Determination of agronomic performance, genetic parameters and association among grain yield and its related components in wheat (*Triticum aestivum L.*).

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ABSTRACT: An experiment was conducted to determine the agronomic performance, genetic parameters and correlation among different traits in 72 bread wheat genotypes. Data were recorded for days to heading, days to maturity, plant height, peduncle length, spike length, number of tillers per plant, number of grains per spike, number of spikelets per spike, 1000-grain weight and grain yield per plant. Highly significant differences were observed among genotypes for all measured traits. Wheat genotype Seher-06 was the highest yielder (26.05 g). Genotypic and phenotypic coefficients of variations were high (20.43%) for number of tillers per plant. Higher heritability estimates were recorded for all the traits. High genetic advance values as percent of the mean were found for number of tillers per plant (35.22%) and grain yield per plant (25.44%). Correlation of grain yield was highly significant and positive with peduncle length and 1000-grain weight.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a worldwide commercially grown crop. It contributes more than 20% of calories in daily diet of 4.5 billion people (FAO 2012). Wheat is the staple food for the people of Pakistan. Wheat contributed for about 9.9% to the agriculture and 2.0% to GDP. In 2015-16, wheat was grown on an area of 9260 thousand hectares and the production of wheat was 25.482 thousand tons (Govt. of Pakistan, 2016). Enhancement in crop productivity is usually the result of continued efforts. Identification of traits that contribute to grain yield is crucial to increase breeding efficiency. Genetic improvement depends upon the presence of variability in the germplasm. The heritability and genetic advance provide useful criteria for the selection of suitable parameters. It helps in breeding program for the selection of good varieties or genotypes from large genetic population. It is not important that a trait exhibiting the high heritability will also shows high genetic advance (Johnson *et al*. 1955). For this purpose plant traits with higher heritability and showing useful correlation with grain yield have vital importance to obtain higher crop yields (Gashaw ., 2007). Estimation of correlation among different attributes in wheat was early described by Ibrahim *et al*. 1983. The studies on correlation analysis provide better knowledge of the nature of association of different components with grain yield (Dixet and Dubey, 1984) and their contribution for the improvement of grain yield (Kotal *et al*. 2010). The objectives of present study were to compare the agronomic performance of different wheat genotypes for grain yield and its attributes, to determine the genetic parameters for different traits and nature correlation among yield and yield related traits.

METHODOLOGY

The present research was conducted at research field of Ghazi University Dera Ghazi Khan. Seventy two wheat genotypes were planted during 1st week of December 2014 using Randomized Complete Block Design with three replications. Genotypes were sown by keeping distance between plant to plant and row to row 10 cm and 30 cm, respectively. The experiment was provided with recommended uniform seeding rate, irrigations, plot management and cultural practices to all plots. Data were recorded for parameters including days to heading, days to maturity, plant height, peduncle length, spike length, number of tillers per plant, number of spikelet per spike, number of grains per spike, 1000-grain weight and grain yield per plant. Data collected for the above mentioned traits were subjected analysis of variance to find out significance of differences among genotypes according to procedures given by Steel *et al*. (1997). Mean squares from analysis of variance were used for the estimation of genotypic variance, phenotypic variance, heritability, and genetic advance. Genotypic and phenotypic Correlations among different traits were calculated by the formula given by Singh and Chaudhary (1985) while, estimates broad sense heritability and genetic advance were calculated by the formula described by Poehlman and Sleeper (1987).

RESULTS AND DISCUSSION

Days to heading

Selection for early heading is required in wheat. Mean squares (Table 1) for days to heading indicated highly significant differences among genotypes. Genotype DH-43 was identified with minimum days to heading (78 days) followed by DH-45 (78.5 days) and DH-44 (84 days) (Table- 2). Genotypic and phenotypic coefficients of variations for days to heading were 23.83% and 24.58%, respectively. Higher heritability estimates of 95.55% along with low genetic advance percent of the mean with a value of 7.53% were observed for days to heading (Table 3). The findings of Khan et al. (2015) validated the results of current study for heritability and genetic advance. Highly significant and positive correlation of days to heading was observed with days to maturity (Table 4). Similar findings have been reported by Afridi et al. (2014).

