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Genetic Variability and Direct Selection Parameters in Wheat (*Triticum aestivum* L. M. Thell.)

Ramesh Kumar Maurya [a*], Alok Kumar Singh [b], Bharat Lal Maurya [a], N. V. Durga Prasad Rao [a], Vishal Singh [b] and Kanhaiya Lal [b]

[a] Tilak Dhari Post Graduate College, Jaunpur, 222002, (UP), India.
[b] Kamla Nehru Institute of Physical and Social Sciences, Sultanpur, 228118, (UP), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment on 141 genotypes of wheat consisting one hundred ten F1's,twenty-seven parental lines (22 females + 5 males) and four standard varieties (UP-2338, PBW-550, NW-1067 and NW-5054) of wheat was conducted to work out the genetic variability, heritability and genetic advance estimates of various attributes**.** The maximum value of phenotypic coefficient of variance (PCV) and genotypic coefficients of variance (GCV) were recorded in case of tillers per plant (PCV=13.37%, GCV=8.94%) and biological yield per plant (PCV=10.40%, GCV= 5.47). High estimates of heritability (>30%) were recorded for tillers per plant (44.74), harvest index (34.45), grain yield per plant (31.51) and 1000-grain weight (30.54). Moderate estimates of genetic advance (10-20%) were recorded for tillers per plant (12.32). High heritability and high or moderate genetic advance indicated the that there was additive gene action for the determination of the characters and this confirmed that these characters could be utilized for making efficient selection strategies for development of improved wheat varieties.

**Corresponding author: E-mail: rameshkumarmaurya6@gmail.com;*

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1. INTRODUCTION

"Wheat is the most important food crop in most areas of the world and also occupies major position in Indian agriculture after rice. It is nutritionally important cereal which is essential for the food security, poverty mitigation and for livelihoods. *Triticum aestivum* (bread wheat) is an allohexaploid has 42 chromosomes" [1].

"In India, Uttar Pradesh is the largest producer of wheat with 32.09 million ton, followed by MP (18.58 million ton), Punjab (18.21 million ton), Haryana (12.07 million ton), Rajasthan (10.57 million ton) and Bihar (6.55 million ton), These top six states together contributed about 93 per cent of the total production" (Anonymous 2019-20).

"Wheat is known as King of cereals because of the acreage it occupies, its high productivity potential and its prominent position in the international food grain trade" [1]. Besides higher productivity the overall production of wheat is not sufficient to capture the increasing demand due to continuous increasing population. Therefore, there is urgent need to develop the improved wheat varieties that have multiple resistance and a wide range of adaptation. Genetic variability is a prerequisite to start any breeding programme therefore, evaluation of wheat genotypes for variability is much more important. "Heritability and genetic advance are important direct selection parameters; they not only serve as predictive function of crop performance in a succeeding generation but also guide the breeder for efficient selection. The magnitude of heritability is very important in selection because high heritability makes the selection process more efficient [2,3]. However, the use of heritability alone in advance generations is not very effective to bring sufficient improvement through selection if not accompanied with estimates of genetic advance. Therefore, estimates of heritability coupled with estimates of genetic advance further strengthen the effectiveness of selection. For a successful breeding program, the presence of genetic variability plays a crucial role [4,5,6]. It is true that if there is more diversity among the selected materials, there will be more chance of getting high heterotic cross combinations or to generate productive recombinants and broad variability in segregating generations during genetic improvement" [7,8,9]. Taking above point in consideration the present investigation has been carried out.

2. MATERIALS AND METHODS

The study was designed to work out the Genetic variability and direct selection parameters in wheat. 110 genotypes with four check varieties *viz.,* UP-2338, PBW-550, NW-1067 and NW-5054 were evaluated at the Main Experimental Station of PiliKothi farm, Tilak Dhari Post Graduate College Jaunpur U.P. India during *rabi,* 2019-20. The experiment was laid out in randomized block design. The observation were recorded on thirteen characters *viz.,* days to 50% flowering, days to maturity, plant height (cm), tillers per plant, flag leaf area (cm), chlorophyll content (mg/100g), spike length (cm), peduncle length (cm), grains per spike,1000-grain weight, biological yield per plant (g), harvest index and grain yield per plant (g). Analysis of variance for randomized block design, phenotypic coefficient of variance (PCV), genotypic coefficient of variance (GCV) and environmental coefficients of variance (ECV) for different characters were estimated as per the formula suggested by Burton and de Vane [10]. Heritability in broad sense (h^2b) was estimated as per [11]. The expected genetic advance (Ga) was calculated by using the formula suggested by Johnson et al. [12].

3. RESULTS AND DISCUSSION

The success any crop improvement programme depends mainly on presence of substantial amount of genetic variability and high estimates of heritability coupled with high estimates of genetic advance. Genetic variability works as raw material for any plant breeding programme on which selection acts to evolve superior genotypes. The phenotypic, genotypic and environmental coefficients of variance can be utilized for assessment and comparison of the nature and magnitude of genetic variability present in the breeding materials for different characters. Broad sense heritability quantifies the proportion of heritable genetic variance to the total observable phenotypic variance. Estimates of heritability help in estimating expected progress through selection while, the estimates of genetic advance provides indication of expected selection response.

Analysis of variance for Randomized Block Design (RBD) was carried out for 13 characters to test the significance of differences among different genotypes is presented in Table 1.

Analysis of variance for the design showed the significant difference between the genotypes for the characters such plant height (45.94), tillers per plant (1.34), 1000-grain weight (3.48), biological yield per plant (31.14), harvest index (13.96) and grain yield per plant (3.58). Similar findings have also been reported by Rangare et al. [13]; Maan and Yadav 2010; Zine et al. 2013; Verma et al. [8], Yadav et al. [14], Maurya et al. [15]; Meena et al. [16] and Mecha et al. [17].

