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F_2 Generation and their Parental Performance of Bread Wheat (*Triticum aestivum* L.) under Abiotic Stress

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A B S T R A C T

The present investigation on mean performance and genetic parameters estimation was conducted on genetically dissimilar ten parents and their F_2's. The observation were recorded on yield, days to 75 % flowering, days to maturity, duration of reproductive phase, plant height (cm), number of effective tillers per plant, number of spikelets per spike, number of grains per spike, grain weight per spike (g), spike length (cm), biological yield per plant (g), harvest index (%), 1000 seed weight (g), spike density, canopy temperature depression (CTD) (^{0}c), chlorophyll intensity (%), chlorophyll fluorescence (Fv/Fm) and protein content (%). Analyses of variances in all treatment showed highly significant differences for eighteen characters indicate the presence of extensive amount of genetic variability. On the basis of mean performance, none of the cross combination did not find high yield performance compared to K0307. Cross combination K 0607 x K 0307 expressed high mean performance of protein per cent (14.37) with grain yield of 7.85 gram per plant. Variability of the present evaluated materials is backbone of any successful breeding scheme. Therefore, results can be used further for isolation of new pure line by using of recurrent breeding approach.

Introduction

The wheat grown in India is spring type belonging to species *Triticum aestivum* (bread wheat). This wheat is cultivated predominantly in sub-tropical countries. India has become self sufficient in meeting wheat grain consumption of its population at present but substantial increase in wheat production will be required to provide food security to the ever increasing population of our country. The population of India is likely to reach around 1.3 billion by the year 2020. Thus, the huge target of increasing wheat production by

about 35 million tonnes within two decades is a big challenge that cannot be met only by increasing the area under production and improving the production technology until and unless the genetic potential of wheat varieties for different areas and environments is enhanced considerably. Nature always favours to plant populations having much variability in term of adaptation across the years and locations. It is true that greater plant diversity provides more diverse plants, greater chances of obtaining high heterotic crosses and broad spectrum of variability in segregating generations during genetic improvement (Cheema *et al.*, 2006; Rathi *et al.*, 2006; Dagustu, 2008).

Therefore, selection of desirable genotypes and choice of breeding procedures for genetic improvement of any crop is largely dependent on the knowledge of type and relative amount of genetic components. Considering the importance of the crop, there is a need to generate more information on genetic variability and others genetic components of yield and its associated characters.

Materials and Methods

Field experiment on mean performance and genetic parameters estimation was conducted during the season of *Rabi* 2014-15 at Crop Research Farm, Nawabganj of C.S. Azad University of Agriculture and Technology, Kanpur, India. The materials in the present investigation included 45 F_2's and their ten genetically diverse parents. Forty five crosses made during *Rabi* 2013-14 were sent to IIWBR Regional Research Station, Dalang Maidan, Lahu Spiti (H.P.) for raising F_1 seed. After obtained of F_2's genotypes, the trial was assigned in randomized block design with 3 replications; row length was 4 meter in the year of 2014-15. The spacing kept row to row 20 cm for and 5 cm for plant to plant in the experiment. Observations were recorded on grain yield, days to 75 % flowering, days to maturity, duration of reproductive phase, plant height (cm), number of effective tillers per plant, number of spike lets per spike, number of grains per spike, grain weight per spike (g), spike length (cm), biological yield per plant (g), harvest index (%), 1000 grain weight (g), spike density, canopy temperature depression (CTD) (^{0}c), chlorophyll intensity (%), chlorophyll fluorescence (Fv/Fm) and protein content (%). Spike density refers to the ratio of total number of spike lets per plant and spike length.

Results and Discussions

Analysis of variance revealed significant differences among genotypes for all the traits studied, indicating the presence of sufficient diversity in the material under study (Table 1). This suggested that adequate scope is available for use in a program aimed at enhancing genetic yield potential of bread wheat genotypes under late sown condition. This finding was reported earlier by Kumar *et al.*, 2017 and suggests that selection was effective for a population with broad genetic variability. The mean performance of mean of bread wheat genotypes under study is given in table 2.

