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Genetic variability parameters studies under normal and stress conditions of wheat (*Triticum aestivum* L.)

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Abstract
The experiment was conducted with fifty five wheat genotype during *Rabi* 2019-20 under normal sown (27 November 2019) and stress condition was created by delayed sowing the experimental material on 23 December 2019 at research field of AICRP on Wheat, BTCCARS, Bilaspur. Studies on genetic variability parameters for seed yield and ten yield attributing characters recorded lower values under stress conditions. Genotypic and phenotypic variances were higher under normal conditions for all the character studied. Genotypic and phenotypic coefficients are higher for biological and seed yield per plant and moderate for all the characters under study. High heritability was recorded for studied characters in both sowing conditions. Genetic advance as percent of mean were higher for all the character in two sowing conditions except moderate magnitude for 1000 seed weight. Moderate genetic advance were also recorded for days to 50% heading, seed length and seed width under stress conditions.

Keywords: Genetic variability, normal and stress environment, wheat

Introduction
India witnessed a record production of 101.20 Mt of grains from an area of 29.55 M ha. With the productivity of 34.24 q. per ha in 2018-19. In Chhattisgarh wheat covers an area of 101.36 (000ha) with 130.65 (000 tones) of production in 1289 kg^{-1} ha productivity. The lower productivity in the state is due to late sowing of wheat, early rise in temperature and lack of mechanization for early sowing of wheat after paddy harvest. The wheat crop requires favorable winter for about 110-120 days producing its potential yields, which is limited upto 80-90 days in normal sowing conditions and 65-70 days under late sown conditions in Chhattisgarh. The late sowing and early rise in the temperature during winter season are the main causes of the lower productivity. Genetic variability parameters studies will gives idea about the direction of crop improvement research. So the present study was undertaken to find out the affect of sowing date on the genetic variability parameters.

Material and Methods
The present research was conducted under All India Co-ordinated Research Project on Wheat at Barrister Thakur Chhedilal College of Agriculture and Research Station, IGKV, Bilaspur Chhattisgarh during *rabi* season 2019-20. In this experiment 55 genotype including five check *viz.*, MP 3336, HD 2932, Chhattisgarh Genhu 4, HD 2864, RAJ 4238 were sown in two replications on 27\11\19 as normal sowing (D1) and 23\12\19 as stress sowing (D2). The weekly temperature records (Minimum, Maximum & Mean) of experiment year reviles, below 20 ^{0}C temperature for 77 days was experience by the crop, when sown on 27 November 2019, however number of favorable days limits up to 56 days when crop sown on 23 December 2019. Similarly post heading weekly mean temperature is 20.58 ^{0}C for timely sown crop and 22.5 ^{0}C for late sown crop. Data were recorded for shoot length at 15DAS (cm), days to 50% heading, spikelets per spike, seeds per spike, seeds per plant, spike length (cm), 1000 grain weight (g), seed length (mm), seed width (mm), biological and seed yield per plant (g). Genetic variability parameters such as genotypic and phenotypic coefficient of variation, heritability (broad sense) and genetic advance as percent of mean were calculated as per standard formula for both the sowing dates are compared and discussed.

Results and Discussion
Wheat crop requires favorable winter for about 110-120 days producing its potential yields. Wheat crop required low day temperature for favorable yield potential. Temperature below and above from the optimum temperature (20-22 ^{0}C) causes significantly yield losses in wheat.

Heat stress is defined as rise in temperature above the optimum level cause irreversible damage to plant growth and development (Wahid *et al.,* 2007) [13]. Yang *et al.,* 2002 [14] reported that heat tolerance is complex trait and controlled by polygene therefore should be studied by component characters.

Analysis of the variance worked out for seed yield and its component characters of wheat under irrigated timely and late sown conditions. The mean sum of squares due to genotypes was highly significant for all the characters in both sowing dates. Raj Navodeeta (2018) [10], Manal, H Eid (2009) [6] also reported significant difference among the genotypes for all the parameter under both timely and late sown conditions, this is an indication of existence of satisfactory variation for the traits under study. Higher variance under normal sown conditions is due to favorable environment for expression of characters. Anwar *et al.,* (2015) [2] reported higher values under November sown conditions.

