

Original Research Article

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Studies on Variability, Heritability and Genetic Advance in Some Quantitative Characters in Bread Wheat (*Triticum aestivum* L.)

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ABSTRACT

Keywords

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An experiment was conducted on genetic variability, heritability and genetic advance in wheat population including 48 F₁'s + 48 F₂'s + 16 parents in RBD during Rabi 2014-15. Analysis of variance for the design of experiments revealed that mean squares due to treatments were highly significant for all the ten characters studied, while mean squares due to replications were non-significant in both F₁ and F₂ generations. The high estimates of phenotypic and genotypic coefficient of variation (>20%) were recorded for grain yield per plant and biological yield per plant only in F₁ generation. Whereas, in F₂ generation moderate estimates (10-20%) of PCV and GCV observed in grain yield per plant and biological yield per plant, whereas number of effective tillers per plant and plant height in both F₁ and F₂ generations exhibited moderate PCV and GCV. High estimates of heritability was observed for plant height followed by 1000 grain weight, days to maturity and grain yield per plant in both F₁ and F₂ generation. Genetic advance in per cent of mean were high for grain yield per plant, biological yield per plant, plant height in both F₁ and F₂, whereas, number of effective tillers per plant in F₁ only, which in fact demonstrated the presence of additive gene effects indicating effectiveness of selection for improvement of these traits.

Introduction

Wheat (*Triticum aestivum* L.; 2n=42) is a self-pollinated crop belong to *Poaceae* family and one of the most leading cereal of world including India. It is the most important food crop of India and is a main source of protein and energy. In India, wheat is the second most important food crop after rice both in terms of area and production.

It is a C₃ plant grown in temperate, irrigated to dry and high-rain-fall areas and in warm, humid to dry, cold environments. The record

production in the country during last few years has enabled India to attain the position of being second largest producer of the wheat in the world.

Hence in present investigation an attempt was made to assess the variability on grain yield and biological yield contributing traits which indicating genetic variability *i.e.* genotypic coefficient variation (GCA), phenotypic coefficient variation (PCV), environment coefficient variation (ECV), heritability in

broad sense (h^2_{bs}), genetic advance (GA) in per cent of mean.

Materials and Methods

The experimental material consisted of 112 treatments including 48 F_1 's + 48 F_2 's + 16 parents and conducted at Main Experiment Station of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during Rabi, 2014-15 in Randomized Block Design with three replications in a single (F_1 's), two (parents) and four rows (F_2 's) plot & of 3 m length with inter and intra-row spacing of 23 and 10 cm, respectively.

On the basis of 15 randomly selected plants, data were recorded on days to 50 per cent flowering, days to maturity, plant height (cm), number of effective tillers per plant, number of spikelets per spike, number of grains per spike, 1000-grain weight (Test weight) (g), biological yield per plant (g), harvest index (%) and grain yield per plant (g). Data recorded on above quantitative traits were subjected to statistical analyses following analysis of variances Sukhatme (1967), heritability in broad sense (H_{bs}) and genetic advance (GA) (Robinson *et al.*, 1949).

Results and Discussion

Analysis of variance for the design of experiments revealed that mean squares due to treatments were highly significant for all the ten characters studied (Table 1). The existence of genetic variability in the population provides ample opportunities for selection being effective.

The pool of genotypes was therefore, assessed for variability analysis. The existence of wide diversity among the constituent genotypes with regard to characters under study was confirmed through various statistical parameters. The basic material, therefore,

offers positive opportunities for investigation furtherance of the aforesaid objectives. The estimates of mean, range, variability, heritability (Broad sense) and genetic advance in per cent of mean presented for both F_1 and F_2 generations in table 2.

The grain yield per plant among parents ranged from (5.97 and 6.13g) DBW 17 to (9.78 and 9.56) NW 5054 in both F_1 and F_2 generations, respectively, while among crosses, ranged from 10.62 (K 8027 X NW 1014) to 16.16 (NW 5054 X K 911) in F_1 and from 5.89 (DBW 17 X K 911) to 10.08 (HPW 355 X NW 1067) in F_2 generation.

The high estimates of phenotypic and genotypic coefficient of variation (>20%) were recorded for grain yield per plant and biological yield per plant only in F_1 generations. The characters which exhibited moderate estimates (10-20%) of PCV and GCV were grain yield per plant and biological yield per plant and number of spikelets per spike exhibited moderate PCV in F_1 generation only.

Whereas, number of effective tillers per plant and plant height in both F_1 and F_2 generations. Rest of the characters showed low estimates (<10%) of PCV and GCV in both F_1 and F_2 generations. These findings were in conformity with finding of Panwar and Singh (2000), Kumar *et al.*, (2003), Cheema *et al.*, (2006) and Nagireddy and Jyothula (2009). High estimate of heritability in broad sense (>75%) was recorded for all the characters except for number of effective tillers per plant (73.90 and 49.57%) and harvest index (37.12 and 51.33) in both F_1 and F_2 generations.

The high estimates of heritability was observed for plant height (97.70 and 97.55%) followed by 1000 grain weight (96.59 and 96.58%), days to maturity (96.21 and 95.54%) grain yield per plant (93.85 and 80.33%) in both F_1 and F_2 generations.