Days to 75% flowering and days to maturity

The grand mean of days to 75 % flowering of 55 genotypes (10 parents and their F_2's) was 79.061. Top early 75 % flowered genotypes were NW 2036 x K 9423 (63.33), DBW 14 x K 0307 (66.00), K 0424 x K 9423 (67.33), K 0424 x K 0911 (68.33) and K 0607 x K 0911 (69.67) whereas, late flowered genotypes were K 0607 x K 0307 (97.67), DWB 14 x K 0911 (93.00), DBW 14 x K 0307 (93.00), K 9162 x DBW 14 (91.33) and K 9162 x K 0911 (91.33). Based on early and late flowered genotypes can use further for

development of late and early flowering promising/pure lines of wheat.

The grand mean of maturity of plant was 118.752. Cross combinations of K 0424 x K 0307 (102.33), NW 2036 x K 9423 (102.67), K 0424 x K 9423 (103.33), K 0307 x NW 2036 (104.33) and K 0424 x K 0911 were showed early matured plants to be use in breeding programme for isolation of genotypes suitable for late sown condition. Whereas, cross combination, K 0607 x K 0307 (142.00), K 1114 x K 0307 (139.33), DBW 14 x K 0911 (137.67), K 9162 x DBW 14 (134.33) and K 9162 x K 0911 (133.67) indicated late matured genotypes.

Duration of reproductive phase and plant height

The cross combination based on mean performance having fast reproductive phase were K 0424 x K 0307 (30.33), K 1114 x K 0607 (30.33), K 9533 x K 0607 (32.00), NW 2036 x K 9423 (32.00) and K 1114 x K 9423(33.67), whereas, K 1114 x K 0307 (55.00), K 0607 x K 0307 (48.33), DBW 14 x K 9423 (48.00), K 0607 x K 0911 (47.00) and K 1114 x DBW 14. Fast and delay reproductive phase having genotypes to be use further in breeding programme for improvement of genetic quality/size of wheat grain under different environments. Plant height is also most desirable feature to selection of plant for different region as well as environments because the dwarfism and tall types of genotypes to be useful for improvement of crops against lodging and heat tolerance conditions. According the results, the grand mean of 55 genotypes was 90.539 and cross combinations, K 0424 x K 0911 (77.07), K 0424 x K 9533 (79.83), K 9162 x K 0424 (80.13), K 0424 x K 0307 (80.33) and K 0424 x NW 2036 (81.13) showed dwarfism phenotypes whereas, K 0911 x K 9423 (107.00), K 9162 x K 1114 (106.13), K 9533 x DBW 14 (102.17), K 1114 x K 0911 (100.77) and K 9162 x K 0607 exhibited tallness of their phenotypes.

Number of effective tillers per plant and number of spike lets per plant

Effective tillers per plant are most concerned feature regarding assessment of biological and grain yield plant at vegetative stage. Top five highest effective tillers having plant were K 1114 x K 0911 (6.87), K 9533 x K 0307 (5.33), K 1114 x NW 2036 (5.33), K 9533 x K 0607 (5.27) and K 9533 x K 9423 (5.27) whereas, top five plant in aspect of more number of spike lets per plant were K 0607 x K 0424 (21.07), K 1114 x K 0607 (21.00), DBW 14 x K 0307 (20.93), K 9533 x K 1114 (20.87) and DBW 14 x NW 2036 (20.87). The grand mean of number of spike lets per plant was 19.518.

Number of grains per spike and grain weight per spike

The grand means of number of grains per spike and grain weight per spike were 48.518 and 1.96, respectively. Both characters are very effective feature regarding grain yield per plant. Top cross combinations regarding maximum number of grain yield per plant were K 0307 x NW 2036 (65.80), K 0911 x K 9423 (60.47), K 9533 x K 0307 (57.80), DBW 14 x K 0424 (55.00) and K 1114 x K 0424 (54.07) whereas, cross combinations K 0307 x NW 2036 (2.51), DBW 14 x K 0424 (2.46), K 0911 x K 9423 (2.34), K 9533 x K 0307 (2.27) and K 0607 x K 0424 (2.25) expressed highest weight of grains per spike.

