Original Article **Asian J Agri Biol, 2016, 4(4): 114-119.**

GENETIC VARIABILITY AND HERITABILITY STUDIES IN F_2 POPULATION OF SPRING WHEAT

Asghar, K.[1], Z.A Soomro[1*], S.N. Mari[1], T.A. Baloch[2], A.A. Rajper[1], U.A. Kasi[1] and F. Asghar[3]
[1]Department of Plant Breeding and Genetics, Sindh Agriculture University Tandojam-70060, Pakistan
[2]Department of Agriculture Research, Government of Balochistan, Pakistan
[3]Department of Entomology, Sindh Agriculture University Tandojam-70060, Pakistan

ABSTRACT

A research experiment was conducted to investigate the variability and heritability in F_2 population of spring wheat at the experimental field of Sothern Wheat Research Station, Tandojam during 2014-15.The experimental material consisted of 8F_2 hybrid *viz:* Sassui x Anmol-91, WL-711 x Anmol-91, Sassui x Johar, Abadgar x SKD-1, Sassui x Abadgar-93, Marvi x Noori, Moomal- 2002 x Anmol-91, Marvi x Sassui and their parents were sown in Randomized Complete Block Design (RCBD) with 3 replications. Genotype were highly significant at 0.01 level of probability for days to 75 % heading, days to 75% maturity, plant height, spike length and spikelets spike^{-1}. The highest heritability (95.39%) regarding spike length was displayed by cross WL-711 x Anmol-91. Spike length is the main contributors to the grain yield and may be kept as selection criteria for developing high yielding varieties. The F_2 population Sassui x Anmol-91 and WL-711 x Anmol-91 could be selected for higher yield in advanced generations.

Keywords: Heritability, genetic advance, genetic variability, segregating population

INTRODUCTION

Wheat is an important cereal crop and the distribution of the world wheat and grains and believed to progenitors of the cultivated wheat supports the belief that wheat was originated in South Asia (Ansari *et al*., 2005). Some species were cultivated in Greece Persia, Turkey and Egypt in pre-historic times, while the cultivation of other species may be more recent origin. In Pakistan evidence from Mohen-jo-Daro excavation, indicates that wheat was cultivated and used as staple food some 7000 years ago (Bharat *et al*., 2013).

The breeders are interested in population with high mean performance and concerned with genetic variation within the population so that further progress can be made. The genetic variance and heritability provide useful guide lines in the plant breeding programme. The heritability variance is the total variance among the phenotypes when grown over the range of environments. Heritability of a character helps to predict the performance of subsequent invention for superior results in terms of future generation. However, reliable comparison of genetic variance or heritability of the population requires large sample of progeny from each population. (Thebo *et al*., 2005). Keeping in view the above facts the present research was undertaken to assess the genetic variability and heritability in F_2 population of spring wheat.

**Corresponding author:* e-mail: zasoomro_cap@hotmail.com

MATERIALS AND METHODS

The research experiment was conducted to study the genetic variability and heritability studies in F_2 population of spring wheat in the experimental field of Southern Wheat Research Station Tando Jam during 2014-15.The experimental material consisted 8 F_2 population Sassui x Anmol-91, WL-711 x Anmol-91, Sassui x Johar, Abadgar x SKD-1, Sassui x Abadgar-93, Marvi x Noori, Moomal- 2002 x Anmol-91, Marvi x Sassui and their parents were sown in Randomized Complete Block Design (RCBD) with 3 replications. Each genotype was planted in four rows in each replication with plant to plant and row to row spacing of 15 and 30 cm, respectively. The data were recorded on days to 75% heading, days to 75% maturity, plant height, spike length and spikelets spike^{-1}.

Statistical analysis

The collected data were subjected to analysis of variance as described by Gomez and Gomez (1984), the comparison of means was done through least significant difference at 0.5% and heritability was worked out following Burtain (1951).

RESULTS

The analysis of variance for the traits studied are presented in table 1, whereas the mean performance are presented in table 2.The heritability and the genetic advance are presented in table 3.

Table 1 showed that genotype are highly significant at 0.01 for days to 75 % heading , days to 75% maturity, plant height, spike length and spikelets spike^{-1}. The mean performance of yield and its component are presented in table 2, which further exhibited that cross Sassui x Abadgar-93 took maximum days to 75% heading (84.67),while the variety Anmol-91 took 62.00 days to 75% heading, whereas the cross Abadgar -93 x SKD-1 take maximum days (139.7) to 75% maturity while cross Sassui x Anmol-91 take minimum 121.71 days to 75% maturity .For the character plant height Johar take maximum (93.00) while the cross Sassui x Anmol-91 (66.40 cm) displayed short stature. In case of spike length the large spike (13.43cm) displayed by cross Sassui x Anmol-91 followed by cross Moomal-2002 x Anmol-91 (11.83cm) whereas WL-711 x Anmol-91 (22.53) had maximum spikelets spike^{-1}, followed by Moomal-2002 x Anmol-91(22.17).

