Assessment ofHeritability and Genetic Advance for Yield and Yield Related Traitsunder different dates of sowing of Bread Wheat (*Triticum aestivum* L.)

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ABSTRACT

Wheat (*Triticum aestivum* L.) is a self-pollinating annual plant extensively grown as staple food source in the world. Information on the extent of heritability and genetic advance among different traits of bread wheat genotypes is essential to designing breeding strategieswith the objectiveto estimate heritability and genetic advance for different characters of bread wheat genotypes. A total of 10 bread wheat genotypes were evaluated for 15traitssown, three at different dates in 10 days intervalThe first on 30 November 2022, second on 10 December 2022, and third 20 December 2022 in a Randomized Block Design with three replications at Student Instruction Farm, C.S. Azad University of Agriculture and Technology, Kanpur-208002 (U.P.) during *Rabi*, 2022-23. in Randomized Block Design. High PCV and GCV were observed from biological yield, grain yield, plant height and productive tiller per plant high heritability estimate were recorded for grain yield per plant followed by biological yield per plant, plant height, days to 50% heading, days to maturity, number of productive tillers per plant, 1000-grain weight and number of grains per ear in both generationson individual and grain yield per plant followed by biological yield, number of productive tillers per plant, plant height, seed hardness, days to maturity in both generations on pooled basis. High genetic advance was observed for grain yield per plant and biological yield per plant in both the generation; seed hardness, number of productive tillers per plant in F_1 generation and grain yield per plant and biological yield per plant in both the generation on pooled basis. Therefore, the attention should be given for those traits for wheat breeding program, because the phenotypic expression of these characters governed by additive gene action. Hence, direct selection for these traits will be improved grain yield.

Keywords: Genetic advance, Wheat, heritability, Grain yield

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Introduction

Wheat (*Triticum aestivum* L.), is a self-pollinating annual plant, it is in the true grass family, *Gramineae*, is extensively grown as staple food source in the world (Mollasadeghi and Shahryari, 2011). And it is one of the most important crops among the prime cereals at the global level (Wani *et al*., 2018). Bread Wheat evolved through years of cultivation in the southern Caspian plains (Feldmann, 2001). Wheat is the second important food crop after rice worldwide (Nishant *et al*., 2018) and it provides 20% of the calories and protein and feeding about 40% of the world population (Shiferaw *et al*., 2013).

Ethiopia is one of the largest wheat producer countries in Africa (Yasin, 2015, Regasa, 2019) in Ethiopia, wheat production is based on two modern species: hexaploid wheat (*Triticum aestivum* L,

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2n=6x=42, AABBDD) and durum or tetraploid wheat (*T. turgidum* subsp. durum, 2n=4x=28, AABB). However, wheat production and productivity is relatively small by global standards. The main reason is that mostly subsistence farming of wheat is produced by small-scale farmers through rain feed production system with less irrigated production (Anteneh and Asrat, 2020) and constrained by several infectious diseases including rust and Septoria leaf blotch diseases which are the major problem of wheat production in Ethiopia (Hailu and Woldeab, 2015; Tadesse *et al.*, 2018)

Precise knowledge about germplasm variability, heritability and genetic advance is a pre-requisite for crop improvement programs, as it helps in the development of superior recombinants for all traits of interest (Rauf *et al.*, 2012, Tilahun *et al.*, 2020). The existence of genetic variability is very essential to meet the present and future crop breeding challenges (Hailu, 2011), Such as breeding for increasing yield, wider adaptation, desirable quality, drought tolerance, insect and disease resistance (Ferdous *et al.*, 2011).

Materials and Methods

The experimental material comprised of 45 F_1s developed by crossing 10 lines *viz.*, DBW-187, HD-3249, K-1006, PBW-723, PBW-757, HD-3271, HD-3298, K-8434, KRL-350, K - 9107 following half diallel mating design. The experimental materials consisted of 55 genotype (45 F1s +10 Parents) were sown in Randomized Block Design with three replicationsat the Student Instruction Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, during the rabi season of 2022-23. Each cultivar was grown in a single row plot measuring 3 meters in length, with a distance of 22.5centimetres between rows. The plants within each plot were spaced 10 centimetres apart. Various quantitative characteristics of the wheat plants were recorded as observations. These characteristics included the number of days to reach 50% heading, the number of days to maturity, plant height, flag leaf area in square centimetres, number of leaves on the main tiller, number of productive tillers per plant, ear length in centimetres, number of spikelets per ear, number of grains per ear, biological yield per plant in grams, grain yield per plant in grams, harvest index as a percentage, 1000-grain weight in grams, seed hardness, and protein content as a percentage. For each replication and for all characteristics except for the number of days to 50% heading and days to maturity, five randomly selected competitive plants were recorded. The heritability in broad sense (h^2) was determined using the method described by Burton and Devane (1953). The genetic advance was calculated based on the formula provided by Johnson *et al.* (1955).

