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ESTIMATION OF GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES UNDER NORMAL AND LATE SOWN CONDITION

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Abstract

The present investigation was carried out at CRC, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut. The experimental materials for the present study involved 10 genetically diverse wheat varieties namely, HUW 510, PBW 373, RAJ 3765, K 9423, AAI 1536, RAJ 4128, HUW 251, C 306, DBW 17 and PBW 343. These parental lines were mating in diallel fashion excluding reciprocals during the *rabi* season of 2015-2016. The parents and their 45 F1s were also grown in the next year during *rabi* season of 2016-2017 under irrigated conditions in randomized block design with three replications with two date of sowing *i.e*., timely sown (E1) on 25 November, 2016 and late sown (E2) 30 December 2016. In general, the magnitude of phenotypic coefficient of variation (PCV) was higher than the corresponding genotypic coefficient of variation (GCV) for all the traits. High estimates of heritability in broad sense were found for the traits namely, proline content, days to maturity, biological yield per plant, plant height, leaf senescence, number of grain per spike, days to 50 % flowering, flag leaf area, number of productive tillers per plant, grain filling duration and chlorophyll content at anthesis under both timely sown and late sown condition. Moderate genetic advance was observed for number of productive tillers per plant, grain filling duration, plant height, flag leaf area, number of grain per spike and chlorophyll content at anthesis in both timely sown and late sown condition. This study suggests that the presence of adequate genetic variability, heritability and genetic advance for these traits under timely and late sown condition is suitable for breeding programs and crop improvement.

Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop for the majority of world's populations. It is an important staple food of about two billion people (36% of the world population). Wheat is cultivated over a wide range of climatic conditions and therefore, understanding of wheat genetics is of great value. Wheat belongs to family *Poaceae* (*Gramineae*) which includes major crop plants such as, barley (*Hordeum vulgare* L.), oat (*Avena sativa* L.), rye (*Secale cereale* L.), maize (*Zea mays* L.) and rice (*Oryza sativa* L.). *Triticeae* is one of the tribes containing more than 15 genera and 300 species including wheat and barley. Wheat accounts about 30% of the world's cereal area, with over 200 million ha cultivated area often under abiotic stresses (Cossani and Reynolds, 2012). *Triticum aestivum* and *Triticum durum* account for about 95 % and 5% of the world wheat production respectively, providing food to 36% of the global population contributing 20% of the food calories (Prerna *et al.,* 2013).

In India, temperatures during grain filling of wheat frequently rise above 30^0C and can reach upto 40^0C occasionally. The main objective of any breeding programs is to develop high yielding and better quality lines and release as cultivars to farmers (Ehdaie and Waines, 1989). To achieve this goal sufficient variability must be present to select the desired lines. For successful varietals improvement program, the identification of better genotypes with desirable traits is imperative. Selection for grain yield improvement can only be effective if sufficient genetic variability is present in the genetic material (Ahmed *et al*., 2007) Yield contributing traits with high heritability and high genetic advance have great importance in selection of genotypes in early generations (Mangi *et al*., 2008). In the present investigation was conducted to estimate the vaiability and heritability in 45 $F_{1,s}$ (half diallel crosses) and 10 parental line under timely and late sown conditions.

Materials and Methods

The experimental materials for the present study involved 10 genetically diverse wheat varieties namely, HUW 510, PBW 373, RAJ 3765, K 9423, AAI 1536, RAJ 4128, HUW 251, C 306, DBW 17 and PBW 343. These parental lines were mating in diallel fashion excluding reciprocals during the *rabi* season of 2015-2016. The parents and their 45 F1s were also grown in the next year during *rabi* season of 2016-2017 under irrigated conditions in randomized block design with three replications with two date of sowing *i.e.* timely sown (E1) on 25 November, 2016 and late sown (E2) 30 December 2017. Data were recorded for 16 characters namely, days to 50 % flowering, days to maturity, plant height (cm), number of productive tillers per plant, grain filling period, spike length (cm), number of grains per spike, 1000 grain weight (g), biological yield per plant (g), grain yield per plant (g), proline content (mg/g), chlorophyll content at anthesis, chlorophyll content 10 days after anthesis, flag leaf area (cm2), leaf senescence and harvest index (%). Five randomly selected plants in each row of each raplication for all characters were recorded under study except of days to 50% flowering and days to maturity which were recorded on plot basis.

