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Research article

Association of seed morphology with seedling vigor in wheat (*Triticum aestivum* L)

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Phenotyping of 225 spring wheat genotypes was carried out to determine the association of seed morphological traits with seedling vigour traits. The seed length appeared to be key trait being significantly and positively correlated with seed thickness, seed width, and coleoptile length. The seed length was also positively but non-significantly associated with root length, shoot length and number of seminal roots. The seed length, seed thickness and seed width were the major contributors to diversity among genotypes. The most diverse genotypes with respect to seed morphological traits and seedling vigor traits were KANCHAN, LU-26, OASIS, SHAHKAR-95, and SHALIMAR-88. The overall effect of seed length, seed width and seed thickness was positive on seedling vigor traits.

Key words: Seed morphology, seedling vigour, *Triticum aestivum* L., Wheat

Wheat is one of the most important grain crops worldwide. It provides staple foods for 35% of the world population (www.idrc.ca/en/ev-31631-201-1-DO_TOPIC.html) and is traded across the globe based in part on the physical characteristic of grain. Its grain is used to make flour for leavened, flat and steamed breads, biscuits, cookies, cakes, breakfast cereal, pasta, noodles, couscous and for fermentation to make beer, other alcoholic beverages, or biofuel.The important wheat grain characteristics include, seed size, seed length, seed width, seed thickness, colour, groove, brush and shape.

Furthermore, grain texture and morphology affects many milling characteristics and end-use qualities in wheat such as milling yield, flour particle size, and starch damage (Hogg *et al* 2005). Wheat seed size also influences the seedling vigour and establishment in field. Characterization of seed morphology is also helpful in varietals identification and products quality.

Since morphological characters like Seed length (SL), Seed width (SW), Seed thickness (ST), Length to width ratio (L-W ratio), length to thickness ratio (L-T ratio), width to thickness ratio (W-T ratio), colour, shape, brush, groove contribute towards the products quality. There is also need for genetic improvement of the seed morphology of wheat because it is a source of high quality flour for human consumption and for other

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industrial uses (Abbas *et al.,* 2005). The assessment of genetic ddiversity for these ignored traits would be helpful in genetic improvement of wheat crop with respect to products quality.

The present study was carried out to characterize 225 spring wheat genotypes for seed morphological traits and seedling traits. Trait associations and genetic diversity among genotypes were also determined on the basis of these traits.

Materials and methods

Kernel Characteristics

The grains were cleaned to remove chaff. Cracked and shriveled grains were also removed. Average seed length (SL) was determined by aligning 25 random seeds end to end (crease down, brush to germ) and measuring total length. Ten sets of 25 seeds were measured and averaged for each grain sample. Average seed width (SW) was measured in millimeters on the same sets of seeds by placing the seed crease down, side by side so that each connected the adjacent seed at its widest points. Average kernel length to width ratio was calculated as average kernel length was divided by average kernel width. Seed thickness was measured with electronic verniorcalliper of all 25 seed used for length and width measurement. The traits including colour, groove, brush and shape were scored.

Seedling Characters

After ten days of sowing shoot length of ten seedlings was measured in centimeters from ground level to tip of seedling after ten days of sowing. The same seedlings were uprooted and their root length was measured in centimeters and the seminal roots were also counted. Coleoptile's length was also measured of the same seedlings of each genotype in centimeters (cm).

Statistical analysis

Association between various traits was worked out at genotypic levels according to the method given by Kwon and Torrie (1964). The data were also analyzed through Principal Component Analysis (Ogunbayo *et al.*, 2005) for the determination of diversity in current germplasm.

