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COMBINING ABILITY FOR YIELD TRAITS IN CERTAIN RUST RESISTANT LINES OF WHEA

V. TEWARI[1], B. D. SINGH[2] and G. S. SHARMA[3]

Twenty-one rust resistant lines of wheat from the National Genetic Stock Nursery were crossed with five testers. Additive gene action was predominant for most of the characters studied. CPAN1360, CPAN1529, CPAN1666, CPAN1757, CPAN1810, CPAN1830 CPAN1874 and CPAN1848 are reocmmended for exploitation in breeding programmes on the basis of gca effects and F_1 performance. The *per se* performance of the croses should be more useful than the sca effects for selecting best specific combinations.

The National Genetic Stock Nursery (NGSN) of wheat has served as a germplasm bank and also as a crossing-block. Wheat Breeders throughout the country untilize the NGSN lines in their breeding programmes. It has often been observed that plant breeders generally select parents for their hybridization programme on an *ad hoc* basis. Joshi (1979) has stressed the importance of systematic evaluation of germplasm for a sound and dynamic breeding programme. Combining ability studies are useful in assessing the nicking ability of parents which thereby aids in selection of desirable parents to produce useful segre gants. The present study was planned with a view to assess the combining ability of some selected rust resistant NGSN lines and here we report their genetic architecture for agronomic traits

MATERIALS AND METHODS

Twenty one rust resistant lines of wheat from the NGSN were crossed with five testers namely, Kalyansona, WL711, Agra local, K68 and Hyb 65. The 105 F_1s were raised in a randomized block design with 3 replications The 26 parents were laid out in a contiguous plot with 3 replications for comparsion with the hybrids (Arunachalam, 1974). Each plot had a single row of 2 m length and spaced 30 cmbetween and 10 cm within rows. Recommended agronomic practices were followed to raise a good crop. Data on spikes/metre, spike length (cm), grains/ spike "grain wieght/spike', (g), test weight (g) and grain yield/metre (g) were recorded from one metre row length. Statistical analysis for combining ability variances and effects was done following the method outlinedby Kempthorne (1957).

RESULTS AND DISCUSSION

According to Borlaug (1965) the "effective life of a disease resistant variety is only 4 to 5 years This means that we have to be on the look-out for new sources of disease resistance to meet the demand of varietal change

1. Present address: Department of Plant Breeding & Genetics, Birsa Agricultural Uciversity, Kanke, Ranchi-834006.

2&3. Professor and Wheat Breeder, respectively, Department of Genetics & Plant Breeding B. H. U., Varanasi-221005.

necessitated by evolution of new races. The NGSN serves this purpose to a great extent in our country by introducing newer genetic stocks from CIMMYT and other wheat growing countries. Wheat Breeders throughout the country utilize the NGSN lines in their breeding programmes. Traditionally selection of parents for hybridization has been based on *per se* performance. However, in the absence of information on the reletionship between different lines with similar performance, there is a possibility of related lines being chosen as parents, thereby resulting in limited or no advance under selection in the segregating generations. Thus, a wide genetic base together with acceptable levels of productivity and high general combining ability are essential in the parents chosen for hybridization to yield superior segregants.

The analysis of variance for hybirds (Teble 1) revealed that the mean squares due to linas and testers were highly significant for all the characters studied, whereas mean squares for line x tester were non-significant for all the traits. The ratio δ^2gca/δ^2sca showed that additive gene action was predominant for spikes/metre, spike length, grain weight/spike, test weight and grain yield/meter. A number of workers have observed additive gene action for the characters studied here (Saroha *et al*. 1982). However, non-additive gene actions have also been reported for the secharacters by other workers The relative importance of different components of genetic variance for different characters varies from study to study. These differences may be attributed to the number of parents chosen, diversity among the parents, mating design employed and genotype x environment interactions. Since additive gene action is fixable, we wold be more interested in the accumulation of additive genes for genetic improvement in wheat.

