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ASSESSMENT OF HERITABILITY ESTIMATES FOR SOME YIELD TRAITS IN WINTER WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

Information about the genetic variability and other associated parameters for different traits is very useful in crop improvement programs. Yield components and some morphological characters were studied in an experiment comprising 42 winter wheat genotypes. The experiment was laid out in RCB design in 2004-05 at the New Development Farm of Khyber Pakhtunkhwa Agricultural University Peshawar. Mean values, genotypic and phenotypic variances, broad sense heritability and genetic advance were calculated for all the traits. Moderate to very low and high heritabilities were estimated for all the morphological characters except days to 50% physiological maturity. Grain yield exhibited highest heritability value of 92.45% while harvest index and days to 50% physiological maturity showed minimum values 27.55% and 15.42% respectively. High heritability estimates were observed for grain yield and biological yield. Genetically the data revealed highly significant mean squares for all the characters i.e., tiller plant^{-1}, plant height, days to 50% physiological maturity, grain weight, grain yield, biological yield and harvest index which suggested the presence of genetic difference among the winter wheat genotypes.

Introduction

Grain yield in cereals is a complex phenomenon and is the result of multi growth factors. It is integration where each component contributing to yield is partially interdependent in expression. Therefore, selection on the basis of traits with higher heritability makes the progress easier of traits with low heritability (Shahid *et al*., 2002). The genetic factor is of most importance in plant breeding since it can be used to improve the population. The greater the proportion of total variability due to environmental factors, the more difficult it will be to select for inherited differences. If environmental variability is small in relation to genetic differences, selection will be more efficient (Khan, 2001).

The success of a crop improvement program depends upon the amount of genetic variability existing in the germplasm. To bring the heritable improvements in economic characters through selection and breeding, estimation of genetic parameters must be made before starting a program. There are different techniques available to compute the genetic parameters and the index of transmissibility of characters. Heritability estimates provides information about the extent to which a particular character can be transmitted to the successive generations. Knowledge of heritability of a trait thus guides a plant breeder to predict behavior of succeeding generations and helps to predict the response to selection. High genetic advance coupled with high heritability estimates offer a most suitable condition for selection (Larik *et al*., 1989). Therefore, availability of good knowledge of heritability and genetic advance existing in different yield parameters is a pre-requisite for effective plant improvement exercise (Haq *et al*., 2008). The presence of high heritability and genetic advance regarding different yield related attributes in wheat was reported by Arshad & Chowdhry (2003), Khalil & Afridi (2004) and Inamullah *et al*., (2006). Present investigations were planned to measure the extent of genetic variability, heritability, genetic advance and interrelationship of various traits to devise suitable selection criteria for further yield improvement of winter wheat in Peshawar valley.

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Materials and Methods

A set of 42 winter wheat genotypes i.e., OK9561656, K98G508W, OK99212, OK00421, OK00514, OK00611W, OK00518W, OK00608W, INTRADA, 05F54, 05F55, 05F59, 05F510, 05F515, 05F519, 05F521, 05F534, 05F538, 05F542, 05F553, 05F563, 05F564, 05F569, 05F570, 05F571, 05F578, 05F583, 05F586, 05F587, 05F599, 05F5103, 05F5104, 05F5110, 05F5115, 05F5117, 05F5122, 05F5134, 05F5135, 05F5139, 05F5164, 05F5146 and 05F5141 obtained from Department of Plant Breeding and Genetics, KPK Agricultural University, Peshawar were evaluated in an RCB Design with three replications at the New Development Farm of KPK Agricultural University, Peshawar. Recommended plant production and protection measures were adopted to raise the crop. Observations were recorded on tiller plant^{-1}, plant height, days to 50% physiological maturity, grain weight, grain yield, biological yield and harvest index. The data were randomly collected on five plants and after compilation were statistically analyzed using SAS statistical package (Anon., 1988). The means were separated by Least Significant Difference test (LSD). Analysis of variance was done using the method of Steel and Torrie (1984). Heritability in broad sense was estimated from the result of variance analysis according to the formula used by Burton & DeVane (1953). Genetic advance estimates were worked out according to the procedure described by Allard (1960).

h^2(B.S) = (Genotypic variance/phenotypic variance) = σ^2_g / σ^2_p

$GA = \sigma_p \times h^2 \times k$

where,

σ_p = standard deviation of phenotypic variance

h^2 = broad sense heritability in fraction.

k = selection intensity.