Days to maturity

Early maturity is considered one of the most important traits in wheat breeding. Early maturing varieties have the ability to escape the biotic and abiotic stresses. Analysis revealed highly significant differences among genotypes for days to maturity (Table-1). Comparison of means for days to maturity showed that the genotype Blue Silver was early maturing and took minimum days (117.5 days) to mature followed by SA-42 (118.5 days) and V-9428 (119.0 days) (Table-2). The estimates of genotypic and phenotypic coefficient of variation were 1.82% and 1.89%, respectively. The analysis also revealed high heritability estimates of 92.82% along with a low genetic advance of 5.59% (Table 3) Khan and Marker (2016) also observed high heritability along with low genetic advance percent of the mean for days to maturity. Days to maturity showed highly significant and positive relationship with plant height and number of grains per spike both at genotypic and phenotypic levels (Table 4). Our results are similar with the findings of Rahman et al. (2016), Afridi et al. (2014) and Khan et al. (2010).

Plant height (cm)

Taller plant types in wheat tend to lodge and cause reduction in grain yield. Therefore, breeding efforts are made to develop short stature wheat varieties. Highly significant variations among wheat genotypes were observed for plant height. Minimum plant height (59 cm) was measured in DH-20 followed by DH-60 (67.05 cm) and GD-51 (70.0 cm) (Table 2). The estimates for genotypic and phenotypic coefficients of variations (Table 3) were 9.01% and 9.03%, respectively. Broad sense heritability estimates were high with values of 99.32% along with moderate genetic advance of 14.18% (Table 3). Rehman et al. (2016b) found high heritability with moderate genetic advance for plant height. Plant height revealed significantly positive genotypic and phenotypic association with peduncle length (Table 4). Significantly positive relationship of plant height with peduncle length was also observed by Khan et al. (2010).

Peduncle length (cm)

Peduncle length is an important plant trait in wheat that transfers stored carbohydrates to the seed at maturity (Pirahamadi et al (2016). Significant variability was observed for peduncle length (Table 1). Maximum peduncle length (41.2 cm) was recorded in genotype GD-111 followed by V-271 and C-250 (39.25 cm) each with same value (Table 2). The estimates of phenotypic and genotypic coefficients of variations were 9.70% and 9.71%, respectively. Heritability estimates were high 99.97% coupled with moderate genetic advance of 17.01% (Table 3). Our results are in accordance with the findings of Rehman et al. (2016). Phenotypic and genotypic relationship of peduncle length was positive and highly significant with spike length and grain yield per plant (Table 4). Similar results have been reported by Khan et al. (2010) and Iftikhar et al (2012).

Spike length (cm)

Larger spikes are considered to produce more grains and increased grain yield per plant. Mean squares indicated significant variability for spike length (Table 1). Wheat genotype Inquilab-91 produced maximum spike length (13.5 cm) followed by SH-2002 (13.45 cm) and PB-76 (13.15 cm) (Table 2). The estimates for genotypic and phenotypic coefficients of variations were 8.23 and 8.78, respectively (Table 3). The values of high heritability and moderate genetic advance for spike length were 87.87% and 13.50%, respectively. High heritability for spike length has also been reported in the findings of Khan et al. (2017). Mecha et al. (2016) reported moderated genetic advance for spike length. Significantly positive correlation of spike length was observed with number of tillers per plant at both genotypic and phenotypic levels (Table 4). Similar results have been reported by Akram et al (2008).

Number of tillers per plant

Highly Significant variability was revealed among wheat genotype for number of tillers per plant (Table 1). Maximum numbers of tillers (12.5) per plant were recorded for genotype Chenab-70 followed by Seher-06 (10.6) and V-16 (10.4) (Table 2). The magnitudes of genotypic and phenotypic coefficients of variations were 20.43% and 20.73%, respectively. Number of tillers per plant exhibited high heritability estimates with a value of 97.03% along with a high genetic advance as percent of the mean of 35.22% (Table 3). Khan et al. (2017) also reported high broad sense heritability for number of tillers per plant. High genetic advance as percent of the mean was documented by Ghallab et al. (2016). Numbers of tillers per plant were found highly significantly and positively associated with number of spikelets per spike (Table 4). Significant and positive association of tillers per plant with spikelets per spike has previously reported by Ali et al. (2008).

