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Genetic Variability, Heritability and Yellow Rust Resistance in F_2 Population of Bread Wheat (*Triticum aestivum* L.)

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Abstract The aim of present study was to estimate the genetic variability for grain yield, their other contributing traits and evaluation of F_2 population for yellow rust resistance of a cross WH 1105 × WH 711 along with their parents. Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the eleven traits studied. PCV and GCV were highest in biological yield per plant followed by ear weight, number of grains per ear and grain yield per plant. High heritability was observed for biological yield per plant, grain yield per plant and ear weight. Highest genetic advance were recorded for number of grains per ear and biological yield per plant. For yellow rust incidence, high genetic coefficients of variation along with high heritability and genetic advance were recorded indicating the greater effectiveness of selection and improvement can be expected for yellow rust resistance. Present investigation suggests that selection in F_2 population of WH 1105 × WH 711 possessed sufficient variability for selecting superior recombinants for evolving high yielding and yellow rust resistance genotypes in wheat.

Keywords Genetic advance, Heritability, PCV, GCV, Bread wheat.

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Introduction

Wheat has many natural advantages as a food crop, which has made it the national staple food of more than 43 countries of the world. Developing countries, which consume 60% of the global wheat production, have shown higher yield increase than the developed countries in the past. It was driven by the hunger prevalence in these countries and is attributable to the introduction of high yielding and rust resistant semi dwarf varieties developed under the collaborative efforts of international and national research systems. Since, climate change and emergence of new pests and diseases are threatening the food sustainability genetic manipulation is one of the best tool to increase wheat production.

Study of genetic variability in segregating population is helpful in understanding the genetic consequences of hybridization. High heritability associated with high genetic advance for different yield components have a better scope for selecting high yielding genotypes according to Shoukat Ali et al. [1]. Hence, in the present investigation an attempt was made to assess the genetic variability of important grain yield and yield contributing traits along with its parameters i.e. GCV, PCV, heritability in broad sense (h^2), genetic advance (GA) and genetic advance as percent of mean.

Materials and Methods

The experiment was conducted at the Research Farm, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University Hisar (India) duruing *rabi* season of 2013-2014. The experimental material comprised of the F_2 population of a cross WH 1105 × WH 711. Two hundred sixty F_2 seeds generated from this cross were space planted along with resistant parent WH 1105 for yellow rust and a susceptible parent WH 711, keepng plant to plant distance of 10 cm and row to row distance of 30 cm and each row was of two meter length. Data were recorded at the time of maturity for various quantitative traits viz. plant height (cm), number of tillers per plant, number of spikelets per ear, ear length (cm), ear weight (g), number of grains per ear, number of grains per spikelet, 100 grain weight (g), biological yield per plant (g), grain yield per plant (g), harvest index and field reaction of yellow rust. Data were statistically analyzed to work out mean,range genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense). Genetic advance and the expected genetic gain were calculated.

Screening of yellow rust resistance

A mixture of stripe rust pathogens 46S102, 78S84 used for screening parental genotypes and F_2 population. Infectors rows were planted and also artificial inoculation were carried out. The disease data were recorded and the final disease severity data for the yellow rust was converted into average coefficient of infection (ACI) by multiplying severity with a constant value for field response .

Results and Discussion

A high level of genetic variability was observed among 260 plants of F_2 population of a cross WH 1105 × WH 711 for various characters. Results revealed high mean and wide range of expression of different characters indicating sufficient variability existed in the population selected for the study and indicating the scope for selection of suitable initial breeding material for crop improvement according to Bhushan et al. [2]. For yellow rust resistance also wide range of variation was exhibited by the plants of F_2 population, suggesting that there is an ample scope for selection of superior and desired lines for further improvement of yield and yellow rust resistance.

Table 1 reveals that estimated value of PCV in different traits were greater than those of the GCV. The close proximity between PCV and GCV values for most of the characters indicated less influence of environment on the expression of the characters under study according to Shankarrao et al. [3] and these traits are governed by additive gene action according to Vijayakumar et al. [4] and Abinasa et al. [5]. The highest values of PCV and GCV were observed for biological yield per plant followed by ear weight and moderate values of PCV and GCV were observed for number of grains per ear, grain yield and number of tillers per plant and lowest values observed for plant height. For yellow rust incidence also high values of PCV and GCV were recorded and it indicates that low environmental influence. Hence, simple selection can be relied upon and practiced for further improvement of resistance to yellow rust. High heritability estimates were recorded for all the traits except yellow rust incidence. Sachan and Singh [6] and Chandra et al. [7] also reported high heritability estimates for grain yield per plant, number of seeds per spike, plant height, 1000 seed weight and number of tillers per plant, which support the present findings. High heritability for yield related traits like plant height, spike length, number of tillers per plant and grain yield have been reported by Kumar et al. [8], Salman [9] and Yousaf et al. [10], which also sup-

Table 1. Estimates of genotypic and phenotypic coefficient of variance, heritability and genetic advance for grain yield and component characters in F_2 population of cross-IV (WH 1105 ×WH 711) in wheat.

