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COMBINING ABILITY ANALYSIS FOR YIELD AND ITS COMPONENT CHARACTERS IN TRITICALE

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ABSTRACT

A 10 x 10 diallel combining ability analysis showed that gca and sca variances were significant for all the characters except yield/plant for gca and number of tillers/plant for sca effects. The parent variety DTS 1112 was the best general combiner, followed by DTS 1227. Parent DTS 1112 is a good general combiner for plant height, spike length, spikelets/spike and 100-grain weight and DTS 1227 for spike length, 100-grain weight and yield/plant. In general, in the expression of high sca effects, all the combinations of parents, namely those with high x high, high x low and low x low gca effects were involved. For improvement of the crop, reciprocal recurrent selection is suggested as it can exploit both additive as well as nonadditive gene effects.

Key words: Combining ability, yield, triticale.

The knowledge of nature of combining ability effects and their resulting variances have paramount significance in deciding the selection procedure for exploiting either heterosis or obtaining new recombinants of desirable types in triticale. It has been commonly experienced that lines with adequate gca effects coupled with reasonably high means tend to result in superior hybrids. In triticale, several workers have investigated combining ability. In the present investigation, 45 F_1s of a 10 x 10 diallel set were studied to obtain more information on combining ability.

MATERIALS AND METHODS

The present study is based on a diallel set of ten genetically diverse parents, viz. DTS 1031, DTS 1112, DTS 1260-4, DTS 1044, DTS 1260-8, DTS 1127, DTS 47A-15, JNIT 74, TL 1771 and DTS 1227. The 45 F_1s along with their 10 parents were grown in randomized block design with three replications. Each treatment was sown in a single row of 3 m length.

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The rows and plants within rows were spaced 30 cm and 10 cm apart, respectively. The recommended cultural practices were followed to raise a good crop. Observations were recorded on five random plants in each entry for days to maturity, plant height, tillers/plant, spike length, spikelets/spike, number of grains, 100-grain weight, and yield/plant. Combining ability analysis was carried out according to Method 2, Model 1 of Griffing [1].

RESULTS AND DISCUSSION

The general (gca) and specific combining ability (sca) variances are presented in Table 1. It shows significant gca and sca variances for all the characters except yield/plant for gca and tillers/plant for sca, suggesting the importance of additive and nonadditive gene actions in the expression of the traits. Significant estimates of gca and sca variances were

Table 1. ANOVA (M.S.S.) for combining ability for yield and its component characters in triticale

Source	d.f.	Days to maturity	Plant height	Tillers per plant	Spike length	Spikelets per spike	No. of grains	100-grain weight	Yield per plant
Gca	9	4.49**	163.08**	5.73**	3.31**	8.35**	116.81**	0.352**	31.66
Sca	45	2.43*	29.52**	2.29	0.31**	0.85**	35.52*	0.09**	37.34**
Error	108	1.51	10.17	2.13	0.17	0.24	20.26	0.02	20.83

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

also reported by [2–5] in triticale. In our study higher magnitude of gca variances than the sca variances were recorded for all the characters except yield/plant, which indicated a predominant role of additive and additive x additive epistatic components of genetic variance which are fixable. These findings are in agreement with those of Rojas and Sprague [6] and Griffing [1]. Nonadditive effects (dominance and epistatic components of variation) are also important in the present material. Such gene action was also reported by Kaltsikes and Lee [7] in triticale.

The estimates of gca effects (Table 2) showed that the parent cv. DTS 1112 was a good general combiner for plant height, spike length, spikelets/spike and 100-grain weight. Parent DTS 1227 was a good general combiner for spike length, 100-grain weight and yield/plant, and DTS 1260-8 for plant height, spike length and spikelets/spike.

The specific combining ability (sca) effects of crosses for different characters have been grouped in three categories, i.e. those involving parents with high x high, high x low and low x low gca. The cross DTS 1112 x DTS 1227 showed high sca effect for 100-grain weight and belongs to the first category of high x high gca parents. Obviously, high sca effects in

Table 2. Estimates of general combining ability effects for yield and its component characters in triticale

