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Research Article

Estimation of variability for yield parameters in Bread Wheat (*Triticum aestivum* L.) grown in Gangetic West Bengal

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Abstract
Thirty eight genotypes of bread wheat (*Triticum aestivum* L.) collected from DWR, Karnal, Haryana were evaluated in Randomized Block Design with three replications at the Teaching Farm of the Bidhan Chandra Krishi Viswavidyalaya in 2008-09 crop season. Observations for eighteen different yield contributing characters viz., plant height, days to heading, flowering, maturity, tiller number per plant, length of spike, number of spikes per plant, and per meter square, number of spikelets per spike, number of grains per spike, grain weight per spike, chlorophyll-a, b and total chlorophyll content, thousand grain weight, grain protein content, yield per plant and grain weight per meter square were recorded. The genotypes exhibited significant variation for all the characters studied. The estimate of PCV in all the traits studied were greater than those of the GCV, The close proximity between PCV and GCV values for most of the characters indicated less influence of environment on the expression of the characters under study. Considering heritability, most of the characters showed high values. High heritability coupled with high genetic advance (in % of mean) were recorded for the grain weight per spike, per plant and per meter square, number of grains per spike, thousand grain weight and the grain protein content indicating the characters to be under additive genetic control and also scope of improvement through direct selection.

Key words: Bread wheat, variability, yield parameters

Introduction

Wheat (*Triticum aestivum* L.) is the second most important cereal crop and plays a vital role in food and nutrition security in this sub-continent. India has firmed up its position as the second largest producer of wheat in the world. The two mega environments namely North Western Plain Zone and North Eastern Plain Zone account for almost 80% of the total wheat area in the country. The scenario of wheat cultivation in West Bengal is different from those of the other plains. This is mainly due to due to medium to short winter and humid climate. In India, wheat map is covered by a wide range of varieties suitable for different agro-climatic regions. Therefore, looking at short and extremely erratic winter, there is a need to develop and identify ideal types of wheat genotypes suitable for respective agro-climatic region of the state. Thus, the objective of the present study was to identify suitable wheat genotypes for growing in timely sown irrigated condition in the Gangetic plains of West Bengal. To identify such genotypes, study on genetic variability of yield contributing characters and their transmissibility into the progeny is essential (Sharma *et al*., 2005). Keeping this in view, a field experiment was conducted to assess the genetic variation present in the genotypes with respect to yield and yield contributing characters when they are sown timely under irrigated condition.

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Materials and Methods

A field experiment was conducted in the Teaching Farm of Bidhan Chandra Krishi Viswavidyalaya, Mondouri, Nadia during Rabi 2008-09 with 30 diverse wheat (*Triticum aestivum* L.) genotypes. The experimental farm is located at 22.87 º N Latitude and 88.59 º East Longitude. The genotypes were collected from DWR (ICAR), Karnal through AICW & BIP centre Uttar Banga Krishi Viswavidyalaya, Pundibari Coochbehar, West Bengal. They were sown in a Randomized Block Design with three replications on November 25, 2007. There were 6 rows of 1.5m length at a distance of 25cm between rows. Observations were recorded from five randomly selected plants in each plot for plant height

(cm), days to heading, days to flowering, day to maturity, number of tillers per plant, number of spikes per plant, number of spikelets per spike, number of spikes per square metre, spike length (cm), number of grains per spike, grain weight per spike (g), chlorophyll-a, b and total chlorophyll content (mg/g fresh tissue in flag leaf), thousand grain weight (g), grain protein percent (%), yield per plant (g) and yield per square meter. Analysis of variance was carried out for each of the characters studied as per Panse and Sukhatme (1985). For computation of genotypic and phenotypic coefficient of variations (GCV & PCV) Burton (1952); for heritability and genetic advance Allard (1960) and the genetic advance in per cent of mean Johnson *et al*. (1955) were followed.

Results and Discussion

The analysis of variance for all the characters under study revealed highly significant differences thereby indicating presence of substantial genetic variation among the genotypes for all the eighteen characters. The present findings corroborate the earlier reports of Kumar et *al.* (2003), Palve and Raghavaiah (2002) and Mahato and Kerketta (2004) in wheat.