Results and Discussion

Heritability estimates have been utilized as a selection criterion in the plant improvement programme. It has been widely adopted to estimate the degree to which a character may be transmitted from parent to offspring. High heritability estimates showed high value for grain yield per plant, biological yield per plant, plant height, days to 50% heading, days to maturity, number of productive tillers per plant, 1000-grain weight and number of grains per ear in both generations; for seed hardness and protein content in F_1 generation and flag leaf area, harvest index in F_2 generation. The moderate magnitude of heritability estimates below 30 and above 10 per cent was observed for the characters, harvest index in F_1 generation and number of spikelets per ear seed hardness and ear length in F_2 generation. The low magnitude of heritability observed in number of leaves/main tiller in both generations; number of spikelets per ear, ear length and flag leaf area in F_1 generation on individual basis and The finding on heritability estimates showed high value for grain yield per plant, biological yield, number of productive tillers per plant, plant height, seed hardness, days to maturity in both generations; 1000-grain weight, protein content, number of grains per ear in F_1 generation and days to 50% heading in F_2 generation. The moderate magnitude of heritability estimates below 30 and above 10 per cent was observed for the characters, harvest index and number of leaves/main tiller in both generation; number of grains per ear, protein content, 1000-grain weight, number of spikelets per ear, flag leaf area in F_2 generation. The low magnitude of heritability observed in ear lengthin both generations; number of spikelets per ear and flag leaf area in F_1 generation. It indicated that non additive gene action was more prevalent and thus, the heritability selection procedure expedited that these traits could be improved by selection in later generation. The related traits are greatly influenced by environment, which reduced the degree of correspondence due to its phenotypic and breeding values on pooled basis.

The estimated value of genetic advance (GA) for all the characters as shown in Table 1 and Table 2 focused on direct selection in both the generations. High genetic advance in percentage over mean was estimated for grain yield per plant and biological yield per plant in both the generation; seed hardness, number of productive tillers per plant in F_1 generation Moderate values were also observed for number of productive tillers per plant and plant height F_2 generation. exhibited the similar performance. It indicated that these traits were governed grain weight, harvest index and protein content in both the generation and for plant height in by additive which are fixable and the desired selection will be rewarding for improvement of such traits in early generations. Singh *et al.,* (1987), Singh *et al.,* (1991) and Garg and Pal (1991) also estimated the high heritability and high genetic advance for the various characters in wheat. Lower values of genetic advance were recorded for 1000-grain weight, protein content, number of grains per ear, days to maturity, number of spikelets per ear, days to 50% heading, ear length, harvest index, number of leaves/main tiller, flag leaf area in both generations; plant height in F_1 generation and seed hardness in F_2 generation on individual basis and high genetic advance in percentage over mean was estimated for grain yield per plant and biological yield per plant in both the generation; number of productive tillers per plant in F_2 generation Moderate values were also observed for seed hardness in both generations; number of productive tillers per plant in F_1

generation. Lower values of genetic advance were recorded for 1000-grain weight, protein content, number of grains per ear, days to maturity, number of spikelets per ear, days to 50% heading, ear length, harvest index, number of leaves/main tiller, flag leaf area and plant height in both generations on pooled basis. indicated that these characters are governed by non-additive genes where heterosis breeding may be useful. As Rathwa *et al.* (2018), Sateesh Chandra Gaur (2019) and Malbhage *et al.* (2020).

