Research Article

Heritability estimation for morpho yield traits in commercial varieties of spring wheat (*Triticum aestivum* L.)

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Abstract

The present investigations regarding analysis of the variance, mean performance and heritability was carried out at the experimental area of Department of Plant Breeding and Genetics, Sindh Agriculture University, Tandojam during 2014-15, for the purpose of estimating heritability for various quantitative traits in commercially grown wheat varieties, wheat varieties were included Amber, Benazir, Sundar, Sassuai, Sunehri and Bhittai were grown in a randomized complete block design with three replications. Traits studied were days to 75% maturity, number of productive tillers, spike length (cm), grains spike⁻¹, seed index (g), harvest index % and yield grain plant⁻¹. The observed genotypes showed highly significant difference for all the traits recorded. The variety Benazir proved to be early variety by taking lowest days to 75% maturity. The same variety produced highest number of productive tillers and grain yield plant⁻¹. The variety Bhittai gave maximum number for grains spike⁻¹, seed index and harvest index. Sunehri gave maximum value for total biomass plant⁻¹, in terms of spike length; the variety Sassue produced longest spikes. As per major findings, the results indicated that high heritability and genetic advance was observed for all the traits recorded; however, genetic advance was low for traits like yield plant⁻¹, total biomass and harvest index.

Keywords: Spring wheat; Heritability; Morpho-yield; Commercial; Quantitative traits

Introduction

Wheat is one of the most valuable and widely grown crop in the world. A number of species have been cultivated, but only two are grown now a day's i.e hexaploid bread wheat (*Triticum aestivum* L.) (AABBDD)

and durum tetraploid wheat (AABB). Bread wheat (*Triticum aestivum* L.) ranked third position in the cereals being harvested in the world and occupied second rank next to rice in provision of protein and other essential nutrition's for one third of population of

human beings [1]. It is also most key and widely adapted cereal crop in Pakistan. Pakistani people are using wheat as main ingredient of their daily routine diet. The wheat production during the years of 2014-15 was recorded about 25.478 million tons, which showed about 1.9% decrease in production due to prolonged winter season and unprecedented rains during April and May and caused damages to grain at harvesting time (GOP, 2015). The population of Pakistan is increasing day by day which challenges to the breeders to evolve better and high yielding varieties of wheat to fulfill the food requirement of the people of Pakistan. Genetic diversity in wheat genotypes is very much important. Genetic diversification in wheat provides many chances to evolve new and favorable genotypes through hybridization programs and other breeding techniques. Therefore, understanding of genetics factors which are governing the grain yield component is very important. The search of new and desirable germ plasm is continuous process and development of new varieties is an unending goal of plant breeders. The heritability is valuable in determining the parameter and predicting the magnitude and genetic gain that can be used for selection of any desirable character [2-5]. The high heritability and high genetics advance for yield and yield contributing traits is also aimed to investigate inheritance for yield and its components in commercial wheat varieties. Heritability ends to have a significant role in expecting the performance of further generations [6, 7]. The increase in yield is attributed to increase in any one of these major factors, while understanding the mechanism of genetic control of these economic traits allows effective selection for improved traits.

Materials and methods

The experiments was laid out in the experimental field of Department of Plant

Breeding and Genetics Sindh Agriculture University, Tandojam during 2014-2015 to estimate heritability for morphological traits in commercial varieties of spring wheat. The plot was designed in randomised complete block design in which the six genotypes were tested in three replications. The plot consisted of 4 rows; each row was 6 feet long. The distance between one row to the next row and one plant to the next plant was 20 and 5 cm respectively. The genotypes were Amber, Benazir, Sassui, Sundar, Sunehri and Bhittai. The data was analysed through

Statistical analysis

Analysis of variance by Gomez and Gomez (1984), while DMRT was calculated for comparison of means. Whereas, heritability in broad sense was calculated by Allard (1960).

1. Genetic Variance = $\sigma^2_g = \text{MSG} - \text{MSE}/r$
2. Phenotypic variance = $\sigma^2_{ph} = \text{MSG}/r$
3. Heritability (h w) = $\sigma^2_g / \sigma^2_{ph}$
4. Selection index (S) = $k \times \sigma^2_{ph}$
5. Genetic advance = $h w \times s$

Results

The analysis of variance was conducted for eight different traits recorded from six genotypes of commercial wheat varieties as presented in Table 1 and 2. It shows that all the genotypes were highly significant for all the traits.