The estimates of gca effects are presented in Table II. Significant positive gca effects were observed in Kalyansona, CPAN1529 CPAN1532 and CPAN1538 for spikes/metre: K68, CPAN1666, CPAN 1687, CPAN 1689, CPAN 1810, CPAN 1829, and CPAN 1874 for spike length; Agra local, CPAN1360, CPAN1681, CPAN1689, and CPAN1874 for grians/spike; Kalyansona, K68, WL 711 CPAN1360, CPAN1529, CPAN 1757 and CPAN1874 for grain weight/spike; Kalyansona, K68, WL711, CPAN 1360, CPAN 1581, 1757 CPAN CPAN1830, CPAN 1842, CPAN 1884 and HW517 for test weight; and Kalyansona, WL711, CPAN 1360, CPAN1529 and CPAN1884 for grain yield/metre Thus for the three main

Table I - ANOVA for combining ability of yield traits in wheat.

Sources	Df	Spikes/ metre	Spike length (cm)	Grains/ spike	Grain wieght/ spike (g)	Test weight (g)	Grain yield/ metre (g)
Replications	2	139.5	0.1	18.5	0.05	6.1	150.0
Hybrids	104	211.3**	1.1**	88.1**	0.2**	74.8**	1031.5**
Testers	4	967.4**	4.6**	232 4**	2.1**	1262.3**	12679 5**
Lines	20	482.2**	3.8**	224.0**	0.4**	85.5**	758.2**
Line x tester	80	1.3	0.03	0.6	0.01	0 2	6.5
Error	208	112.0	0 2	28.2	0.1	2.3	378 0
δ^2gca		15.9	0.1	4.7	0.03	17.0	159 0
δ^2sca		2.1	0.02	6.2	0.01	3.5	46.5
δ^2gca δ^2sca		7.6	5 0	0.8	3.0	4.9	3.4

** Significant at P = 0.01

Table II - Estimates of gca effects for yield traits in wheat.

	Spikes/ metre	Spike length (cm)	Grains/ spike	Grain weight/ spike (g)	Test weight (g)	Grain yield/ metre (g)
Testers						
Agra local (AL)	−3.77**	−0.02	3.26**	−0.25**	−6.94**	−17.86**
Kalyansona (KS)	6.46**	0.03	−1.73**	0.08*	2.92**	15.40**
K68	−1.88	0.31**	−0.61	0.07*	1.54**	3.81
WL711	0.39	−0.43**	−0.07	0.21**	4.24**	10.13**
Hyb65	−1.22	0.11	−0.85	−0.12**	−1.76**	−11.85**
SE (gi) ±	1.19	0.05	0.60	0.03	0.17	2.19
Lines						
CPAN1285	−6.31*	−0.47**	0.15	0.02	−0.08	−6.32
— 1360	−1.85	−0.29**	5.47**	0.29**	1.59**	11.21*
— 1529	7.75**	−0.05	2.91*	0.15*	0.19	15.18**
— 1532	12.29**	−0.47**	−0.54	−0.01	0.25	2.65
— 1538	6.49*	−0.33**	−2.38	−0.20**	−1.18**	−7.03
— 1581	2.09	0.21	−1.94	0.01	2.15**	4.81
— 1666	4.15	0.98**	−2.52	−0.25**	−2.97**	−3.11
— 1681	−1.05	−0.20	3.44**	−0.07	−3.01**	−1.89
— 1687	2.02	0.30**	1.67	0.06	−2.20**	−4.48
— 1689	1.42	0.32**	6.03**	0.07	−3.37**	0.62
— 1757	−1.18	−0.29**	2.30	0.17**	2.28**	9.07
— 1810	−3.18	0.84**	−1.42	0.01	−0.09	−0.40
— 1829	−8.31**	0.78**	2.39	0.02	−1.74**	−9.77
— 1830	−3.38	0.94**	−3.96**	0.03	3.91**	0.26
— 1842	−1.11	−0.61**	−1.70	−0.04	0.83*	−3.26
— 1874	−14.05**	0.47**	−8.35**	0.33**	0.47	0.33
— 1884	3.29	−0.01	−6.48**	0.02	5.63**	7.92*
— 1885	−2.98	−0.48**	−0.68	−0.05	−0.30	−10.79*
HI667	0.69	0.07	−6.26**	−0.38**	−3.76**	−9.45
HW517	0.69	0.29**	−1.42	−0.01	−0.95*	6.38
−441	2.55	−0.13	−3.14*	−0.07	−0.46	−1.93
SE(gj) ±	2.67	0.11	1.34	0.06	0.38	4.90

* and **, Significant at P=0.05 and 0.01, respectively.