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CONCLUSION

High heritability estimatewas recorded for grain yield per plant followed by biological yield per plant, plant height, days to 50% heading, days to maturity, number of productive tillers per plant, 1000-grain weight and number of grains per ear in both generations on individual and grain yield per plant followed by biological yield, number of productive tillers per plant, plant height, seed hardness, days to maturity in both generations on pooled basis. High genetic advance was observed for grain yield per plant and biological yield per plant in both the generation; seed hardness, number of productive tillers per plant in F_1 generation and grain yield per plant and biological yield per plant in both the generation on pooled basis.Thus, attention should be given for those traits for breeding program.

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Table-1. Direct selection parameters for 15 characters of 10 parent diallel cross set of wheat (*Triticum aestivum* L.)

Characters	Grand mean		Heritability (%) (h^2)		GA		GA in% over mean	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Days to 50% heading	85.22	87.96	30.5	72.1	1.06	3.21	1.25	3.69
Days to maturity	125.19	124.41	67.7	70.6	3.64	3.11	2.91	2.50
Plant height (cm)	95.23	91.89	84.3	91.5	8.74	12.49	9.22	13.56
Flag leaf area (cm^2)	24.13	26.00	1.2	41.5	0.04	1.65	0.16	6.41
Number of leaves/main tiller	5.32	5.35	9.9	9.8	0.043	0.03	0.81	0.72
Number of of productive tillers/plant	8.20	7.16	78.9	68.2	1.83	1.22	23.04	17.16
Ear length (cm)	10.06	9.25	3.7	14.9	0.12	0.51	1.18	5.35
Number of spikelets/ear	20.03	19.13	8.5	25.2	0.27	0.83	1.36	4.30
Number of grains/ear	50.08	48.87	36.9	32.0	2.26	2.28	4.50	4.62
Biological yield/plant (g)	41.07	36.11	92.8	92.7	13.47	11.08	34.62	31.79
Grain yield/plant (g)	16.53	15.66	95.2	90.3	6.12	4.82	39.18	32.40
Harvest index (%)	40.32	43.62	13.9	41.1	0.43	1.21	1.03	2.85
1000-grain weight (g)	45.37	42.91	74.6	52.8	4.11	1.89	9.26	4.47
Seed hardness	8.39	8.74	81.2	18.8	2.01	0.59	23.16	6.25
Protein content (%)	12.50	11.78	42.5	39.1	0.97	0.83	7.84	7.04

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1000-grain weight (g)
Seed hardness
Protein content (%)

Table.2: Direct selectionparametersfor15charactersof10parentdiallelcrossset of wheat(*Triticumaestivum*L.)- Pooled

Characters	Grandmean		Heritability(%)(h^2)		GA		GAin% overmean	
	F_1	**F_2**	**F_1**	**F_2**	**F_1**	**F_2**	**F_1**	**F_2**
Days to 50% heading	79.99	82.63	24.83	36.03	1.33	1.32	1.67	1.70
Days to maturity	118.66	117.56	79.98	59.05	2.51	2.48	2.12	2.09
Plant height (cm)	87.25	85.84	83.27	77.84	5.44	7.20	6.27	7.91
Flag leaf area (cm^2)	21.23	21.93	1.97	12.56	0.64	2.01	3.02	8.97
Number of leaves/main tiller	4.72	4.56	10.14	21.77	0.22	0.09	4.66	2.07
Number of productive tillers/plant	7.08	6.44	91.95	89.71	1.29	1.88	18.88	25.38
Ear length (cm)	8.86	8.61	3.32	8.37	0.38	0.29	4.24	3.07
Number of spikelets/ear	18.21	17.95	8.16	15.05	0.52	0.25	2.87	1.30
Number of grains/ear	46.05	45.26	42.05	24.21	1.09	0.91	2.37	1.87
Biological yield/plant (g)	34.45	31.97	95.87	88.39	8.42	9.97	25.66	27.82
Grain yield/plant (g)	13.69	13.23	97.87	95.02	3.68	4.23	28.26	29.42
Harvest index (%)	39.63	41.40	29.72	26.08	3.05	2.40	7.72	5.98
1000-grain weight (g)	41.50	40.52	76.82	16.41	1.85	0.30	4.51	0.75
Seed hardness	7.61	8.05	81.32	56.07	1.12	1.04	14.46	13.24
Protein content (%)	11.74	11.51	64.08	22.45	1.03	1.13	8.85	9.82

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Comment [RP22]: Any need to represent the pooled table too? Check once some difference in see in F1 and F2 generations in the pooled table plz cross check or skip the table 2