International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; SP6: 104-106

Sunil Kumar Jatav
Krishi Vigyan Kendra, Badgaon, Balaghat, Jawaharlal Nehru Krishi Vishva Vidyalaya, Jabalpur, Madhya Pradesh, India

VS Kandalkar
Department of Genetics and Plant Breeding, College of Agriculture, Gwalior, Rajmata Vijayaraje Scindia Krishi Vishva Vidyalaya, Gwalior, Madhya Pradesh, India

Correspondence
Sunil Kumar Jatav
Krishi Vigyan Kendra, Badgaon, Balaghat, Jawaharlal Nehru Krishi Vishva Vidyalaya, Jabalpur, Madhya Pradesh, India

(Special Issue -6)
3rd National Conference
On
PROMOTING & REINVIGORATING AGRI-HORTI, TECHNOLOGICAL INNOVATIONS [PRAGATI-2019]
(14-15 December, 2019)

Combining ability for grain yield and its components through line X tester mating design in wheat

Sunil Kumar Jatav and VS Kandalkar

Abstract
Combining ability analysis for grain yield and other related charterers was studied in 7 lines, 3 testers and 21 F_1's in a randomized block design with two replications. The analysis of genetic components revealed that both additive as well as non-additive components were prevalent for the control of grain yield and its components. The combining ability effects revealed that parent DL 803-3 was identified as good general combiners for grain yield and GW190 and GW 173 for grain yield. The significant specific good combing cross 'GW 322 X GW 173' having one promising parent for grain yield would be advanced through simple or recurrent selection in segregating generations. Most of the good specific combinations for various characters involved parents with high X low or low X low or low X high GCA effects. These genotypes may be used in breeding programs targeting high potential under drought stress. These parents may be used for varietal improvement through the simple or recurrent selection in separating generations to increase in yield potential of wheat. This may lead in the fixation of both additive and non-additive components while making development in grain yield and its characteristics.

Keywords: Bread wheat, combining ability, yield attributes

Introduction

Wheat (*Triticum aestivum* L.) is the second most important cereal crop after rice in the context to its antiquity and its use as source of staple food in India. Wheat crop has occupied almost 29.55 million hectares and producing 101.20 million tones in India (Anonymous, 2018). Improvement in wheat production can be achieved by enhancing through the development of new cultivars having wider genetic base and better performance. Earlier research review revealed that both general and specific combining abilities were involved in the inheritance of grain yield and its components (Singh *et al*., 2000; Murliya and Sastry, 2001) [8]. Selection of parents together with information on nature and magnitude of gene action controlling grain yield and its attributing characters is prerequisites while improving the plant type efficiently. Hence an attempt has been made to study suitable parents through general combining ability and specific combining ability for improvement in yield potential.

Materials and Methods

An experiment was conducted at Research Farm, College of Agriculture, Gwalior located in the Gird region (Agro climatic zone No 6, wheat-pearl millet crop zone). The Gwalior is situated at an altitude of 211.52 MSL, 260 13´ N Latitude and 780 14´ E Longitude. The experiment consisting 10 parents and their 21 F_1s was conducted along with 2 checks in randomized block design with two replications. Twenty one crosses were developed in Line x

Tester mating design using 7 lines *viz.*, C-306, DL 803-3, GW-190, GW-322, PBW-175, MACS 6222, HI 1544 and 3 tester's *viz.*, HD-2932, GW-173 and PBW-343. The sowing was done by dibbling seeds in rows with spacing of 20 cm apart and 4-6 cm within row. The recommended packages of practices were adopted for optimum crop growth. Observations were recorded on five randomly selected plants in each line for grain yield and its attributes *viz.*, Days to heading, Days to flowering, Days to maturity, Plant height, Tiller per plant, Spike length, Grain weight per spike, Grain per spike, Test weight, Flag leaf area, Harvest Index and Biological Yield. Combining ability analysis was worked out in Line X Tester mating design by following Kempthorne (1957).

Results and Discussion

Combining ability variances

The mean sum of square due to genotypes in lines were significant for grain yield per plant**,** grain per spike and test weight and testers for grain yield per plant**,** days to heading, days to flowering, grain weight per spike, grain per spike, flag leaf area and biological yield. Crosses were significant for grain yield per plant, test weight and biological yield (Table 1). The similar reports were also published earlier by Drikvand *et al.*, (2005) [3].