Heritability:

During the course of breeding for improvements of any particular trait must be practical for effective change. The success of selection is governed by the degree to which the derived character is transmitted to the off-springs of the selected parents which is called heritability. The heritability and genetic advance of important traits are presented in table 3.

Days to 75% heading:

Table 3 revealed that crosses showed wide range of phenotypic variance from (21.98 to 83.33) and showed low, moderate and high heritability for this trait. The highest heritability (83.33%) exhibited by cross Marvi x Noori followed by cross Sassui x Anmol-91 (57.14%). The lowest heritability (17.21%) showed by cross Marvi x Sassui. The cross showed highest heritability showed high genetic advance (1.717). Whereas low heritability cross showed the lowest genetic advance (0.355).

Days to 75% maturity:

Regarding days to 75% maturity, this trait showed the wide range of genotypic, environmental and phenotypic variances (0.23 to 39.73). The heritability observed from high, moderate and low. The highest heritability (98.70%) exhibited by cross Sassui x Johar followed heritability (93.77%) for the cross Abadgar-93 x SKD-1.The high genetic advance showed by the cross. Sassui x Johar (2.033). The lowest heritability showed by cross Marvi x Noori which is (0.82 %) with the lowest genetic advance (0.017) respectively.

Plant height (cm):

The genotypic, environmental and phenotypic variance ranged from 7.73 to 67.725. The highest heritability 81.06% exhibited by cross Sassui x Anmol-91 coupled with high genetic advance (1.670) followed by the cross WL-711 x Anmol-91 (69.27%). The lowest heritability 17.59% showed by cross Abadgar-93 x SKD-1 alongside with lowest genetic advance (0.362).

Spike length (cm)

Spike length showed high, moderate and low genotypic, environmental and phenotypic variance. The highest heritability (95.39%) shown by cross WL-711x Anmol-91 along with high genetic advance (1.965) followed by cross Marvi x Noori (79.70%). Lowest heritability 8.14% was shown by cross Moomal-2002 x Anmol-91 together with the minimum genetic advance (0.168).

Spikelets spike^{-1}

High, moderate and low heritability observed for the trait spikelets spike^{-1}. The genotypic, environmental and phenotypic variance ranges from (0.9 to 8.805). The high heritability (53.35%) shown by cross Moomal-2002 x Anmol-91 coupled with moderate genetic advance (1.099).Wheras the minimum heritability 16.37 % was shown by cross Abadgar-93 x SKD-1 with low genetic advance (0.337).

Table 1: Mean Squares from analysis of variance for grain yield and its components of wheat

Source of variation	DF	Days to 75% heading	Days to 75% maturity	Plant height	Spike length	Spikelets per spike
Replication	2	3.784	0.255	3.153	0.034	0.512
Genotype	16	125.294**	88.230**	165.603**	6.478**	15.853**
Parents	8	126.620**	52.750**	147.628**	3.691**	3.426*
Crosses	7	94.190**	141.214**	195.138**	4.343**	7.315**
Error	32	6.680	0.734	4.483	0.517	1.303
Total	65					

**= Significant at 0.01 level of probability

Table 2: Mean performance of nine wheat varieties and their eight F_2 population for grain yield and its contributing characters

Genotypes	Days to 75% heading	Days to 75% maturity	Plant height (cm)	Spike length (cm)	Spikelets per spike
Sassui	72.67 fg	129.0 g	79.03 f	10.30 c d	17.60 fg
Anmol-91	62.00 j	122.3 hi	80.37 ef	8.233 h	16.60 gh
Wl-711	75.00 ef	131.0 e	74.10 h	8.833 fgh	16.40 h
Johar	77.00 de	130.7 ef	93.00 a	8.700 gh	17.40 fgh
Abadgar-93	81.67 b	138.7 b	85.00 c d	9.733 de	18.87 de
Skd-1	62.33 j	130.7 ef	68.47 i	8.233 h	16.37 h
Marvi	74.67 ef	132.7 d	74.73 gh	11.57 b	17.90 ef
Noori	71.33 gh	131.3 e	81.67 e	9.067 efg	17.73 fg
Moomal-2002	69.00 hi	130.7 ef	80.87 ef	8.500 gh	15.27 i
Sassui X Anmol-91	73.33 fg	121.7 i	66.40 j	13.43 a	21.77 abc
WL-711 X Anmol-91	69.00 hi	128.3 g	80.33 ef	10.83 c	22.53 a
Sassui X Johar	78.00 cd	137.0 c	90.70 b	10.63 c	21.13 bc
Abadgar-93 X SKD-1	80.33 bc	139.7 a	86.13 c	10.23 cd	19.53 d
Sassui X Abadgar-93	84.67 a	138.3 b	86.37 c	10.70 c	21.17 bc
Marvi X Noori	67.33 i	130.0 f	76.50 g	9.467 ef	17.73 fg
Moomal-2002 X Anmol-91	67.33 i	122.7 h	83.83 d	11.83 b	22.17 ab
Marvi X Sassui	77.67 d	131.0 e	90.13 b	11.63 b	20.67 c

