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Assessment of genetic variability, heritability and genetic advance in wheat (*Triticum aestivum* L. *em.* Thell) under salt affected soil

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Abstract
Analysis of variance for augmented design was carried out for eleven characters to test the significance of differences among various treatments. The variation due to blocks was highly significant for days to 50% flowering, flag leaf area, days to maturity, biological yield per plant, harvest index and 1000-grain weight however the differences among the blocks were not significant for remaining characters. The high estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation was observed in case of flag leaf area (PCV=31.81%, GCV=25.68%) followed by grain yield per plant (PCV=27.37, GCV=21.75). The highest estimate of heritability in broad sense was recorded by days to 50% flowering (84.00%) followed by test weight (78.99%), harvest index (75.88%). The highest value of genetic advance was shown by grain yield per plant (g) (35.60%). If the heritability estimates are high in a narrow sense, it means the character is largely governed by additive genes and selection for improvement of such character would be rewarding.

Keywords: Bread wheat, genetic advance, genetic variability and heritability

Introduction
Wheat (*Triticum aestivum* L. *em.* Thell) the world's largest cereal crop which belongs to the Poaceae family of the genus *Triticum*. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position in the international food grain trade. The term "Wheat" is derived from many different locations, specifically from English, German and Welsh language. Wheat (*Triticum aestivum and T. duram*) is the most important winter cereal crop of India and is grown during November to mid –April. Wheat was cultivated in ancient Greece and Egypt in pre-historic times. The central Asia, Near East, Mediterranean and Ethiopian regions are the world's most important centers of diversity of wheat and its related species (Kundu and Nagarajan, 1996; Perrino and Porcedu, 1990) [7]. Hindukush area is the centre Diversity of hexaploid wheat (Kundu and Nagarajan, 1996) [7]. The majority of the cultivated wheat varieties belong to three main species of the genus Triticum. These are the hexaploid, *T. aestivum* L. (bread wheat), the tetraploid, *T. durum* Desf and the diploid, *T. dicoccum*., and *T. monococcum*. Globally, aestivum wheat is the most important species which covers ninety percent of the area. Second popular wheat being durum wheat which covers about nine percent of the total area while *T. diccoum* wheat and *T. monococcum* wheat cover less than one per cent of the total area.
Production of wheat in India is 107.42 million tons from an area of 29.31 million hectare during 2019-20 (Anonymous 2019-20) [1]. The production of wheat in U.P. is 32.09 million tonnes followed by Madhya Pradesh (18.58mt), Punjab (18.21mt), Haryana (12.07mt), Rajsthan (10.57), and Bihar (6.55mt). The total production of wheat in the country has increased very significantly; the productivity increases are still comparatively low. Furthermore, the expected demand of 100 million tons of wheat by 2030 and possible adverse impacts of climate change on wheat productivity are the factors to plan and implement strategy for yield enhancement per unit area and the further genotypes need to have high yield with better resistance to biotic factors and increased tolerance to abiotic stresses. Genetic improvement for quantitative traits depends upon the nature and amount variability present in the genetic stock and the extent to which the desirable traits are heritable. For effective selection of superior genotypes in the germplasm lines, knowledge of genetic parameters such as variability, heritability and genetic advance is very much essential. Heritability and genetic

advance are the important parameters under the direct selection Heritability denote transmissibility of a character from parent to offspring. Genetic advance, though not an independent identity, has an added advantage over heritability as a guiding factor to the breeders in selection programmed. Johnson *et al.* (1955) [4]. stated that without genetic advance, estimates of the heritability would not be of practical importance based on phenotypic expression and emphasized the concurrent use of genetic advance along with heritability.

