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Genetic Variability in Seed Traits Considering Some Genotypes of Wheat

Sudip Mandal[1], Utpal Biswas[1] and Prabir Chakraborti[1*]

[1]Department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia (W.B.)-741252, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author SM managed the work and wrote the first draft of the manuscript of the study. Author UB performed the statistical analysis and managed the analyses of the study. Author PC wrote the protocol, managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

To evaluate the superior genotype (s) with the authenticate selection procedure, twenty (20) various wheat genotypes were undertaken utilizing their qualitative seed attributes like morphology and biochemical action through studies on genetic variability. The statistical design CRD was followed to analyse those seed traits on collected seed from the farms. Considering the seed morphology, V_{14} (HD3218) genotype showed prominence effect though an inconsistent leaning was observed for biochemical activities considering diverse genotypes in addition to wide range of variable expression for all characters among genotypes. Coefficient of variation provided a relative measure on variance among different traits. GCV and PCV were found highest in thousand seed weight followed by seed volume, length-breadth ratio, seed breadth etc. In biochemical parameters, the GCV and PCV specified its maximum difference for certain characters like soluble protein, peroxidase etc. but the values were very near in other cases representing high heritability. Heritability played a vital role in

**Corresponding author: E-mail: prabcbckv@gmail.com;*

deciding the aptness and approach for selection of the character. Water absorption potential at initiation and after 24 hours, thousand (1000) seed weight, seed volume, peroxidase activity of fresh seed had high heritability (broad sense) coupled with high genetic advance as percentage of mean specified the multitude of additive gene action. These characters could be upgraded through selection procedure and these were most significant characteristic of seed. Hence, the assortment built on these traits would be very active for wheat genotype grown under West Bengal condition.

Keywords: Wheat genotypes; variability; heritability; genetic advance.

1. INTRODUCTION

The vital determinant of seed quality is the varietal genuineness. Varietal purity showed significant impacts on seed yields besides upsetting the cultivation practices. Therefore, the farmers should be sentient about varietal purity in their production system essentially in seeds. The quality of seed was exposed through various observable features chiefly related to structure and texture, i.e. morphological parameters. Seed quality was also be quantified through incidence of biochemical parameters particularly at initiation of seed germination. Rendering the food habit and preference of the population, Wheat ranked the second cultivated crop of India covering an area of 30.23 million ha. in addition to production and productivity of 93.50 million ton and 3093 kg/hectare respectively in India (Annual Report, 2015-16, ICAR-IIWBR).

The bread wheat *Triticum aestivum (*2n = 6x = 42) was commonly cultivated in almost all wheat growing zones in India. The existing cultivated types were developing after introduction of Mexican dwarf wheat. Presently, these were covered about 86% of the total wheat acreage in India through numeral genotypes to achieve the explicit target of the breeder related to dissimilar cultivation programme at different agro-climatic zones of the country [18]. But, there was a significant gap in between expected and observed production in developed genotypes due to improper exploitation of genetic resources. As seed was one of the valuable sources for production consistency, its formation must be continued through up gradation of qualitative mode with quantitative traits. Studies on variability in respect of various seed parameters were taken up for detecting the appropriate parents conserving better seed quality then consuming them in a breeding programme for the production of more efficient strains. It is obvious to recognize the genotypes not only on growth pattern of yield attributing characters but seed quality parameters must be crucial for stabilizing the proper production system on crop or seed. The seed quality attributes like morphology, and biochemical activity was undertaken to appraise the extent of genetic variability among various timely and late sown irrigated wheat genotypes. The proper selection criteria may fulfil the required target essential for development of good seed helpful to stabilize the production. To realize or create variability, addition of diverse genotypes with the available collection was necessary for formation of proper variability helpful to fulfil the obligatory selection. The selection various seed traits were closely linked to seed superiority that was very much accommodating in crop establishment with optimum production. In this perception, the current study was undertaken to evaluate the extent of genetic variability present among various genotypes of wheat. Proper selection measures might helpful to achieve the required production potential with accurate emphasis on quality seed.

