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Research Article

ASSESSMENT OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE OF YIELD, AND ITS COMPONENTS IN WHEAT (*Triticum aestivum* L.) UNDER TERMINAL HEAT TOLERANCE

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Abstract: The present was conducted at Crop Research Farm, Nawabganj, C. S. Azad University of Agriculture and Technology, Kanpur- 208 002. (U.P.) during *Rabi*, 2012-13. The experimental material comprised of 45 F'1s developed by crossing 10 lines *viz*., K-9533, K-9162, K9465, K8962, HUW-234, NW-2036, K-9423, K9351, KRL-210 and K-906 following half diallel fashion design. A total of 100 treatments 10 parents (45 F_1's and 45 F's_2) were used for the study for eighteen quantitative characters in Wheat. The medium or moderate heritability estimates (below 30 per cent) for specific leaf weight, leaf angle, canopy temperature depression, day to physiological maturity, plant height, spike length, number of spikelets per spike and 1000 grain weight in both the generation and moderate estimates were also recorded for number of productive tillers per plant and grain per spike in F_1 and for chlorophyll fluorescence and biological yield per plant in F_2 generation was also moderately estimated according to our findings. High genetic advance in percentage over mean was estimated for specific leaf weight, leaf angle, canopy temperature depression, and harvest index in both the generation and for productive tillers per plant and grain yield per plant in F_2 generation. Moderate values were also observed for days to anthesis, chlorophyll intensity, flag leaf area, plant height, spike length, number of spikelets per spike, spike density, grain per plant, 100 grain weight and biological yield per plant in both the generation and for number of productive tillers per plant and grain yield per plant in F_1 generation exhibited the similar performance.

Keywords: *Spikelets, Chlorophyll intensity, Flag leaf area, Plant height*

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Introduction

Wheat (*Triticum aestivum* L.) cultivation reaches far back into history. Wheat is a self-pollinated crop of the member of Poaceae family and one of the most important cereal of the world. The majority of the cultivated wheat varieties belong to three main species of the genus Triticum. These are the hexaploid (2n=42), *T. aestivum* L. (bread wheat), the tetraploid (2n=28), T. durum Desf and the diploid (2n=14), *T. dicoccum Schrank* and *T. monococcum*. Globally, *T. aestivum* wheat is most important species which covers near about 90 per cent of the cultivable area. Thus, the maximum correlated response in grain yield via, biological yield per plant, harvest index was much appreciable for enhancement of grain yield as the ultimate result. The relative selection efficiency through these traits may directly be useful while might be effective indirect selections for early growth vigour in advance stages for improvement of the productivity.

Methods and materials

The present investigation was conducted at Crop Research Farm, Nawabganj, C. S. Azad University of Agriculture and Technology, Kanpur- 208 002. (U.P.) during *Rabi*, 2012-13. Geographically, this place is located between 25°28´ and 26°58´ N latitude, 79°31´ and 80°34´ E longitudes and at an altitude of 125.9 m above from mean sea level. This area falls in sub-tropical climatic zone. The soil type is sandy loam. The annual rainfall is about 1270 mm. The climate of district Kanpur is semi-arid with hot summer and cold winter.

Experimental materials

The experimental material for present investigation comprised of 45 F'1s developed by crossing 10 lines *viz*., K-9533, K-9162, K9465, K8962, HUW-234, NW-2036, K-9423, K9351, KRL-210 and K-906 following half diallel fashion design.

A total of 100 treatments 10 parents (45 F_1's and 45 F's 2) were used for the study of combining ability for eighteen quantitative characters in Wheat.

Producing F_1 seed

All possible single crosses ware made during the year *Rabi* 2011-12 to complete a 10x10 diallel set without reciprocals due to absence of extra nuclear inheritance in wheat.

Producing F_2 seed (Advancement of generation through off season nursery)

A part of F_1 hybrid seed of each cross was selfed in order to get seed for raising in the summer nursery at Lahul and Spiti Valley during summer 2012 to get F_2 generation.

