



REGULAR ARTICLE

HERITABILITY ESTIMATES AND TRAITS ASSOCIATION IN WHEAT ADVANCED LINES

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ABSTRACT

In the present investigation, 14 spring wheat advanced lines with four checks were evaluated for six yield parameters during 2011-12 in an RCB design with three replications. Results showed significant differences ($P \leq 0.01$) for all the studied traits except harvest index which showed significant differences ($P \leq 0.05$). Mean values ranged between 87.7 to 110.4 cm for plant height, 29.1 to 38.1 cm for peduncle length, 1.91 to 2.89 g for grain weight spike⁻¹, 5617.3 to 7197.5 kg for grain yield ha⁻¹, 15679 to 20123 kg for biological yield ha⁻¹ and 34.94 to 42.40% for harvest index. Grain yield has significant correlation with grain weight spike⁻¹ (0.407**), biological yield (0.486**) and harvest index (0.549**). High heritability was observed for grain weight spike⁻¹ (71.74%), grain yield ha⁻¹ (69.01%) and biological yield ha⁻¹ (71.87%).

Keywords: Advanced lines, Heritability, Wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one among the major cereal crops of the world as a source of human diet and energy rich crop and also called as the “king of cereals”. It occupies superior position in the international food grain [1]. Globally, Asia is the major sharer of the wheat production and produce more than 40% of the total wheat production (292.5 million tones) as compared to the world production (653.6 million tones). China is major wheat producing (115.5 million tones) country in Asia followed by India and Pakistan (80.8 and 23.3 million tones respectively). However, average yield per hectare of wheat in Pakistan is too low as compared to other countries [2]. In Pakistan, there is a production gap during last years. The production gap is due to a reduction in crop area, reduced availability of irrigation water, inputs (chemical fertilizers etc.) and low rainfall pattern. In Khyber Pakhtunkhwa wheat was grown on area of 0.725 million hectares with total production of 1.2 million tones. The yield in our province during 2010-11 was 1595 kg ha⁻¹ [3]. Wheat has always been subjected to extensive research work to maximize its production. Grain yield in cereals and particularly in wheat is a complex trait and is highly environment based and it results from interaction among its component sub-traits. Conducting wheat breeding programs, direct selection against yield is deceptive. Successful

selections rely on genetic divergence, heritability estimates and association of agro-morphological traits with grain yield. The estimates of heritability along with correlation studies offer a better consideration of the association of important traits with grain yield [4].

Crop improvement depends on genetics during different breeding strategies. Higher the proportion of environmental variance less will be the chance to select inherited differences. Similarly, the rate of selection increases if the ratio of variability due to environmental factors is less than that of genetic variability [5]. It is therefore recommended to be sufficient knowledge about heritability and selection response for important yield related traits during crop improvement programs [6]. Traits having higher heritability could be selected during breeding programs which makes the progress easier to those traits containing low heritability estimates [7]. Numerous researchers reported high heritability estimates and selection response while studying different yield contributing traits during wheat improvement programs [8-10]. Grain yield is the most important polygenetic trait in cereal crops which is not only affected by external environment but also depends upon other yield related traits. Therefore, our selection should not be directly based upon grain yield but focus should also be given to other yield related traits. Besides the knowledge of

Received 11 November 2017; Accepted 29 December 2017

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heritability and selection response, the understanding of mutual relationship between different yield contributing traits is also noteworthy [11, 12]. Present study was conducted to explore genetic variability, heritability and correlation among wheat advanced lines using six yield related traits to devise selection criteria for isolation of best performing lines in Peshawar valley.

MATERIALS AND METHODS

To assess the genetic variability and traits association in different wheat advanced lines, a field experiment was conducted during 2011-12 at the University of Agriculture, Peshawar. Breeding material used was 14 advanced lines along with 4 checks. The wheat genotypes were sown during mid of November 2011, with inter-row spacing of 30 cm in an RCB Design with three replications. Each subplot of a genotype had three rows. The recommended cultural practices such as land preparation, sowing and hoeing were similar for all treatments to minimize the environmental effects on breeding material.

Statistical analysis

The recorded data regarding each parameter were subjected to analysis of variance (ANOVA) techniques appropriate for RCB design through MSTATC software as outlined by Steel and Torrie [13] to compare the mean

differences among wheat genotypes. Broad sense heritability was calculated for all parameters. Phenotypic correlation between these six traits was determined as suggested by following Kwon and Torrie [14].