Table.1 Analysis of variance for 10 characters in wheat (Parents, F₁'s and F₂'s)

Characters	Sources of variation					
	Replications		Treatments		Error	
	2		63		126	
d.f.	F ₁	F ₂	F ₁	F ₂	F ₁	F ₂
Days to 50% flowering	1.52	1.91	47.26**	34.48**	1.16	1.11
Days to maturity	0.28	1.96	88.95**	74.75**	1.16	1.14
Plant height (cm)	2.10	0.17	245.41**	249.21**	1.91	2.07
Effective tillers per plant	0.50	0.01	2.23**	0.64**	0.23	0.16
Spikelets per spike	0.26	0.23	10.81**	3.63**	0.44	0.30
Grains per spike	1.39	0.47	58.68**	16.38**	3.68	2.08
1000 seed weight (g)	0.10	0.42	26.13**	21.51**	0.30	0.25
Biological yield per plant (g)	15.78	0.83	145.16**	23.24**	5.97	3.23
Grain yield per plant (g)	0.71	0.62	22.92**	3.61**	0.49	0.27
Harvest index (%)	1.79	0.30	3.70**	4.63**	1.33	1.11

*, ** Significant at 5% and 1% probability levels, respectively

Table.2 Estimate of range, mean, coefficient of variation (PCV and GCV), heritability and genetic advance for 10 characters in wheat (F₁ & F₂)

Characters		General mean ±SE	Range		Coefficient of variation (%)		Heritability in broad sense (%)	Genetic advance	Genetic advance in per cent of mean
			Parents	Crosses	Phenotypic	Genotypic			
Days to 50% flowering	F ₁	90.14±0.62	75.33-97.67	83.67-95.00	4.51	4.35	92.97	7.79	8.64
	F ₂	87.68±0.61	78.67-97.00	83.67-92.67	3.99	3.80	90.93	6.59	7.47
Days to maturity	F ₁	122.64±0.62	117.00-135.67	119.00-137.67	4.41	4.32	96.219	6.29	8.73
	F ₂	128±0.62	115.67-134.00	116.00-134.67	4.13	4.04	95.54	2.52	9.97
Plant height	F ₁	85.28±0.80	68.56-109.85	75.96-114.81	10.20	10.08	97.70	8.83	20.53
	F ₂	45.64±0.83	67.13-105.01	68.01-11.72	10.77	10.64	97.55	7.24	21.65
Effective tillers per plant	F ₁	4.23±0.28	3.60-5.33	3.73-7.20	18.53	15.93	73.90	0.56	28.22
	F ₂	16.38±0.23	3.60-4.87	3.40-5.13	13.44	9.46	49.57	0.34	13.72
Spikelets per spike	F ₁	18.58±0.38	14.93-19.53	16.27-22.73	10.62	10.00	88.62	4.21	19.40
	F ₂	42.41±0.31	14.47-19.73	13.60-19.73	7.24	6.43	78.88	4.45	11.77
Number of Grains per spike	F ₁	47.87±1.10	40.67-50.52	41.83-56.75	9.80	8.94	83.23	22.82	16.81
	F ₂	39.14±0.83	38.60-50.83	37.00-50.63	6.17	5.15	69.56	11.96	8.84
1000 seed weight (g)	F ₁	39.80±0.31	14.01-45.22	32.97-47.01	7.50	7.37	96.59	0.09	14.93
	F ₂	19.81±0.29	33.92-45.18	32.74-45.50	6.92	6.80	96.58	0.12	13.77
Biological yield plant ⁻¹ (g)	F ₁	29.31±1.41	14.86-23.95	26.37-41.64	24.68	23.23	88.60	15.45	45.05
	F ₂	25.03±1.03	14.48-23.88	14.29-24.25	15.88	13.03	67.33	11.57	22.63
grain yield plant ⁻¹ (g)	F ₁	11.86±0.40	5.98-9.78	10.62-16.17	23.78	23.04	93.85	28.42	45.99
	F ₂	8.13±0.30	6.14-9.56	5.90-10.09	14.46	12.96	80.33	15.75	23.93
Harvest index (%)	F ₁	40.64±0.67	39.25-42.40	38.80-42.81	3.58	2.18	37.12	13.02	2.74
	F ₂	41.21±0.61	40.16-44.26	38.58-43.31	3.67	2.63	51.33	6.03	3.88

The high estimate of genetic advance in per cent of mean (>20%) was observed in grain yield per plant (45.99 and 23.93%) followed by biological yield per plant (45.05 and 22.63%), plant height (20.53 and 21.65%) in both F₁ and F₂, whereas, number of effective tillers per plant (28.22%) in F₁ generation only. Moderate estimate of genetic advance in per cent of mean (>10% - <20%) was observed for number of spikelets per spike (19.40 and 11.77%) followed by 1000-grain weight (14.93 and 13.77%) in both F₁ and F₂ generation, while number of grains per spike in F₁ generation only. High heritability coupled with high estimate of genetic advance in per cent of mean was observed for plant height, and grain yield per plant in both F₁ and F₂ generation, while biological yield per plant in F₁ generation only. High heritability coupled with moderate estimate of genetic advance in per cent of mean was recorded for all the characters except days to 50 per cent flowering, days to maturity, and harvest index in both F₁ and F₂ generation, whereas, number of grains per spike in F₁ generation which exhibited high or low heritability coupled with low genetic advance in per cent of mean, which in fact demonstrated the presence of additive gene effects indicating effectiveness of selection for improvement of these traits. High heritability coupled with moderate genetic advance was observed for only harvest index. Similar findings were reported by Kisana *et al.*, (1982), Abid and Mohammad (1993), Prasad *et al.*, (2006), Saxena *et al.*, (2007), Yousaf *et al.*, (2008), Rahman *et al.*, (2008), Nagireddy and Jyothula (2009). High to medium values of heritability estimates were found associated with moderate expected and actual gain in the most traits. These obtained results indicated that, these traits could be used in the early generation, but would be more effective if postponed to late generation (Kaumber and Gammaal, 2012).

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