Field lay out

The experimental materials consisted of 100 treatments (45 F_1's + 45 F_2's + 10 parents) were sown in Randomized Block Design with three replications in late sown (LS) condition.

Estimation of coefficient of variability

The genotypic coefficient of variability (GCV), phenotypic coefficient of variability (PCV) and environmental coefficient of variability (ECV) were computed following Burton and de Vane (1953).

GCV = [Genotypic standard deviation /Mean] x 100 or $\sigma g/\bar{x}$ x 100
PCV = [Phenotypic standard deviation / Mean] x 100 or $\sigma p/\bar{x}$ x 100
ECV = [Environmental standard deviation / Mean] x 100 or $\sigma e/\bar{x}$ x 100

Table-1 Mean Range, GCV, PCV, ECV, Heritability and Genetic advance for 18 different characters in wheat (Triticum aestivum L.)

Characters	Grand mean		GCV (%)		PCV(%)		ECV(%)		Heritability (%) (narrow sense)		Genetic advance		Gen. adv as % of means (5%)	
	F_1s	F_2s	F_1s	F_2s	F_1s	F_2s	F_1s	F_2s	F_1s	F_2s	F_1s	F_2s	F_1s	F_2s
Days to Anthesis	85.27	84.49	6.56	6.99	6.85	7.05	1.98	0.92	7.37	6.64	11.03	12.06	12.93	14.27
Specific Leaf Weight (mg/cm²)	5.36	5.05	15.37	15.11	15.64	15.30	2.91	2.41	11.96	10.38	1.67	1.55	31.10	30.74
Leaf Angle	56.94	54.66	24.83	24.65	24.90	24.67	1.88	1.15	21.99	20.06	29.04	27.72	51.00	50.72
Chlorophyll Florescences	0.71	0.67	4.86	9.35	4.96	9.37	1.02	0.55	5.94	10.30	0.07	0.13	9.79	19.23
Canopy Temperature Depression (°c)	5.82	5.11	23.61	31.90	23.83	32.07	3.22	3.37	11.38	13.43	2.81	3.34	48.19	65.34
Chlorophyll Intensity %	44.01	39.98	12.68	12.70	12.72	12.75	0.93	1.17	8.27	6.95	11.47	10.42	26.06	26.05
Flag Leaf Area	24.18	22.10	12.92	13.92	13.14	14.15	2.42	2.57	4.01	3.50	6.33	6.23	26.16	28.19
Days to Physiological Maturity	121.22	119.84	2.40	2.41	2.54	2.51	0.84	0.67	18.41	21.17	5.65	5.74	4.66	4.79
Plant Height (cm)	93.97	91.11	9.24	9.94	9.28	9.98	0.85	0.93	28.47	25.01	17.81	18.57	18.96	20.38
Spike Length (cm)	9.63	8.57	11.83	12.95	12.03	13.12	2.18	2.13	11.42	11.94	2.31	2.26	23.98	26.33
Spikelets/ Spike	21.14	19.72	7.98	8.48	8.07	8.66	1.19	1.77	18.31	11.55	3.44	3.37	16.27	17.1
Spike Density	2.22	2.33	12.44	13.35	12.69	13.55	2.49	2.34	7.69	8.37	0.56	0.63	25.13	27.09
Productive Tillers/ Plant	5.08	4.02	11.51	23.93	12.50	24.28	4.89	4.07	24.32	9.22	1.11	1.95	21.82	48.61
Grains/ Spike	40.77	38.41	9.18	9.60	9.24	9.69	0.97	1.30	11.52	9.20	7.67	7.53	18.81	19.59
1000 Grain Weight (g)	40.23	38.37	8.02	9.20	8.03	9.29	0.35	1.27	27.55	23.67	6.64	7.21	16.51	18.78
Grain Yield/ Plant (g)	8.84	7.30	13.80	24.58	13.86	24.71	1.34	2.51	8.73	7.31	2.50	3.68	28.29	50.38
Biological Yield/ Plant (g)	23.57	21.65	11.26	11.18	11.39	11.36	1.67	1.98	9.35	12.10	5.41	4.91	22.95	22.68
harvest Index %	37.84	33.83	15.77	24.72	15.91	24.92	2.06	3.19	8.83	8.45	12.19	17.08	32.22	50.5