Genetic variability parameters along with mean, percent reduction, range (minimum and maximum) genotypic and phenotypic variance for eleven characters are presented in Table-1. Percent reduction ranged from 5.99% (Days to 50% heading) to 47.26% in biological yield per plant due to stress environment condition. Seed yield per plant recorded 38.82% reduction in performance followed by shoot length at 15 DAS (33.88%), seeds per plant (22.9%), seeds per spike (19.24%) and spike length (18.66%). You *et al.,* (2009) [15] reported that with $1^{O}C$ rise in temperature caused 3-10% reduction in wheat yield. Reduction in shoots length under late sown conditions was also reported by Ali *et al.,* (2018) [1]. Higher value for grains per spike under timely sown condition is also reported by Anwar *et al.,* (2015) [2]. Reduction in seeds per spike up to 39% is also reported by Pimentel *et al.,* (2015) [9].

The results of genetic parameters are discussed considering the two sowing dates simultaneously. In general the estimates of phenotypic coefficient of variation (PCV) were higher than the genotypic coefficient of variation (GCV) for all the characters. Mecha *et al*., (2016) [7] also reported similar pattern of variation in wheat. GCV and PCV are high for biological and seed yield per plant, however low for 1000 grain weight. Rest of characters *viz.*, shoot length at 15 DAS, days to 50% heading, spikelet per spike, seeds per spike, seeds per plant, spike length, seed length and seed width recorded moderate GCV and PCV with exception of low magnitude for days to 50% heading in D2. Medium coefficient of variation for days to 50% heading is also reported by Mecha *et al.,* (2016) [7]. Medium PCV and GCV for seeds per spike found under late sown conditions is supported by Mecha *et al.,* (2016) [7], Chavan *et al.,* (2013) [4].

Genetic advance as percentage of mean was highest for biological yield per plant followed by seed yield per plant in both sowing dates. Shoot length at 15 DAS, spikelet per spike, seeds per spike, seeds per plant and spike length recorded high genetic advance as percentage of mean in both sowing environments. High heritability with high genetic advance as percent of mean for spikelet per spike was also reported by Baloch *et al.,* (2013) [3] and Kumar *et al.,* (2003) [5]. Days to 50% heading, seed length and width showed high genetic advance in D1 and moderate genetic advance in D2. 1000 grain weight recorded moderate genetic advance in both the sowing dates. High heritability with moderate genetic advance for 1000 grain weight is under the both additive and non-additive gene control and selection for improvement for this trait will be effective up-to limited extant. Seed length and seed width to-gather decide the shape of the seed, in wheat generally seed shape is classified as round, ovate, oblong and Elliptical. In the present study both seed length and seed width were studied in concern with terminal heat stress. Seed length recorded high heritability, coupled with high genetic advance as percent of mean was recorded under timely sown condition. However, under late sown condition heritability was high coupled with moderate genetic advance as percentage of mean. The variable results are due to varying climatic conditions in two crop growing season. Seed width recorded high heritability coupled with high genetic advance as percent of mean in both the sowing dates. Review for this character is scanty. Biological and seed yield per plant recorded high heritability coupled with high genetic advance as percent of mean in both the sowing dates. High heritability estimate for biological yield per plant was also reported by Thapa *et al.,* (2019) [12]. High heritability with high genetic advance as percent of mean for seed yield per plant was also reported by Raj, Navodeeta (2018) [10], Naik *et al.,* (2015) [8], Baloch *et al.,* (2013) [3], Shukla and Singh (2004) [11].

Stress environment reduced the seed yield and yield attributing traits of wheat genotypes. Level of reduction in measurement of traits depends up-on the sensitivity of traits for changing climate. Genetic variability parameters are affected by the crop growing season and climatic conditions. Generally lower values are obtained under the stress conditions.