(The value for k = 1.554 in this study at 15% selection pressure)

Results and Discussion

Tillers plant^{-1}: Number of tillers per plant is playing a vital role in increasing the final grain yield. Genotypes in the present study exhibited highly significant differences ($p<0.01$) for tillers plant^{-1} (Table 1). Maximum numbers of tillers (37) per plant was recorded for the genotype K98G508W where as the genotype 05F534 showed minimum tillers (7) per plant (Table 2). The results are in accordance with the findings of Munir *et al* (1999) and Rajora (1999).

Among estimates of heritability and genetic advance (Table 3), tillers plant^{-1} exhibited moderate broad sense heritability of (71.54%) with high genetic advance of 8.75. The results are in agreement with the findings of Shabana *et al*., (2007).

Table 1. Mean squares for Tillers Plant^{-1} (TPP), Plant Height (PH), Days to 50% Physiological Maturity (PMT) , 1000-Grain Weight (TGW), Grain Yield (GY), Biological Yield (BY), and Harvest Index (HI) for 42 winter wheat genotypes evaluated at Agricultural University Peshawar during 2004-05.

SOV	D.F	TPP	PH	PMT	TGW	GY	BY	HI
Reps	2	9.52^{Ns}	14.88^{Ns}	480.09**	43.01*	128152.38**	1971666.67^{Ns}	76.18*
Genotypes	41	148.87**	207.44**	45.05*	55.09**	949617.81**	5799355.40**	34.15**
Error	82	17.43	44.00	29.12	9.57	25152.38	702520.33	15.95
C.V%		23.85	7.44	3.11	10.85	6.89	11.71	12.51

*Significant at 5% level of probability, ** Significant at 1% level of probability
Ns: Non significant, D.F: Degrees of freedom, C.V: Coefficient of variation

Table 2. Means for Tillering plant^{-1}, Plant height, Days to 50% physiological Maturity, 1000-grain weight, Grain Yield, Biological Yield, and Harvest Index for 42 winter wheat genotypes evaluated at AUP during 2006-07.

VARITIES	TPP	PH	PMT	TGW	GY	BY	HI
OK9561656	31	93	170	27	2550	7000	36
K98G508W	37	80	173	25	2050	6500	32
OK99212	21	89	168	28	2700	7500	36
OK00421	22	83	176	24	1875	6000	31
OK00514	20	94	170	23	2250	7000	32
OK00611W	31	92	170	29	2400	7250	33
OK00518W	22	90	175	25	2200	7250	30
OK00608W	28	84	175	27	2200	6500	34
INTRADA	20	87	173	29	3100	9500	33
05F54	22	83	168	26	3400	10000	34
05F55	11	85	169	29	2800	8000	35
05F59	14	88	174	22	2000	6000	33
05F510	11	85	174	24	2500	7000	36
05F515	21	86	173	31	2000	6000	33
05F519	15	87	172	27	2600	7800	33
05F521	15	82	171	23	2200	7000	31
05F534	7	79	175	33	1700	5900	29
05F538	13	106	175	36	2800	9000	31
05F542	16	88	169	40	2200	6000	37
05F553	8	84	174	29	2300	8000	29
05F563	13	78	177	22	1600	6000	27
05F564	9	87	181	31	2000	6800	29
05F569	16	80	172	29	1900	6000	32
05F570	11	86	174	28	1500	5900	25
05F571	15	95	170	33	2000	6900	29
05F578	23	123	168	28	2800	8200	34
05F583	10	90	168	27	1700	5200	33
05F586	20	88	179	30	1900	6900	28
05F587	15	95	170	31	2300	7000	33
05F599	13	91	171	31	2000	5300	38
05F5103	17	79	175	26	1500	5800	26
05F5104	14	102	168	32	2400	8600	28
05F5110	9	89	170	28	1700	5000	34
05F5115	15	96	183	29	1800	7100	25
05F5117	17	94	171	37	3000	9300	32
05F5122	9	91	179	37	2800	9000	31
05F5134	11	92	177	27	2200	6800	32
05F5135	28	102	175	20	2000	5800	34
05F5139	14	85	174	25	3000	8100	37
05F5164	22	89	180	29	1700	5800	29
05F5146	29	91	177	33	2700	8800	31
05F5141	20	79	178	28	4300	11100	39
LSD	6.78	**10.78**	**8.765**	**5.02**	**257.6**	**1361.4**	**6.49**

Table 3. Genetic variance (Vg), environment variance (Ve), heritability (h^2) and expected genetic advance (G. A) for tillers plant^{-1}, plant height, days to 50% physiological maturity, 1000-grain weight, grain yield, biological yield and harvest index.