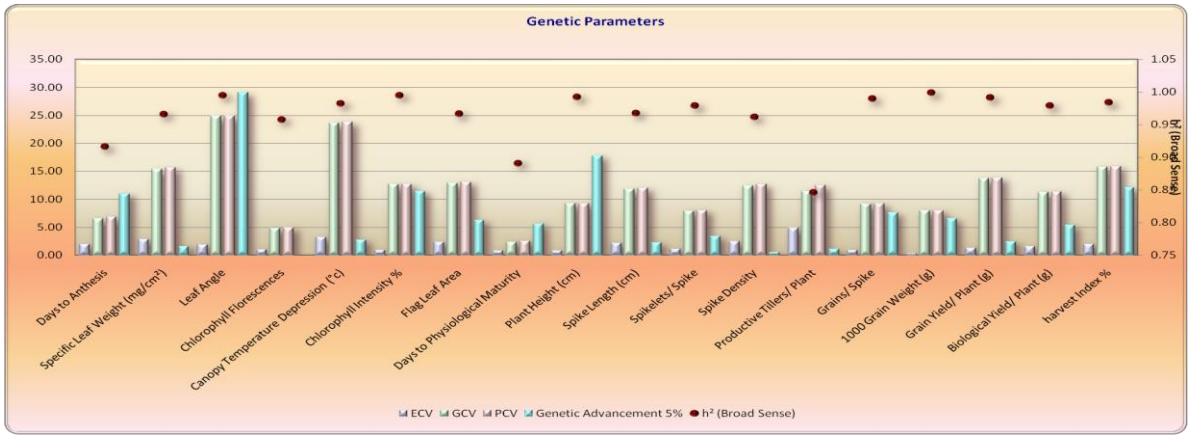

Fig-1 Diagrammatic representation of Mean Range, GCV, PCV, ECV, Heritability and Genetic advance for 18 different characters in F1generation of wheat (Triticum aestivum L.)

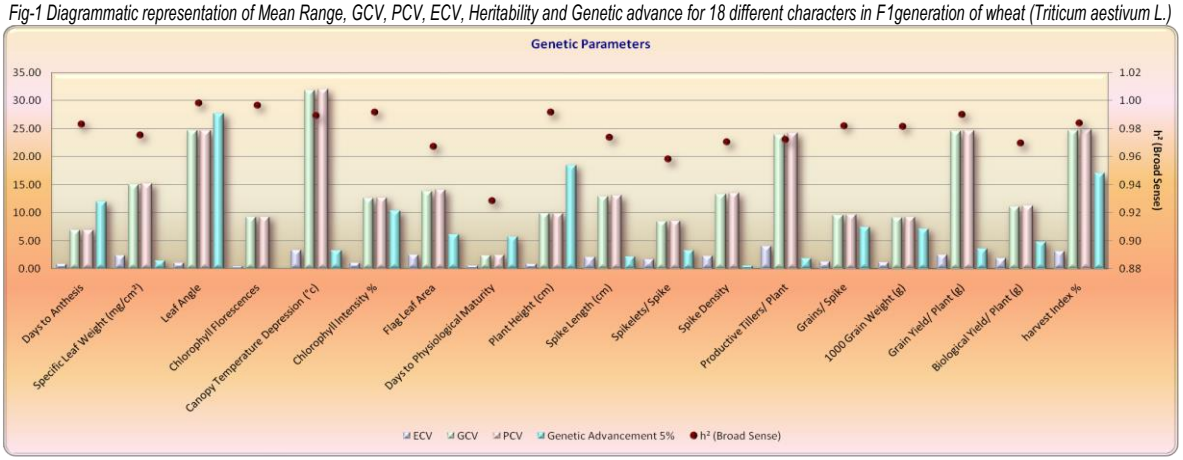

Fig-2 Diagrammatic representation of Mean Range, GCV, PCV, ECV, Heritability and Genetic advance for 18 different characters in F2 generation of wheat (Triticum aestivum L.)