The values with similar alphabets are statistically similar

Table 3: Heritability estimates and genetic advance of eight F_2 population for important traits

Genotypes	Genotypic Variance	Environmental Variance	Phenotypic Variance	Heritability %	Genetic advance
Days to 75% heading					
Sassui x Anmol- 91	0.32	0.24	0.56	57.14	1.177
WL 711 x Anmol-91	0.4	1.42	1.82	21.97	0.453
Sassui x Johar	0.23	0.47	0.7	32.85	0.677
Abadgar- 93 x SKD-1	0.23	0.255	0.485	47.42	0.977
Sassui x Abadgar-93	0.32	0.96	1.28	25	0.515
Marvi x Noori	3.6	0.72	4.32	83.33	1.717
Moomal- 2002 x Anmol-91	0.27	0.89	1.16	23.27	0.479
Marvi x Sassui	0.26	1.25	1.51	17.21	0.355
Days to 75% maturity					
Sassui x Anmol- 91	0.54	1.045	1.585	34.06	0.702
WL 711 x Anmol-91	0.62	0.47	1.11	55.85	1.151
Sassui x Johar	29.66	0.395	30.05	98.7	2.033
Abadgar-93 x SKD-1	2.71	0.18	2.89	93.77	1.932
Sassui x Abadgar- 93	0.23	0.36	0.59	38.98	0.803
Marvi x Noori	0.32	38.99	38.98	0.82	0.017
Moomal-2002 x Anmol- 91	0.54	0.485	1.025	52.68	1.085
Marvi x Sassui	0.76	38.97	39.73	1.91	0.039
Plant height (cm)					
Sassui x Anmol- 91	54.9	12.825	67.725	81.06	1.67
WL 711 x Anmol-91	19.78	8.775	28.555	69.27	1.427
Sassui x Johar	29.37	16.825	46.195	63.57	1.31
Abadgar -93 x SKD-1	7.73	36.215	43.945	17.59	0.362
Sassui x Abadgar-93	11.78	33.935	45.715	25.76	0.531
Marvi x Noori	45.34	21.935	67.275	67.39	1.388
Moomal-2002 x Anmol- 91	10.71	13.625	24.335	44.01	0.907
Marvi x Sassui	20.98	25.52	46.5	45.11	0.929
Spike length (cm)					
Sassui x Anmol- 91	2.04	2.33	4.37	46.68	0.962
WL 711 x Anmol-91	19.78	0.955	20.735	95.39	1.965
Sassui x Johar	0.26	2.485	2.745	9.47	0.195
Abadgar 93 x SKD-1	0.48	1.02	1.5	32	0.659
Sassui x Abadgar-93	0.3	2.51	2.81	10.67	0.22
Marvi x Noori	5.95	1.515	7.465	79.7	1.642
Moomal-2002 x Anmol-91	0.48	5.415	5.895	8.14	0.168
Marvi x Sassui	1.38	3.485	4.865	28.36	0.584
Spikelets per spike					
Sassui x Anmol-91	3.6	3.285	6.885	52.28	1.077
WL 711 x Anmol-91	2.5	3.67	6.17	40.51	0.835
Sassui x Johar	1.87	2.66	4.53	41.28	0.85
Abadgar- 93 x SKD-1	1.15	5.875	7.025	16.37	0.337
Sassui x Abadgar-93	0.9	3.58	4.48	20.08	0.414
Marvi x Noori	2.05	5.05	7.1	28.87	0.595
Moomal-2002 x Anmol -91	2.9	2.535	5.435	53.35	1.099
Marvi x Sassui	3.56	5.245	8.805	40.43	0.833

DISCUSSION

Genetic improvement of any crop depends upon the trend and frequency of the genetic heritability and the degree of relationship of heritable and non-heritable variation between yield and its contributing traits. The analysis of variance displayed that genotypes are highly significant at 0.01 levels and displayed highest variation in F_2 population and their parents for the traits studied. The results regarding the heritability in broad sense for the character days to 75% maturity exhibited that cross WL-711 x Anmol-91 showed highest, heritability for days to 75 % heading whereas Sassui x Anmol-91 displayed highest heritability for days to 75% maturity and the highest heritability for plant height, displayed by Sassui x Anmol-91 .It showed that higher heritability for heading and particular maturity produced the shorter plant statures. The previous workers like Khilwat *et al*. (2014) concluded in their research that higher heritability for heading, maturity and plant height produced early matured and dwarf statured plants.

