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RESEARCH ARTICLE

GENETIC VARIATION AND GRAIN YIELD ANALYSIS IN LATE SOWN WHEAT VARIETY

***,[1]Saket Kumar, [1]Rajeev Pratap Singh and [2]Rajesh Singh**

[1]Environment Science and Technology, Institute of Environment and Sustainable Development, BHU, Varanasi-221005

[2]Department of Genetics and Plant Breeding (GPB), Institute of Agricultural Sciences, BHU, Varanasi-221005

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ABSTRACT

The present study was estimating the association between grain yield and its component, which is essential to improvement yield traits. In 6 wheat genotypes analyze the genetic variability and correlation of germplasm in last week of December at Field Experimentation in Agricultural farm, BHU, Varanasi during Rabi season 2015-16. The significant mean sum of squares for most of the characters indicated the presence of substantial amount of variability. The differences between GCV and PCV for important characters studied indicating the less effect of environment on the expression of these characters. The GCV was observed high for grain yield followed by harvest index, canopy temperature and total grain yield. The phenotypic coefficient of variation (PCV) was exhibited high by canopy temperature followed by tillers per plant, spike length and grain weight per spike. High heritability coupled with high genetic advance was observed for plant height followed by harvest index. Grain yield exhibited positive significant correlation with 100 grain weight, grain weight per spike, spike length, grain filling period, harvest index, tillers per plant, test weight, days to maturity and canopy temperature depression at different genotypic level. Therefore selection can be expressed upon these characters for yield improvement of wheat in late sown condition. The results revealed that wheat planted on of December 2015 produced low spike length, plant height and grain yield with a comparable number of tillers and number of grains per spike. There was 9.4% reduction in grain yield as compared to late sowing. However, it showed negative significant correlation with plant height and grain yield in both environment. The path coefficient analysis revealed that biological yield per plant is the major contributor towards the grain yield per plant. Hence, main emphasis should be given on biological yield in breeding program.

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INTRODUCTION

Wheat (*Triticum aestivum*) is one of the most important cereal crops of the world in area and production. The wide range cultivation of the crop is largely along the globe due to high versatility in genome. It enables adaptation to different agro climatic condition and also unique property of wheat flour and dough which allows its processing into a range of food products. The production of wheat is 29.90 million ha, with 94.88 million tones an average productivity of 3177 kg per hectare (DWR, 2012). The development of high yielding wheat varieties in different agro-climatic conditions depends upon the nature and amount of genetic variability in the germplasm under consideration. Time of sowing is one of the most important aspects in obtaining good yield of wheat. In India, wheat is generally grown under three sowing conditions, i.e., normal (November), late (December) and very late (January) conditions. Wheat sowing is perhaps the one of the major factors responsible for low crop yield. This reduction in yield is due to the sub-optimal temperature during the germination, stand establishment and supra-optimal during the reproductive growth (Sattar *et al.*, 2010). Late planting are poor tillering, reduces the tillering period and more chances of winter injury. Generally wheat crop is seeded in normal temperature for growth and development toward maturity before the heat stress. So, mid winter season is favorable for seeding of winter wheat in any locality whereas late sown wheat suffers more winter injury, with produces fewer tillers and may ripen in lower grain weight and number of grains per plant (Razzaq *et al.*, 1986). Late planted wheat given low production during germination and seedling emergence (Timmermans *et al.*, 2007). Each day delayed wheat sowing after 20 November onward in decreases grain yield at the rate of 36 kg ha^{-1} day^{-1} (Hussain *et al.*, 1998). Delayed sowing from normal to late and very late increased the canopy temperature depression significantly, whereas other parameters

****Corresponding author: Saket Kumar,***
Environment Science and Technology, Institute of Environment and Sustainable Development, BHU, Varanasi-221005

such as anthesis, maturity, spike length and grain-filling period were reduced as sowing was delayed. Normal sowing prolongs the duration of tillering (Ishag; 1994) and produces more number of tillers, number of spikes, grains spike-1and grain weight that ultimately boosts up grain and straw yields (Qasim *et al*., 2008). Rajput & Verma, (1994) also observed that normal sowing time gave higher grain yield than late sowing. The local climate and associated micrometeorological variations are key factors in optimizing the date of sowings in a particular location because the relations between maximum temperature and sowing date gives best predictions of the growth intervals in various wheat growing areas (French *et al.,* 1979). Earlier reports also emphasized the need of studying response of crops to weather variations for evaluating the impact of seasonal temperature change and estimating yield dependence of temperature rise of crops (Kalra *et al.,* 2008).