The average performances of the genotypes for all the characters under study are presented in table I. As revealed by the CD value, significantly higher mean value for the number of tillers per plant was recorded in HD-2285 and EGPYT-13. Interestingly the former genotype had produced the highest mean for number of spikes per plant and that for per meter square. However, considering number of grains per spike and average grain weight per spike, the genotype WR-1464 exhibited significantly higher mean with compared to those for most of the genotypes. Thousand-grain weight was highest in EGPSN-50 while EGPYT-4, EGPSN-50, KLP-410 and EGPSN-55 recorded significantly high grain yield per plant. Such significant intervarietal differences for different characters might have appeared due to differential genotypic constitution. Similar reports have earlier been made by Mandal et al. (1991) and Mahato and Kerketta (2004). So far as the biochemical parameters are concerned, AKAW-4247, NIAW-1419, EGPSN-74, Sonalika, HD-2009, EGPSN-50, LBPY-04-4 for chlorophyll-a, and K-221, NIAW-1417, Sonalika, KLP-410, EGPYT-4, HD-2009 for chlorophyll b and LBPY-05-5, EGPSN-50, HRWYT-245 for total chlorophyll produced significantly higher mean. Among these genotypes only Sonalika, HD-2009, EGPSN-50 were common for both the characters. However, considering all the three types of chlorophylls studied, AKAW-4247 and VW 486 produced the highest mean values. The highest protein percentage was recorded in the genotype, RD-1252.

Variability with respect to the characters measured in terms of range, mean, PCV and GCV, heritability in broad sense and genetic advance in terms of per cent of mean have been presented in Table II. The values for range among different genotypes varied highly for the characters like Plant height, Number of grains per spike, Chlorophyll content Spike number and grain weight per meter square. Similar findings have earlier been reported by Sahu *et al*. (2005) in wheat, Babu and Hanchilal (1998) in barley. Generally, the magnitude of phenotypic coefficient variation (PCV) was higher than the corresponding genotypic coefficient variation (GCV) as noted Kumar et *al.* (2003), Palve and Raghavaiah (2002). The highest values for GCV and PCV were recorded for the character Chlorophyll-b content and tiller number per plant. A close proximity between GCV and PCV values for almost all the characters revealed less influence of the environment on expression of the characters (Sharma *et al*., 1995; Patel and Jain, 2002; Kumar *et al.,* 2003).

Estimates of heritability and genetic advance are critical for predicting genetic improvement for any quantitative character (Khali and Afridi, 2004). High estimates of heritability for all the characters studied except number of tillers and number of spikes per plant suggested high genetic control over the characters. Heritability estimates indicate effectiveness of selection for phenotypic performance but it does not necessarily mean a high genetic gain for particular characters. But, the high heritability estimates along with high genetic advance is more useful for the selection (Johnson *et al.* 1995). In the present experiment high heritability along with high genetic advance was obtained for grain weight per spike, yield per plant and that per meter square, number of grains per spike, grain protein per cent and thousand grain weight. A close proximity between GCV and PCV could also be noticed for these characters indicating them to be less influenced by environment. It may therefore be concluded that selection pressure can be applied in the desired direction on the basis of phenotype to improve such characters. Kumar and Mishra 2004; Kumar *et al*., 2003; Yadav *et al*., 2003 & 2006 obtained similar results earlier.

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Table 1: i) Mean of eighteen characters of thirty genotypes of wheat (*Triticum aestivum* L.)