Results and Discussion

The estimates of coefficient of variation, genotypic coefficient of variation and phenotypic coefficient of variation along with general mean and range for 16 traits are given in table 1. In general, the phenotype coefficients of variation were higher than of genotypic coefficient of variation for all the characters studied which indicated the influence of environment on the expression of these characters. In the present study, moderate (10 to 20%) phenotypic coefficients of variation were found for the traits namely proline content, grain yield per plant, biological yield per plant and number of productive tillers per plant under both timely sown and late sown condition and chlorophyll content at anthesis under late sown condition. Whereas, grain filling duration, flag leaf area, harvest index, spike length, number of grain per spike, plant height, chlorophyll content after 10 days from anthesis, 1000 grain weight, days to 50% flowering, days to maturity, leaf senescence under both timely sown and late sown condition; and chlorophyll content at anthesis under timely sown condition showed low (< 10%) phenotypic coefficients of variation.

Highest genotypic coefficient of variation was observed for proline content, grain yield per plant and biological yield per plant under both timely sown and late sown condition and number of productive tillers per plant under late sown which is showed moderate (10 to 20%) genotypic coefficients of variation. Whereas, flag leaf area, chlorophyll content at anthesis, grain filling duration, number of grain per spike, plant height, chlorophyll content after 10 days from anthesis, harvest index, spike length, days to maturity, leaf senescence, days to 50 % flowering and 1000 grain weight under both timely sown and late sown condition and number of productive tillers per plant under timely sown condition showed low (< 10%) genotypic coefficients of variation.

The systematic breeding programme involved three main steps namely, creating genetic variability, practicing selection and utilization of selected genotype to develop promising varieties. Heritability denotes transmissibility of a character from parent to offsprings. Higher the heritability of a character, more effective will be the selection. Heritability and genetic advance are influence by a number of factors like type of genetic materials, size of sample, sampling method, conduct of experiment, method of calculation and linkage (Hanson, 1959). In the present study, High estimates of heritability in broad sense were found for the traits namely, proline content, days to maturity, biological yield per plant, plant height, leaf senescence, number of grain per spike, days to 50 % flowering, flag leaf area, number of productive tillers per plant, grain filling duration and chlorophyll content at anthesis under both timely sown and late sown condition and spike length under timely sown condition and 1000 grain weight under late sown condition which showed high (>60%) heritability. Whereas, harvest index and chlorophyll content at 10 days after anthesis under both timely sown and late sown condition and grain yield per plant and 1000 grain weight under timely sown and spike length showed moderate heritability (60 to 30%). Johnson *et al*., (1955) stated that without genetic advance, the estimates of heritability would not be of practical importance based on phenotypic expression and emphasized the concurrent use of genetic advance along with heritability. Direct and indirect selection may be judged by their genetic gain. The effective improvement in the attributes would be based on quantum of genetic advance. Genetic advance has no independent identify but has an added advantage over heritability as a guiding factor to the plant breeders during selection programmes, where the character is to be improved through the series of selections in segregating generations.

