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Study of Heritability and Genetic Advance for Grain Yield and its Attributing Characters in F_1 Generation of Bread Wheat (*Triticum aestivum* L.)

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ABSTRACT

In terms of both its age and usefulness as a source of food for humans, wheat is one of the most significant cereal crops. It is possible to trace the beginnings of wheat to Asia Minor. It occupies more than 17% of all arable land, is consumed by nearly 40% of the world's population, and makes up roughly 32% of all cereal-growing land. Over 4.5 billion people in developing countries rely on it to meet 21% of their protein needs. The experimental material for the present investigation comprised of 28 F_1s developed by crossing 8 lines viz., K - 9107 , HD – 2733 , HD – 2888 , WH – 1218 , K – 1313 , DBW – 187 , HD – 3086 , and DBW – 107 by following half diallel mating design. The experimental materials consisted of 36 genotype (28 F_1s + 8 Parents). Accordingly, high estimates of heritability were observed for days to 75 % heading (days), days to maturity (days), plant height (cm), no. of tillers / plant, no. of grains /ear, no. of spikelet's/ear and grain yield plant(g) in F_1 generation. The moderate heritability estimate was found for ear length(cm) and 1000 grain weight(g). The estimate of genetic advance in percentage over mean ranged from 5.492 (No. of spikelet's/ ear) to 41.668 (Grain yield / Plant (g)) in F_1 generation. The high genetic advance in percent over mean was observed in number of tillers per plant, grain yield per plant (g).

Key words *: Heritability, Genetic advance, Grain yield and Bread wheat*

Introduction

In terms of both its age and usefulness as a source of food for humans, wheat is one of the most significant cereal crops. Around 10,000 and 15,000 years ago, it was initially grown in ancient Persia, Egypt, Greece, and Europe. The Swiss lake people grew wheat, and there are signs of its production in China approximately 3,000 B.C. In archaeological digs, several grains of ancient wheat have been found. Despite the carbonization of the grains in these samples, the anatomical structure has occasionally been preserved. According to evidence from the Mohen-Jo-Daro excavations in India and the ancient ruins of Janno in Eastern Iraq, wheat was first grown in India more than 5,000 years ago. Ancient Indian literature make frequent mention of wheat. Wheat grain is mentioned in the Atharva - Veda, which is believed to have been written between 1,500 and 500 B.C. We can trace the beginnings of wheat to Asia Minor. Currently, wheat (*Triticum aestivum* L.) is categorised as a poaceae family plant. Wheat is an

allohexaploid plant (AABBDD). It has a fascinating history and is a unique example of how closely related species can come together in nature to generate polyploidy. The genesis of bread wheat involved combining the tetraploid species *Triticum turgidum* var. dicoccoides (AABB) and the diploid species *Aegilopsquarosa* (DD), followed by doubling the number of chromosomes.

Genetic variety serves as the foundation upon which selection starts to produce superior genotypes. Understanding it is therefore essential for its successful application in crop improvement programs. Heritability is a reliable predictor of how well a parent's character transfers to their children. High genetic advancement along with high heritability facilitates the selection of superior genotypes. Environment has a significant influence on yield, a quantitative attribute that is polygenically controlled, according to Allard (1960). Partitioning observed variability into heritable and non-heritable components is essential to obtain a true indication of the genetic coefficient of variation as a useful measure of the quantity of genetic variance present in the population. Genetic advance is characterized as a rise in the genotypic value of a chosen population relative to the original population. High genetic advancement facilitates the selection of best genotypes. Genetic advance is the increase in the mean genotypic value of the chosen plants over the base population. Character development may be accomplished through straightforward selection based on phenotypic performance because of the strong heritability and genetic progress.

Materials and Methods

The present investigation "Study of heritability and genetic advancefor grain yield and its attributing characters in F_1 generation of bread wheat (*Triticum aestivum* L.)" was carried out at Crop Research Farm, Nawabganj, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur- 208 002 (U.P.) during *Rabi*, 2018-20. This area falls in subtropical 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. The present investigation comprised of 28 F_1s developed by crossing 8 lines *viz*., K - 9107, HD – 2733, HD – 2888, WH – 1218, K – 1313, DBW – 187, HD – 3086, and DBW – 107 (Table 1) following half diallel mating design. The experimental materials consisted of 36 genotype (28 F_1s +8 Parents) were sown in Randomized Block Design with three replicationsin timely sown (TS) condition. The entries were sown in a single row plotof 3 m length with inter and intra-row spacing of 23 cm and 10 cm, respectively. Recommended agronomic practices were adopted to raise agood crop.