Spike length and biological yield per plant

The cross combinations based on maximum spike length were K 9162 x K 0307 (12.70), K 0424 x K 9423 (12.27), K 9533 x DBW (12.23), K 9533 x K 0307 (12.17) and K 0307 x NW 2036 (12.17) whereas, Crosses, K 9533 x K 0307 (28.60), K 0911 x K 9423 (25.56),

K 9162 x K 9423 (25.26), K 9533 x K 9423 (24.30) and K 0307 x NW 2036 (23.73) showed more biological yield per plant to be use further development of heat tolerance promising lines of wheat.

Harvest index and 1000 grains weight

Both traits are much more important for view of either grain and seed quality. Bold grain is look like better compared to thin as per breeder interest or breeding aim. Harvest index has expressed economic potential of plant. Good cross combinations based on high harvest index were K 1114 x K 9423 (57.67), DBW 14 x K 0911 (57.38), K 1114 x K 0911 (51.88), K 9533 x K 0911 (51.04) and DBW 14 x K 0307 (50.41). Based on high 1000 grains weight, cross combinations were K 0424 x NW 2036 (45.74), K 0424 x K 0307 (44.58), K 1114 x NW 2036 (44.12), K 9162 x K 0607 (44.09) and K 9162 x K 9423 (44.00). Grand mean of harvest index and 1000 grains weight were 46.49 and 41.43, respectively.

Spike density and canopy temperature depression (CTD)

Cross combinations, K 9533 x K 0911 (1.95), K 9533 x K 0607 (1.92), DBW 14 x NW 2036 (1.89), K 9533 x K 9423 (1.85) and K 1114 x K 0911 (1.79) had high spike density whereas, good canopy temperature depression found in cross combinations namely, K 0607 x NW 2036 (3.90), NW 2036 x K 9423 (3.77), K 9533 x DBW 14 (3.73), K 9533 x K 1114 (3.47) and DBW 14 x NW 2036 (3.37) indicates cooling system having genotype of bread wheat.

Table.1 Analysis of variance for 18th characters in F_2's generations of bread wheat

Characters	Source of variations		
	Replication	Treatment	Error
	d.f=2	*d.f*=54	*d.f*=108
Days to 75% flowering	3.16	181.97**	3.94
Days to maturity	13.40	331.63**	7.12
Duration of reproductive phase	1.03	80.45**	1.83
Plant height (cm)	2.52	149.74**	8.95
No. of effective tillers per plant	0.26	1.23**	0.11
No. of spikelets per spike	0.59	2.64**	0.23
No. of grains per spike	41.69	103.09**	22.01
Grain weight per spike (g)	0.03	0.20**	0.027
Spike length (cm)	0.06	1.37**	0.09
Biological yield per plant (g)	0.24	23.61**	1.30
Harvest index (%)	32.82	49.09**	11.56
1000 grain weight (g)	1.50	10.01**	0.51
Spike density	0.01	0.03**	0.01
CTD (^{0}C)	0.09	0.82**	0.14
Chlorophyll intensity (%)	14.63	70.24**	5.42
Chlorophyll fluorescence (Fm/Fv)	0.001	0.009**	0.001
Protein content (%)	0.30	2.66**	0.10
Grain yield per plant (g)	1.26	5.41**	0.54

**** Indicated significant level at 1%.**

Table.2 Mean performance of 45 F_2s and their parents of bread wheat for 18th characters

