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VARIABILITY STUDIES IN BREAD WHEAT (*Triticumaestivum* L.) UNDER RESTRICTED IRRIGATED CONDITION

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Abstract: *In the present investigationforty genotypes of wheat were evaluated foridentification of promising genetic stock of wheat (Triticumaestivum L.) under restricted irrigated conditionduring Rabi 2015-16 with objective to study the variability, heritability, genetic advance and correlation coefficient. Highest estimates of genotypic and phenotypic coefficient of variation was observed for grain yield per plant and moderate estimate of genotypic coefficient of variance (GCV) were observed for protein content followed by, sedimentation value, beta (β) carotene, harvest index, number of productive tillers per running meter and spike length. Phenotypic coefficient of variation (PCV) was found to be little more than the genotypic coefficient of variation (GCV) for all the characters, indicating the less role of environment in the expression of these characters.Heritability (broad sense) revealed that it was high for all characters except hectolitre weight and number of productive tillers per running meter. Traits viz., protein content, followed by sedimentation value, grain yield per plant, beta (β) carotene and harvest index shows high heritability with high genetic advance as a percent of mean indicating additive gene action. Thus, selection for these traits in wheat may be effective for increasing yield. High heritability with low genetic advance as per cent of mean was observed for days to maturity. This result indicate the non-additive genetic variance for expression such trait*

Key words: *Variability, heritability, genetic advance, genotypic coefficient of variation, phenotypic coefficient of variation.*

Introduction

Wheat is the second most important food crop next to rice consumed by nearly 35% of the world population and providing 20% of the total food calories. It belongs to the genus *Triticum* of the family Poaceae and its origin is to be Middle East region of Asia. The presence of genetic variability is pre requisite that aims at genetic improvement of any cropwhereas heritability is important parameters for the success of breeding programme. Grain yield, which is the most important component of wheat crop is a complex character and is a final product of several contributing factors and their interactions. The effectiveness of the selection of both yield, which is quantitative character and the yield components depend on the genetic variability and heritability. It is necessary to specify the components that establish the phonotypical variation in order to predict the genetic variation and heritability based on the variation.

The study of genetic variability is the pre-requisite for any crop improvement programme. Success in recombination breeding depend on suitable exploitation of genotypes as parent of obtaining high heterotic crosses and transgressive sergeants or the presence of genetic variability in base population is essential (Allard, 1960). Selection on the basis of phenotypic variation is not efficient and selection therefore, based on evaluation and utilization of genetic variability in a desired direction is extremely important in wheat improvement programme.

Keeping in view the importance of yield present study was designed to find out the extent of variability, heritability, genetic advance present among various yield and yield associated traits.

Material and Methods

This study was conducted at Post Graduate Research farm, Mahatma PhuleKrishiVidyapeeth, Rahuri, District Ahmednagar (Maharashtra) during *Rabi,* 2015-16 withforty genotypes of bread wheat

(*Triticumaestivum* L.) along with eight checks [NI 5439, *Netravati* (NIAW 1415), *PhuleSamadhan* (NIAW 1994), NIAW-34, RAJ 4083, LOK-1, DBW 17 and DBW 93] obtained from the Agriculture Research Station, Niphad, Dist- Nashik. The experiment was conducted in Randomised Block Design (RBD) with two replications. For restricted irrigated condition only single irrigation was given at 42 days after sowing during the entire crop season.All the recommended cultural practices were followed to raise a good crop.Quality parameters including physical and chemical were also worked out at Department of Food Science & Technology, by following the standard protocol for each parameter. Physical parameter includes hectolitre weight (kg/hl) while chemical parameters includes sedimentation value (ml), beta (β) carotene (ppm) and protein (%).Ten plants were selected randomly from each treatment and average of these ten plants were used for statistical computation.

