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Short Communication

Variability and character association for various floral characters in wheat [*Triticum aestivum* (L.) em Thell.]

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Wheat [*Triticum aestivum* (L.) Thell.] production in the north-west plains zone has reached to a saturation level and to break the yield barriers, new innovative approaches are needed for which development of wheat hybrids is one of the most promising techniques. In this regard, knowledge about the variability and character association between floral characters is crucial. An experiment was conducted with the objective of studying the extent of variability present in some wheat genotypes for various floral characters and correlation between these floral characters. For the study 92 CPAN (Coordinated Project Accession Number) genotypes of wheat were taken from the wheat germplasm maintained at Banaras Hindu University, Varanasi. These genotypes are basically exotic genotypes that are acclimatized to the Indian climate. These genotypes were sown in randomized block design with three replications for two consecutive years with plot size of double row of 3m length. The data were recorded for eight floral characters in following manner and analyzed to work out the variance [1], coefficients of variability [2], heritability in broad sense [3], genetic advance and correlation coefficients [4].

Days to 50% flower were the number of days from sowing to the stage when about 50% plants had anther emerged from spike. Anther length was measured in mm using a dissecting microscope and ocular micrometer scaled to 0.1 mm increments and was recorded as the average of three anthers belonging to a lateral floret of the central spikelet of a spike. Stigma length (mm) was also measured using a dissecting microscope and ocular micrometer, and was recorded as the average from two stigma of one lateral floret from a central spikelet of a spike. Anther extrusion (%) was measured after counting the extruded anthers of two lateral florets of five central spikelets from each of the ten spikes/replication. Openness of floret was measured in degree using divider and protractor. It was taken as the separation angle between the glumes of first two florets of a spikelet. Duration of floral opening was recorded in minutes from the time of opening to closing of florets. The data was recorded on five florets of each of the three randomly selected spikes in each replication. The observations were made on three consecutive days on five florets of the same spike. The dark stained pollen grains were counted after preparing the slide under microscope in three anthers from each of the three central spikelets of five randomly selected spikes per replication for measuring the pollen viability (%). Spikelet length (mm) was measured from the base to the tip excluding awns.

The pooled analysis of variance (Table.1) showed highly significant differences among genotypes for all the floral characters. A wide range was observed for almost all the floral characters [5,6]. In general,

Table 1. Analysis of variance (ANOVA) for various floral characters in wheat

Source	df	Mean sum of squares							
		Days to 50% flower	Anther length	Stigma length	Anther extrusion	Openness of floret	Duration of floral opening	Pollen viability	Spikelet length
Year	1	0.001	0.003	0.001	0.125	0.093*	0.000	1.000*	0.008
Replications	2	22.000**	0.242**	0.161**	2.688**	0.109**	43.462**	4.000**	0.172**
Year × replication	2	0.010	0.001	0.001	0.437**	0.031	0.000	0.750*	0.000
Genotypes	91	124.594**	0.526**	0.557**	1976.521**	56.061	227.427**	24.465**	6.87
Year × genotypes	91	0.010	0.001	0.000	0.060	0.001	0.000	0.007	0.001
Error	364	0.249	0.002	0.002	0.048	0.014	0.530	0.170	0.013

*,** Significant at 5% and 1 % level, respectively.

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phenotypic coefficients of variability were higher than the corresponding genotypic coefficients of variability (Table.2). Anther extrusion had maximum phenotypic as well as genotypic coefficient of variability followed by duration of floral opening, openness of floret and stigma length. Very high estimates of heritability % in broad sense were observed for all the characters studied but genetic advance as per cent of mean was high for anther extrusion and duration of floral opening only. High heritability in combination with higher genetic advance for anther extrusion and duration of floral opening indicates that substantial improvement for these characters could be achieved through direct selection. Such characters are considered to be governed by additive gene action or by fewer numbers of genes. From the results, some promising genotypes for various floral characters were identified. Among them, CPAN 1990, CPAN 1992, CPAN 4003, CPAN 4104, CPAN 3013 and CPAN 3050 were superior for three or more characters and these can be used as donors for these floral characters in order to generate parental lines for hybrid development programme.

Table 2. Estimates of genetic parameters for different floral characters in wheat

Characters	Range	Mean	Coefficients of variability (%)		Heritability (%)	Genetic advance (GA)	GA as % of mean
Days to 50% flower (days)	73.33-90.33	82.90±0.29	5.53	5.50	98.80	9.33	11.25
Anther length (mm)	3.16-4.81	4.15±0.02	7.21	7.14	97.90	0.60	14.45
Stigma length (mm)	2.13-3.42	3.00±0.02	10.24	10.15	98.30	0.62	20.67
Anther extrusion (%)	14.10-82.58	50.62±0.13	35.86	35.86	99.90	37.39	73.80
Openness of floret (o)	15.23-32.57	23.80±0.07	12.85	12.84	99.90	6.29	26.43
Duration of floral opening (minute)	11.00-36.00	21.72±0.42	28.55	28.35	98.60	12.59	57.97
Pollen viability (%)	86.56-95.82	90.94±0.24	2.27	2.22	96.00	4.08	4.48
Spikelet length (mm)	12.28-17.43	14.80±0.06	7.27	7.23	98.90	2.19	14.80

Study of the associations between these floral characters (Table. 3) showed high values of genotypic correlation coefficients than their respective phenotypic correlation coefficients. Anther length had shown high and significant association with stigma length, anther extrusion, openness of floret and duration of floral opening. Anther extrusion also had significant association with openness of floret and duration of floral opening [7]. Pollen viability on the other hand was significantly associated with days to 50% flower in negative direction that indicated more pollen viability in early flowering genotypes. These associations may be used to select the genotypes for the floral characters that enable sufficient cross fertilization like more duration of floral opening, improved anther extrusion in the male parent and open flowering habit and more stigma receptivity in the female parent for successful development of hybrids.

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Table 3. Correlation coefficients between floral characters in wheat genotypes

Characters	Days to 50% flower	Anther length	Stigma length	Anther extrusion	Openness of floret	Duration of floral opening	Pollen viability	Spikelet length
Days to 50% flower	1.000	–0.105	–0.056	–0.044	–0.028	–0.101	–0.830**	0.014
Anther length	–0.102	1.000	0.852**	0.263**	0.226*	0.196*	0.039	0.015
Stigma length	–0.055	0.848	1.000	0.211	0.126	0.180	0.004	0.074
Anther extrusion	–0.044	0.260	0.209	1.000	0.250*	0.893**	0.157	-0.036
Openness of floret	–0.028	0.223	0.124	0.250	1.000	0.191	0.015	0.170
Duration of floral opening	–0.098	0.194	0.177	0.886	0.190	1.000	0.197*	0.001
Pollen viability	–0.807	0.037	0.006	0.154	0.014	0.182	1.000	0.001
Spikelet length	0.014	0.014	0.073	–0.036	0.169	0.001	0.001	1.000

Above diagonal are the genotypic correlations and below diagonal are the phenotypic correlation coefficients.