Crosses	Days to 75 % flowering	Days to maturity	Duration of reproductive phase	Plant height (cm)	No. of effective tillers per plant	No. of spikelets per spike	No. of grains per spike	Grain weight per spike (g)	Spike length (cm)	Biological yield per plant (g)
1.K 9533 x K 9162	79.67	111.67	32.00	89.80	4.80	19.67	43.40	1.71	11.60	20.94
2.K 9533 x K 1114	89.00	126.33	37.33	92.53	4.27	20.87	47.47	1.63	11.97	18.53
3. K 9533 x DBW 14	84.33	125.33	41.00	102.17	3.93	19.27	41.13	1.66	12.23	16.72
4.K 9533 x K 0607	82.33	118.00	35.67	92.33	5.27	19.87	49.27	1.84	10.37	23.53
5.K 9533 x K 0424	71.33	106.67	35.33	83.30	3.53	19.67	47.20	1.75	12.00	16.25
6.K 9533 x K 0911	81.33	125.00	43.67	88.90	5.07	20.47	50.27	1.97	10.50	19.90
7. K 9533 x K 0307	80.00	115.33	35.33	92.37	5.33	20.07	57.80	2.27	12.17	28.60
8. K 9533 x NW 2036	72.67	115.00	42.33	89.53	3.60	19.40	42.67	1.72	11.70	19.08
9. K 9533 x K 9423	86.00	123.67	37.67	97.23	5.27	19.13	51.13	1.96	10.37	24.30
10. K 9162 x K 1114	75.00	120.67	45.67	106.13	3.93	18.33	39.87	1.75	11.43	16.90
11.K 9162 x DBW 14	91.33	134.33	43.00	90.90	3.80	17.40	47.00	1.80	11.70	18.58
12. K 9162 x K 0607	85.33	127.33	42.00	99.57	5.00	19.67	45.67	1.99	12.00	20.64
13. K 9162 x K 0424	78.33	114.67	36.33	80.13	4.40	19.13	46.67	1.91	11.20	19.43
14. K 9162 x K 0911	91.33	133.67	42.33	87.03	4.60	19.40	49.07	1.99	11.53	22.50
15. K 9162 x K 0307	75.33	114.00	38.67	81.37	5.13	19.07	44.67	1.82	12.70	21.73
16. K 9162 x NW 2036	86.67	128.33	41.67	92.97	3.73	19.60	47.93	2.08	10.97	17.19
17. K 9162 x K 9423	77.33	115.33	38.00	97.90	5.27	19.60	47.33	2.01	11.93	25.26
18. K 1114 x DBW 14	73.67	120.33	46.67	94.23	4.13	20.33	44.07	1.85	11.53	17.95
19. K 1114 x K 0607	75.33	105.67	30.33	83.77	5.00	21.00	40.53	1.70	12.00	17.12
20. K 1114 x K 0424	86.33	125.33	39.00	96.00	4.33	17.13	54.07	1.92	10.27	18.05
21. K 1114 x K 0 911	91.33	133.00	41.67	100.77	6.87	19.80	38.93	1.53	11.10	20.23
22. K 1114 x K 0307	84.33	139.33	55.00	98.20	4.33	19.40	50.47	2.12	10.87	18.43
23. K 1114 x NW 2036	71.67	113.00	41.33	91.53	5.33	19.00	44.67	1.98	11.03	22.25
24. K 1114 x K 9423	85.00	118.67	33.67	85.07	3.73	18.20	43.13	1.79	10.97	16.87
25. DBW 14 x K 0607	66.00	112.00	46.00	93.87	5.00	19.93	52.67	2.02	11.93	21.06
26. DBW 14 x K 0424	73.33	116.00	42.67	86.77	5.00	20.73	55.00	2.46	11.60	22.69
27. DBW 14 x K 0911	93.00	137.67	44.67	95.97	4.00	19.40	37.27	1.46	10.93	17.11