2. MATERIALS AND METHODS

The seeds of twenty wheat genotypes were collected from experimental plots of the Farm that were arranged in augmented design to observe the considerable seed characters scheduled for authentication of the genetic purity. The true seeds of specific genotype were evaluated on qualitative attributes of seed like morphology, biochemical action to confirm the superior genotype and seed traits favourable for selection. The collected seed of considerable genotypes viz., Sonalika (V_1), HD 3118 (PusaVatsala)(V_2), HD 3226 (V_3), UP 2936 (V_4), WH 1201 (V_5), Hi-1563 (V_6), K 1006 (V_7), RAJ 3765 (V_8), HD 2733 (V_9), PBW 343 (V_{10}), HD 2985 (Pusa Basant) (V_{11}), DBW 14 (V_{12}), PBW 747(V_{13}), HD 3218 (V_{14}), JKW 230 (V_{15}), HD 3229 (V_{16}), DBW 196 (V_{17}), K 1508 (V_{18}), BRW 3775 (V_{19}), UAS 384 (V_{20}) were studied at RKVY laboratory, Department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal, India in the year 2016-2017. The measurable morphological seed parameters were seed length and width, ratio of length and breadth, seed volume (ml, measuring water

volume), water holding capacity (WHC) after twenty four h of seed imbibition, 1000 seed weight, water absorption potential (WAP) (ml h^{-1}) up to 6 h seed soaking. For measuring the biochemical activity, the Carbohydrate (Anthrone method), Alpha-amylase (colorimetric method with DNS reagent) at 24 hours, soluble protein and Peroxidase [1] at 24 hours were evaluated considering the stage of germination initiation. The statistical analysis was done through completely randomised design considering three replications for each character. The consequence was achieved at 1% level of significance [15] through application of OPSTAT software. The genotypic and phenotypic coefficient of variation was assessed through the methods of Burton [2]. Heritability in broad sense was designed as per method of Allard [3] and Robinson, et al. [4]. The expected Genetic Advance as per cent of mean was calculated as suggested by Johnson et al. [5].

3. RESULTS AND DISCUSSION

The observation on seed morphological parameters as well as seed quality representing bio-molecular action specified for a definite genotype would be valuable for qualitative up-gradation of the produce. The strategic approach on diverse research especially in cultivation process and breeding programme were very much dependent on seed specification, where inconstant configuration of seed in different genotypes should be explanatory [6]. The present study was used to fulfil the intentions partially on a crop, Wheat. The reflection on seed morphology and the activity of few bio-molecules may accentuate the knowledge in this aspect. The variability was observed in seed morphology containing different numerical parameters in relationship to some noticeable sign for a few definite characters. The plant growth related parameters were liable to attain optimum production level that can protect nutritional stability through proper assimilation of photosynthates required for definite quantitative and qualitative parameters of seed [7]. The present observation on seed morphology and activity of few bio-molecules may emphasize the knowledge in this aspect. The freshly harvested seeds of twenty (20) Wheat genotypes were collected from specific plant under field condition. After good care, these were evaluated considering their seed morphology and biochemical parameters crucial for authentication of seed purity and quality. The differential nature of seed was observed on morphological pattern considering the different numerical observations like length, breadth, volume, seed weight etc. to standardise the initial information on seed of particular genotype. Considering the value of length, the different genotypes showed a variable nature in a significant manner where maximum value was observed in V_7 (K 1006) and V_{13} (PBW 747). Another character seed breadth was valuable for indication of specific seed belongs to particular genotypes. A significant distinct observation was followed among all genotypes though a few genotypes showed higher value in maximum cases viz. V_{14} (HD 3218), V_{18} (K 1508), V_{19} (BRW 3775), V_{20} (UAS 384). The ratio of seed length and breadth was considered in the present study as specific seed character under different cultivars. The comparable standard values in ratio were observed in most cases though an exception was observed in few genotypes like V_9 (HD 2733) specifying the higher ratio. The distinct variability in ratio of seed length and breadth may assuredly characterize the seed. The volume of seed was expressed in millilitre as amount of water raise in measuring cylinder by utilization of specific seed. The seed volume indicated significant demarcation among different genotypes where timely sown wheat genotypes indicated the prominent outcome. The highest value was observed in V_{13} (PBW 747) followed by V_{19} (BRW 3775). Seed volume may be achieved as seed quality marker due to existence of accumulated nutritive substances essential to induce seedling activity at initial stage. The seed weight was firmly allied to selection process as genetic marker, agronomical marker for sign of crop quality as well as productivity. The highest seed weight was observed in V_{14} (HD 3218) followed by V_{13} (PBW 747) which were extremely superior in relation to other genotypes.