Table 1: Parameters of genetic variation for quantitative characters in two sowing dates

Characters	Sowing date	Mean	% reduction	Range		Genotypic variance	Phenotypic variance	GCV (%)	PCV (%)	Heritability (Broad sense)	Genetic advance	Genetic advance % of mean
				Min.	Max.							
Shoot length	D1	17.94	33.88	14.00 (RAJ 4238(c))	23.00 (CG 1254-1-1)	6.34	7.65	14.04	15.42	82.90	4.72	26.33
at 15 DAS	D2	13.40		10.30 (CG 1811-A)	16.00 (SBWYT 202-B)	2.96	3.77	12.83	14.48	78.53	3.14	23.43
Days to 50%	D1	59.74	5.99	51.00 (CG 1524-C)	68.50 (CG 1811-A)	36.87	37.75	10.16	10.28	97.66	12.36	20.69
heading	D2	56.36		50.50 (CG 1254-1-1)	61.50 (CG 8812-A)	20.48	21.36	8.77	8.24	95.87	9.13	16.29
Spikelet	D1	16.15	8.97	11.80 (PYT (BSP)15-79-A)	19.40 (CG 1812-B)	5.70	7.30	14.91	16.87	78.18	4.35	27.17
$spike^{-1}$	D2	14.82		12.00 (CG 13148)	17.80 (SSN 1373-9)	3.79	4.93	13.14	14.98	76.94	3.52	23.74
Seeds $spike^{-1}$	D1	33.70	19.24	23.00 (PYT (BSP)15-79-A)	40.00 (HTWYT 18-37)	27.75	30.21	15.62	16.30	91.84	10.4	30.85
	D2	28.26		23.80	34.40	11.93	13.66	12.21	13.79	87.27	6.64	23.51

				(NHP12-1-2-1)	(HD-2932 (C))							
Seeds plant^{-1}	D1	145.4	22.9	88.40 (NHP12-1-2-1)	188.00 (CG 14101)	673.4	853.58	17.89	20.14	78.89	47.48	32.73
	D2	118.2		88.00 (NHP 12-1-2-1	163.00 (HD 2932 (C))	483.4	541.31	18.58	19.66	89.36	42.82	36.20
Spike length	D1	9.41	18.66	6.30 (EIGN 18-70)	11.90 (CG 14103)	3.27	3.53	19.24	19.97	92.84	3.59	38.19
	D2	7.93		5.60 (EIGN 18-70)	11.10 (CG 1812-A)	1.26	1.65	14.18	16.19	76.75	2.03	25.60

Characters	Sowing date	Mean	% reduction	Range		Genotypic variance	Phenotypic variance	GCV (%)	PCV (%)	Heritability (Broad sense)	Genetic advance	Genetic advance % of mean
				Min.	Max.							
1000 Grain weight (g)	D1	41.77	8.24	35.05 (CG 1723)	47.85 (OS15-380-B)	10.06	12.14	7.59	8.34	82.87	5.94	14.24
	D2	38.59		34.45 (CG 1524-B)	44.20 (MP 3336 (C))	7.93	10.11	7.31	8.24	78.48	5.14	13.32
Seed length (mm)	D1	7.29	8.16	6.10 (PYT (BSP) 15-79-A)	8.70 (CG 1522-1)	0.91	1.11	13.08	14.50	81.35	0.18	25.64
	D2	6.74		6.00 (NHP 12-1-2-2)	7.95 (CG1028-2-1)	0.35	0.46	8.84	10.95	76.84	0.10	15.98
Seed width (mm)	D1	3.84	12.28	3.20 (PYT (BSP) 15-79-A)	4.60 (CG 1524-C)	0.41	0.43	16.80	17.18	95.59	0.13	33.84
	D2	3.42		3.15 (EIGN18-7-A)	4.20 (PYT (BSP) 15-79-C)	0.12	0.13	10.14	10.83	87.66	0.06	19.57
Biological yield plant^{-1}	D1	12.65	47.26	6.56 (EIGN 18-74)	21.21 (CG1812-B)	22.06	23.43	37.11	38.25	94.14	9.38	74.18
(g)	D2	8.59		5.51 (PYT DWR 15-15-B)	10.97 (NHP 12-1-2-2)	3.21	3.56	21.62	22.19	90.25	3.50	41.16
Seed yield plant^{-1}	D1	6.83	38.82	3.27 (NHP 12-1-2-1)	9.70 (HD2932 (C))	3.68	3.83	28.11	28.65	96.26	3.88	56.82
(g)	D2	4.92		3.09 (NHP 12-1-2-1)	7.05 (HD2932 (C))	2.34	2.51	31.11	32.22	93.24	3.04	61.90

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