MATERIALS AND METHODS

The six variety of wheat genotypes were selected and sowing in six randomized block design (RBD) with three replications. These varities are sowing in six plot with two different month as first week of November (E1) and last week of December (E2) at experimentation field, Agricultural Farm, BHU, Varanasi (25.28º N latitude and 82.96º 'E longitude) and IESD foeld BHU Varanasi during rabi season 2015-16. Per plot size were 228x144cm with normal recommended agronomic packages and practices (Table 2).

variance technique and significant means were separated using least significance difference (LSD) test for comparing the treatment means (Steel & Torrie; 1980). Data of five plants were taken from per row of each genotype in each replication for recording observations on plant height (cm), tillers/plants, Spike length (cm), chlorophyll content (%), canopy temperature (^{o}C), grains /spike, grain weight per spike(g), biological yield (g), harvest index (%) and test weight (g). Whereas, grain yield/plot (g), days to 50% flowering, grain filling period and days to maturity were recorded on plot basis. The mean values of different traits were subjected to analysis of variance (Fisher, 1936), coefficient of variation (Burton, 1952), heritability (Burton and Devane, 1953), genotypic and phenotypic correlation coefficients were calculated by Jibouri *et al*. (1958).

RESULTS AND DISCUSSION

A breeding program is depending on proper management of genetic variability in wheat crop. High magnitude of variability in a population provides the opportunity of selection to evolve a variety having desirable characters. All measurements of wheat variety can be made at phenotypic level, in which study all phenotypic characters, such as, plant height (cm), Number of tiller, days to heading, days to maturity, number of tiller per plant, number of grains per year, 1000 grains weight (g), biological yield, grain yield per plant and harvest index.

Table 1. Six varieties of wheat as sowing during rabi season-2015-16 in two environments

Sr. No.	Different Varieties of Wheat	Environment (E)	Location of Sowing Wheat Crop
1	HUW-510,ND-1014,ND-2036,HUW-468,Harvest Plus and HUW-234	E1	IESD field BHU, Varanasi
2	HUW-510,ND-1014,ND-2036,HUW-468,Harvest Plus and HUW-234	E2	Agricultural Farm BHU, Varanasi

Table 2. Six varieties of wheat as sowing in rabi season-2015-16 with applicable fertilizers

Sr. No.	Six Varieties	Symbol	Different Doses of Fertilizers
1	HUW-510	W1	Control
2	ND-1014	W3	NPK
3	ND-2036	W3	NPK+30 Kg N
4	HUW-468	W4	NPK+ 5 Kg N
5	Harvest Plus	W5	NPK+5 Kg Zn
6	HUW-234	W6	NPK+5Kg Fe+5Kg Zn+5Kg N

Each plot was consist in eighteen rows in which one feet space given in per plant. Fertilizers were applied at the rate of 150(N):60(P_2O_5): 60 (K_2O) kg/ha along with 25 kg Zink sulphate as basal application of fertilizers. 1/2 of fertilizers were applied at the time of sowing and remaining 1/4 nitrogen was top dressed with first irrigation and 1/4 with second irrigation. Meteorological data were revealed and shown (Figure 1,2 and 3), the lowest temperature (5^{o}C) in December and January, and highest temperature was (39^{o}C) during maturity at the environment E1 and 32 ^{o}C at E2.

The relative humidity was the highest in December and February (81%) and the lowest (38%) in February. The crop received rain showers from December to May. Total climatic situation were recorded during the crop growth season. Plant samples were collected randomly to determine number of tillers (cm), spike length (cm), number of grains spike, 1000-grain weight (g), plant height at maturity (cm) and grain yield (kg/ha). The data were analyzed statistically using analysis of

Plant Height (cm)

Plant height was manually recorded with the help of scale during maturity. Significant differences among varieties are found. The maximum plant height (102.6cm) was measured in Harvest Plus. HUW-468 and HUW-234 produced almost same plant height of 96.43 and 95.48 cm respectively while produced short statured plants of 64.13cm. Sowing wheat on November had significantly taller plants (102.6) and longer vegetative growth period with better environmental conditions than December sowing plant. It fluctuated to temperature and solar radiation (Qasim *et al*., 2008).