Results and Discussion

The seed length ranged from 3.28mm to 7.97mm with the mean value of 6.78. The range of seed width in the germplasm was 2.47mm to 4.68mm with the mean of 3.19mm. Seed thickness was ranged from 2.30 to 3.68mm with mean value of 2.78. Length to width ratio (L-W ratio) was from 1.01 to 2.99 with mean 1.12, length to thickness ratio (L-T ratio) from to 1.26 3.08 with mean 2.42, width to thickness ration (W-T ratio) was from 0.97 to 1.54 with mean 1.15, colour was from 1.00 (Whitish) to 5.00(Dark red) and with the mean 2.10, seed shape was from 1.00 to 3.00 with the mean 1.50, brush was from 1.00 to 3.00 with the mean 2.32, groove 1.00 to 3.00 with the mean 2.46 , root length 5.97cm to 17.43 cm with the mean 10.95cm, shoot length 3.17cm to 10.60 cm with the mean value 6.12cm, coleoptile length 2.00cm to 5.17cm with the mean 3.27cm and number of roots 3.00 to 6.00 with the mean value 4.43. Gulnaz et al 2010 explored a set of 300 genotypes and found coleoptile range as 1cm to 8.8 cm. The difference in range might be because of different set of genotypes and sowing depth. Such considerable range of variations provides a good opportunity for yield improvement (Table 1).

Correlation analysis

Genotypic correlations for all possible combinations for traits under study are presented in Table 2. Seed length had positive and highly significant correlation with seed width, seed thickness, L-W ratio, L-T ratio and coleoptile length. It showed positive and non significant correlation with seed colour, seed shape, brush, root length, shoot length and number of roots. The seed length had negative and non significant correlation with seed groove and W-T ratio. The correlation pattern of seed length indicates that the selection based on seed length may improve seed size and seedling vigour through improved coleoptile's length.

Seed width had positive and highly significant correlation with seed thickness and W-T ratio. It showed negative and highly significant correlation with L-W ratio and L-T ratio. It showed positive and non significant correlation with seed colour and coleoptile's length while negative and non significant with seed shape, brush, groove and number of roots. A negative and significant association was observed between seed width and shoot length. Root length was found to have positive and significant correlation with seed width.

Table 1: Mean, Maximum, Minimum, Standard deviation and Standard error of the studied traits

	Mean value	Max. value	Min. value	S.D	Standard error of mean
Seed length	6.78	7.97	3.28	0.51	±0.034
Seed width	3.19	4.68	2.47	0.22	±0.014
Seed thickness	2.78	3.68	2.30	0.19	±0.012
L-W ratio	2.12	2.99	1.01	0.19	±0.012
L-T ratio	2.42	3.08	1.26	0.21	±0.014
W-T ratio	1.15	1.54	0.97	0.07	±0.004
Colour	2.10	5.00	1.00	0.69	±0.046
Shape	1.50	3.00	1.00	0.68	±0.045
Brush	2.32	3.00	1.00	0.78	±0.052
Groove	2.46	3.00	1.00	0.67	±0.042
Root length	10.95	17.43	5.97	1.94	±0.129
Shoot length	6.12	10.60	3.17	1.32	±0.088
Coleoptile length	3.27	5.17	2.00	0.46	±0.030
No. of roots	4.43	6.00	3.00	0.56	±0.037