28. DBW 14 x K 0307	93.00	133.33	40.33	99.30	4.00	20.93	42.60	1.81	12.10	16.34
29. DBW 14 x NW 2036	70.00	109.00	39.00	85.07	4.67	20.87	49.53	2.12	11.07	21.78
30. DBW 14 x K 9423	73.67	121.67	48.00	87.67	3.73	19.80	49.27	1.91	11.30	17.81
31. K 0607 x K 0424	70.33	105.33	35.00	95.77	4.27	21.07	52.47	2.25	11.93	21.63
32. K 0607 x K 0911	86.00	133.00	47.00	96.70	4.07	19.53	52.50	2.23	12.07	20.82
33. K 0607 x K 0307	93.67	142.00	48.33	82.90	3.80	18.67	46.13	1.90	11.60	16.71
34. K 0607 x NW 2036	68.00	105.67	37.67	81.77	4.20	16.73	37.87	1.51	11.93	14.59
35. K 0607 x K 9423	69.67	110.00	40.33	89.27	4.00	19.27	35.53	1.43	11.50	17.40
36. K 0424 x K 0911	68.33	105.00	36.67	77.07	4.47	19.53	44.33	1.68	11.03	16.74
37. K 0424 x K 0307	72.00	102.33	30.33	80.33	3.93	18.87	52.00	2.15	11.37	19.12
38. K 0424 x NW 2036	72.00	108.00	36.00	81.13	4.13	19.00	50.00	2.22	11.23	19.21
39. K 0424 x K 9423	67.33	103.33	36.00	79.83	3.93	19.80	48.40	1.96	12.27	17.15
40. K 0911 x K 0307	87.00	133.67	46.67	85.03	4.07	19.93	45.87	1.82	11.97	18.18
41. K 0911 x NW 2036	78.33	116.00	37.67	90.50	4.33	20.60	53.20	2.24	11.87	22.05
42. K 0911 x K 9423	87.33	128.00	40.67	107.00	5.00	20.07	60.47	2.34	11.93	25.56
43. K 0307 x NW 2036	71.33	104.33	33.00	93.13	4.60	20.60	65.80	2.51	12.17	23.73
44. K 0307 x K 9423	74.33	106.33	32.00	97.27	4.47	19.47	49.47	1.96	11.93	19.88
45. NW 2036 x K 9423	63.33	102.67	39.33	91.20	3.47	18.33	42.60	1.78	10.57	16.30
K 9533	78.33	115.33	37.00	81.97	4.20	19.13	49.13	1.92	11.27	19.37
K 9162	85.00	121.00	36.00	91.67	4.93	19.80	49.90	2.03	11.77	19.60
K 1114	80.33	122.33	42.00	96.47	5.07	18.07	50.53	2.14	10.10	20.71
DBW 14	79.00	119.00	40.00	85.50	3.87	19.93	51.83	2.04	11.00	19.04
K 0607	83.67	116.00	32.33	94.30	4.20	19.53	52.60	2.23	11.73	20.22
K 0424	73.33	109.00	35.67	80.27	3.60	18.47	48.00	1.79	12.00	16.03
K 0911	82.33	126.00	43.67	85.27	4.40	19.53	53.47	2.13	11.93	19.12
K 0307	80.33	124.33	44.00	97.33	4.53	20.27	57.87	2.55	13.50	23.18
NW 2036	78.00	124.67	46.67	84.90	3.33	20.80	56.20	2.54	12.50	18.64
K 9423	75.00	107.67	32.67	90.70	4.73	19.33	48.60	1.92	10.10	20.75
Mean	**79.061**	**118.752**	**39.691**	**90.539**	**4.412**	**19.518**	**48.282**	**1.96**	**11.53**	**19.70**
C.V.	2.51	2.25	3.42	3.30	7.66	2.47	9.72	8.47	2.68	5.79
C.D. (5%)	3.22	4.32	2.19	4.84	0.55	0.78	7.59	0.27	0.50	1.85
C.D. (1%)	4.25	5.72	2.90	6.41	0.72	1.03	10.05	0.36	0.66	2.44