Table 1: Analysis of Variance for combining ability for grain yield and its attributes traits in wheat

Sources	DF	Days to heading	Days to flowering	Days to maturity	Plant height	Tiller/plant	Spike length	Grain weight per spike	Grain per spike	Test weight	Grain yield per plant	Flag leaf area	Harvest Index	Biological Yield
Lines	6	10.13	8.97	1.76	96.00	5.07	3.98	0.12	160.22*	85.94**	19.62**	173.54	39.40	68.96
Tester	2	140.21**	158.79**	2.21	29.45	11.00	1.42	1.04**	382.24**	15.99	51.68**	438.01**	745.51	272.40**
L X T	12	5.99	7.98	1.30	83.66	5.62	1.15	0.12	80.56	53.71**	28.25**	48.80	277.02	103.51**
Error	32	9.07	14.72	5.28	51.64	4.94	1.73	0.23	79.69	23.50	4.89	99.97	293.64	28.04

*, ** significant at 5 and 1 percent levels, respectively,

Table 2: Genetic components estimates for 13 characters in wheat crosses in line X tester mating design

Covariance	Days to heading	Days to flowering	Days to maturity	Plant height	Tiller/plant	Spike length	Grain weight per spike	Grain per spike	Test weight	Grain yield per plant	Flag leaf area	Harvest Index	Biological Yield
Cov HS (Line)	0.690	0.165	0.077	2.057	-0.092	0.471	0.000	13.276	5.371	-1.323	20.790	-39.604	-5.759
Cov HS (Tester)	9.587	10.772	0.065	-3.872	0.384	0.019	0.065	21.54	-2.694	1.039	27.801	33.464	12.063
Cov HS (Average)	-5.992	-7.980	-1.298	-83.661	-5.619	-1.153	-0.121	-80.561	-53.708	-22.55	-48.80	-277.02	-103.51
Cov FS	29.510	32.570	-0.031	120.580	8.635	1.765	0.258	171.405	85.803	39.779	125.142	399.530	198.144
Genetic components													
σ2gca (Lines)	0.690	0.165	0.077	2.057	-0.092	0.471	0.000	13.276	5.371	-1.323	20.790	-39.604	-5.759
σ2gca(Testers)	2.762	0.659	0.310	8.228	-0.369	1.883	-0.001	53.10	21.48	-5.29	83.16	-158.41	-23.03
σ2gca (Parents)	876.58	981.22	6.42	-340.00	34.426	4.57	5.94	2040.54	-212.92	86.60	2654.63	2807.57	1063.17
σ2sca	-1.540	-15.96	-2.595	-167.32	-11.23	-2.30	-0.24	-161.12	-107.41	-45.10	-97.59	-554.04	-207.02
σ2gca / σ2sca	-569.05	-61.48	-2.47	2.03	-3.06	-1.98	-24.59	-12.665	1.982	-1.920	-27.19	-5.06	-5.13
σ2 A	1753.17	1962.44	12.84	-680.00	68.85	9.14	11.88	4081.09	-425.85	173.21	5309.26	5615.15	2126.35
σ2 D	65.571	72.034	-1.533	-11.094	3.029	-0.153	0.40	151.27	-3.75	15.87	169.02	225.93	122.17

General combining ability (GCA) or specific combining ability (SCA) variances were substantial for most of the characters, thereby, indicating impotence of both additive as well as non-additive components of genetic variance in the control of these traits. These results are in agreement with reported earlier on GCA and SCA variances for yield and yield components in wheat (Mahmood and Chowdhry, 2000). The additive components of variances were higher compared to dominance components of variances for all characters studied. The ratio of genetic components "σ^2gca / σ^2sca" also showed more than one, indicating predominance of additive variances for almost all characters. The similar reports were also published earlier by Vanpariya *et al.* (2006) [10] for days to heading, plant height, spike length and spikelet per spike. Yadav and Behl (2002) [11] for days to flowering, plant height, tillers per plant, grain per spike, flag leaf area, test weight and grain yield per plant.

General combining ability effects

The significant estimates of significant positive GCA effects revealed that tester "GW 190" was recorded good general combiner for grain yield per plant, spike length, grain weight per spike, grain per spike and flag leaf area; DL 803-3 for grain yield per plant and C 306 for biological yield. Whereas PBW 343 were good general combiner for earliness as showing significant negative GCA effects for days to heading and days to flowering and bad general combiner for grain filling period. Significant negative GCA effects revealed that HD 2932 showed bad general combiner for grain yield per plant and spike length; C 306 for grain yield per plant and PBW 343 for spike length (Table 3). The similar reports were also published earlier by Anwar *et al.*, (2011) [1]; Drikvand *et al.*, (2005) [3] for days to heading, days to flowering, day to maturity, plant height, grain yield; Kamaluddin *et al.*, (2007) [5] for seeds per spike, tillers per plant and grain yield per plant.