Number of Tillers

Tillering was mainly depends upon the green photosynthetic area which is responsible for carbohydrate formation, grain filling and final grain yield (Khalifa, 1968). The tiller of per plant was recorded manually.W5 have more tiller than other wheat plant.

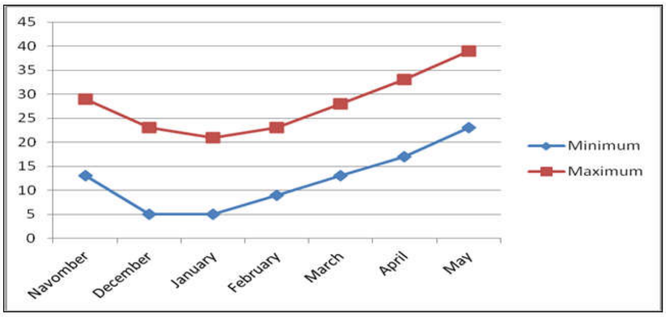

Figure 1. Maximum and minimum temperature of both environment during Navomber to May 2015-16

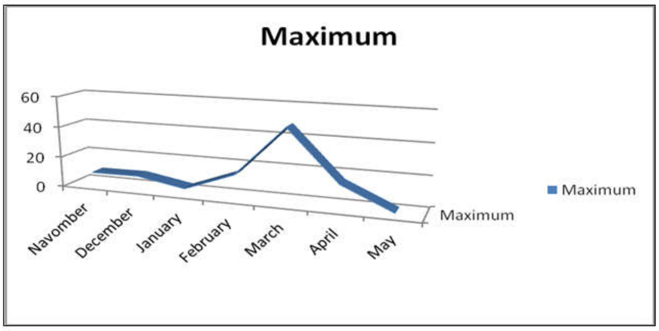

Figure 2. Monthly rainfall of wheat crop during Navomber to May 2015-16

Grain Yield (Kg/ha)

There were non-significant differences among wheat varieties for grain yield. Harvest Plus produced comparatively higher grain yield (1809 kg/ha) followed by HUW-234 (1784 kg/ha). The lowest grain yields were obtained in HUW-468 (1268 kg/ha), HUW-510 (1356 kg/ha), ND-1014 (1268 kg/ha) and ND-2036 (1186 kg/ha) in late season as E2.

heading, number of tiller, days to maturity, 1000 grain weight, biological yield and harvest index. Phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation for all the characters under study. The highest PCV was recorded for effective tillers per plant followed by grain yield per plant, number of grains per plant, biological yield per plant, plant height, and days to heading (Table 3). The highest heritability was recorded (Table 3) for days to maturity followed by biological yield per plant, number of grains per plant, days to heading, grain yield per plant and effective tillers per plant. Moderate value of heritability was observed for these traits. High heritability with high genetic advance indicates additive gene effects and, therefore, these characters can be better exploited through simple selection. The high variability obtained for grain yield, biological yield and grains per ear (Din *et al*., 2010).

Correlation of Environment with Wheat Quality

In the present study, E1 (IESD, BHU, Varanasi) appeared to be the most favorable (Figure 1 and 2) for the genetic manifestation of yield and yield contributing characters as compared to E2 (Agricultural Farm BHU) Varanasi. In wheat, timely sown crop with recommended doses of inputs (irrigation and fertilizers) result in high productivity of different characters with grain yield whereas reduction in productivity were observed in late sown study and low fertility condition. The analysis of variance indicated the existence of sufficient genetic variation among various genotypes for all the characters studied in both environments. Arya *et al*. (2005) also reported sufficient genetic variation among genotypes for all the traits in wheat. In this study, grain yields were 58.37% higher in sowing near October month as applicable, than the subsequent sowing dates. Smith & Humphreys, (2001) developed simulation models to predict the effects of seasonal variation, sowing time etc and suggested that early wheat