TRAIT	MST	MSE	σ^2_g	σ^2_p	h^2(B.S.)	G.A
TPP	148.87	17.43	43.81333	61.24333	71.54	8.75
PH	207.44	44	54.48	98.48	55.32	7.89
PMT	45.05	29.12	5.31	34.43	15.42	1.27
TGW	55.09	9.57	15.17333	24.74333	61.32	4.72
GY tons ha^{-1}	0.95	0.025	0.308333	0.333333	92.49	0.821
BY tons ha^{-1}	5.8	0.703	1.699	2.402	70.73	1.7
HI%	34.15	15.95	6.066667	22.01667	27.55	2.04

Plant height (cm): Analysis of variance for plant height showed highly significant differences ($p<0.01$) among all the genotypes (Table 1). Data for this trait ranged from 79 to 123cm. Taller plants (123cm) were observed for genotype 05F578 where as shorter plants (79cm) were observed for genotype 05F534 (Table 2). Similar results were reported by Ihsanullah & Mohammad (2002) and Akbar *et al.* (2000). Heritability estimates and genetic advance for the trait were recorded as (55.32%) and (7.89) respectively (Table 3). Similar result was found by Khan *et al*., (2003).

Days to 50% physiological maturity: Significant differences ($p<0.05$) were observed among the genotypes for days to 50% physiological maturity (Table 1). Maximum days of 181 to physiological maturity was exhibited by genotype 05F564 (Table 2) whereas minimum days of 168 to physiological maturity was recorded for the genotype 05F54. Lower heritability (15.42%) coupled with lower genetic advance (1.27) were observed for days to physiological maturity (Table 3). The low heritability associated with low genetic advance as observed in some of the progenies is also similar to the findings of Singh *et al*., (2001), Gupta *et al*., (2004) and Ansari *et al*., (2005).

1000-Grain weight: Highly significant differences ($p<0.01$) were observed among genotypes for 1000- grain weight (Table 1). Data for 1000-grain weight ranged between 22 and 40, maximum 1000-grain weight was recorded for genotype 05F542 whereas minimum was recorded for genotype 05F563 (Table 2). Firouzian (2003) got significant results for 1000- grain weight among the genotypes.

1000-grain weight exhibited moderate broad sense heritability (61.32%) with genetic advance (4.72). Moderate heritability estimates (Table 3) suggested that selection should be delayed to more advance generations for this character. However, the findings of Haq *et al.* (2008) are contrary to our findings.

Grain yield (Tones ha^{-1}): All genotypes represented significant differences ($p<0.01$) for grain yield (Table 1). Grain yield for all genotypes ranged between 1.5 tones ha^{-1} and 4.3 tones ha^{-1}. Maximum grain weight was recorded for by the genotype 05F5141 whereas minimum grain weight was obtained from the genotype 05F570 (Table 2).

Grain yield displayed high heritability estimates (92.5%) with relatively low value of genetic advance (0.821) (Table 3). Low genetic advance indicates slight chances of improvement of this trait in subsequent generations as discussed by Mahmood & Shahid (1993), and Firouzian *et al*. (2003).

Biological yield *(Tones ha^{-1})*: Highly significant differences ($p<0.01$) were exhibited by all genotypes for biological yield (Table 1) similar in agreement with finding of Masood *et al*., (2005). Grain yield for all genotypes ranged between 5 tones ha^{-1} and 11.1 tones ha^{-1}. Maximum grain yield was recorded for the genotype 05F5141 whereas minimum grain yield was obtained from genotype 05F5110 (Table 2). Moderate heritability values (70.73%) with low genetic advance (1.7) were observed for biological yield (Table 3).

Harvest index (%): Highly significant differences ($p<0.01$) were exhibited by all genotypes for harvest index (Table 1). Harvest index for all genotypes ranged between 25 and 39. Maximum harvest index was showed by the genotype 05F5141 whereas minimum harvest index was represented by the genotype 05F570 (Table 2).

Low heritability (27.55%) coupled with low genetic advance (2.04) was displayed by harvest index (Table 3) indicating low transfer of this trait in the subsequent generations, the results are in conformity with the findings of Bhatt (2004).

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