GENOTYPE	D/H	D/F	D/M	Plant Height	Tiller No./Plant	Length Of Spike	No. of spike/plant	No. of spike/ m^2	No. spikelet / spike	No. of grain/ spike	Grain wt./ spiek	Chl – a content	Chl- b content	Total chl. content	1000 Grain wt.	Grain protein	Yield/ plant	Grain wt./ m^2
GW-2005-2	73.7	83.0	107.7	101.7	7.3	15.4	7.3	367.7	14.3	33.0	1.3	53.6	7.2	60.8	37.4	13.8	3.5	236.7
EGPSN-74	73.0	84.0	106.7	104.3	6.7	18.3	6.7	344.3	16.0	37.7	1.5	62.4	17.7	80.1	31.3	13.6	3.9	251.3
HRWYT-233	84.7	93.7	110.3	100.0	6.0	14.0	6.0	338.7	17.3	32.3	1.3	56.6	25.8	82.4	34.8	11.8	3.2	429.7
LBPY-04-4	71.0	80.3	108.0	104.0	5.7	16.3	5.7	378.0	16.0	44.7	2.1	60.2	15.8	76.0	39.8	11.9	4.5	344.0
EGPYT-4	70.3	76.0	107.0	107.7	8.3	18.3	8.3	321.7	16.3	42.7	2.1	55.2	41.3	96.5	49.0	13.0	6.7	446.7
EGPYT-13	70.3	78.3	106.7	99.7	9.0	17.3	8.7	360.7	15.7	43.3	1.9	46.6	31.6	78.3	48.7	7.8	4.8	184.0
HRWYT-245	76.0	86.7	110.0	99.7	6.7	14.7	6.7	385.3	15.3	32.0	1.1	55.2	31.2	86.4	36.6	12.9	3.6	476.7
VW-486	70.0	76.0	106.0	92.0	7.3	13.8	7.3	350.0	16.7	39.0	1.5	58.5	66.6	75.5	38.5	13.4	4.2	429.3
EGPSN-50	70.3	76.0	108.0	102.0	6.7	16.0	6.7	403.7	17.3	47.0	2.1	62.0	25.9	88.0	49.8	12.6	6.3	458.0
DBW-14-©	70.3	76.7	107.0	111.7	7.3	17.5	7.3	431.0	16.0	39.0	1.6	52.4	15.9	68.3	41.5	12.0	3.5	450.0
HD-2285©	69.7	76.3	108.0	86.3	9.3	15.0	9.3	486.7	14.7	34.3	1.4	58.7	20.4	79.1	39.4	12.1	3.6	342.3
RAJ-3765©	70.7	83.0	108.0	87.3	6.7	16.0	6.7	427.7	14.3	32.3	1.4	53.0	25.1	78.1	42.8	9.4	3.4	329.0
HD-2009 ©	70.7	79.7	107.0	109.3	7.3	18.7	7.3	306.7	11.3	31.3	1.2	60.5	30.0	90.5	38.4	11.2	3.7	298.3
LBPY-05-5	70.0	79.0	107.0	97.0	8.7	18.0	8.7	279.3	12.3	29.0	1.4	50.9	39.6	90.5	42.6	14.1	4.6	278.3
KLP-410	69.7	81.0	107.0	86.3	6.7	14.0	6.7	328.3	15.0	43.3	1.4	54.0	33.3	87.3	32.2	11.7	6.2	224.0
SONALIKA-(C)	70.3	79.0	108.0	97.7	7.3	17.0	7.3	326.0	15.3	37.7	1.5	62.1	31.0	93.1	41.0	13.5	3.6	293.3
EGPSN-55	71.0	76.7	107.0	100.3	6.3	17.3	6.3	366.0	13.3	32.7	1.4	57.6	27.6	85.2	34.4	13.1	5.9	446.3
RD-1252	72.0	80.7	108.0	85.3	6.3	19.3	6.3	422.3	13.0	28.3	1.4	54.8	15.1	69.8	41.9	14.9	3.9	286.7
EGSPN-84	71.3	79.7	108.0	106.7	6.3	16.7	6.3	418.3	15.7	32.7	1.4	59.5	21.2	80.8	31.3	10.9	3.3	443.3
IBWSN-1047	82.0	90.3	109.0	85.7	5.3	14.7	5.3	423.3	15.7	41.0	1.4	52.0	27.6	79.6	39.2	12.3	3.5	465.0
FKW-3	64.3	72.0	106.0	108.3	7.3	16.8	7.3	371.7	18.0	48.3	2.5	61.0	20.7	81.6	39.4	12.9	3.7	378.7
AKAW-4247	71.0	81.7	108.0	109.3	6.3	13.3	6.3	353.0	15.7	37.3	2.3	64.6	36.2	100.7	44.6	7.6	4.4	501.7
LBPY-04-3	70.7	84.3	107.3	109.7	5.0	17.2	5.0	451.7	14.3	26.3	1.4	51.2	32.3	83.4	34.4	13.7	4.5	443.3
K-221	66.7	77.0	106.0	83.3	6.0	16.7	6.0	397.7	16.3	35.7	1.3	54.5	43.4	97.6	37.2	11.5	4.6	350.0
RAJ-4077	69.0	75.7	106.3	120.3	7.3	16.3	7.3	405.3	15.3	38.7	1.8	50.0	36.3	86.3	48.4	10.4	3.7	446.3
NIAW-1417	70.7	80.3	106.7	79.7	6.0	16.3	6.0	404.3	15.0	35.0	1.4	63.0	36.3	90.1	40.8	14.5	3.8	293.3
KLP-411	68.7	76.7	107.7	93.3	8.0	18.0	8.0	476.3	16.3	46.7	1.8	53.1	17.6	70.7	48.0	11.9	4.1	313.7
HI-8663	77.0	91.3	107.0	92.7	6.0	20.7	6.7	351.7	14.0	33.7	1.4	52.0	28.8	80.8	38.5	14.5	3.9	333.3
HRWYT-215	74.3	82.7	109.3	99.7	6.0	17.7	6.0	366.3	18.7	43.3	2.0	63.8	18.3	82.1	33.2	7.9	3.1	332.3
WR-1464	70.0	77.3	110.7	91.3	6.7	14.0	6.7	386.3	18.3	50.7	2.5	47.5	20.9	68.3	33.1	14.0	3.3	460.7
Mean	**71.6**	**80.5**	**107.6**	**98.4**	**6.9**	**16.5**	**6.9**	**381.0**	**15.5**	**37.7**	**1.6**	**56.2**	**28.0**	**82.3**	**39.6**	**12.2**	**4.2**	**375.5**
CV	**2.7**	**2.7**	**0.4**	**3.0**	**15.0**	**5.8**	**14.0**	**3.8**	**8.0**	**6.4**	**9.4**	**2.5**	**56.0**	**2.1**	**3.1**	**3.6**	**8.4**	**5.5**
C.D. at 5% level	**3.1**	**3.6**	**0.7**	**4.8**	**1.7**	**1.6**	**1.6**	**23.4**	**2.0**	**3.9**	**0.3**	**2.3**	**--**	**2.9**	**2.0**	**0.7**	**0.6**	**34.0**