At initial stage of germination, the imbibing tendency of seed was valuable to initiate germination, where the rate of imbibitions may be linked to biochemical assessment like germination motivated enzyme α-amylase and securing enzyme peroxidase etc. [8]. The initial acceptance of water up to 6 hours showed significant variable frequency in genotypes with highlighting the maximum efficiency in V_{20} (UAS 384) followed by V_{14}. All genotypes showed similar trend by lowering of their water up-take up to 3 hours duration but V_{13} and V_{18} showed the continuity of deterioration up to 4 hours. A noticeable variability was showed afterwards by rising and dropping of water uptake in most cases (Fig. 1). The total uptake of water (24 hours) documented as the capacity of genotypes which

was significantly variable continuing the extreme uptake in V_{14} (HD 3218). The seed nature can be judged by biochemical action of seed, where efficiency of bio molecules linked to seed germination, seedling establishment, and its succeeding influence up to better plant formation. The wheat genotypes were considered for analysis of soluble protein content at 24 hours imbibitions. The non-significant deviation was observed among the different genotypes where maximum soluble protein content was observed in V_5 (WH 1201) followed by V_3 (HD 3226). Lessening of soluble protein may be the cause of metabolic activity at germination initiation. The estimation on total carbohydrate was also important to consider as bio-molecular marker due to its energy releasing nature may be supportive for a cultivar (Table 1). The variable carbohydrate content followed distinct demarcation allowing for its maximum value in V_1 (Sonalika), V_6, V_{12} (DBW 14), V_{18} (K 1508) and V_{19} (BRW 3775). The activity of peroxidase (24 hours imbibitions) showed the maximum in V_7 (K 1006) with differential nature of genotypes. The alpha-amylase activity (24 hours imbibitions) showed maximum in V_4 (UP 2936) followed by V_{14} and V_{20} with significant variation among different genotypes. Considering the seed morphological characters, some genotypes showed prominence effect viz. V_{14} (HD 3218), V_{13} (PBW 747) while the genotypes like V_{20} (UAS 384), V_{15} (JKW 230), V_{14} (HD 3218), V_7 (K 1006) showed promising result in biochemical activities.

In Table 3, the genetic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) noticeably showed the genetic pressure on some morphological parameters [9]. Coefficient of variation provided a relative measure of variance among unlike traits similar to other [17]. Genotypic coefficient of variation (GCV) was found highest in thousand seed weight followed by peroxidase activity, WAP etc. Similar traits were followed for phenotypic coefficient of variation (PCV). The degree of variances between phenotypic coefficient of variability and genotypic coefficient of variability was detected to be somewhat low for all the traits indicating minor effect of environment except in seed volume matching to the observation of Parvathi, et al. [10]. In biochemical parameters, the effective role of GCV and PCV indicated its