Statistical Analysis

The analysis of variance for different characters was carried out using the mean data into different sources by following the method given by Panse and Sukhatme (1995). The phenotypic and genotypic variances were calculated by using respective mean sum squares from variances table. (Johnson *et al.* 1955).The genotypic and phenotypic coefficients of variation were computed as per the methods suggested by Burton (1952). The genotypic and phenotypic coefficients of variability were undertaken according to the formulae of Singh and Chaudhary (1977). The genetic advance as percent of population mean was also estimated following the procedure of Johnson *et al.* (1955).

Table 1: List of Wheat Genotypes

Sr. No.	Genotype	Contributing centre	Sr. No.	Genotype	Contributing centre
1	NIAW 2721		21	NIAW 3340	
2	NIAW 2725		22	NIAW 3354	
3	NIAW 2822		23	NIAW 3411	
4	NIAW 2891		24	NIAW 3423	
5	NIAW 2930		25	NIAW 3498	Agricultural Research Station Niphad
6	NIAW 3033		26	NIAW 3516	
7	NIAW 3056		27	NIAW 3518	
8	NIAW 3074	Agricultural Research Station,Niphad	28	NIAW 3523	
9	NIAW 3096		29	NIAW 3525	
10	NIAW 3108		30	NIAW 3538	
11	NIAW 3170		31	GW 477	JAU,Junagarh (Gujarat)
12	NIAW 3212		32	HI 1605	IARI, Indore
13	NIAW 3217		33	NI 5439 ©	
14	NIAW 3220		34	*Netravati* (NIAW 1415)©	Agricultural Research Station Niphad
15	NIAW 3227		35	*PhuleSamadhan* [NIAW 1994]©	
Sr. No.	**Genotype**	**Contributing centre**	**Sr. No.**	**Genotype**	**Contributing centre**
16	NIAW 3242	Agricultural Research Station,Niphad	36	NIAW 34 ©	ARS, Niphad
17	NIAW 3245		37	RAJ 4083 ©	SKNRAU, Durgapura
18	NIAW 3303		38	LOK 1 ©	Lokbharti, Sansora
19	NIAW 3309		39	DBW 17 ©	IIWBR, Karnal
20	NIAW 3338		40	DBW 93 ©	

Result and Discussion

The analysis of variance results for the fourteen studied traits showed significant ($p<0.01$) differences among genotypes for the yield and yield contributing characters.This suggested the presence of considerable variations among genotypes for many of the traits studied. This also indicated the presence of ample scope of selection for different quantitative characters for the improvement of the crop.

The general mean for grain yield per plant was 3.159 g (Table 4.2). The variation in grain yield per plant ranged from 1.859 g (NIAW 3518) to 4.899 g (NIAW 3220).The genotype NIAW 3220 (4.899 g) was found to be statistically significant for grain yield per plant over the best check*Netravati* [NIAW 1415] (4.161 g).Whereas, lowest grain yield per plant was shown by NIAW 3518 (1.859 g)

The superior genotypes in the population may be attributed to the possible accumulation of favorable genes reservoir of variability for different characters of plant species resulting from available natural or artificially synthesized variants or strains constitute its germplasm. Germplasm bearing high intensity of economic traits is extremely useful in engineering superior genotypes. The quantitative measurement of individual character provides the basis for an interpretation of different variability parameters. The phenotypic variability which is observable includes both genotypic and environmental variation. It changes under different environmental conditions. Estimation of phenotypic and genotypic coefficient of variation for the fourteen characters studied is presented in table 3. The highest variability (VP or σ^2_P and VG or σ^2g) was recorded for number of tillers per running meter (88.30 and 46.03) followed by sedimentation value (26.40 and 24.77).The low values were observed for beta (β) carotene value (0.17 and 0.16)