Materials and Methods

The experiment of present investigation was conducted to evaluate the ninety wheat germplasm lines along with three checks (*viz.*, HD-2967, Sonalika, HI-8713) in Augmented Block Design during *Rabi* 2017-18 at Main Experiment Station A.N.D.U.A.T., Kumarganj, Ayodhya. (ph=9.50) These genotypes exhibited a wide spectrum of variation for various agronomical and morphological characters. The experimental field was divided into six blocks and 15plots, 12 test genotypes along with 3 checks were accommodated in each block. Each plot consisted of two rows of 2.5 m length with spacing of 5 cm within the plants and 25 cm between the rows. The recommended cultural practices were being followed to raise a good normal crop. The observations were recorded for eleven quantitative characters *viz.*, days to 50% flowering, days to maturity, plant height (cm), tillers per plant, flag leaf area (cm^2), peduncle length (cm), spike length (cm), 1000-grain weight (test weight) (g), biological yield per plant (g), harvest index (%) and grain yield per plant (g). The observations were recorded on 5 randomly selected plants from each plot except days to 50% flowering and days to maturity where data will be recorded on plot basis.

Results and Discussion

Analysis of variance for augmented design was carried out for eleven characters to test the significance of differences among various treatments (checks) *viz.* HD -2967, Sonalika, and HI-8713 and is presented in Table-1. The variation due to blocks was highly significant for days to 50% flowering, flag leaf area, days to maturity, biological yield per plant, harvest index and 1000-grain weight however the differences among the blocks were not significant for remaining characters. The differences among the three check varieties were found to be highly significant for the day to 50% flowering and test weight.

The estimates of phenotypic and genotypic coefficients of variation for eleven characters of wheat genotypes are presented in (Table-2). The magnitude of phenotypic coefficients of variation (PCV) was slightly higher than corresponding genotypic coefficients of variation for all the parameters due to the environmental influence. The high estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation was observed in case of flag leaf area (PCV=31.81%, GCV=25.68%) followed by grain yield per plant (PCV=27.37, GCV=21.75) and biological yield per plant (PCV=24.33%, GCV=16.09%) can be considered as high because of being very close to 20%. Moderates estimates (<20% - >10%) of PCV and GCV were noted for peduncle length (PCV=16.27%, GCV=6.90%), spike length (PCV=14.64%, GCV=3.78), tiller per plant (PCV=12.77%, GCV=7.04%), plant height (GCV=10.60%, GCV=5.09) whereas, the low estimates (<10%) of phenotypic and genotypic coefficients variations were observed for test weight (PCV=9.88%, GCV=8.78%), harvest index (PCV=8.71%, GCV=7.59%), day to maturity (PCV=5.82%, GCV=4.65%) days to 50% flowering (PCV=4.83%, GCV=4.45%). Similar results were observed by (Wani *et al.* (2011) [11], Neeru *et al.* (2017) [12], Rathwa *et al.* (2018) [9, 13].

The highest estimate of heritability in broad sense was recorded by days to 50% flowering (84.00%) followed by test weight (78.99%), harvest index (75.88%), exhibited high estimates of heritability (>75%). The characters exhibiting moderate estimates (>50-<75%) of heritability was recorded flag leaf area (65.20%), days to maturity and (63.99%). while the lowest value by spike length (6.67%), peduncle length (18.00), plant height (23.10) and tillers per plant (30.35). Similar results for most of these characters were also recorded by Kumar *et al.* (2018) [5], Hakimi *et al.* (2017) [3] and Kumar *et al.* (2017) [6].

The highest value of genetic advance (Ga.) at 5% of mean was shown by grain yield per plant (g) (35.60%), while spike length (2.01%) had the lowest value for this parameter. The characters exhibiting high estimates (>20%) of genetic advance in per cent of mean were biological yield per plant (g) (21.94%).The characters exhibiting moderate estimates (>10%) of genetic advance in per cent of mean were test weight (g) (16.07), harvest index (%) (13%). The lower estimates of genetic advance (<10) resulted in cases of days to flowering (8.082%), tillers per plant (7.98%), day to maturity (7.67%), peduncle length (6.03) and plant height (5.04). Similar results for most of these characters were also recorded by Sahu *et al.* (2019), Rathwa *et al.* (2018) [9, 13], Kumar *et al.* (2017) [6] and Kyosev *et al.* (2015) [8].