Characters	Mean	Range	Phenotypic coefficient of variance (PCV)	Genotypic coefficient of variance (GCV)	Heritability H^2 (bs) (%)	Genetic advance	Genetic advance as per-cent of mean
Plant height (cm)	80.59	68.0–96.0	7.13	4.48	62.82	7.44	9.23
Number of tillers/plant	4.37	2–10	18.73	14.31	76.38	2.44	29.47
Ear length (cm)	8.63	6.0–11.5	14.70	6.95	47.29	1.24	14.32
Ear weight (g)	2.38	1.1-4.7	26.37	23.36	88.56	1.15	48.11
Number of grains/ear	38.22	10–60	22.94	19.51	85.06	15.36	40.20
Number of grains/spikelet	3.32	1–5	20.21	13.47	66.67	0.92	27.75
Number of spikelet/ear	18.57	11–27	14.29	12.09	84.60	4.62	24.90
100 grain weight (g)	3.95	1.9–4.6	12.19	10.03	82.26	0.82	20.66
Grain yield/plant (g)	11.8	2.3–16.2	20.91	20.03	95.76	4.87	41.25
Biological yield/plant (g)	17.73	7–41	32.52	30.89	94.99	11.28	63.64
Harvest index	0.38	0.15–0.49	14.41	11.77	81.65	0.09	24.24
Yellow rust incidence (ACI)	3.0	0.0–10.0	179.93	73.4	41.00	4.62	151.99

ports present investigation. Hence selection for grain yield per plant and yield related traits like number of tiller per plant and 100 grain weight is suggested to improve the yield. Moderate heritability estimates were recorded for yellow rust incidence indicating the possibility of influence of the environment on the expression of this polygenic trait. High heritability accompanied with high genetic advance as per-cent of mean for all the traits except plant height and ear length. It shows that most likely the heritability is due to additive gene effect and selection may be effective in early segregating generation for these traits. High heritability for plant height and ear length coupled with low genetic advance, which revealed the major role of non-additive gene action in the transmission of these characters from parents to offspring. Therefore, there seems a limited scope for improvement in these traits. Thus, it is evident from the present finding that substantial genetic variability was envisaged for yield and its component traits in the F_2 population of cross WH 1105 ×WH 711. High heritability along with high genetic advance (percentage of mean) were recorded for biological yield per plant, ear weight and grain yield per plant. Therefore, these traits should be taken into account while selecting superior and desirable recombinant plants for further improvement of yield parameters and yellow rust resistance in evolving high yielding and yellow rust resistant genotype in wheat according to Yadawad et al. [11].

References

1. Shoukat Ali M, Mahboob Ali S, Bashir Ahmed A, Afzal A (2007) Study of genetic parameters in segregating populations of spring wheat. Pak J Bot 39 : 2407—2413.
2. Bhushan B, Gaurav SS, Kumar R, Pal R, Panday M, Kumar A, Bharti S, Nagar SS, Rahul VP (2013) Genetic variability, heritability and genetic advance in bread wheat (*Triticum aestivum* L.). Environ Ecol 31 : 405—407.
3. Shankarrao BS, Mukherjee S, Pal AK, De DK (2010) Estimation of variability for yield parameters in bread wheat (*Triticum aestivum* L.) grown in Gangetic West Bengal. Elect J Pl Breed 1 : 764—768.
4. Vijay Kumar H, Naik R, Nadaf H L, Desai SA, Deshpande SK, Kalappanavar IK, Patil BN (2013) Genetic studies in free threshable advanced segregating population of tetraploid wheat (*Triticum dicoccum*). Karnataka J Agric Sci 26 : 10—13.
5. Abinasa M, Ayana A, Bultosa G (2011) Genetic variability, heritability and trait associations in durum wheat (*Triticum turgidum* L. var *durum*) genotypes. Afr J Agric Res 6 : 3972—3979.
6. Sachan MS, Singh SP (2003) Genetics of yield and its components in durum wheat (*Triticum durum* Desf.). J Interacademicia 7 : 140—143
7. Chandra D, Sharma R, Rani S, Singh DK, Sharma R, Sharma SK (2010) Genetic variability for quantitative traits in wheat (*Triticum aestivum* L. em. Thell). Pl Archives 10 : 871—874.
8. Kumar B, Singh CM, Jaiswal K (2013) Genetic variability, association and diversity studies in bread wheat (*Triticum aestivum* L.) . The Bioscan 8 : 143—147.

9. Salman S (2014) Genetic variability studies in bread wheat (*Triticum aestivum* L.) accessions. Pak J Agric Res 27 : 1—7.
10. Yousaf A, Atta BM, Akhter J, Monneveux P, Lateef Z (2008) Genetic variability association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. Pak J Bot 40 : 2087—2097.
11. Yadawad A, Rati Y, Hanchinal RR, Nadaf HL, Desai SA, Biradar S, Naik VR (2015) Genetic variability for yield parameters and rust resistance in F_2 population of wheat (*Triticum aestivum* L.). The Bioscan 10 : 707—710.