RESULTS AND DISCUSSIONS

Results and discussions pertaining to six yield contributing traits are documented using heritability and traits association analysis.

Analysis of variance

Highly significant differences ($P \leq 0.01$) were observed for all the studied traits except harvest index which display significant differences ($P \leq 0.05$) among wheat genotypes (table 1). Similar findings were reported by many researchers and confirmed our results [15, 16-23].

Mean performance of the fourteen wheat advanced lines along with four checks

Mean performance show us the actual genetic potential of different genotypes across different environments. We should identify and recommend genotypes performing better in an environment.

Table 1: Mean square values for plant height, peduncle length, grain weight spike⁻¹, grain yield, biological yield and harvest index of wheat genotypes

Source of variation	Replication	Genotype	Error	CV (%)
Degrees of Freedom	2	17	34
Plant Height	21.962	121.625**	16.271	4
Peduncle Length	6.294	21.658**	1.824	3.92
Grain Weight Spike-1	0.157	0.201**	0.07	11.6
Grain Yield	227464.627	620356.163**	242279.246	7.67
Biological Yield	6858633.67	3953787.226**	1369037.849	6.9
Harvest Index	12.487	18.498*	9.526	8.12

**=Highly significant ($P < 0.01$), *=Significant ($P < 0.05$)

Table 2: Mean performance for plant height, peduncle length, grain weight spike⁻¹, grain yield, biological yield and harvest index of wheat genotypes

Genotypes	Plant height (cm)	Peduncle length (cm)	Grain weight (g)	Grain yield (Kg ha ⁻¹)	Biological yield (Kg ha ⁻¹)	Harvest index (%)
MPT1	104.67	34.97	2.89	7098.76	16790.13	42.4
MPT2	92.73	32.46	2.38	6135.8	16419.77	37.46
MPT5	97.73	33.74	2.35	6703.7	17037	39.39
MPT6	95.87	34.52	1.99	6197.53	16790.13	36.86
MPT7	110.4	38.09	2.41	7197.53	20123.43	35.84
MPT8	108.67	37.27	2.45	6999.99	18641.97	37.57
MPT9	99.67	30.4	2.1	5888.88	16419.73	35.96
MPT10	102.93	35.91	2.07	6728.39	17901.23	37.58
MPT11	105.33	35.55	1.91	5617.28	16049.4	34.98
MPT12	108.07	36.88	2.28	6481.48	18148.13	36.05
MPT13	108.53	36.81	2.28	5888.89	16049.4	36.79
MPT14	102.73	34.46	2.02	6160.49	17037.03	36.21
MPT15	98.47	32.78	2.25	6851.85	16419.77	41.78
MPT16	97.13	36.44	1.95	6055.55	16419.77	37
ATTA HABIB	94.6	32.84	2.5	6419.75	15802.5	40.6
SIREN	95.47	30.13	2.32	6358.02	15679	40.68
PIRSABAK-2005	87.67	29.09	2.14	6703.7	15925.93	42.07
PIRSABAK-2008	105.33	37.42	2.69	6067.07	17530.9	34.94
MEAN	100.89	34.43	2.28	6419.7	16954.73	38.01
LSD (0.05)	6.69	2.24	0.44	816.75	1941.5	5.12

Plant height ranged from 87.67 to 110.40 cm with a mean value of 100.89 cm. Advanced line MPT7 had maximum plant height (110.40 cm), while Pirsabak-2005 had minimum plant height (87.67 cm). Peduncle length ranged from 29.09 to 38.09 cm with a mean value of 34.43 cm. Maximum peduncle length was observed for MPT7 (38.09 cm), while minimum peduncle length was observed for Pirsabak-2005 (29.09 cm). Grain weight ranged from 1.91 to 2.89 g with an average of 2.28 g. Unlike, plant height and peduncle length, MPT1 showed maximum grain weight (2.89 g), while advanced line MPT11 had minimum grain weight (1.91 g). Grain yield ha⁻¹ ranged from 5617.28 to 7197.53 kg with an average of 6419.70 kg. Advanced line MPT7 exhibited maximum grain yield (7197.53 kg), while advanced line MPT11 showed minimum grain yield (5617.28 kg). Biological yield ha⁻¹ ranged from 15679.0 to 20123.4 kg. Maximum biological yield ha⁻¹ was observed for MPT7 (20123.4 kg), while minimum biological yield ha⁻¹ was observed for Siran (15679.0 kg). Harvest index ranged from 34.94 to 42.40%. Advanced line MPT1 had maximum harvest index (42.40), while minimum harvest index was recorded for Pirsabak-2008 (34.94) (table 2).