Table 3. Analysis of variance for 9 characters and 36 genotypes of Wheat

Characters	Mean ±SE	Range	GCV (%)	PCV (%)	Heritability (%)	Mean of Genetic Variability (%)
Plant height (cm)	86.03±0.416	69.50- 103.51	8.43	11.63	30.80	11.19
Number of tillers per plant	13.19±0.103	8.12- 14.55	22.66	26.38	57.10	43.66
Days to maturity	124.12±0.197	108.50- 119.39	9.84	9.38	68.38	13.52
Days to heading	82.38±0.487	73.00- 97.18	6.87	12.39	53.30	19.67
Number of grains per ear	47.81±0.276	31.90- 67.23	13.52	14.42	64.80	29.13
1000-grain weight (g)	37.93±0.928	23.44- 42.18	9.44	12.40	36.30	9.48
Biological yield	66.23±0.340	52.26- 72.06	14.35	16.32	61.40	27.29
Grain yield per plant	29.67±0.113	18.53- 42.32	14.57	19.73	53.60	30.56
Harvest index	36.93±0.104	37.04- 56.36	6.79	15.10	28.30	9.67

Highest and similar grain yield (2474 and 2296 kg/ha) were obtained from applicable sowing dates whereas the last planting date (December) produced the lowest (931 kg/ha) grain yield. The data again elucidated significant differences between varieties and planting dates. Higher grain yield in Harvest plus was mainly higher grain weight due to higher number of tillers as comparable. This interaction between cultivar and sowing date for yield can largely be explained by differences in time to heading among the cultivars (Ortiz-Monasterio *et al.,* 1994).

Genetic Variation in Wheat Variety

In the present investigation the highest genotypic coefficient of variation (GCV) was observed for effective tillers per plant followed by plant height, number of grains per plant, days to

sowing should be done to high yields. The lower grain yield with delayed sowing was attributed to reduced number of grains due due to high post-anthesis temperatures (McDonald *et al*., 1983). Wheat traits association is relevant to mutual relationship between traits of wheat and regarding to natural selection. These were followed by wheat improvement of crop under manipulation in suiTable environmental condition. Grain yield per plant were highly significant and positively affected by genotypic and phenotypic correlations with grains per spike, tillers per plant, spike length, grain filling period, grain weight per spike, and harvest index. Wheat is a winter crop, requires particular environmental conditions for better emergence, growth and flowering if exposed to high temperatures during reproductive stages (Kalra *et al*., 2008), it is seasonally, fluctuate in different temperature (Figure 1) and create potential impacts in the plant for grain development and complete life cycle. More lately sowing produces weak plants with poor root system, which leads to irregular germination, frequent death of the embryo and decomposition of endosperm due to high wind and temperature (Paul, 1992). These planting are affects germination, growth, grain development and produces poor tillering (Tahir *et al*., 2009). These traits were the key contribute to yield per plant suggesting the need of more emphasis on these component characters for increasing the grain yield in wheat. These results are followed by Chanddra *et al*. (2007) for spike length and days to maturity. Khan *et al*. (2010) reported that plant was positively correlated with grain yield at genotypic level. Therefore, substantial amount of yield improvement is possible in wheat, even in the late sown condition consideration. The wheat crop selections were monitored to environmental consideration. All late wheat varieties produced poor grain yield when planted in December.

Conclusion

A substantial amount of genetic variability was observed for all the traits under study. Genotypic coefficients of variation were lower than the phenotypic coefficients of variation. The highest phenotypic and genotypic coefficients of variation were observed for effective tillers per plant in all the environments. Significant and positive correlation of grain yield with biological yield per plant, effective tillers per plant and number of grains per ear were recorded. Effective tillers per plant showed positive and significant correlation with biological yield per plant. The path coefficient analysis suggested that biological yield per plant is the most important component assessing the grain yield per plant in all the environments except days to maturity and effective tillers per plant in E2. Thus, this study will be importance in breeding for higher grain yield.

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Abbreviation

E= Environment, LSD=least significance difference, GCV= genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, G=Gram, C= Centimeter, Kg= Kilogram, Ha= Hectare, N= Nitrogen, IESD= Institute of Environment and Sustainable Development, BHU= Banaras Hindu University.

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