The analysis of variance was conducted for eight different traits recorded from six genotypes of commercial wheat varieties as presented in Table 1 and their mean performance is given in Table 2. The genotypes were highly significant for days to 75% maturity, tillers plant⁻¹, spikelets spike⁻¹, grains spike⁻¹, seed index (1000-seed wt. g⁻¹), total biomass (g), grain yield plant⁻¹ (g), harvest index (%). The results regarding mean performance for days to 75% maturity of different genotypes with regarding to heritability indicated that Sunehri had highest heritability 131.93%

followed by Benazir 124.13%. As far as genetic variance and phenotypic variance is concerned for the trait days to 75% maturity. The achieved values were 6.52 and 6.637 respectively. While for the character productive tillers the Benazir variety ranked 1st (13.53) and Sunehri occupied 2nd position (12.73). The Genotypic variance was 1.038 and phenotypic variance was recorded 1.098. The variety Bhittai exhibited maximum number of grains spike⁻¹ at an average of 61.933 followed by Sunehri. Whereas the genotypic variance was recorded for the trait grains spike⁻¹ as 41.922 and phenotypic variance was recorded as 42.137. For the trait spike length the variety Sassue was observed maximum value *i.e* 13.13 followed by Bhittai which gave spikes

with the length of 12.73 cm. The maximum seed index was given by Bhittai (46.62), while the variety Sassue gave the lowest seed index value (40.18). Moreover, the genetics variance for the trait seed index was 5.74 and phenotypic variance was 6.146. For the trait grain yield plant⁻¹, the genotype Benazir recorded maximum value (8.92) while the genotypic variance for the character grain yield plant⁻¹ was 0.714 and phenotypic variance value was 0.716 only. The highest extent of heritability for the trait harvest index was recorded for the varieties Bhittai and Benazir (50.26 and 50.24%) respectively. Whereas, the lowest percentage was recorded for the genotype Amber (48.48%).

Table 1. Mean performance from the analysis of variance for yield and its contributing traits

SOV	DF	Days to 75% maturity	Productive tiller Plant ¹	Spike length	Grains spike ⁻¹	Seed index	Grain yield plant ⁻¹	Total biomass Plant ¹	Harvest index
Replication	2	0.215	0.228	0.134	0.062	0.572	0.00272	0.025	0.0377
Varieties	5	19.912**	3.294**	2.145* *	126.413 **	18.439**	2.149**	7.590**	1.277**
Error	10	0.346	0.178	0.096	0.436	1.209	0.005	0.020	0.064
Total	17	-	-	-	-	-	-	-	-

*, ** significant at 1 % of probability level. The mean performance for genotypes were highly significant at for days to 75% maturity, tillers plant⁻¹, spikelets spike⁻¹, grains spike⁻¹, seed index (1000-seed wt. in g), total biomass plant¹ (g) grain yield plant⁻¹ (g), harvest index (%)

The results for days to 75% maturity of different genotypes indicated that Sunehri had better performance for the trait days to 75% maturity. While for the character productive tillers, the variety Benazir was ranked 1st (13.53) and Sunehri occupied 2nd position (12.73). The variety Bhittai exhibited maximum number of grains spike⁻¹

¹ at an average of 61.933 followed by Sunehri. For the trait spike length the variety Sassue recorded maximum value *i.e* 13.13 followed by Bhittai which gave spikes with the length of 12.73 cm. The maximum seed index was given by Bhittai (46.62), while the variety Sassue gave the lowest seed index value (40.18).

Table 2. Mean performance of the genotype for yield and its traits in spring wheat

Genotypes	Days to 75% maturity	Productive tiller	Spike length	Grains /spike	Seed index	Grain yield/plant	Harvest index %
Amber	129.13 BC	10.467 C	12.657 A	52.867 C	42.510 CD	6.840 E	48.480 C
Benazir	124.13 E	13.533 A	11.497 B	49.400 D	44.497 BC	8.923 A	50.240 A
Sunder	127.93 D	11.200 BC	11.180 B	44.800 E	40.180 E	8.433 C	49.770 B
Sassue	129.73 B	11.267 B	13.133 A	45.533 E	45.440 AB	7.223 D	49.873 AB
Sunehri	131.93 A	11.800 B	11.333 B	55.400 B	41.447 DE	8.730 B	49.697 B
Bhittai	128.20 CD	11.200 BC	12.733 A	61.933 A	46.626 A	8.310 C	50.263 A

Heritability

Heritability is a convenient expression of phenotype value. For improvement of a desirable character, heritability estimate is very essential to assess the relative effect of genotype and environment in order to document the extent of possible improvement. As per major findings, the results indicated that the genotypes showed high heritability and genetic advance for all the traits recorded such as days to 75% maturity, number of productive tillers, spike length, grains spike⁻¹, seed index however, genetic advance was low for traits like grain yield plant⁻¹ and harvest index.