Heritability estimation on entry mean base among six traits of the fourteen wheat advanced lines along with four checks

Heritability among fourteen advanced lines and four checks ranged from 61.66 to 92.03% for all the studied traits. Plant height revealed high heritability estimates (87.72%) among fourteen advanced lines and four checks (table 3). In correspond to our study, earlier reports also observed higher magnitudes of heritability for plant height which support the present findings [24, 4]. Similarly, for plant height, high heritability estimates were also noticed by previous workers [25, 26].

Peduncle length revealed high heritability (92.03%) among fourteen advanced lines and four checks (table 3). The results of Baranwal *et al.* [27] are in line with our findings who also exhibited similar heritability range for peduncle length. Grain Weight Spike⁻¹ exhibited high heritability (71.74%) among fourteen advanced lines and four checks (table 3). These results are in conformation with the findings

of Al-Tabbal and Al-Fraihat, [28]. For grains per spike, other researchers also reported high heritability estimates [16, 17]. Grain yield ha⁻¹ exhibited high heritability (69.01%) among fourteen advanced lines and four checks (table 3). In correspond to our study, one of the previous studies also obtained high heritability for grain yield; however moderate heritability for the same trait was recorded [29]. Similarly, high heritability was also observed for grain yield [16]. Heritability estimate of 71.87% was obtained for biological yield (table 3). Our results are further supported by the previous findings who also reported similar heritability estimate for biological yield. Harvest index revealed heritability estimates of 61.66% (table 3). Similar effects were also found moderate heritability for harvest index [30].

Pearson correlation analysis among six traits of the fourteen wheat advanced lines along with four checks

Plant height was significantly correlated with peduncle length (0.709**), biological yield (0.423**) and harvest index (0.270*). Peduncle length was significantly correlated with biological yield (0.434**) and harvest index (0.405**). Grain weight spike⁻¹ shown significant correlation with grain yield (0.407**) and harvest index (0.286*). Grain yield was significantly correlated with biological yield (0.486**) and harvest index (0.549**). Biological yield presented significant correlation with harvest index (0.469**). Harvest index revealed significant correlation with all the studied traits like, plant height (0.270*), peduncle length (0.405**), grain weight (0.286*) spike⁻¹, grain yield (0.549**), and biological yield (0.469**) (table 4).

Significant positive associations were obtained by Uddin *et al.* [31] between grain yield and grains spike⁻¹, 1000-grain weight, flag leaf area and plant height. Further, many previous studies also found positive association between grain yield and grains spike⁻¹ [32, 17, 12]. Biological yield is positively associated with grain yield and suggests that grain yield increase parallel with biological as it assists to accumulate additional photosynthates in developing grain. This finding is supported by earlier works [33-35].

Table 3: Genotypic variance, phenotypic variance and heritability estimates for six yield contributing traits of wheat genotypes

Traits	Genotypic variance	Phenotypic variance	Heritability (%)
Plant Height	38.73	44.16	87.72
Peduncle Length	7.02	7.62	92.03
Grain Weight Spike ⁻¹	0.06	0.08	71.74
Grain Yield	179865.47	260625.22	69.01
Biological Yield	1165813.76	1622159.71	71.87
Harvest Index	5.11	8.28	61.66

Table 4: Correlation coefficients for plant height, peduncle length, grain weight spike⁻¹, grain yield, biological yield and harvest Index of wheat genotypes

Traits	Plant height	Peduncle length	Grain weight spike ⁻¹	Grain yield	Biological yield	Harvest index
Plant Height	0.709**	0.129NS	0.132NS	0.423**	0.270*
Peduncle Length	0.028NS	0.015NS	0.434**	0.405**
Grain Weight Spike ⁻¹	0.407**	0.145NS	0.286*
Grain Yield	0.486**	0.549**
Biological Yield	0.469**

**=Highly significant (P<0.01), *=Significant (P<0.05), NS=Non significant (P>0.05).

CONCLUSION

It is concluded that genotypes MPT1, MPT7 and MPT15 showed superiority for various traits and hence the genetic potential of the mentioned wheat lines for the desired traits can be utilized in future wheat breeding programs. Also, the mentioned lines should be tested at various locations and be released as a variety.

ACKNOWLEDGEMENT

We are grateful to Department of Plant Breeding and Genetics, The University of Agriculture, Peshawar-Pakistan for the support by providing wheat seed and experimental area to carry out the research work.

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