Conclusion

The variation due to blocks was highly significant for days to 50% flowering, flag leaf area, days to maturity, biological yield per plant, harvest index and 1000-grain weight however the differences among the blocks were not significant for remaining characters. The high estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation was observed in the case of flag leaf area (PCV=31.81%). The highest estimate of heritability in broad sense was recorded by days to 50% flowering (84.00%). The highest value of genetic advance (Ga.) was shown by grain yield per plant (g) (35.60%).

Table 1: Analysis of variance of augmented design for 11 characters in wheat genotypes

	d.f.	Days to 50% flowering	Flag leaf area (cm^2)	Plant height (cm)	Days to maturity	Tillers/plant	Spike length (cm)	Peduncle length (cm)	Biological yield/plant (g)	Grain yield/plant (g)	Test weight (g)	Harvest index (%)
Block (Ignoring Treatments)	5	68.66**	123.03 **	72.871	206.29**	0.041	17.69 *	25.97	475.07**	73.87**	23.042**	29.70 **
Treatment (Eliminating Blocks)	92	14.43 **	55.06 *	57.74	44.32	0.62	4.65	14.87	12.84	2.340	17.69**	10.04**
Checks	2	40.38**	30.90	66.91	13.16	0.29	5.76	11.07	25.93	3.51	86.83 **	2.55
Checks + Var vs. Var.	90	13.86**	55.60*	57.53	45.01	0.62	4.62	14.96	12.55	2.31	16.15**	10.21**
Error	10	2.32	19.21	44.34	17.63	0.38	4.79	11.06	18.12	1.94	3.15	2.37
Block (eliminating Check + Var.)	5	2.85	47.46	42.13	16.76	0.37	1.38	17.13	82.87*	10.65*	9.71	12.50*
Entries (Ignoring Blocks)	92	18.01**	59.17*	59.41	54.62*	0.60	5.53	15.35	34.15	5.77*	18.41**	10.98**
Checks	2	40.38**	30.90	66.91	13.16	0.29	5.76	11.07	25.93	3.51	86.83**	2.55
Varieties	89	17.10**	60.47*	59.61	53.54*	0.57	5.18	13.84	34.29	5.771*	16.72**	10.91**
Checks vs. Varieties	1	54.15**	0.00	26.03	233.38**	3.19*	36.24 *	158.48**	38.68	10.76*	31.87**	33.97**
Error	10	2.32	19.21	44.34	17.63	0.38	4.79	11.06	18.12	1.94	3.15	2.37
Ci – Cj	1	1.96	5.63	8.56	5.40	0.79	2.81	4.27	5.47	1.79	2.28	1.98
BiVi – BiVj	1	4.80	13.81	20.98	13.23	1.95	6.90	10.48	13.41	4.39	5.59	4.85
BiVi – BjVj	1	5.54	15.95	24.23	15.27	2.26	7.96	12.10	15.48	5.07	6.45	5.60
Ci – VI	1	4.23	12.18	18.50	11.66	1.72	6.08	9.24	11.83	3.87	4.93	4.27

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

Table 2: Estimates of general mean, range, phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability in broad sense (h^2b) and genetic advance in percent of mean for eleven characters in wheat