Estimates of variability components

1. Genotypic and phenotypicvariations:

The genotypic variance ranged from 0.16 to 46.03. The magnitude of genotypic variance was maximum for number of productive tillers per running meter (46.3) followed by sedimentation value (24.77), days to 50 per cent flowering (24.40), plant height (21.65), harvest index (15.46), number of grains per spike (10.38), 1000 grain weight (9.76).The range of phenotypic variance (σ^2p or VP) was observed from 0.17 to 88.3. The magnitude of phenotypic variance was maximum for number of productive tillers per running meter (88.3) followed by sedimentation value (26.4), days to 50 per cent flowering (26.19), plant height (23.33) and harvest index (18.43). Lowest phenotypic and genotypic variance (σ^2g or VG and σ^2p or VP) was observed for Beta (β) carotene 0.16 and 0.17 respectively. Gupta and Verma (2000) reported that phenotypic coefficient of variation (PCV) is much higher than the genotypic coefficient of variation (GCV) for number of tillers per plant, grain yield per plant and harvest index indicating that apparent variation for the characters was not only due to genotypes but also due to influence of wide range of phenotypic (VP or σ^2_P) and genotypic variance (VG or σ2g) observed in the experimental material.

As per Sivasubramanian and Madhavamenon (1973),the highest estimate of genotypic coefficient of variance (GCV) was observed for grain yield per plant (20.52) and moderate estimate of genotypic coefficient of variance (GCV) were observed for protein content (19.20) followed by, sedimentation value (15.86), β carotene (12.89), harvest index (12.24).

The lower magnitude of GCV was observed for days to maturity (2.41) followed by hectolitre weight (2.68).The highest estimate of phenotypic coefficient of variance (PCV) was observed only for grain yield per plant (22.61) [Table 2]. The medium PCV were observed for protein content (19.64) followed by sedimentation value (16.38), number of productive tillers per running meter (15.75), and lower PCV was recorded for days to maturity (3.05), followed byhectolitre weight (3.57).

The PCV was relatively greater than GCV for all the fourteen traits, however, the magnitude of the difference was low for spike length, protein content, beta carotene and grain yield per plant. This suggested that the marked influence of environmental factors for the phenotype expression of genotypes was low and the higher chance of improvement of these traits through selection based on the phenotype performance. The difference between PCV and GCV were relatively high for number of tillers per running meter, number of grains per spike, thousand grain weight, hectolitre weight and days to maturity (Table 2). This implies greater influence of environmental factors for the phenotypic expression of these characters that make difficult or practically impossible to exercise selection based on phenotypic performance of the genotypes to improve the characters.

2. Estimates of heritability in broad sense:

According to Johnson, *et al.* (1955), highest estimates of heritability was computed for protein content (95.50 %)followed by sedimentation value (93.80 %), days to 50 per cent flowering (93.18 %), plant height (92.79 %), β carotene (92.26 %), harvest index (83.86 %), grain yield per plant (82.35 %). Rest of the characters also shows highest estimates of heritability except characters hectolitre weight (56.17 %) and number of productive tillers per running meter (52.13 %) showed medium heritability.(Table 2). This result suggested selection could be fairly easy and improvement is possible using selection breeding for these traits improvement. Characters hectolitre weight and number of productive tillers per running metershowed moderate heritabilitywhich suggested that selection should be delayed to more advance generations for these traits.Salman*et al.* (2014) reported high heritability estimates for grain yield, number of kernels per spike, spike length and number of tillers per plant.

3. Estimates of expected genetic advance

The range of genetic advance was from 0.79 to 10.09. The moderate estimate of genetic advance was noticed for number of productive tillers per running meter (10.09). Whereas lower estimate of genetic advance was noticed for sedimentation value (9.93) followed by days to 50 per cent flowering (9.82), plant height (9.23), harvest index (7.42) (Table 2)

As perJohanson*et al.* (1955a), genetic advance as percent of meanwas observed highest for protein content (38.64 %) followed by, grain yield per plant (36.26 %), sedimentation value (31.65 %), β carotene (25.50 %) and harvest index (23.09 %) (Table 2). Whereas the moderate estimate of genetic advance as a per cent of mean was noticed for spike length (19.15 %) followed by days to 50 per cent heading (17.63 %), plant height (17.43 %). The low genetic advance as a per cent of mean was noticed days to maturity (3.91) and for hectolitre weight (4.14 %). This refers to improvement of this character in genotypic value for the new population compared with the base population with one cycle of selection is not rewarding. It was suggested that the importance of considering both the genetic advance and heritability of traits rather than considering separately in determining how much can progress be made through selection (Johnson *et al.*, 1955).