The highest heritability regarding spike length, showed by cross WL-711 x Anmol-91 which displayed moderate heritability for this character. As the spike length increases the biological yield plant^{-1} increases. Whereas Sultana and Malik, (2005) stated that spike length, biological yield and 1000-grain weight are the main contributes to the grain yield and may be kept as selection criteria for higher yield plant^{-1}.

For the character spikelets spike^{-1} cross Moomal-2002 x Anmol-91 showed moderate heritability. The other workers like Saifullah *et al*. (2009) got the similar results. Grain yield plant^{-1} showed low high heritability in the F_2 population, the highest heritability (91.94%) displayed by the cross Marvi x Abadgar-93 observed great variability in their material and suggest that improvement achieved through selection.

The cross Sassui x Anmol-91 displayed minimum days to maturity, shorter plant height and larger spike length compared to the rest of the genotypes the previous works like Shoukat *et al.* (2007) and Hussain *et al*. (2013) got highly significant differences among the genotypes which is similar results as obtained from this research, which may be due to similar type of experimental material and environmental.

The cross Moomal-2002 x Anmol-91 displayed minimum days to 75% heading and higher in grain yield spike^{-1} whereas crosses WL-711 x Anmol-91 and Sassui x Abadgar-93 showed higher spikelets spike^{-1}.

CONCLUSION

Cross Sassui x Anmol-91 perform early in days to 75 % maturity and produced larger spike length. Cross Moomal-2002 x Anmol-91 perform higher heritability coupled with genetic advance for days to 75 % heading and Spikilets spike^{-1} whereas cross WL-711 x Anmol-91 displayed higher heritability for spike length.

Selection of the genotypes could be made on the longer spike length and crosses Sassui x Anmol-91, WL-711 x Anmol-91and Marvi x Sassui could be selected for further evaluation in future successive generations.

REFERENCES:

Ansari K. A., Soomro Z. A., B.A. Ansari and M. H.Leghari 2005 Genetic variability and heritability studies of some quantitative traits in bread wheat (*Triticum aestivum* L.). Pakistan J. Agri. Agril. Engg. Vet. Sci., 21(1):18-24.

Bharat B., S. S. Gaurav, Kumar, Pal, Panday, Kumar, Bharti, S. S. Nagar and VP Rahu.2013. Genetic variability, heritability and genetic advance in bread Wheat (*Triticum aestivum* L.). Environment and Ecology, 31 (2):405-407.

Hussain. M. A., H. S. Askandar and Z. A. Hassan.2013. Selecting high yielding wheat hybrids from a restricted factorial mating design. Sarhad J. Agric., 29(2): 173-179.

Khilwat A. Ahmad, Ishaq, I. A. Khalil, I. Shah, Saeed and N.Ahamd. 2014. Genetic potential and variability for morpho-yield traits in durum wheat (*Triticum turgidum* L. var. durum). Int. J. of Farming and Allied Sci., 3(12):1206-1212.

Saifullah A., N. Zakir and Mujahid.2009. Estimation of genetic parameters and character association in wheat. J. Agric. Biol. Sci., 1(1):15-18.

Shoukat A. M., M. A. Sial, B. A. Ansari and M. A. Arain. 2007. Study of genetic parameters in segregating populations of spring wheat. Pak. J. Bot., 39(7): 2407-2413.

Soshma J., M. Fida M. and F. U. Khan. 2015. Genetic potential and heritability estimates of yield traits in F_3 segregating populations of bread wheat. Int. J. Envir., 4(4):106-115.

Sultana, R. and S.K. Malik. 2005. Genetic variability and character association between yield and yield attributing traits in bread wheat (*Triticum aestivum* L.em. Thell). Annals of Agricultural Res., 26 (1):118-125.

Thebo S. K., Ansari B. A., L. A., Bhutto B., Munaiza and B. Sheereen 2005 Estimation of genetic variability in F3 generation of spring wheat. Indus J. Pl. Sci., 4(4):570-575.

Yousaf A. B. M. Atta, J. Akhter, P. Monneveux and Z. Lateef. 2008. Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. Pak. J. Bot., 40(5): 2087-2097.