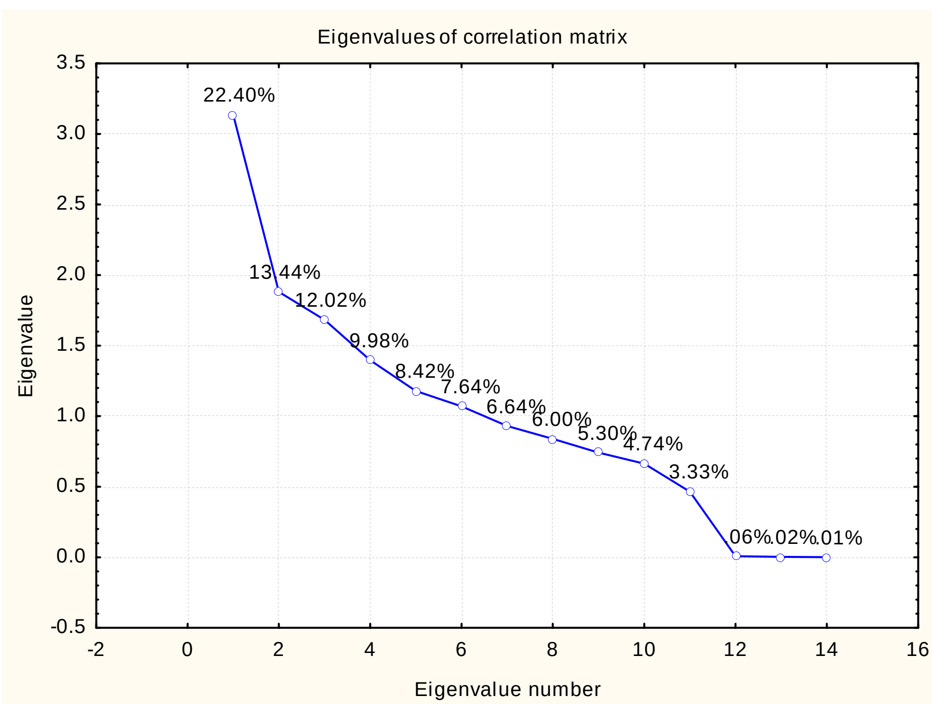

Fig 1: Eigen values of all principal components

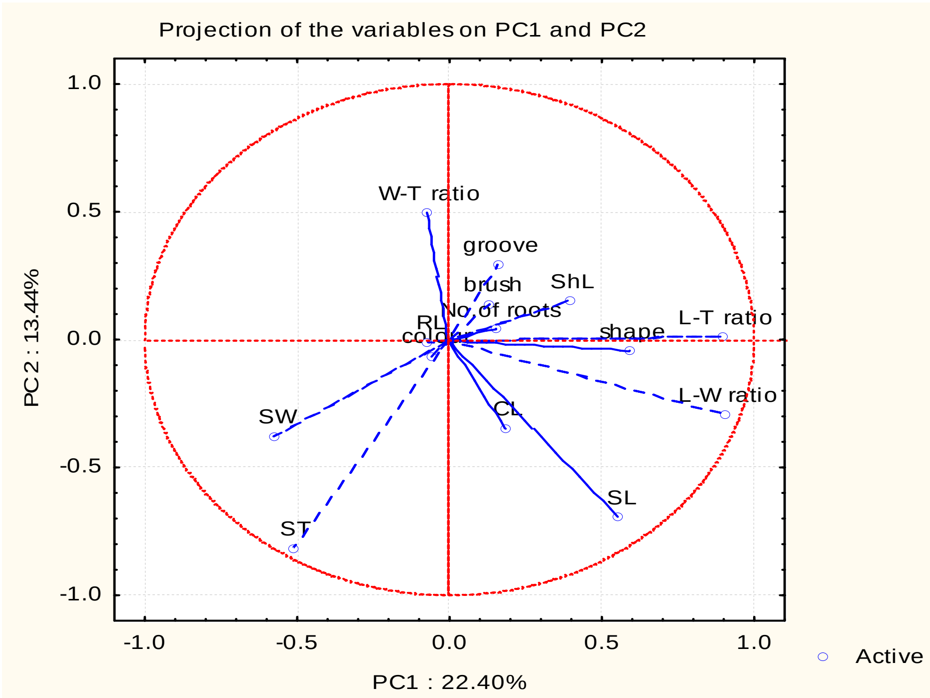

Fig 2: The projection of variables on PC1 and PC2

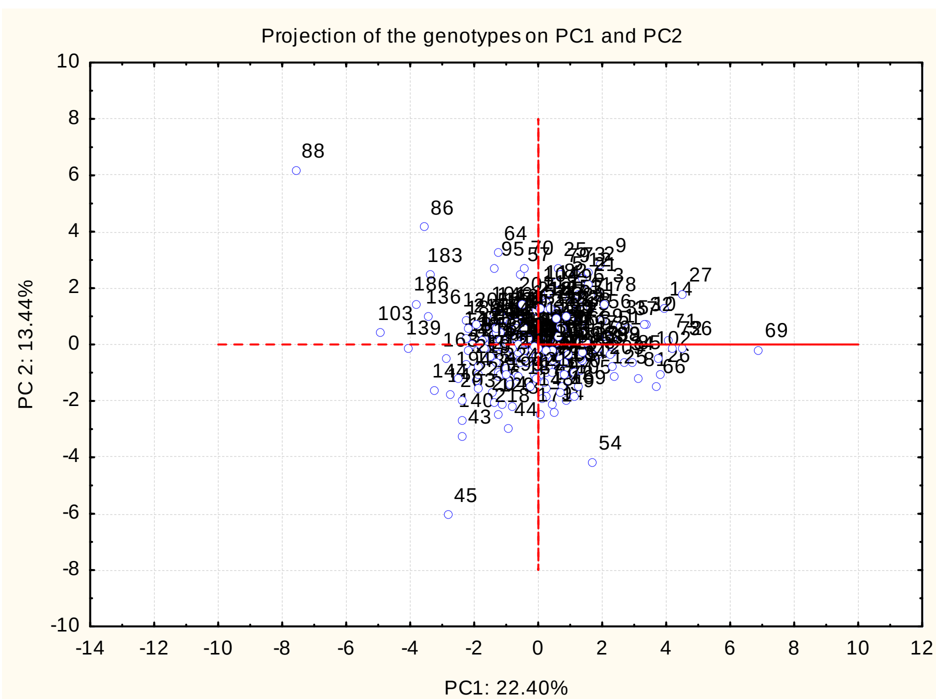

Fig 3: The projection of genotypes on PC1 and PC2

Table 2. Correlation matrix among the morphological characters

Variables	*SL*	*SW*	*ST*	*L-W ratio*	*L-T ratio*	*W-T ratio*	*colour*	*shape*	*brush*	*groove*	*RL*	*ShL*	*CL*	*No. of roots*
SL	1.00													
SW	0.201**													
ST	0.281**	0.612**												
L-W ratio	0.696**	-0.551**	-0.228**											
L-T ratio	0.668**	-0.303**	-0.521**	0.802**										
W-T ratio	-0.096	0.438**	-0.439**	-0.374**	0.245**									
Colour	0.027	0.035	0.089	0.021	-0.046	-0.075								
Shape	0.259	-0.231	-0.214	0.397	0.396	-0.013*	-0.091**							
Brush	.068	-0.002	-0.098	0.053	0.126	-0.106	0.006	0.037						
Groove	-0.032	-0.158	-0.178**	0.102	0.108	0.012	0.120	0.008	0.114					
RL	0.061	0.142*	0.046	-0.066	.020	0.116	-0.044	-0.078	0.016	-0.108				
SL	0.063	-0.150*	-0.244**	0.176**	0.249**	0.114	-0.021	0.231**	0.019	-0.003	0.144*			
CL	0.171**	0.028	0.111	0.119	0.070	-0.090	-0.145*	0.157	-0.014	-0.142*	-0.152*	0.249**		
No. of roots	0.033	-0.000	-0.051	0.038	0.072	0.057	0.047	0.144*	-0.007	-0.081	-0.010	0.294**	0.026	1.00

** Indicate highly significant results (P <0.05 and P <0.02); * Indicate significant results (P <0.05 and P <0.02)
PCA and Correlation values were calculated by using Statistica software.

Seed thickness showed negative and highly significant correlation with L-W ratio, W-T ratio, and L-T ratio, groove and shoot length. It showed positive and non significant correlation with coleoptile length, root length and seed color while negative and non significant with seed shape, brush and number of roots.

Length to width ratio (L-W ratio) had positive and highly significant correlation with L-T ratio and shoot length. A negative and significant association was observed between L-W ratio and W-T ratio. It also showed positive and non significant correlation with seed color, seed shape, brush, groove, coleoptile length and number of roots. Root length was found to have negative and non significant correlation with L-W ratio.

Length to thickness ratio had positive and highly significant correlation with W-T ratio and shoot length. . It showed positive and non significant correlation with seed shape, brush, groove, root length, coleoptile length and number of roots. Seed colour was found to have negative and non significant correlation with L-T ratio.

Width to thickness ratio negative and non significant correlation with brush, coleoptile length and seed colour. A negative and highly significant association was observed between seed shape and W-T ratio. It showed positive and non significant correlation with groove, root length, shoot length and number of roots.