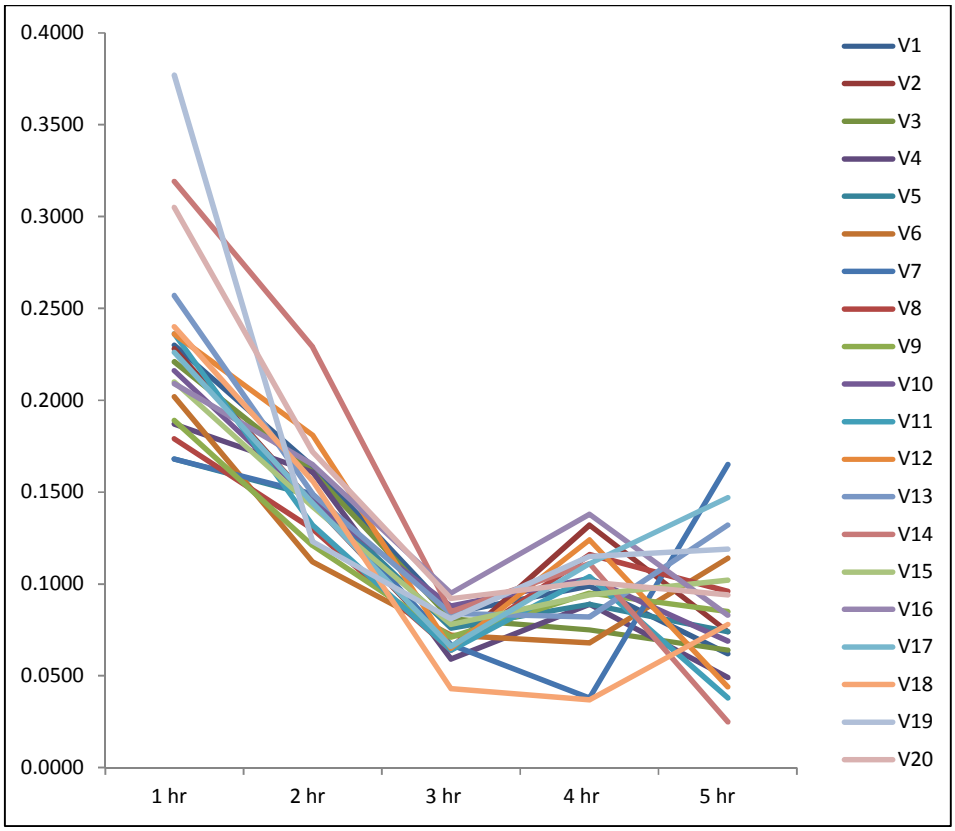

Fig. 1. Water absorption potential (WAP) of wheat genotypes up to 6 hours of seed imbibitions

Table 1. Study on genotypic variability of different Wheat genotypes considering seed morphology with some biochemical actions

Variety	SL (mm)	SB (mm)	SL/SB ratio	SV (ml)	1000 SW (g)	WAP^{-1} ($ml.h^{-1}$)	WHC (ml)	Carbohydrate ($mg100mg^{-1}$)	Peroxidase ($\Delta A\ min^{-1}g^{-1}$) 24 hours	α-amylase ($\mu g\ min^{-1}\ g^{-1}$) 24 hours	Soluble protein($mg\ ml^{-1}$) 24 hours
V_1	6.47	2.90	2.23	0.025	29.90	0.124	0.898	48.7	0.23	264.68	8.48
V_2	5.89	2.59	2.28	0.023	22.93	0.056	0.738	47.45	0.37	268.65	8.37
V_3	6.27	2.72	2.30	0.019	24.43	0.123	0.645	37.9	0.37	276.58	9.23
V_4	6.41	2.66	2.42	0.018	21.50	0.113	0.652	43.37	0.25	292.45	8.97
V_5	6.31	2.76	2.30	0.023	26.10	0.121	0.740	43.51	0.41	267.57	9.55
V_6	6.11	2.92	2.09	0.021	24.73	0.127	0.780	48.64	0.37	280.19	7.67
V_7	6.81	2.61	2.62	0.021	23.43	0.084	0.960	41.34	0.42	265.40	8.74
V_8	6.08	2.81	2.16	0.019	20.43	0.115	0.683	43.68	0.30	275.50	8.27
V_9	6.62	2.40	2.76	0.020	17.57	0.119	0.682	46.19	0.25	271.17	8.35
V_{10}	5.92	2.83	2.10	0.023	24.30	0.119	0.770	44.13	0.27	266.84	8.95
V_{11}	6.40	2.82	2.27	0.021	27.40	0.109	0.745	39.23	0.40	259.55	8.11
V_{12}	6.48	2.95	2.21	0.021	25.83	0.140	0.777	48.24	0.29	251.34	8.22
V_{13}	6.81	2.84	2.40	0.031	36.80	0.140	0.900	38.25	0.25	267.57	8.78
V_{14}	6.67	3.79	1.76	0.023	40.13	0.150	1.328	36.05	0.23	284.32	8.13
V_{15}	6.18	2.68	2.31	0.020	20.50	0.123	0.886	39.82	0.22	266.12	7.94
V_{16}	6.14	2.61	2.36	0.026	19.30	0.137	0.870	45.42	0.38	276.22	9.00
V_{17}	6.01	2.63	2.28	0.021	19.60	0.130	0.747	37.49	0.24	248.81	8.52
V_{18}	5.70	3.06	1.86	0.025	29.53	0.121	0.887	48.01	0.28	263.24	8.23
V_{19}	5.91	3.44	1.72	0.031	26.83	0.076	0.923	48.07	0.24	257.11	8.28
V_{20}	6.02	3.24	1.85	0.029	26.93	0.164	0.950	41.72	0.26	284.88	8.14
Mean	6.26	2.86	2.21	0.023	25.40	0.120	0.828	43.36	0.30	269.41	8.50
LSD(0.01)	0.42	0.23	0.21	0.003	1.50	0.004	0.045	3.44	0.07	1.74	NS

SL: Seed Length, SB: Seed Breadth, SL/B: Seed length/breadth ratio, 1000SW: 1000seed weight, WAP: Water Absorption potential per hour, WHC: Water holding capacity at twenty four hours