Number of spikelets per spike

Mean squares indicated highly significant variability among wheat genotypes for number of spikelets per spike (Table 1). Maximum numbers of spikelets per spike (24.25) were produced by genotype Chenab-70 followed by Iqbal-2000 (23.7) and Chenab-2000 (23.3) (Table 2). The estimates genotypic and phenotypic coefficients of variations were 9.13% and 9.34%, respectively. A high heritability of 95.63% along with a moderate genetic advance of 15.68% was recorded for number of spikelet per spike (Table 3). Similar findings of high heritability for number of spikelet per spike were reported by Afridi et al. (2014). Moderate genetic advance as percent of the mean was also reported by Ghallab et al. (2016). Positive and highly significant relationship of number of spikelets per spike was observed with number of grains per spike at genotypic and phenotypic levels (Table 4). These results are in agreement with the findings of Kotal et al. (2010)

Number of grains per spike

Number of grains per spike is an important yield component. Highly significant variations were recorded among wheat genotypes for number of grins per spike (Table1).

The genotype PB-76 produced maximum number of grains per spike (57.8) followed by C-591 (56.95) and C-518 (56.2) (Table 2). The phenotypic and genotypic coefficients of variations for number of grains per spike were recorded as 10.47% and 10.52%, respectively. High heritability estimates of 99.01 % coupled with moderate genetic advance of 18.28% were recorded for number of grains per spike (Table 3). Similar findings of high heritability coupled with moderate genetic advance percent of the mean for number of grains per spike have also been reported by Ajmal et al. (2009). Highly significant and positive association of number of grains per spike was observed with 1000-grain weight at genotypic level only (Table 4). Akram et al. (2008) .

1000-grain weight (g)

Thousand grain weight is among key components of grain yield. Highly significant differences were recorded among genotypes for 1000-grain weight (Table 1). The mean performance indicated those genotypes Chenab-70 and Blue silver each produced maximum 1000-grain weight (40.98 g) (Table 2). The estimates of phenotypic and genotypic coefficients of variations were 5.65 % and 5.80 %, respectively. Higher broad sense heritability with a magnitude of 96.47 % accompanied by a low genetic advance of 9.66% (Table 3) was recorded for 1000-grain weight. Farshadfar et al. (2013) reported high heritability for 1000-grain weight. Contrary to our investigations Khan and Hassan (2017) reported high genetic advance for this trait. 1000-grain weight showed highly significant and positive association with grain yield per plant at both genotypic and phenotypic levels (Table 4). Similar results were reported by other researchers like Ajmal et al. (2009), Iftikhar et al. (2012a) and Iftikhar et al. (2012b).

Grain yield per plant (g)

Improvement in grain yield is the ultimate objective of any wheat breeding program. Highly significant differences were observed among whet genotypes for grain yield (Table 1). Significant differences were also reported by Afridi et al. (2014) and Khan and Hassan (2017). The comparison of means indicated that genotype Seher-06 was the highest yielder (26.05 g) followed by AARI-11 (25.14 g) and Pak-81 (23.12 g) (Table 2). Genotypic and phenotypic coefficients of variations were 15.65 % and 16.93 %, respectively. A heritability estimate of 85.4 % accompanied with higher genetic advance of 25.44 % was recorded for grain yield per plant (Table 3). High heritability and higher genetic advance for grain yield in wheat populations were also reported by Rohani and Marker (2016). Ghuttai *et al.* (2015) and Ghallab *et al.* (2016) reported moderate to high heritability and genetic advance.

Conclusion

Significant differences among genotypes for all the traits indicate the presence of sufficient variability to make successful selection. Higher heritability estimates were recorded for all the traits. High heritability and high genetic advance as percent of the mean were observed for number of tillers per plant and grain yield per plant suggesting that selection can be practiced for these traits. Peduncle length and 1000-grain weight were significantly and positively correlated with grain yield per plant that indicated the importance these traits for the improvement of grain yield.

