highly significant and positive association with grain yield plot^{-1} (r = 0.567**) and negative but highly significant (r = 0.680**) with harvest index. The previous researcher Ayer *et al.* (2017) reported that biological yield had the positive but high significant association through effect on grain yield explained the true association and selection of the genotypes through these traits effective yield potentiality for improving.

Grain yield plot $^{-1}$ (kg)

Grain yield plot^{-1} had positive and non-significant (r = 0.216 ^{NS}) association with harvest index. Previous researchers such as Meena *et al.* (2014) have also explained that grain yield per plot showed significant and positive relationship with biomass and harvest index.

Table 4. Correlation (r) coefficient of determination (r^2) and regression coefficient of yield components on grain yield plot^{-1} (kg).

Traits	Correlation Coefficient (r)	Coefficient of Determination (r^2)	Regression Coefficient (b)
spike length (cm)	-0.023 ns	0.001	0.145
Spikelets spike^{-1}	0.032 ns	0.001	0.038
Grains spike^{-1}	-0.181 ns	0.033	0.001
Biological yield plot^{-1} (kg)	0.567**	0.321	0.565
Harvest index %	0.216 ns	0.047	0.090

** = Significant at 1% probability level. NS = non-significant,

REFERENCES

Ali F., A. Shahab, A. Javed, A.T. Mehran, M.S. Afridi and I. Toheed (2017). Heritability estimates and traits association in wheat advanced lines. *International Multi-disciplinary. Res. J.,* 7: 13-17.

Ayer D.K., A. Sharma, B.R. Ojha, A. Paudel and K. Dhakal (2017). Correlation and path coefficient analysis in advanced wheat genotypes. *SAARC. J. Agri.,* 15(1): 1-12.

Bhutto A.H., A.A. Asghar, K.A. Shahmir, A. Amjad, K.A. Fahad, A. Muneer, A. Sajjad and A.K. Niaz (2016). Correlation and regression analysis for yield traits in wheat (*Triticum aestivum* L.) genotypes. *Natural Sci.,* 8: 96-104.

Donald, C.M., and J. Hamblin (1976). The Biological Yield and Harvest Index of Cereals as Agronomic and Plant Breeding. *Advances in Agronomy*. 28:361–405.

Economic Survey Government of Pakistan (2022). Ministry of Finance, Economic Advisor's Wing, Islamabad.

Gomez, K.A. and A.A. Gomez (1984). Statistics for Agricultural Research (2nd Edition). John Willey and Sons, New York.

Haile J.K., K. Hammer, A. Badebo, M.M. Nachit and M.S. Röder (2013). Genetic diversity assessment of Ethiopian tetraploid wheat landraces and improved durum wheat varieties using microsatellites and markers linked with stem rust resistance: Genetic Resources and Crop Evolution. 60(2): 513-527.

Meena N., V.K. Mishra, D.K. Baranwal, A.K. Singh, V.P. Rai, R. Prasad, B. Arun, and R. Chand (2014). Genetic evaluation of spring wheat (*Triticum aestivum* L.) Recombinant inbred lines for spot blotch resistance and yield components under natural conditions for South Asia. *J. Agri. Sci. Tech.,* 1(6):1429-1440.

Noorka I.R., M.U. Akram, J.S.P. Heslop-Harrison, W.N. Mhiret, S.A. Shahid, and Inam-ul-Haq (2018). The appraisal of comparative genetic variability in diverse wheat genotypes for yield and yield contributing traits. *OIDA Int. J. Sustainable Dev.,* 11(10):37-42.

Pushkarev D.V., A.S Chursin, O.G. Kuzmin, Yu.S. Krasnova, I.I. Karakoz, V.P. Shamanin, and Omsk (2018). Correlation of yield with elements of productivity of varieties of spring soft wheat in the conditions of the steppe zone of the Omsk region. *J. Agri, sci, tech info.,* 3(31):26-35.

Raghaverao, D (1983). Statistical Technology in Agriculture and Biological Research. Oxford & IBH Publishing Company. New Dehli, India.

Rahman, M.A., M.L. Kabir, M. Hasanuzzaman, R.H. Rumi and M.T. Afrose (2016). Study of variability in bread wheat (*Triticum aestivum* L.). *Int. J. Agri. Res.,* 8(5):66-76.

Safi L., S. Rajesh and A. Thomas (2017). Analysis of agro-morphological characters in wheat (*Triticum aestivum* L.) genotypes for yield and yield components. *Int. J. Curr. Microbiol. App. Sci.,* 6(9): 578-585.

World Economic Forum (2022). Agriculture, Food and Beverage. Published in collaboration with Visual Capitalist.

Zhang Y., W. Zhong, F. Zheru, L. Jianfeng, G. Xin, Z. Hongzhi, Z. Qi, W. Zhaoying and L Zhiyong (2019). Phenotyping and evaluation of CIMMYT WPHYSGP nursery lines and local wheat varieties under two irrigation regimes. *Breed. Sci.,* 69(1): 55–67.

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