Discussion

Heritability estimate revealed that all the genotypes exhibited in moderate range of genotypic and phenotypic variances for the character days to 75% maturity, the genotypes exhibited highest heritability 98.2% for the same trait (Table 3). These findings are in confirmation to those of Larik *et al.* [8] who reported high heritability due to the presence of additive and additive x additive gene effects. His results also matched those which were obtained by previous researchers like [9]. For the trait 1000 seed weight of moderate range of phenotypic and genotypic variances was recorded. Among the genotypes tested for heritability estimates the recorded value was as high as (93.4%). These results are in the line with the result of Rehman et al. (2016), they observed that all the traits performed significantly in all the morpho physical parameters [10]. The similar results were obtained by Dutamo et al. (2016) who found in their study that all the characters in regard with genetic variance were high [11]. The results for days to 75% maturity of different genotypes with regarding to heritability indicated that Sunehri had

highest heritability 131.93 % followed by Benazir 124.13%. As far as genetic variance and phenotypic variance is concerned. for the trait days to 75% maturity. the values achieved were 6.52 and 6.637, respectively. While for the character productive tillers, the variety Benazir was ranked 1st (13.53) and Sunehri occupied 2nd position (12.73). The Genotypic variance was 1.038 and phenotypic variance was recorded 1.098. The variety Bhittai exhibited maximum number of grains spike⁻¹ at an average of 61.933 followed by Sunehri. Whereas the genotypic variance was recorded for the trait grains spike⁻¹ as 41.922 and phenotypic variance was recorded as 42.137. For the trait spike length the variety Sassue recorded maximum value *i.e* 13.13 followed by Bhittai which gave spikes with the length of 12.73 cm. The maximum seed index was given by Bhittai (46.62), while the variety Sassue gave the lowest seed index value (40.18). Moreover, the genetics variance for the trait seed index was 5.74 and phenotypic variance was 6.146. For the trait grain yield plant⁻¹, the genotype Benazir recorded maximum value (8.92) while the genotypic variance for the character grain yield plant⁻¹ was 0.714 and phenotypic variance value was 0.716 only. However, the result regarding total biomass of different genotypes showed that in case of heritability estimates, the variety Benazir gave the maximum percentage of heritability (17.77%) followed by Sunehri with 2nd maximum value of heritability. The highest extent of heritability for the trait harvest index was recorded for the varieties Bhittai and Benazir (50.26 and 50.24%) respectively. Whereas, the lowest percentage was recorded for the genotype Amber (48.48%).

Table 3. Heritability estimates for yield and its contributing traits in spring wheat

Characters	Genotypic variance (δ^2g)	Phenotypic variance (δ^2p)	Environmental Variance (δ^2e)	Heritability % (Broad sense)
Days to 75% maturity	6.522	6.637	0.115	98.2
Productive tillers plant ¹	1.038	1.0988	0.06	94.5
Spike length	0.683	0.715	0.032	95.5
Grains spike ⁻¹	41.922	42.137	0.145	99.6
Seed index 1000	5.743	6.146	0.403	93.4
Grain yield plant ⁻¹	0.714	0.716	0.002	99.7
Harvest index%:	0.404	0.425	0.007	95
Biomass Plant ¹	2.523	2.53	0.007	99.7

Conclusion

It is concluded that observed plant varieties exhibited significant differences for all studied traits. As per major findings, the results indicated that high heritability for all the traits recorded.

Authors' contributions

Conceived and designed the experiments: AA Kaleri & AA Kaleri, Performed the Experiments: SN Mari, AL Laghari, M Kumar, Analyzed the Data: SH Kaleri & J Kumar, Contributed reagents/ materials/ analysis tools: M Khan & AW Baloch, Wrote the paper: AA Kaleri.

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