Parent	Days to maturity	Plant height	Tillers per plant	Spike length	Spikelets per spike	No. of grains	100-grain weight	Yield per plant
DTS 1031	-1.23**	0.43	-1.55**	-0.17*	-0.22	2.98*	-0.04	-3.44**
DTS 1112	-0.38	3.30**	0.36	0.66**	2.09**	-5.54**	0.23**	1.59
DTS 1260-4	0.72*	1.10	1.08**	0.28**	-0.64**	0.36	-0.03	-0.26
DTS 1044	0.18	2.42**	0.11	-0.36**	0.03	0.57	-0.17**	-0.47
DTS 1260-8	0.47	4.11**	-0.35	0.76**	0.29*	1.86	-0.08*	0.59
DTS 1127	0.02	2.02*	0.29	-0.41**	-0.84**	-3.45**	-0.01	-0.92
DTS 47A-15	0.22	0.29	-0.46	-0.97**	-0.26*	-1.50	-0.16**	0.61
JNIT 74	-0.53	-1.64	-0.34	-0.02	0.39**	5.12**	-0.28**	0.15
TL 1771	-0.17	-8.03**	0.19	-0.07	-0.45**	1.14	-0.04	-0.54
DTS 1227	0.75*	-3.99**	-0.02	0.30**	-0.41**	-1.54	0.25**	2.67*
SE ± (g)	0.34	0.87	0.39	0.11	0.13	1.23	0.04	1.25

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

such a case can be attributed to additive type interaction between the parents and thus can be utilized in a variety of ways to improve the crop. In view of the considerable importance of additive x additive effects and possibility of their fixation, single plant selections may be practised in segregating generations for isolating superior inbreds. On the other hand, the parents with high gca effects did not give equally high sca effects. The crosses involving both parents with high gca effects, e.g., DTS 1112 x DTS 1260-8 and DTS 1260-4 x DTS 1227 for spike length and DTS 47A-15 x DTS 1227 for 100-grain weight gave low sca estimates. This is probably due to mutual cancellation of gene effects for these characters in the parents. High sca effect for days to maturity in the cross DTS 1031 x DTS 1127 involving one parent with high gca (negative gca estimates being desirable for early maturity) and the other with low gca is probably due to dominant x recessive interaction. Due to epistatic interactions, even poor combiner parents in the cross DTS 1044 x DTS 1127 for spikelets/spike and in DTS 1260-8 x JNIT 74 for yield/plant showed high sca effects. Under the present situation where both additive and nonadditive variances are present, it is suggested that reciprocal recurrent selection [8] may be adopted for rapid improvement. After a couple of cycles of recurrent selection, the selected elite lines should be tested in multilocation trials.

Table 3. Estimates of specific combining ability effects of different characters in triticale

Cross	Days to maturity	Plant height	Tillers per plant	Spike length	Spikelets per spike	No. of grains	100-grain weight	Yield per plant
DTS 1031 x DTS 1112	2.69*	-0.58	3.22*	0.04	-0.89*	0.07	0.13	7.36
DTS 1031 x DTS 1260-4	-1.21	1.15	1.24	0.55	1.71**	-0.67	0.19	-3.52
DTS 1031 x DTS 1044	-0.09	-1.36	-0.72	0.26	-0.03	-1.77	0.19	0.92
DTS 1031 x DTS 1260-8	-0.57	1.94	-0.25	0.01	0.97*	11.80**	0.01	-1.41
DTS 1031 x DTS 1127	-5.64**	-0.23	-0.09	-0.42	-0.02	-4.88	-0.06	0.54
DTS 1031 x DTS 47A-15	-0.24	0.02	-1.08	0.42	0.34	6.37	0.06	-1.86
DTS 1031 x JNIT 74	-0.63	0.69	-2.01	-0.34	0.01	3.81	-0.09	-4.40
DTS 1031 x TL 1771	0.35	8.02**	-2.06	0.31	-0.07	-4.14	-0.11	-2.24
DTS 1031 x DTS 1227	0.55	6.57*	0.41	0.60	0.47	0.27	0.30	6.91
DTS 1112 x DTS 1260-4	0.07	3.74	-2.81*	0.12	0.39	1.22	0.18	-8.55*
DTS 1112 x DTS1044	1.25	6.96*	-0.23	-0.11	0.38	-1.25	0.36**	1.02
DTS 1112 x DTS 1260-8	-1.47	5.07	0.23	0.04	0.39	4.26	0.17	7.48
DTS 1112 x DTS 1127	-0.75	6.03*	-0.68	0.41	0.43	-2.69	0.29*	0.23
DTS 1112 x DTS 47A-15	0.35	5.55	-0.26	0.11	0.62	-0.50	0.05	-1.56
DTS 1112 x JNIT 74	0.59	-4.24	-0.45	0.48	0.62	-4.79	-0.13	-5.47
DTS 1112 x TL 1771	-0.43	-1.12	-0.71	0.67	0.81	2.35	0.45**	1.25
DTS 1112 x DTS 1227	-0.49	3.37	1.23	0.49	0.49	2.53	0.36**	5.27
DTS 1260-4 x DTS 1044	-0.25	-0.24	0.05	0.74*	0.66	0.97	0.02	1.58
DTS 1260-4 x DTS 1260-8	-0.05	-3.86	1.25	-0.17	-0.60	3.08	-0.10	0.11
DTS 1260-4 x DTS 1127	-0.59	2.23	-1.53	0.19	1.14*	-0.94	0.09	0.12
DTS 1260-4 x DTS 47A-15	-0.79	2.15	0.15	0.03	0.36	3.32	-0.12	8.49*
DTS 1260-4 x JNIT 74	1.98	-0.44	3.35*	0.67	0.76	8.09	0.03	2.25
DTS 1260-4 x TL 1771	0.73	1.67	-0.36	-0.01	-1.25**	-3.25	-0.18	-5.78
DTS 1260-4 x DTS 1227	-0.20	3.17	0.37	0.35	0.70	3.02	-0.07	4.33
DTS 1044 x DTS 1260-8	-0.14	-7.04*	1.42	0.01	0.92*	-3.32	-0.05	1.19
DTS 1044 x DTS 1127	-0.67	3.32	-0.08	1.04**	1.53**	2.86	0.06	5.20
DTS 1044 x DTS 47A-15	-1.88	3.50	-0.41	-0.39	0.28	6.32	-0.04	-0.56
DTS 1044 x JNIT 74	0.86	4.84	-1.27	-0.28	-0.64	11.16**	0.11	6.26