Table 1. Mean squares for different traits measured in 72 wheat genotypes.

Source of variation	DH	DM	PH	PL	SL	NT/P	NS/S	NG/S	1000-GW	GY/P	
Blocks	1.77	0.84	0.07	0.01	0.42	6.94	0.40	0.04	0.57	2.03	
Varieties	48.41**	15.93**	197.9**	32.35**	2.73**	5.97**	10.0**	71.93**	12.53**	19.3**	
Error	0.74	0.40	0.45	0.003	0.12	0.06	0.15	0.24	0.22	1.04	

*, **= significant at 5% and 1% probability levels, respectively

DH= Days to heading, DM= Days to maturity, PH= Plant height, PL= Peduncle length, SL= Spike length, NT/P= Number of tillers per plant, NS/S= Number of spikelets per spike, NG/S= Number of grains per spike, 1000-GW= 1000 grain weight, GY/P= Grain yield per plant.

Table 2. Mean values for different traits measured in 72 wheat genotypes.

Sr.#.	Genotype	DH	DM	PH	PL	SL	NT/P	NS/S	NG/S	1000-GW	GY/P
1	294-1	84.5 rs	123.5 jk	108.9 b	36.3 kl	9.7 y-B	8.6 ef	18.2 r-t	39.05 F	33.95 y-D	13.02 v-z
2	AARI-11	86.5 pq	123.5 jk	89.9 y	33.6 t	9.5 z-C	9.2 d	19.2 pq	48.75 mn	38.1 h-k	25.14 ab
3	As-2000	86.5 pq	120.5 mn	86.7 zA	33.3 u	12.0 d-l	6.5 r-w	23.2 b-d	44.05 x-z	40.70 a-c	17.22 g-k
4	As-2002	85.5 q-s	120.5 mn	86.9 z	32.3 z	11.0 p-u	6.1 w-z	22.7 c-e	45.05 s-w	40.75 a-c	17.01 h-l
5	Barani-83	90.5 lm	124.5 ij	97.0 kI	37.9 g	11.6 j-q	6.6 q-u	20.2l-o	52.8 ef	34.835 u-y	17.24 g-j
6	Bhakar-2000	95.5 d-f	123.5 jk	93.7 tu	36.0 m	11.6 i-p	7.0 n-r	21.5 i-k	47.8 no	34.77 v-y	18.16 f-h
7	Blue-silver	86.5 pq	117.5 q	92.0 w	37.4 h	11.0 p-u	4.7 H-J	21.7 f-i	52.05 f-h	40.90 a	19.12 e-g
8	C-217	94.5 e-g	123.5 jk	98.9 f	33.6 t	11.3 m-s	6.4 s-x	21.7 f-i	44.95 t-x	39.87 c-e	16.96 h-l
9	C-250	89.5 no	124.5 ij	100.9 e	39.2 b	9.8 x-B	6.2 u-z	17.5 tu	36.95 G	34.85 u-y	13.04 v-z
10	C-271	95 e-g	123.5 jk	97.8 gh	32.7 w	12.3 c-i	6.1 v-z	22.5 d-f	44.8 v-x	34.1 x-B	16.86 h-m
11	C-518	92.5 i-k	124.5 ij	107.3 d	37.5 h	11.7 h-p	5.1 F-H	20.3 l-n	56.2 bc	34.82 u-y	14.14 p-w
12	C-591	93.5 g-i	120.5 mn	108.3 c	37.4 h	12.1 d-k	9.1 d	19.7 m-p	56.95 ab	35.05 s-w	10.48 A
13	Chakwal-86	97.5 b-d	128.0 cd	96.7 lm	35.7 n	12.4 b-g	8.0 g-j	21.7 f-i	52.2 fg	37.84 j-l	16.54 h-n
14	Chenab-2000	95.5 d-f	125.5 g-i	97.2 jk	38.3 f	11.5 k-r	7.5 j-m	23.3 bc	50.85 ij	32.81 E-H	17.27 g-j
15	Chenab-70	96.5 c-e	123.0 k	97.6 hi	35.6 n	13.0 a-c	12.5 a	24.2 a	56.05 bc	40.98 a	15.918 j-s
16	CHILL-2*	95.5 d-f	128.5 bc	77.3 J	26.2 M	10.5 t-x	8.4 fg	19.5 o-q	48.85 lm	37.04 l-o	15.15 l-u
17	DH-20	98.5 b	127.0 d-f	59.6 P	24.1 P	9.8 x-B	6.0 x-A	14.7 wx	42.75 BC	30.92 I	15.18 k-u
18	DH-32	85.0 q-s	123.5 jk	86.6 z-B	37.0 j	11.6 j-q	7.4 l-n	18.2 r-t	37.9 G	34.1 x-B	14.12 q-w
19	DH-35	95.5 d-f	127.5 c-e	77.3 J	37.5 h	11.5 l-s	5.4 C-F	19.2 pq	44.85 u-x	34.755 v-y	14.91 m-v
20	DH-43	78.0 t	126.5 e-g	95.7 pq	31.4 B	8.7 D	7.1 m-p	20.2 l-o	43.1 z-B	37.41 j-m	13.89 s-y
21	DH-44	84.0 t	128.5 bc	91.0 x	34.05s	9.7 y-B	5.3 D-G	20.3 l-n	35.6 H	34.61 v-z	14.64 n-v
22	DH-45	78.5 t	126.5 e-g	91.2 x	39.2 b	11.9 f-m	5.1 F-H	16.7 uv	30.9 K	37.97 i-l	12.06 x-A
23	DH-47	84.0 s	125.5 g-i	89.9 y	36.2 l	10.6 s-w	4.2 K	19.1 pq	35.85 H	33.05 C-H	16.17 h-p
24	DH-60	95.5 d-f	129.5 ab	67.0 O	28.3 H	9.6 z-C	6.5 r-w	14.2 x	50.85 ij	33.75 z-E	14.31o-w
25	Dirk	103.5 a	127.5 c-e	94.4 s	34.1 s	12.5 b-f	5.1 E-H	21.2 i-k	45.9 q-t	35.75 q-u	14.01 r-x
26	FSD-08	94.5 f-h	126.5 e-g	95.8 p	33.2 u	12.3 c-i	6.4 t-x	21.2 i-k	48.85 lm	34.51 v-z	20.41 de
27	GA-02	96.5 c-e	124.5 ij	93.9 t	30.9 C	12.9 a-c	6.9 o-s	21.7 g-i	55 d	36.01 p-r	11.64 zA
28	GD-111	93.5 g-i	124.5 ij	91.1 x	41.2 a	12.4 c-h	8.6 ef	18.7 q-s	34.15 I	39.91 b-d	12.27 w-A
29	GD-116	84.0 s	126.5 e-g	96.2 no	32.1 A	9.2 B-D	4.5 I-K	19.5 o-q	42.9 A-C	34.50 v-z	13.9 s-y