Seed color showed positive and non significant correlation with number of roots, brush, and groove. A negative and highly significant association was observed between seed shape and seed colour. It showed negative and non significant correlation with root length and shoot length. It had negative and significant correlation with coleoptile's length.

Seed shape showed positive and non significant correlation with brush, and groove coleoptile length. A positive and highly significant association was observed between seed shape and shoot length. It had negative and non significant correlation with root length while positive significant with number of roots.

Brush showed positive and non significant correlation with groove, root length and shoot length. It had negative and non significant correlation with coleoptile length and number of roots. Groove had negative and non significant correlation with root length, shoot length and number of roots. It had negative and significant correlation with coleoptile length.

Root length showed positive and significant correlation with shoot length. The result is converse to that reported by Maqbool *et al.* (2010) as root length showed negative, non-significant correlation with shoot length. It had negative and significant correlation with coleoptile's length while negative and non significant correlation with number of roots. Shoot length showed positive and highly significant correlation with coleoptile's length and number of roots. Coleoptile's length showed positive and significant correlation with number of roots.

Principal component analysis

Out of fourteen, six principal components (PCs) exhibited more than one eigen value and showed about 73.9 % of variability. The PC1, PC2, PC3, PC4, PC5 and PC6 showed 22.40%, 13.44%, 12.02%, 9.98%, 8.42% and 7.64%variability, respectively, among the genotypes for the traits under study (Fig 1). The first principal component was more related seed length (SL), length to width ratio ((L-W ratio), length to thickness ratio (L-T ratio), seed shape, shoot length (ShL)and coleoptile length (CL)as these traits projected on positive axis of PC1. The first principal component was poor in seed width (SW), seed thickness (ST), W-T ratio, seed color and root length (Fig 2) The second principal component exhibited positive effects for L-T ratio, W-T ratio, brush, groove, root length, shoot length and number of roots. The negative projection on principal component was seed length, seed width, seed thickness, L-W ratio, seed colour, and seed shape and coleoptile length (Fig 2).

A principal component scatter plot of wheat varieties depicted that accessions that are close together are being similar when related on 14 variables. The genotypes were not more diverse from each other as they are congested on the same area. The genotypes 45, 54, 69, 86, and 88 (KANCHAN, LU-26, OASIS, SHAHKAR-95, SHALIMAR-88 respectively) were present at distance from other varieties with respect to PC1 and PC2 (Fig 3). Therefore, crossing between these genotypes may result into better segregants.

Conclusion

Seed length, width and thickness have positive effect on seedling vigour and, therefore, diversity in these traits can be exploited to improve seedling vigour in wheat crop.

References

Abbas, S. J., S.R.U. Shah, G. Rasool and A. Iqbal. 2008. Analysis of genetic diversity in Pakistani wheat varieties by using simple sequence repeat (SSR) primer sets. *Am-Eurasian J. Sustain. Agric*. 2(1): 34-37.

Gulnaz, S., M. Sajjad, I. Khaliq, A. S. Khan and S. H. Khan. 2010. Relationship among coleoptile length, plant height and tillering capacity for developing improved wheat varieties. *Int. J. Agric. Biol*. 13: 130-133

Hogg, A.C., T. Sripo, B. Beecher, J. M. Martin, and M. J. Giroux. 2004. Wheat puroindolines interact to form friabilin and control wheat grain hardness. *Theor. Appl. Genet.* 108:1089–1097.

Kwon, S.H. and J.P. Torrie. 1964. Heritability and inter relationship among traits of two soybean populations. *Crop Sci.* 4: 196-198.

Maqbool, R., M. Sajjad, I. Khaliq, Aziz-ur-Rehman, A. S. Khan, S. H. Khan. 2010. Morphological diversity and traits association in bread wheat (*Triticum aestivum*). *Am-Euras. J. Agric. Environ. Sci.*, 8(2): 216-224.

Ogunbayo , S. A., D. K. Ojo, R. G. Guei, O.O. Oyelakin and K. A. Sanni, 2005. Phylogenetic diversity and relationship among 40 rice accessions using morphological and RAPDs techniques. *Afr. J. Biotechnol.*, 4: 1234-1244.