Table 2 Genetic variability parameters for grain yield and its component in wheat (*T.aestivum*L.)

Sr. No.	Characters	General Mean	σ^2p	σ^2 g	σ^2 e	PCV (%)	GCV (%)	ECV (%)	Heritability % (b.s.)	Genetic Advance	GA as a % of mean
1	Days to 50 per cent flowering	55.71	26.19	24.40	1.79	9.19	8.87	2.40	93.18	9.82	17.63
2	Days to maturity	101.40	9.56	5.95	3.61	3.05	2.41	1.87	62.25	3.97	3.91
3	Plant height (cm)	53.19	23.33	21.65	1.68	9.12	8.78	2.45	92.79	9.23	17.43
4	Spike length (cm)	7.42	0.78	0.61	0.17	11.87	10.51	5.53	78.31	1.42	19.15
5	No. of spikelets/spike	11.30	1.33	0.97	0.36	10.21	8.71	5.33	72.78	1.73	15.30
6	No. of grains/spike	34.59	13.27	10.38	2.89	10.53	9.32	4.91	78.25	5.87	16.98
7	No. of productive tillers /running meter	59.68	88.30	46.03	42.27	15.75	11.37	10.90	52.13	10.09	16.91
8	1000 grain weight (g)	33.28	12.77	9.76	3.01	10.74	9.39	5.21	76.44	5.63	16.90

9	Harvest Index	32.12	18.43	15.46	2.98	13.37	12.24	5.37	83.86	7.42	23.09
10	Hectolitre weight (g)	77.38	7.65	4.30	3.35	3.57	2.68	2.37	56.17	3.20	4.14
11	Protein content (%)	9.06	3.15	3.01	0.14	19.64	19.20	4.17	95.50	3.49	38.64
12	Sedimentation value (ml)	31.38	26.40	24.77	1.64	16.38	15.86	4.08	93.80	9.93	31.65
13	Beta (β) carotene (ppm)	3.10	0.17	0.16	0.01	13.42	12.89	3.73	92.26	0.79	25.50
14	Grain yield/plant (g)	3.159	0.48	0.39	0.09	21.94	19.65	9.76	80.23	1.15	36.26

In the present study, high heritability with high genetic advance as a percent of mean indicating additive gene action was observed for traits *viz*., grain yield per plant, harvest index, protein content, sedimentation value andbeta (β) carotene, (Table 2). Thus, selection for these traits in wheat may be effective for increasing yield.

These results are in conformity with results of Gupta and Verma (2000) for grain yield; Majumder*et al*. (2008) for harvest index and grain yield per plant; Subhashchandran*et al*. (2009)and Yadav*et al*. (2011) for grain yield per plant.

Whereas, high heritability with moderate genetic advance as a percent of mean was observed for days to 50 per cent flowering followed by plant height, spike length, number of spikelets per spike, number of grains per spike, 1000 grain weight and high heritability with low genetic advance as per cent of mean was observed for days to maturity. This result suggested the non-additive genetic variance for expression of traits.

High heritability coupled with moderate genetic advance was reported earlier by Subhashchandra (2009) for plant height. Whereas, high heritability with low genetic advance was also reported by kumar*et al*. (2013) for days to maturity.

Conclusions

Significant differences were observed among genotypes for most of the traits studied. Hence, from the present finding it is concluded that the wheat genotypes used has adequate variability for most of the traits which need to be used in future wheat breeding programme. Characters like harvest index, grain yield per plant, protein content, sedimentation value and beta carotene showed high heritability coupled with high genetic advance therefore, these characters should be given top priority during selection breeding in wheat. Character days to maturityshowed high heritability with low genetic advance as per cent of mean indicates the non-additive genetic variance for expression ofsuch trait Since, these findings are based on one year trial; further testing is needed to substantiate the results.

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