ISSN 2229-5518odd page

30	GD-118	94.5 f-h	126.5 e-g	78.5 H	30.0 DE	10.3 u-y	6.6 q-u	19.3 pq	40.85 E	34.91 t-x	15.15 l-u
31	GD-125	86.5 pq	126.5 e-g	73.3 M	27.3 J	8.9 CD	8.1 g-i	19.2 pq	37.9 G	36.05 p-r	12.01 x-A
32	GD-131	91.0 k-m	123.5 jk	95.3 qr	32.8 w	10.4 u-y	7.7 i-l	20.4 lm	45.8 r-u	34.11 w-B	13.14 u-z
33	GD-35	93.5 g-i	128.5 bc	93.4 u	35.1 o	10.9 q-v	6.9 o-s	20.5 k-m	49.75 kl	36.16 o-r	14.71 n-v
34	GD-51	89.5 mn	128.0 cd	70.0 N	28.7 G	9.4 A-D	6.3 t-y	17.2 u	53.75 e	32.22 H	11.99 x-A
35	Inquilab-91	94.5 f-h	123.5 jk	91.9 w	38.6 e	13.5 a	7.3 l-o	22.3 e-g	55.75 cd	40.85 ab	21.06 de
36	Iqbal-2000	90.5 lm	120.0 no	97.6 h-j	31.4 B	10.0 w-A	5.5 C-F	23.7 ab	50.75 ij	36.51 m-q	15.52 j-t
37	Kazi-42	92.0 i-l	125.5 g-i	83.4 D	34.9 q	11.3 l-s	4.9 G-I	16.2 v	39.15 F	33.03 C-H	15.525j-t
38	Kohistan-97	96.5 c-e	130.0 a	96.6 mn	25.9 N	11.9 e-m	5.6 A-E	21.7 f-i	42 CD	34.75 v-y	13.99 r-x