Characters		Grand mean	Range		Coefficient of variation (%)		h^2b	Genetic advance in (%) of mean
			Min.	Max.	PCV	GCV		
1.	Days to 50% flowering	80.71	70.61	90.94	4.83	4.45	84.75	8.43
2.	Flag Leaf area (cm^2)	23.35	10.30	60.65	31.81	25.68	65.20	42.72
3.	Plant height (cm)	71.61	49.86	97.06	10.60	5.09	23.10	5.04
4.	Days to maturity	120.22	89.50	132.50	5.82	4.65	63.99	7.67
5.	Tillers/plant	5.82	3.55	7.62	12.77	7.04	30.35	7.98
6.	Spike length (cm)	15.48	8.00	21.55	14.64	3.78	6.67	2.01
7.	Peduncle length (cm^2)	22.57	13.15	34.44	16.27	6.90	18.00	6.03
8.	Biological yield per Plant (g)	23.33	15.60	32.32	24.33	16.09	43.78	21.94
9.	Test weight (g)	39.19	27.73	49.00	9.88	8.78	78.99	16.07
10.	Harvest index (%)	35.95	27.60	43.14	8.71	7.59	75.88	13.62
11.	Grain yield per Plant (g)	8.39	4.70	12.78	27.37	21.75	63.15	35.60

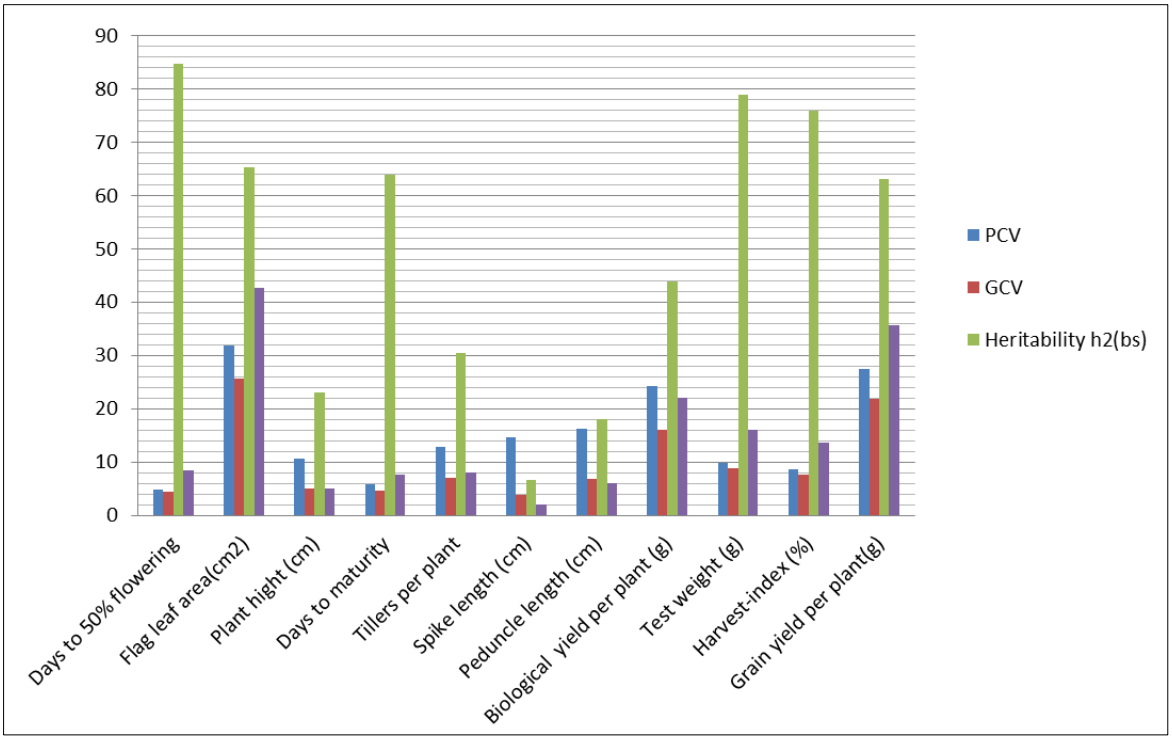

Fig 1: Phenotypic (PCV) and genotypic (GCV) coefficient of variation, heritability in broad sense (h^2b) and genetic advance in percent of mean for 11 characters in *Triticum aestivum*

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