Results and Discussion

Heritability

Heritability (in narrow sense) in F_1 generation was calculated by the method proposed by Crumpacker and Allard, (1960). Accordingly, high estimates of heritability were observed for days to 75 % heading (days), days to maturity (days), plant height (cm), no. of tillers / plant, no. of grains /ear, no. of spikelet's/ear and grain yield / plant (g) in F_1 generation. The moderate heritability estimate was found for ear length (cm) and 1000 grain weight (g) (Table 2). A high heritability means that the most of individual variation is caused by genetic variation rather than environmental variation. Knowing the

Table 1. Details of genotypes

S.No.	Genotype	Species	Pedigree	Placeof origin
1.	K-9107	*T.aestivum*	K-8101/K68	CSA, Kanpur
2.	HD-2733	*T.aestivum*	ATTILA/3/HUITLE(HUI)/(CARC) CARCOMUN//CHEN/(CHTO) CHORLITO/4/ATTILA	IARI, New Delhi
3.	HD-2888	*T.aestivum*	C306/*T. sphaerococcum* // HW	IARI, New Delhi
4.	WH-1218	*T.aestivum*	KA/NAC//TRCH/3/VORB	CCS, Hisar
5.	K-1313	*T.aestivum*	HUW468/K9107	CSA, Kanpur
6.	DBW-187	*T.aestivum*	NAC/TH.AC//3*PVN/3/MIRLO/BUC/4/2* PASTOR/5/KACHU/6/KACHU	IIWBR, Karnal
7.	HD-3086	*T.aestivum*	DBW14/HD-2733//HUW468	IARI, New Delhi
8.	DBW-107	*T.aestivum*	TUKURU/INQLAB	IIWBR, Karnal

Table 2. Grandmean, heritability (narrow sense) % over mean nine characters of bread wheat

Characters	Grand mean	Narrow sense heritability [(h^2)%]
Days to 75 % heading (days)	82.9074	78.3
Days to maturity (days)	126.8213	83.0
Plant height(cm)	100.6889	44.5
No. of tillers /plant	14.6232	66.8
No. of spikelet's/ear	21.3333	37.1
Ear length (cm)	12.1389	15.7
No. of grains/ear	52.9306	30.7
1000 grain weight (g)	44.4957	11.0
Grain yield/Plant (g)	19.6595	58.3

heritability is important because, when a breeder selects a phenotype, only the genes of the plant, not the effects of the environment, are passed on. High heritability qualities are preferred by breeders because they enable them to select individuals who will pass the desired trait to their progeny.

Genetic advance

Genetic advance in percent of mean was calculated for all the characters in the F_1 generation in order to determine the relative merit of certain attributes. The estimate of genetic advance in percentage over mean ranged from 5.492 (No. of spikelet's/ear) to 41.668 (Grain yield / Plant (g)) in F_1generation (Table 3). The high genetic advance in percent over mean was observed in number of tillers per plant and grain yield per plant (g). High value of genetic advance is indicative of additive gene action. The results for various characters are described as under here:

Days to 75 % heading (days)

Days to 75% heading showed grand mean (82.9074), heritability (78.3), genetic advance (16.203) and genetic advance over % mean (19.543).

Days to maturity (days)

Days to maturity (days) showed grand mean (126.8213), heritability (83.0), genetic advance (12.998) and genetic advance over % mean (10.249).

Plant height (cm)

Plant height (cm) showed grand mean (100.6889), heritability (44.5), genetic advance (20.353) and genetic advance over % mean (20.214).

No. of tillers / plant

No. of tillers/plant showed grand mean (14.6232), heritability (66.8), genetic advance (8.267) and genetic advance over % mean (156.535).

No. of spikelet's/ear

No. of spikelet's/ear showed grand mean (21.3333), heritability (37.1), genetic advance (1.172) and genetic advance over % mean (5.492).

Ear length (cm)

Ear length (cm) showed grand mean (12.1389), heritability (15.7), genetic advance (0.958) and genetic advance over % mean (7.891).

No. of grains /ear

No. of grains /ear showed grand mean (52.9306), heritability (30.7), genetic advance (8.674) and genetic advance over % mean (16.387).

1000 grain weight (g)

1000 grain weight (g) showed grand mean (44.4957), heritability (11.0), genetic advance (5.177) and genetic advance over % mean (11.635).

Table 3. Grandmean, genetic advance and genetic advance % overmean nine characters of bread wheat

Characters	Grandmean	Geneticadvance	Genetic advance over % mean
Days to 75 % heading (days)	82.9074	16.203	19.543
Days to maturity (days)	126.8213	12.998	10.249
Plant height (cm)	100.6889	20.353	20.214
No. of tillers /plant	14.6232	8.267	56.535
No. of spikelet's/ear	21.3333	1.172	5.492
Ear length (cm)	12.1389	0.958	7.891
No. of grains/ear	52.9306	8.674	16.387
1000 grain weight (g)	44.4957	5.177	11.635
Grainyield/Plant(g)	19.6595	8.192	41.668

Grain yield / Plant (g)

Grain yield / Plant (g) showed grand mean (19.6595), heritability (58.3), genetic advance (8.192) and genetic advance over % mean (41.668).

High heritability coupled with high genetic advance as percent of mean was recorded for days to 75 % heading (days) days to maturity (days), plant height (cm), no. of tillers / plant and grainyield/ plant(g) reflecting the presence of additive gene action for the expression of these traits and improvement of these traits could be done through selection. High heritability with low genetic advance was observed for no. of tillers / plant, no. of spikelet's/ear, ear length (cm), no. of grains /ear, 1000 grain weight (g). It suggested non-additive gene action for the expressions of these characters. Selection for such features may not be profitable because the high heritability was caused by the environment's beneficial influence rather than the genotype. It became clear that additive gene influences control the character. Due to significant environmental influences, a low heritability was seen. Selection for this character may not be successful as a result. Breeders consider the heritability of a metric character to be a crucial parameter because it measures the degree of similarity between parents and offspring. Its magnitude also indicates how effectively a genotype can be identified by its phenotypic expression, and genetic progress helps apply the necessary selection pressure.

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