Table 2 Cont'd

Sr.#.	Genotype	DH	DM	PH	PL	SL	NT/P	NS/S	NG/S	1000- GW	GY/P
39	Lasani-08	95.5 d-f	125.5 g-i	93.0 v	38.7 d	12.3 c-j	8.1 g-i	21.3 h-j	47.0 op	33.0 D-H	18.1 f-h
40	LU-26	91.5 j-l	120.0 no	97.9 gh	34.4 r	11.4 k-r	6.7 p-t	19.7 m-p	54.9 d	38.1 h-k	13.0 v-z
41	LUP-73	87.5 op	126.5 e-g	95.3 qr	38.3 f	12.3 c-i	6.3 t-y	18.7 q-s	51.0 ij	32.9 E-H	22.0 cd
42	Miraj-08	94.5 f-h	121.5 lm	95.9 op	33.5 t	11.4 k-r	7.4 k-n	20.2 l-o	50.8 ij	33.5 A-F	16.9 h-l
43	NING-8319	86.0 p-r	127.5 c-e	114.9 a	37.5 i	11.0 p-u	10.3 bc	18.2 st	46.8 pq	35.8 q-t	14.1 o-w
44	Pak-81	93.5 g-i	124.5 ij	94.0 st	35.0 pq	11.9 e-m	7.1 m-o	19.2 pq	51.1 h-j	37.2 k-n	23.1 bc
45	PARI-73	93.5 g-i	123.5 jk	81.5 F	32.4 xy	11.8 f-n	5.9 y-C	22.3 e-g	46.0 q-s	33.2 B-G	20.2 de
46	Parula	86.0 p-r	126.0 f-h	74.8 L	27.1 K	8.9 CD	6.6 q-v	19.7 m-p	47.2 op	35.9 p-s	15.0 l-v
47	Parwaz-94	92.5 i-k	122.5 kl	94.9 r	35.4 o	11.5 k-r	7.5 j-m	16.2 v	45.0 t-x	33.9 y-C	15.1 l-u
48	PB-76	94.5 e-g	124.5 ij	78.0 I	35.6 n	13.1 ab	7.9 h-k	22.0 e-h	57.8 a	32.8 E-H	16.2 h-o
49	PB-85	96.5 c-e	126.5 e-g	84.9 C	27.9 I	11.1 n-t	9.0 de	19.2 pq	45.7 r-v	36.2 o-q	13.0 v-z
50	Potohar	89.5 mn	123.5 jk	77.4 J	32.3 yz	11.0 p-u	5.9 y-C	20.3 l-n	43.0 AB	38.2 g-j	16.8 h-m
51	Punjab-81	85.5 q-s	125.5 g-i	89.5 y	38.9 c	11.4 k-r	8.1 g-i	18.2 r-t	43.1 z-B	36.8 m-p	19.1 e-g
52	SA-42	86.0 p-r	118.5 pq	95.9 op	37.4 h	12.4 b-g	6.4 t-x	21.6 g-i	49.6 k-m	39.0 d-g	11.4 zA
53	Seher-06	96.5 c-e	124.5 ij	97.2 i-k	36.0 m	12.7 b-d	10.6 b	21.5 h-j	45.8 q-t	34.0 x-B	26.0 a
54	SH-2002	89.5 mn	120.0 no	92.7 v	32.5 x	13.4 a	7.0 n-q	21.5 h-j	44.1 w-y	35.2 r-v	15.9 j-s
55	Shafaq-06	85.5 q-s	121.5 lm	82.2 E	36.4 k	11.12 o-t	6.6 q-u	22.3 e-g	51.5 g-i	38.9 f-i	19.6 ef
56	Shahkar-95	93.0 h-j	123.5 jk	92.7 v	36.0 m	12.4 b-g	5.4 D-F	21.7 f-i	45.0 t-x	35.9 p-s	16.1 i-q
57	Ufaq	97.0 b-d	125.0 hi	96.9 k-m	34.9 q	12.9 a-c	7.6 j-l	22.3 e-g	51.0 ij	32.6 F-H	18.0 f-i
58	Uqab-2000	92.5 i-k	122.5 kl	94.4 s	39.0 c	12.4 c-i	6.6 q-u	21.5 g-i	44.8 v-x	32.7 FH	20.9 de
59	V-102	86.0 p-r	124.5 ij	86.7 zA	30.1 D	9.9 x-B	9.9 c	20.7 j-l	50.8 ij	39.0 d-h	11.9 y-A
60	V-16	86.5 pq	130.0 a	83.3 D	33.0 v	9.2 B-D	10.4 b	15.3 w	33.0 J	38.9 e-h	14.1 o-w
61	V-18	86.5 pq	124.5 ij	98.1 g	32.4 xy	12.0 d-l	4.9 G-I	20.5 k-m	49.0 lm	34.4 v-A	14.1 p-w
62	V-23	89.5 mn	124.5 ij	80.0 G	26.4 L	10.2 v-z	5.8 z-D	14.7 wx	50.2 jk	34.8 u-y	14.1 q-w
63	V-271	88.5 no	123.5 jk	96.7 lm	39.2 b	11.3 m-s	7.4 l-n	19.0 p-r	54.8 d	39.1 d-f	14.7 n-v
64	V-64179	85.5 q-s	123.5 jk	78.9 H	29.5 F	10.6 s-w	3.2 L	18.7 q-s	43.8 y-A	32.9 E-H	13.8 t-y
65	V-9035	90.5 lm	125.0 hi	75.9 K	35.4 o	11.8 g-o	3.1 L	18.2 st	42.9 A-C	32.2 GH	14.1 o-w
66	V-9372	85.5 q-s	129.5 ab	86.2 B	39.0 c	12.4 b-g	5.5 B-F	20.2 l-o	42.8 A-C	33.9 x-C	13.8 t-y
67	V-9381	87.5 op	127.5 c-e	86.4 AB	34.4 r	12.0 d-m	8.3 f-h	16.2 v	46.0 qr	38.3 f-j	13.9 r-y