Table 2: continued

Crosses	Harvest index (%)	1000 grain weight (g)	Spike density	CTD (^{0}C)	Chlorophyll intensity (%)	Chlorophyll Fluorescence (Fv/Fm)	Protein content (%)	Grain yield per plant (g)
1.K 9533 x K 9162	40.34	39.58	1.70	3.40	45.97	0.748	11.60	8.44
2.K 9533 x K 1114	44.07	39.78	1.75	3.47	53.03	0.766	12.13	8.16
3. K 9533 x DBW 14	45.81	41.44	1.57	3.73	50.77	0.752	11.20	7.65
4.K 9533 x K 0607	42.07	39.51	1.92	3.20	42.93	0.714	10.57	9.86
5.K 9533 x K 0424	45.70	38.78	1.64	3.17	47.20	0.731	10.27	7.38
6.K 9533 x K 0911	51.04	42.23	1.95	2.17	44.97	0.689	10.03	10.11
7. K 9533 x K 0307	41.55	41.95	1.65	2.87	51.83	0.698	9.97	11.88
8. K 9533 x NW 2036	41.99	40.84	1.66	3.03	41.73	0.735	11.13	8.03
9. K 9533 x K 9423	42.17	39.00	1.85	2.70	42.03	0.744	9.87	10.26
10. K 9162 x K 1114	44.34	41.34	1.61	2.90	41.17	0.669	11.67	7.51
11.K 9162 x DBW 14	43.47	40.44	1.49	2.90	46.17	0.710	11.83	8.01
12. K 9162 x K 0607	48.94	44.09	1.64	2.57	37.33	0.618	10.97	10.02
13. K 9162 x K 0424	45.63	41.00	1.71	3.20	37.27	0.682	12.67	8.84
14. K 9162 x K 0911	40.16	41.95	1.68	3.33	46.17	0.727	10.83	9.04
15. K9162 x K 0307	43.89	42.69	1.50	2.67	48.37	0.612	11.53	9.53
16. K 9162 x NW 2036	47.82	41.66	1.78	2.73	42.63	0.720	11.67	8.29
17. K 9162 x K 9423	42.61	44.00	1.64	2.73	45.07	0.740	10.60	10.77
18. K 1114 x DBW 14	42.27	40.13	1.76	2.50	47.40	0.682	11.33	7.59
19. K 1114 x K 0607	45.80	42.11	1.75	1.80	37.10	0.769	11.30	7.86
20. K 1114 x K 0424	45.75	36.95	1.67	2.43	34.83	0.599	11.43	8.24
21. K 1114 x K 0 911	51.88	39.94	1.79	2.57	41.73	0.737	13.67	10.50
22. K 1114 x K 0307	49.78	41.86	1.79	3.13	46.80	0.582	11.63	9.19
23. K 1114 x NW 2036	45.84	44.12	1.72	3.33	44.10	0.677	12.03	10.18
24. K 1114 x K 9423	57.67	39.03	1.66	3.00	41.90	0.747	11.60	9.73
25. DBW 14 x K 0607	49.03	40.54	1.67	2.37	46.53	0.761	12.57	10.31
26. DBW 14 x K 0424	49.51	42.96	1.79	1.80	50.73	0.747	12.13	11.21
27. DBW 14 x K 0911	57.38	39.22	1.78	1.40	40.63	0.753	13.20	9.82
28. DBW 14 x K 0307	50.41	43.16	1.73	3.13	42.30	0.770	11.67	8.23
29. DBW 14 x NW 2036	46.89	43.17	1.89	3.37	51.60	0.747	12.83	10.22
30. DBW 14 x K 9423	41.52	40.93	1.75	3.23	51.40	0.725	11.80	7.39
31. K 0607 x K 0424	47.92	42.64	1.76	3.03	49.57	0.745	12.50	10.37
32. K 0607 x K 0911	43.61	43.52	1.62	3.33	41.23	0.755	12.50	9.08
33. K 0607 x K 0307	46.93	40.32	1.61	3.23	38.43	0.712	14.37	7.85
34. K 0607 x NW 2036	49.39	40.27	1.40	3.90	46.30	0.755	12.73	7.19
35. K 0607 x K 9423	40.19	40.51	1.68	3.07	46.73	0.759	12.73	7.00
36. K 0424 x K 0911	48.15	39.86	1.77	2.60	54.97	0.755	12.37	8.06
37. K 0424 x K 0307	45.76	44.58	1.66	2.60	51.00	0.675	11.50	8.75
38. K 0424 x NW 2036	47.26	45.74	1.69	2.47	43.20	0.755	12.40	9.08
39. K 0424 x K 9423	45.94	43.25	1.61	2.33	47.10	0.743	12.50	7.87
40. K 0911 x K 0307	41.83	40.90	1.67	1.73	41.77	0.674	13.47	7.60
41. K 0911 x NW 2036	44.19	43.62	1.74	3.07	45.20	0.770	12.40	9.74
42. K 0911 x K 9423	45.11	42.93	1.68	2.83	38.57	0.666	12.50	11.53
43. K 0307 x NW 2036	49.50	41.36	1.69	3.33	44.87	0.739	12.30	11.74
44. K 0307 x K 9423	46.44	39.72	1.63	2.83	43.97	0.755	12.43	9.21
45. NW 2036 x K 9423	49.11	41.98	1.73	3.77	37.17	0.777	12.77	8.01
K 9533	43.24	39.52	1.70	3.10	46.73	0.718	11.37	8.37
K 9162	51.58	40.64	1.68	3.07	41.40	0.609	12.95	10.11
K 1114	53.03	42.84	1.79	2.97	35.07	0.565	11.25	10.98
DBW 14	43.40	39.44	1.81	3.27	45.20	0.735	10.29	8.25
K 0607	49.25	43.31	1.67	2.90	45.70	0.669	11.83	9.97
K 0424	46.31	38.87	1.54	2.70	44.87	0.776	12.36	7.41
K 0911	52.79	41.07	1.65	4.03	48.33	0.787	11.93	10.09