Genetic advance as % of mean is more important for observing the genetic gain. In the present study, high % of genetic advance (more than 20 %) was observed for only proline content in both timely sown and late sown condition and biological yield per plant and grain yield per plant under late sown condition. Moderate genetic advance was observed for number of productive tillers per plant, grain filling duration, plant height, flag leaf area, number of grain per spike and chlorophyll content at anthesis in both timely sown and late sown condition and spike length in timely sown condition. days to 50 % flowering, days to maturity, 1000 grain weight, chlorophyll content after 10 days from anthesis, leaf senescence, and harvest index under both timely sown and late sown condition and spike length under late sown condition exhibited low genetic advance. Hanson (1963**)** stated that heritability and genetic advance are two complimentary concepts. Genetic advance would be overestimated in case of low selection proportion with high heritability or high selection proportion with low heritability while it would be underestimated when both selection proportion and heritability were high or low.

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Table 1: Mean, Range, Genotypic Coefficient Variance, Phenotypic Coefficient Variance, Heritability and genetic advance for 16 characters in wheat

Genetic parameters Characters		Range		Mean	Coefficient of variation		H^2 broad sense	Genetic advance	Genetic advance as % of mean
		lowest	Highest		GCV	PCV			
Days to 50% flowering	TS	92.67	105.00	98.61	3.27	3.45	90	6.28	6.37
	LS	80.00	91.67	84.02	3.07	3.33	85	4.89	5.82
Days to maturity	TS	127.00	142.67	133.41	3.06	3.17	94	8.14	6.11
	LS	104.00	119.00	109.70	3.47	3.60	93	7.58	6.91
Plant height	TS	85.83	115.77	94.89	7.18	7.44	93	13.54	14.27
	LS	67.23	94.60	83.69	6.45	6.88	88	10.42	12.45
Number of productive tillers per plant	TS	7.00	11.00	9.17	8.85	10.09	77	1.47	16.01
	LS	5.00	8.00	6.54	10.41	11.61	80	1.26	19.22
Grain filling duration	TS	30.00	40.33	34.79	7.93	8.56	86	5.27	15.14
	LS	22.33	30.33	25.67	7.59	8.72	76	3.49	13.60
Spike length	TS	8.90	11.97	10.71	6.27	7.67	67	1.13	10.54
	LS	8.50	11.03	9.94	5.06	6.77	56	0.78	7.80
Number of Grains per spike	TS	39.72	59.12	52.32	6.13	7.59	65	5.33	10.20
	LS	36.03	51.97	46.70	6.70	7.23	86	5.98	12.80
1000 grain weight	TS	37.43	44.40	41.92	3.08	4.31	51	1.90	4.53
	LS	36.23	41.67	38.68	3.04	3.49	76	2.11	5.47
Biological yield per plant	TS	29.27	52.17	42.16	10.79	13.43	65	7.52	17.85
	LS	17.00	38.63	27.55	15.78	16.43	92	8.60	31.20
Grain yield per plant	TS	13.53	25.18	20.09	11.27	14.72	59	3.57	17.78
	LS	7.51	15.51	11.84	13.82	15.58	79	2.99	25.25
Proline content	TS	9.03	23.87	15.62	24.85	25.47	95	7.80	49.94
	LS	11.50	33.60	23.58	21.40	21.93	95	10.15	43.04
Chlorophyll content at anthesis	TS	29.40	42.90	37.96	6.95	8.82	62	4.28	11.27
	LS	28.10	40.10	34.56	8.55	10.14	71	5.14	14.87
Chlorophyll content at 10 days after anthesis	TS	36.60	49.30	42.02	4.96	7.35	45	2.89	6.88
	LS	32.80	44.30	38.56	6.03	8.12	55	3.56	9.22
Flag leaf area	TS	30.70	40.00	34.76	6.45	8.17	62	3.65	10.50
	LS	23.40	35.10	29.40	8.84	9.83	81	4.82	16.38
Leaf senescence	TS	118.67	135.00	127.05	3.04	3.17	92	7.64	6.01
	LS	100.00	115.00	105.23	3.12	3.33	88	6.33	6.01
Harvest index	TS	41.16	54.10	47.73	5.83	7.98	53	4.19	8.78
	LS	36.90	47.90	43.20	5.11	7.86	42	2.95	6.83