68	V-9407	94.5 f-h	128.5 bc	74.8 L	24.3 O	11.7 h-p	6.9 o-s	16.7 uv	47.2 op	35.9 p-s	14.8 m-v
69	V-9428	84.5 rs	119.0 op	95.0 r	31.5 B	11.5 k-r	4.4 JK	18.2 r-t	53.7 e	38.8 f-i	13.8 s-y
70	V-9436	89.5 mn	128.5 bc	94.9 r	29.9 E	11.6 j-q	9.3 d	16.7 uv	41.7 DE	35.0 s-w	13.1 u-z
71	Watan	90.5 lm	127.5 c-e	85.2 C	27.9 I	12.6 b-e	6.0 x-B	19.6 n-p	49.2 lm	33.7 z-E	15.9 j-r
72	WL-711	93.5 g-i	125.5 g-i	95.6 pq	35.9 m	10.8 r-v	5.5 B-F	21.2 i-k	51.1 h-j	36.4 n-q	16.9 h-l
	LSD (5%)	1.72	1.28	0.87	0.46	0.70	0.49	0.78	0.98	0.94	2.04
	Mean	90.69	124.79	90.14	33.85	11.33	6.87	19.83	46.66	35.79	15.76
	SE	0.61	0.44	0.15	0.04	0.25	0.17	0.27	0.35	0.33	0.72

DH= Days to heading, DM= Days to maturity, PH= Plant height(cm), PL= Peduncle length (cm), SL= Spike length(cm), NT/P= Number of tillers per plant, NS/S= Number of spikelets per spike, NG/S= Number of grains per spike, 1000-GW= Thousand grain weight (g), GY/P= Grain yield per plant (g). SE= Standard error of mean.