Table 2. Correlation study on seed morphology with some biochemical actions

	SL (mm)	SB (mm)	SL/SB ratio	SV (ml)	1000 SW (g)	WAP^{-1} (ml.h^{-1})	WHC (ml)	Carbohydrate (mg100mg^{-1})	Peroxidase (ΔA min^{-1}g^{-1}) at 24 hours	α-amylase (µg min^{-1} g^{-1}) at 24 hours
SB	0.989**									
SL/SB ratio	0.987**	0.991**								
SV	0.985**	0.987**	0.984**							
1000 SW	0.962**	0.967**	0.967**	0.978**						
WAP^{-1}	0.946**	0.918**	0.919**	0.939**	0.952**					
WHC	0.944**	0.915**	0.914**	0.934**	0.944**	0.997**				
Carbohydrate	0.938**	0.911**	0.913**	0.936**	0.941**	0.992**	0.995**			
Peroxidase at 24 hours	0.933**	0.901**	0.909**	0.929**	0.933**	0.985**	0.989**	0.995**		
α-amylase at 24 hours	0.938**	0.906**	0.910**	0.929**	0.934**	0.989**	0.993**	0.991**	0.994**	
Soluble protein at 24 hours	0.938**	0.906**	0.902**	0.24**	0.932**	0.979**	0.987**	0.979**	0.980**	0.990**

*SL: Seed Length, SB: Seed Breadth, SL/B: Seed length/breadth ratio, 1000SW: 1000seed weight, WAP: Water Absorption potential per hour, WHC: Water holding capacity at 24 hours; **- highly significant, *- significant, NS – Non-significant*

Table 3. Genetic variability of different characters on seed morphology with some biochemical actions

Characters	GCV	PCV	H^2 (%)	GA (%)
SL (mm)	4.60	5.96	59.47	4.97
SB (mm)	10.98	11.84	85.99	14.26
SL/SB ratio	11.51	12.71	82.04	14.60
SV (ml)	15.94	17.45	83.45	20.40
1000 SW (g)	22.07	22.32	97.76	30.55
WAP^{-1} (ml.h^{-1})	20.64	20.86	97.87	28.58
WHC (ml)	18.71	19.27	94.17	25.42
Carbohydrate (mg100mg^{-1})	9.33	10.31	81.76	11.80
Peroxidase (ΔA min^{-1}g^{-1}) at 24 hours	21.44	25.45	70.99	25.29
α-amylase (µg min^{-1} g^{-1}) at 24 hours	4.18	4.19	99.99	5.87
Soluble protein(mg ml^{-1}) at 24 hours	4.20	7.48	31.63	3.31

SL: Seed Length, SB: Seed Breadth, SL/B: Seed length/breadth ratio, 1000SW: 1000seed weight, WAP: Water Absorption potential per hour, WHC: Water holding capacity at 24 hours

maximum difference for certain character like soluble protein content and peroxidase activity. The high heritability among different biochemical characters was recorded for alpha-amylase and water absorption potential per hour, thousand seed weight indicating a high scope for genetic improvement though moderate value was observed in activity of peroxidise similar to the opinion of Biswas and Chakraborti [8]. High heritability indicates only the effectiveness of selection on the basis of phenotypic performance; the amount of genetic progress in selecting best individuals is possible only by estimating the genetic advance. Water absorption potential at early and twenty four hrs, peroxidase, seed weight and seed volume showed high heritability couple with high genetic advance indicated the preponderance of additive gene action and such character could be improved through selection. Several research worker estimate the genetic variability in a specific crop by categorization of different characters related to yield attributes [3, 11-14,7]. But, the observation on different procedures of seed traits in estimation on genetic variability was meagre. The present work highlighted these seed characters for scheduling the selection procedure to fulfil the breeder's target for crop improvement highlighting seed quality similar to recent opinion on seed traits on rice [6] Characterization of seed may have an approach or influential role in the strategic future research under cultivation scheduled of specific environment as well as integration of breeding strategy to exploit the genetic gain.

A strong positive correlation was observed in all considerable morphological parameters as well as biochemical activity of seed indicating their close association within them similar to the observation on Rice [8,16]. The considerable biochemical activity may accelerate the morphological parameters of seeds for its up gradation.

4. CONCLUSION

The comprehensive outcome specified the core set of germplasm with high genetic variability where supreme performance was observed in V_{14} (HD 3218) considering all parameters. The broad sense heritability and genetic advance as percentage of mean indicated that seed weight, water absorption capacity and activity of peroxidase showed significant characteristic of seed and selection based on these traits would be very real in wheat genotypes developed under North Eastern Plain Zone.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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