Heritability

Heritability in narrow sense (h^2ns) and broad sense (bs) was calculated as suggested by Crumpacker and Allard, (1962).

Heritability(h^2) = [(1/4D)/(1/4D+1/4H1+E1-1/4F)]

H(bs)= [(1/4D+1/4H1-1/4F)/(1/4D+1/4H1+E1-1/4F)]

$E1 = [(E_{Parent}/n) + (n-1)(EF_1/n)]$

Where,

D= Component of variation due to additive effects of genes

H_1= Component of variation due to dominance effects of gene

F= The mean of Fr over arrays, where Fr is the covariance of additive and dominance effects in a single array.

E_1= The expected environmental component of variation

Genetic advance: The genetic advance was calculated as per formula given by Robinson *et al*. (1949).

Genetic Advance = (σph) x (K) x (h^2 bs)

Genetic advance in per cent of mean of the character

G.A. (%) = [(σph xKx h^2)/$\bar{x}$] x 100

Where,

G.A. = Estimate of genetic advance

K = Selection differential at 5% selection intensity (K = 2.06)

h^2 = Heritability coefficient in broad sense.

σph = Phenotypic standard deviation.

$\bar{x}$= Mean value of the character concerned

Result and discussion

Heritability and genetic advance

The estimates of heritability (narrow sense) and genetic advance in percentage of mean were estimated for eighteen characters in both the generations and results have been presented in Table 10. The estimates of heritability and genetic advance were arbitrarily categoried into three classes by Robinson (1966) as (i) High- above 30 per cent, (ii) moderate- below 30 and above 10 percent, and (iii) low- below 10 per cent. The results obtained have been given here under:

Heritability

Heritability was computed as per methods given by Crumpacker and Allard (1962) in F_1 and Verhalen and Murray (1969) in F_2 generation. Accordingly, high estimates of heritability were on characters found in both the generations. Moderate estimates of heritability were observed for specific leaf weight, leaf angle, canopy temperature depression, day to physiological maturity, plant height, spike length, number of spikelets per spike and 1000 grain weight in both the generation and moderate estimates were also recorded for number of productive tillers per plant and grain per spike in F_1 and for chlorophyll florescences and biological yield per plant in F_2 generation. Low heritability estimate was found for day to anthesis, chlorophyll intensity, flag leaf area, spike density, grain yield per plant, harvest index andfor chlorophyll florescences and biological yield per plant in F_1 and for productive tiller per plant and grain per spike in F_2 generation. The highest heritability estimates were recorded for plant height (28.47) and for plant height (25.01) in both the generation whereas lowest heritability estimates were recorded for flag leaf area (4.01) and for flag leaf area (3.50) in both the generation.

Genetic advance

In order to ascertain relative merit of different attributes, genetic advance in per cent of mean was worked out for all the eighteen characters in both the generation. The estimates were genetic advance in percentage over mean ranged from 4.66 (days to physiological maturity) to 51.00 (leaf angle) in F_1 and 4.79 (days to physiological maturity) to 65.34 (canopy temperature depression) in F_2 generation. The high value of genetic advance was recorded for specific leaf weight, leaf angle, canopy temperature depression, and harvest index in both the generation and for productive tillers per plant and grain yield per plant in F_2 generation. Moderate values were also observed for daye to anthesis, chlorophyll intensity, flag leaf area, plant height, spike lenth, number of spikelets per spike, spike density, number of grain per plant, 1000 grain weight and biological yield per plant in both the generation and for number of productive tillers per plant and grain yield per plant in F_1 generation.

Application of research: Low value of genetic advance was recorded for days to physiological maturity in both F_1 and F_2 the generation.

Research Category: Genotypic and Phenotypic Analysis

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Study area / Sample Collection: Crop Research Farm, Nawabganj

Cultivar / Variety / Breed name: Wheat (*Triticum aestivum* L.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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