Table 3. Genotypic variance (Vg), phenotypic variance (Vp), genotypic coefficient of variation (GCV) phenotypic coefficient of variation (PCV), Broad sense heritability percent (h^2 %), Genetic advance (GA) and genetic advance percent of the mean (GAM %) for different traits measured in 72 wheat genotypes.

Traits	Vg	Vp	GCV	PCV	h^2 %	GA	GAM %
DH	15.89	16.63	4.39	4.49	95.55	6.83	7.53
DM	5.176	5.57	1.82	1.89	92.82	3.84	3.07
PH	65.81	66.26	9.01	9.03	99.32	14.18	15.73
PL	10.78	10.78	9.7	9.71	99.97	5.76	17.01
SL	0.87	0.99	8.23	8.78	87.87	1.53	13.50
NT/P	1.97	2.03	20.43	20.73	97.04	2.42	35.22
NS/S	3.28	3.43	9.13	9.34	95.63	3.11	15.68
NG/S	23.89	24.13	10.47	10.52	99.01	8.53	18.28
1000-GW	4.11	4.32	5.65	5.8	94.91	3.46	9.66
GY/P	6.01	7.12	15.65	16.93	85.4	4.01	25.44

DH= Days to heading, DM=Days to maturity, PH= Plant height, PL= Peduncle length, SL= Spike length, NT/P= Number of tillers per plant, NS/S= Number of spikelets per spike, NG/S= Number of grains per spike, 1000-GW= 1000 grain weight, GY/P= Grain yield per plant.

Table 4. Genotypic (r_g) and phenotypic (r_p) correlation coefficients among different traits measured in 72 wheat genotypes.

Trait		DM	PH	PL	SL	NT/P	NS/S	NG/S	1000-GW	GY/P
DH	r_g	0.67^{**}	0.15	-0.28^{*}	-0.50^{**}	- 0.02	-0.38^{**}	-0.14	-0.48^{**}	-0.67^{**}
	r_p	0.63^{**}	0.13	-0.26^{*}	-0.46^{**}	-0.02	-0.35^{**}	-0.01	-0.44^{**}	-0.63^{**}
DM	r_g	1	0.40^{**}	-0.30^{**}	-0.66^{**}	-0.39^{**}	-0.15	0.35^{**}	-0.02	-0.40^{**}
	r_p	1	0.37^{**}	-0.29^{*}	-0.63^{**}	-0.39^{**}	-0.14	0.34^{**}	-0.2	-0.40^{**}
PH	r_g		1	0.67^{**}	0.21	-0.25^{*}	-0.48^{**}	-0.01	-0.37^{**}	-0.13

	r_p		1	0.63^{**}	0.19	-0.24^{*}	-0.45^{**}	-0.01	-0.33^{**}	-0.12
PL	r_g			1	0.44^{**}	-0.27^{*}	-0.65^{**}	-0.40^{**}	-0.13	0.39^{**}
	r_p			1	0.42^{**}	-0.27^{*}	-0.62^{**}	-0.39^{**}	-0.12	0.38^{**}
SL	r_g				1	0.66^{**}	0.16	- 0.28	-0.50^{**}	0.002
	r_p				1	0.64^{*}	0.14	-0.26^{*}	-0.47^{**}	-0.001
NT/P	r_g					1	0.39^{**}	-0.29^{**}	-0.66^{**}	-0.38^{**}
	r_p					1	0.388^{**}	-0.28	-0.64^{**}	-0.38^{**}
NS/S	r_g						1	0.68^{*}*	0.19	-0.26^{*}
	r_p						1	0.65^{**}	0.18	-0.25^{*}
NG/S	r_g							1	0.42^{**}	-0.30^{*}
	r_p							1	0.4	-0.29^{*}
1000-GW	r_g								1	0.65^{**}
	r_p								1	0.62^{**}

, **= significant at 5% and 1% probability levels, respectively

DH- Days to heading, DM-Days to maturity, PH- Plant height, PL- Peduncle length, SL- Spike length, NT/P- Number of tillers per plant, NS/S- Number of spikelets per spike, NG/S- Number of grains per spike, 1000-GW- 1000 grain weight, GY/P- Grain yield per plant.

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