Table 2: Mean range and other genetic parameters in wheat (*Triticum aestivum* L.)

Characters	Range		Mean	SED	Variances			CV	GCV	PCV	ECV	H^2 broad sence	Genetic advance mean 5%	Genetic advancement % mean 5%
	Min.	Max.			PV	GV	EV							
D/H	64.333	84.667	71.664	1.557	18.338	14.704	3.634	2.661	5.352	5.977	2.661	0.802	7.073	9.873
D/F	72.000	93.667	80.500	1.802	28.142	23.270	4.872	2.742	5.992	6.590	2.742	0.827	9.036	11.225
D/M	106.000	110.667	107.644	0.343	1.611	1.435	0.177	0.390	1.113	1.179	0.390	0.890	2.328	2.163
Plant height (cm)	79.667	120.333	98.422	2.408	104.241	95.545	8.696	2.996	9.931	10.374	2.996	0.917	19.278	19.587
Tiller No./plant	5.000	9.333	6.867	0.840	1.783	0.725	1.059	14.983	12.396	19.447	14.984	0.406	1.118	16.227
Length of Spike (cm)	13.333	20.667	16.514	0.788	3.809	2.879	0.930	5.838	10.275	11.818	5.839	0.756	3.039	18.403
No. of spike/ plant	5.000	9.333	6.878	0.788	1.628	0.697	0.931	14.026	12.141	18.551	14.026	0.428	1.126	16.369
No. of spike /m^2	279.333	486.667	381.000	11.669	2510.140	2305.896	204.245	3.751	12.604	13.150	3.751	0.919	94.811	24.885
No. of spikelets/ spike	11.333	18.667	15.456	1.009	3.820	2.291	1.528	7.198	9.794	12.645	7.999	0.600	2.415	15.626
No. of grain/ spike	26.333	50.666	37.656	1.968	44.182	38.374	5.808	6.399	16.451	17.645	6.40	0.869	11.893	31.583
Grain wt./ spike (g)	1.106	2.540	1.632	0.126	0.167	0.144	0.024	9.419	23.219	25.057	9.419	0.859	0.724	44.323
Chlorophyll- a content	46.643	6.5600	56.213	1.139	25.863	23.919	1.944	2.480	8.700	9.047	2.480	0.925	9.689	17.236
Chlorophyll- b content	7.2367	66.600	28.19	12.819	293.781	47.307	246.473	56.031	24.548	61.173	56.031	0.161	5.686	20.292
Total Chlorophyll (mg/g)	60.800	100.726	82.261	1.439	87.505	84.398	3.107	2.142	11.168	11.372	2.143	0.964	18.586	2.594
1000 Grain Wt. (g)	31.333	49.766	39.606	0.987	30.466	24.005	1.461	3.052	13.598	13.936	3.052	0.952	10.825	27.332
Grain protein %	7.560	14.910	12.160	0.345	3.963	3.775	0.188	3.564	15.979	16.372	3.565	0.953	3.907	32.126
Yield / plant (g)	3.140	6.746	4.169	0.286	1.007	0.885	1.222	8.392	22.563	24.074	8.392	0.878	1.816	43.564
Grain wt./ m^2 (g)	224.000	501.667	375.545	16.979	7270.819	6838.377	432.442	5.538	22.02	22.705	5.537	0.941	165.207	43.991

GCV=Genotypic coefficient variation; PCV=Phenotypic coefficient variation; h^2 =Heritability (broad sense); GA= Genetic advance.