K 0307	52.55	44.40	1.51	2.43	33.53	0.728	12.56	12.18
NW 2036	43.31	43.05	1.69	2.83	43.30	0.615	11.20	8.07
K 9423	45.05	40.16	1.91	2.63	48.43	0.784	11.45	9.35
Mean	**46.49**	**41.43**	**1.70**	**2.89**	**44.44**	**0.716**	**11.86**	**9.13**
C.V.	7.31	1.74	3.91	13.25	5.24	1.657	2.76	8.10
C.D. (5%)	5.50	1.16	0.11	0.62	3.77	0.019	0.53	1.20
C.D. (1%)	7.28	1.54	0.14	0.82	4.99	0.025	0.70	1.58

Chlorophyll intensity and chlorophyll fluorescence

Both chlorophyll intensity and chlorophyll fluorescence are major features indicated greenness and photo system of plant, respectively. Both observations are responded plant health. High chlorophyll intensity found in K 0424 x K 0911 (54.97), K 9533 x K 1114 (53.03), K 9533 x K 0307 (51.83), DBW 14 x NW 2036 (51.60) and DBW 14 x K 9423 (51.40) whereas, top crosses having good chlorophyll fluorescence were NW 2036 x K 9423 (0.777), DBW 14 x K 0307 (0.770), K 0911 x NW 2036 (0.770), K 1114 x K 0607 (0.769) and K 9533 x K 1114 (0.766). The grand mean of chlorophyll intensity and chlorophyll fluorescence were 44.44 and 0.716, respectively.

Protein content and grain yield per plant

Enhancement of protein content with grain yield per plant is major aim of plant breeder under breeding progamme of crop improvement. The grand mean of protein content and grain yield per plant were 11.86 and 9.23, respectively. Cross combinations, K 0607 x K 0307 (14.37), K 1114 x K 0911 (13.67), K 0911 x K 0307 (13.47), DBW 14 x K 0911 (13.20) and DBW 14 x NW 2036 (12.83) exhibited highest protein content (ash is basis) whereas, K 9533 x K 0307 (11.88), K 0307 x NW 2036 (11.74), K 0911 x K 9423 (11.53), DBW 14 x K 0424 (11.21) and K 9162 x K 9423 (10.77) had maximum grain yield per plant.

Any implication of plant breeding for genetic improvement of crop based on breeder object response pre-breeding for enhancement of genotypes. Based on results obtained from present study, it is concluded that superior cross combination/genotypes as per breeding object of breeder can be utilized for development of wheat genotypes for different environments. These findings supported by Kumar *et al.*, (2013), Kumar *et al.*, (2014), Kumar *et al.*, (2016) and Kumar *et al.*, (2017).

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