(Contd.)

Table 3 (contd.)

Cross	Days to maturity	Plant height	Tillers per plant	Spike length	Spikelets per spike	No. of grains	100-grain weight	Yield per plant
DTS 1044 x TL 1771	1.58	6.49*	1.61	0.36	0.34	4.34	-0.01	6.82
DTS 1044 x DTS 1227	2.28*	6.97*	-2.35	-0.54	-0.37	-15.94**	-0.33**	-9.03*
DTS 1260-8 x DTS 1127	2.78*	1.35	0.51	0.32	0.20	4.56	0.34**	5.17
DTS 1260-8 x DTS 47A-15	0.98	3.07	0.25	0.48	0.55	-3.57	0.07	1.30
DTS 1260-8 x JNIT 74	1.46	4.02	1.59	0.86*	0.15	-4.60	0.08	10.29*
DTS 1260-8 x TL 1771	0.31	-0.66	0.61	-0.02	-0.52	2.51	-0.13	-4.47
DTS 1260-8 x DTS 1227	0.84	-4.18	-2.72*	0.59	-1.14*	-6.84	-0.02	-5.73
DTS 1127 x DTS 47A-15	1.31	-0.63	1.81	-0.21	-0.37	2.81	-0.04	3.11
DTS 1127 x JNIT 74	1.12	6.24*	-1.45	0.29	0.43	5.31	0.07	5.67
DTS 1127 x TL 1771	0.70	3.16	0.83	-0.32	0.15	1.76	-0.14	7.90
DTS 1127 x DTS 1227	0.86	6.84*	-0.09	-1.02**	-1.06*	5.42	-0.43**	-10.78*
DTS 47A-15 x JNIT 74	1.18	4.36	2.96*	-0.01	-0.41	-3.82	0.16	10.21*
DTS 47A-15 x TL 1771	0.03	2.15	0.58	-0.22	-0.09	1.68	0.69**	3.66
DTS 47A-15 x DTS 1227	0.49	-0.22	-0.34	0.54	1.13*	-0.29	0.10	-2.55
JNIT 74 x TL 1771	-0.02	-1.17	-2.02	0.09	0.84	1.73	-0.13	0.52
JNIT 74 x DTS 1227	-1.35	1.52	-0.74	-0.41	-0.54	-3.59	0.41**	-1.82
TL 1771 x DTS 1227	0.16	4.50	0.20	0.57	1.24**	3.85	0.50**	1.44
SE ± (ij)	1.13	2.94	1.34	0.37	0.45	4.15	0.13	4.20
CD (5%)	2.21	5.76	2.63	0.72	0.88	8.13	0.25	8.23
CD (1%)	2.90	7.55	3.44	0.95	1.15	10.66	0.33	10.79

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

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