Table III — Two best parents selected on the basis of *per se* performance and gca and two best crosses selected on the *per se* performance, heterosis and sca effec

	Parents		Hybrids			
Character	Per se performance	gca effect	Per se performance	Heterosis over mid parent	Heterosis over best parent	sca effect
Spikes Per	CPAN1538	CPAN1532	CPAN1532XAL	HW551XWL711	CPAN1532XAL	CPAN1757XHyb65
metre	Agra Local	CPAN1529	CPAN1529XAL	CPAN1532XKS	CPAN1529XAL	HW551XWL711
Spike length	CPAN1666	CPAN1666	CPAN1666XAL	CPAN1885XK	— —	CPAN1360XAL
	CPAN1810	CPAN1810	CPAN1829XK68	CPAN1885XHyb65	— -	CPAN1830XKS
Grains per	Kalyansona	CPAN1874	CPAN1874XKS	CPAN1360XAL	CPAN1874XKS	CPAN1666XWL711
spike	K68	CPAN1689	CPAN1689XWL711	HW551XAL	CPAN1689XWL711	CPAN1842XKS
Grain Weight	K68	CPAN1875	CPAN1874XHyb65	CPAN1687XAL	CPAN1874XHyb65	CPAN1829XK68
per spike	Hyb65	CPAN1360	CPAN1829XK68	HW551XHyb64	CPAN1829XK68	HI667XAL
Test weight	Hyb65	CPAN1884	CPAN1884XHyb65	CPAN1532XAL	CPAN1884XHyb65	CPAN1830XWL711
	CPAN1884	WL711	CPAN1830XYHyb65	CPAN1830XWL711	CPAN1830XHyb65	H1667XAL
Grain yield	CPAN1360	Kalyansona	CPAN1757XHyb75	CPAN1874XAL	CPAN1757XPHyb65	CPAN1757XHyb65
per metre	CPAN1285	CPAN1525	CPAN1360XAL	CPAN1689XAL	CPAN1360XAL	CPAN1842XKS

yield components: number of spikes grains/spike and test weight In wheat (Grafius, 1964), the best general combiners for yield showed high gca effects for one or two of these yield traits. For example, CPAN1360 with positive and significant gca for yield, had high gca effects for grains/ spike and test weight; similarly Kalyansona showed high gca effects for spikes/metre and test weight.

In a dynamic and systematic breed ing programme, criteria like good general combining ability for all the characters to be improved, high heterosis and high estimates of sca efftects are very important. The ultimate choice of parents in a breeding programme should be based on their *per se* performance. F_1s performance, gca of parents and sca effects of crosses. Table III shows that the *per se* performance of the parents was not related to their gca effect for all the characters except spike length This clearly indicates the importance of combining ability tests for selection of parents for hybridization because lines with similar *per se* performance may lead to limited or no advance under selection.

It was not necessary that parents having high estimates of gca effects would also give high estimates of sca effects (Table III). Most of the crosses showing significant positive sca effects combined one good and and one poor, even negative, general combiner. For grain yield, crosses CPAN1757 × Hyb 65 and CPAN1842 × Kalyansona gave the highest significant positive sca effects. The parents Kalyansona and CPAN1757 had positive gca effects, while Hyb 65 and CPAN 1842 had negativd gca effects. Apparently, the parents showing low gca effects had a relatively high magnitude non-additive gene effects and thus resulted in high sca effets when crossed.

In most of the cases, the best F_1s (*per se* performance) were not the cross-combinations which showed the maximum sca effects.. Thismay be so since the sca effects are merely a measure of the deviation of F_1 performance so that for a given hybrid performance the sca-effects may or may not be high depending upon the performance of the parental lines. Thus high sca need not necessarily mean a high performance by the hybrid as well. In most of the casses, however, the best F_1 had involved one of the bes, general combiners as one of the parents The best crosses selected on the basis of *per se* performance and heterosis over best parents were the same for all the characters studied except forspike length in which none of the hybrids surpassed the best parent. Heterosis over mid parent was not valuable for selection of best crosses Thus, the selection of best cross combinations should be done on the basis of *perse* performance of the hybrids. The lines CPAN1360, CPAN1529 CPAN1666, CPAIN757 CPAN1810 CPAN1830, CPAN 874 and CPAN1884 are recommended for exploitation in breeding progrmmes on the basis of high gca effects and F_1 performance.

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