The characters having high genotypic coefficient of variance has better scope of improvement through selection. The influence of environment on each character could be determined on the basis of differences between PCV and GCV. A perusal of Table 2 showed that magnitude of PCV was higher than GCV for all the traits studied. The maximum values of phenotypic coefficient of variance were recorded for tillers per plant (13.37), followed by grain yield per plant (8.29), grains per spike (7.80), harvest index (6.72), plant height (5.89), spike length (5.42), peduncle length (5.30), flag leaf area (5.21), days to maturity (5.19), chlorophyll content (5.14) and 1000-grain weight (3.71),. Similar findings for these traits were also recorded by Yousaf et al. 2008; Rangare et al. [13]; Meena et al. [16]; Govind et al. [18] and Mecha et al. [17].

Heritability gives an idea of the magnitude of environmental effect on the phenotypic expression of the characters. A perusal of Table 2 showed high estimates of heritability for tillers per plant (44.74), harvest index (34.45), grain yield per plant (31.51) and 1000-grain weight (30.54). Above results are in close agreement with the findings of Maurya et al. [15]; Meena et al. [16] and Mecha et al. [17].

High heritability for any characters suggested that the selection on the basis of such characters will be more effective. According to Panse, [19] the characters with high heritability are predominantly governed by additive gene action and could be improved through individual plant selection. Whereas, the characters with low heritability indicated that they highly influenced by the environmental conditions and genetic improvement through selection will be difficult due to environmental effect.

Johnson et al. [12] have showed that it is not necessary that the characters having high heritability also would have high genetic advance. In the present investigation moderate estimates of genetic advance (10-20%) were recorded for tillers per plant (12.32). High heritability and high or moderate genetic advance indicated that the characters are governed by additive gene action and these characters will be more reliable for their utilization in selection process.

Above results are in close agreement with the results of Abid and Muhammad [20]; Prasad et al. [21]; Payal et al. 2007; Yousaf et al. 2008; Nagireddy and Jyothula [22]; Laghari et al. 2010; Yadav et al. [14]; Maurya et al. [15]; Meena et al. [61] and Mecha et al. [13].

Table 1. Analysis of variance for 13 characters in wheat

S. No.	Characters df	Replication	Treatments	Error
		2.00	**136.00**	**280.00**
1.	Days to 50% flowering	5.19	2.28	272
2.	Days to maturity	0.54	45.17	2.08
3.	Plant height	80.79*	45.94*	40.18
4.	Tiller per plant	7.24**	1.34**	22.47
5.	Flag leaf area	19.44**	1.23	0.38
6.	Chlorophyll content (mg/100g)	191.32**	10.80	10.14
7.	Spike length	5.13**	0.28	1.04
8.	Peduncle length	16.48**	1.19	0.235
9.	Grains per spike	33.05**	2.12	1.11
10.	1000-grain weight	89.87**	3.48**	2.02
11.	Biological yield per plant	806.79**	31.14**	1.52
12.	Harvest index	221.04**	13.96**	15.66
13.	Grain yield per plant	17.24**	3.58**	5.61

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

Table 2. Estimate of range, PCV, GCV, heritability, genetic advance for 13 characters in wheat

S. No.	Characters	Range		General mean	Coefficient of variation (%)		h² (Broad sense)	Genetic advance 5%	Gen. adv as % of Mean 5%
		Parents	Crosses		GCV (%)	PCV (%)			
1	Days to 50% flowering	80-82.66	78.33-82.67	80.82±0.88	0.35	1.81	3.75	0.11	0.14
2	Days to maturity	121.33.-126.33	81.33.-126.33	122.97±3.84	1.05	5.19	4.12	0.54	0.44
3	Plant height (cm)	91.57-98.64	79.12.-99.41	92.72±3.90	3.02	5.89	26.42	2.97	3.20
4	Tillers/plant	3.47-7.13	4.53-8.1	6.25 ±0.66	8.94	13.37	44.74	0.76	12.32
5	Flag leaf area $(cm)^2$	19.54-21.53	19.13-22.37	20.20±0.65	1.30	5.21	6.20	0.13	0.66
6	Chlorophyll content (mg/100g)	60.66-64.8	52-65.6	61.93±1.88	0.73	5.14	2.20	0.13	0.21
7	Spike length (cm)	8.7-9.83	8.43-10	9.30±0.31	1.54	5.42	8.16	0.08	0.91
8	Peduncle length (cm)	18.91-21.46	17.92-21.95	20.07±0.63	0.68	5.30	1.68	0.03	0.18
9	Grains per spike	17.33-19	15-21.33	18.23±0.83	0.93	7.80	1.45	0.04	0.23
10	1000-grain weight (g)	37.37-40.23	36.9-42.36	39.34±1.07	2.05	3.71	30.55	0.92	2.33
11	Biological yield per plant (g)	39.79-48.81	36.6-50.44	44.59±3.34	5.47	10.40	27.62	2.64	5.92
12	Harvest index (%)	40.40-46.60	39.37-48.26	43.35±2.19	3.94	6.72	34.45	2.06	4.77
13	Grain yield per plant (g)	15.43-19.35	15.79-20.52	17.70±1.08	4.65	8.29	31.51	0.95	5.38

4. CONCLUSION

The characters that have high genotypic coefficient of variance, heritability as well as genetic advance such as tillers per plant, harvest index, grain yield per plant and 1000-grain weight can be utilized for making of efficient selection strategy for development of improved wheat varieties.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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