Table 3: Estimates of general combining ability effects of lines and tester parent's in wheat

Parents	Days to heading	Days to flowering	Days to maturity	Plant height	Tiller/plant	Spike length	Grain weight per spike	Grain per spike	Test weight	Grain yield per plant	Flag leaf area	Harvest Index	Biological Yield
Lines													
MACS 6222	-1.976	-1.810	0.452	-1.322	-0.249	0.512	-0.151	1.078	-7.979**	-0.755	5.341	0.162	-2.672
GW 322	-1.310	-1.310	0.286	0.635	-0.880	1.280**	0.118	6.080	-0.832	-0.198	-1.154	1.297	-1.487
GW 173	0.857	1.024	0.119	-2.719	0.076	0.275	0.227	-1.308	1.863	2.447**	0.221	2.544	-3.722
HI 1544	0.190	0.190	-0.048	-6.215	-1.362	-0.416	0.008	-7.422**	1.498	-1.835**	-5.326	0.337	-1.460
PBW 175	0.524	0.024	-0.881	3.258	0.485	0.229	0.033	3.025	1.095	-0.236	-0.762	2.620	0.271
DL 803-3	-0.143	0.190	-0.548	0.268	0.596	-0.875	-0.158	4.522	0.568	2.460**	-6.686	-3.540	3.438
C 306	1.857	1.690	0.619	6.095	1.333	-1.005	-0.077	-5.975	3.788	-1.883**	8.366	-3.421	5.633**

SE (gca for line)	1.230	1.566	0.938	2.934	0.908	0.536	0.197	3.644	1.979	0.903	4.082	6.996	2.162
Tester													
PBW 343	-3.643**	-3.857**	-0.357	-1.116	0.695	-0.108**	-0.187	-1.708	-0.040	-0.200	-3.949	-5.046	4.729
HD 2932	1.571	1.500	-0.071	-0.523	-0.998	-0.251**	-0.125	-4.157	-1.048	-1.814**	-2.452	-3.321	-0.725
GW 190	2.071**	2.357**	0.429	1.640	0.303	0.359**	0.312**	5.865**	1.088	2.013**	6.401**	8.367	-4.004
SE (gca for tester)	0.805	1.025	0.614	1.921	0.594	0.351	0.129	2.386	1.295	0.591	2.672	4.580	1.415

*, ** significant at 5 and 1 percent levels, respectively,

Specific combining ability effects

The significant positive SCA effects revealed that 'GW 322 X GW 173' and 'MACS 6222 X PBW 343' were good specific combiner for grain yield per plant; 'MACS 6222 X HD 2932' for test weight. Whereas cross 'DL 803-3 X PBW 343' showed high mean grain yield but was average specific combiner for biological yield but it showed good specific combiner for yield. The superiority of average X average or average X low combination may be due to the presence of genetic diversity among the parent and there could be some complementation indicating importance of non-additive effects. The similar results were also reported earlier by Srivastava *et al.* (2012) [9]; Jatav *et al.* (2014) [4] and Pansuriya *et al.* (2014) [7] for grain yield per plant.

Analysis of combining ability in the present wheat material suggested an idea about breeding methodology to be applied and use of promising crosses for further improvement in wheat. In self–pollinated crops like wheat, SCA effects are not much important as they are mostly related to non-additive gene effects excluding those of arising from complementary gene action or linkage effects they cannot be fixed in pure lines. Further superiority of the hybrids might not indicate their ability to yield transgressive segregates; rather SCA would provide satisfactory criteria and expected to throw desirable transgressive segregates in later generations. Grain yield and major yield components revealed the significance of both additive and non-additive gene action for grain yield and its different components. The presence of both significant additive and non-additive genetic variances for grain yield and major yield attributing traits suggested that high performance of yield and contributing traits can be fixed in subsequent segregating generation of 'GW 322 X GW 173' and 'MACS 6222 X PBW 343' (Table 4). The good general combining parents DL 803-3, GW 190 and GW 173 used for varietal improvement through the recurrent selection, inter-mating and bi-parental mating in F_2 generation of promising crosses consisting for next generation. The parents DL 803-3, GW 322 and PBW 343 in identified as higher yielder would be used for improvement for high yielding varieties through the simple or recurrent selection from segregating generations in wheat. DL 803-3 appeared to be promising genotype may be used for varietal improvement through the recurrent selection, inter-mating and bi-parental mating in F_2 generation. The significant specific cross 'GW 322 X GW 173' having one promising parent for grain yield would be advanced through simple / recurrent selection in segregating generations, which may lead in the fixation of both additive and non-additive components while making improvement in grain yield and its attributes.

Table 4: Crosses showing significant specific combining ability (SCA) effect for grain yield and its attributes

Crosses	Days to heading	Days to flowering	Days to maturity	Plant height	Tiller /plant	Spike length	Grain weight per spike	Grain per spike	Test weight	Grain yield per plant	Flag leaf area	Harvest Index	Biological Yield
GW 322 X GW 173	-1.405	-1.833	-1.429	-3.433	2.033	-0.236	0.067	1.826	1.651	4.514**	-1.810	3.373	4.110
HI 1544 X PBW 343	2.429	3.333	0.738	-3.470	-0.674	-1.366	-0.207	-7.286	0.171	-4.091	-2.795	-4.009	-0.030
MACS 6222 X PBW 343	-1.571	-2.024	-0.762	2.277	2.941	0.875	0.111	6.191	0.750**	5.417**	-0.567	-14.929	7.999**
HI 1544 X HD 2932	-0.238	-0.524	0.238	-5.460	0.032	-0.009	-0.235	-2.807	-2.082	-1.145	-0.194	3.438	-8.165**
MACS 6222 X HD 2932	-0.357	0.024	0.190	7.196	1.443	0.351	0.355	-2.915	1.514**	4.071	2.649	9.676	3.771
SE (sca)	2.130	2.713	1.625	5.081	1.572	0.929	0.341	6.312	3.428	1.564	7.070	12.117	3.744

*, ** significant at 5 and 1 percent levels, respectively,

References

1. Anwar J, Akbar M, Hussain M, Asghar S, Ahmadand J, Owais M. *et al*. Combining ability estimates for grain yield in wheat. Journal Agric. Res. 2011; 49(4):437-445.
2. Ali Z, Khan AS. Combining ability studies of some morpho-physiological traits in bread wheat (*Triticum aestivum* L.) Pakistan Journal Agriculture Science. 1998; 35:1-3.
3. Drikvand R, Farshadfar E, Nazarian F. Genetic study of some morpho-physiological traits in bread wheat lines under dry land conditions using diallel crossing. Seed and Plant. 2005; 4(20):429-444.
4. Jatav M, Jatav SK, Kandalkar VS. Combining ability and heterosis analysis of morpho- physiological characters in wheat. Annals of Plant and Soil Research. 2014; 16(2):79-83.
5. Kamaluddin Rishi M, Singh Lal C, Prasad Malik Z, Abdin, Arun K Joshi *et al*. Combining ability analysis for grain filling duration and yield traits in spring wheat (*Triticum aestivum* L. em. Thell.) Genetics and Molecular Biology. 2007; 30(2):411-416.
6. Kemthrone O. An introduction to genetical statistics. John Wiley and sons, Inc, New York, 1957.
7. Pansuriya AG, Dhaduk LK, Vanpariya LG, Savaliya JJ, Patel MB, Mehta DR. Combining ability over environmnets for grain yield and its components in bread wheat (*Triticum aestivum* L.). AGRES – An International e-Journal. 2014; 1(3):39-46.
8. Singh I, Sameena S, Singh J. Inheritance of some quantitative traits in bread wheat (*Triticum aestivum* L. em. Thell). Annals Agriculture Research. 2000; 21(1):51-54.
9. Srivastava MK, Singh D, Sharma S. Combining ability and gene action for grain yield and its components in bread wheat [(*Triticum aestivum*) (L.) *em.* Thell] Electronic Journal of Plant Breeding. 2012; 3(1):606-611.
10. Vanpariya LG, Chovatia VP, Mehta DR. Combining ability studies in bread wheat (*Triticum aestivum* L.) National Journal Plant Improvement. 2006; 8(2):132-137.
11. Yadav R, Behl RK. Genetics of morpho-physiological characters and grain yield in wheat. National Journals Plant Improvements. 2002; 4(2):26-29.