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LINE X TESTER ANALYSIS FOR COMBINING ABILITY IN SALINE RICE CULTIVARS

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ABSTRACT

Combining ability for eight quantitative characters in saline rice cultivars was studied through Line X Tester analysis involving five saline susceptible lines and seven saline tolerant testers. The combining ability analysis revealed that variance due to lines x testers was significant for all the eight characters studied. The estimates of $\sigma^2 sca$, $\sigma^2 gca$ and their ratio indicated preponderance of non-additive gene action for all the eight characters studied. Among the parents, CNA 4121, IR 61457-8-3-3-1, IR 10198-66-2 and IR 54717-C10-113-1-2-2-2 were found to be good general combiners for grain yield. Six crosses were identified as best hybrids based on their *per se* performance, high heterosis and high *sca* effects.

KEY WORDS : Combining ability, heterosis, *gca*, *sca*, non-additive gene action.

As rice is moderately sensitive to salinity (Akbar *et al.*, 1972), the knowledge on genetics for developing superior veriety to overcome the salinity problem is essential. For this, the combining ability will provide the required knowledge on nature of gene action which will facilitate commercial exploitation of heterosis, isolation of purelines among the progenies of heterotic F1s and to design efficient breeding programme for corp improvement. Hence, the present study was undertaken to study the gene action to identify good combining parents and heterotic crosses that could be used for saline breeding by using L x T mating design.

MATERIALS AND METHODS

The experimental material consisted of five saline susceptible lines, *viz.*, CNA 4121 (L1), CNA 4206 (L2), IR 59788-37-1-1- 2-1 (L3), IR 61457-8-3-3-1 (L4) and IR 64 (L5) and seven saline tolerant testers *viz.*, CSR-1(T1), IR 4595-4-1-1-3 (T2), IR 4630-22-2-5-13 (T3), IR 10198-66-2 (T4), IR 54717-C10-43-1-2-2- 2(T5), IR 54717-C10-94-3-2-3-2(T6) and IR 54717-C10-113-1-2-2-2(T7) crossed in LXT mating design and their 35 F1 hybrids. The parents and F1s were grown in randomised block design replicated thrice, spaced with 15 x 20 cm at the Agricultural College and Research Institute, Madurai during 1994 *kharif* (June-July) season. Five random competitive plants were used to record observations on days to 50% flowering, plant height, number of productive tillers/plant, ear length, ear weight, number of filled grains/ear, 100 grain weight and grain yield / plant. Combining ability analysis was done following the method suggested by Kempthorne (1957) and heterosis was worked out over mid parent and better parent.

RESULTS AND DISCUSSIONS

The analysis of variance revealed that variation in genotypes (parents and hybrids) was highly significant for all the characters studied (Table 1). The combining ability variance of lines and testers

Table 1. Analysis of variance for combining ability in rice

Source	df	Days to 50% flowering	Plant height	No.of Productive tillers/plant	Ear length	Ear weight	No.of filled grains/ear	100 grain weight	Grain yield/plant
Genotypes	46	160.39**	267.27**	11.18**	23.62**	0.67	359.21**	0.46	49.89**
Lines	4	106.96	530.21	23.23	22.44	1.49**	549.59	1.08**	92.55
Testers	6	219.48	158.35	7.22	67.89**	0.79**	543.87	0.82**	52.47
Lines X Testers	24	122.21**	236.21**	10.16**	14.32**	0.29**	219.67**	0.17**	47.05**
Error	92	0.75	14.88	0.37	3.43	0.09	32.74	0.04	1.61
gca		0.300	0.407	0.019	0.203	0.005	1.876	0.004	0.123
sca		48.397	96.164	4.307	9.672	0.238	127.484	0.198	20.311
gca: sca		0.006:1	0.004:1	0.004:1	0.021:1	0.015:1	0.02:1	0.006:1	

*Significant at five pre cent level ** Significant at one per cent level

was significant for ear weight and 100 grain weight, and in addition to that, the testers were also significant for ear length. The highly significant mean squares of lines x testers revealed that they interacted and produced markedly different combining ability effects and it might be due to wide genetic diversity of lines and testers. The estimates of general combining ability variance and specific combining ability variance and their ratio (Table 1) revealed that the specific combining ability variance was high for all the eight characters studied. This stresses the need for exploiting *sca* variance to obtain high yielding combination and also indicates a predominantly non-additive and also indicates a predominantly non-additive type of genetic component governing these characters. Ram *et al.* (1991), also found high magnitude of specific combining ability variance for all these characters.

The estimates of general combining ability effects of lines and testers are given in Table 2. The lines CNA 4121 and IR 61457-8-3- 3-1 and testers IR 10198-66-2 and IR 54717-C10-113-1-2-2-2 were found to be the good general combiners for grain yield. Among these, IR 61457-8-3-3-1 and IR 54717-C10-113-1-2-2-2 were good combiners for most of the yield traits. These parents can be extensively used in breeding programme for getting better combinations because of the capacity to transmit their characters to the offsprings.

The specific combining ability effects were estimated for all the 35 hybrids for all the 8 characters (Table 3). The estimates of *sca* effects revealed that 11 out of 35 hybrids showed high *sca* effects for grain yield per plant. The heterosis over mid parent and better paraent was worked out and it ranged from - 20.10 to 41.33 and from -29.42 to 38.94 respectively (Table 4). Among the 11 hybrids

Table 2. General combinig ability effects of parents

Parents	Days to 50% Flowering	Plant height	No.of Productive tillers / plt	Ear length	Ear Weight	No.of Filled Grains / ear	100 Grain weight	Grain yield/Plant
CNA 4121	-2.39**	-0.86	-0.18	-0.55	-0.33**	2.37	0.30**	1.59**
CNA 4206	-0.87**	-2.78**	-1.38**	-1.54**	-0.36**	-7.63**	-0.08	-2.69**
IR59788-37-1-1-2-1	-0.67	0.81	-0.51**	0.90*	-0.14*	5.08**	-0.29**	-1.14**
IR61457-8-3-3-1	3.66**	8.04**	0.86**	0.38	0.15*	2.83*	0.12**	2.54**
IR64	0.28	-5.22**	1.22**	0.81*	0.02	-2.65*	-0.05	-0.30
SE	0.19	0.84	0.13	0.40	0.07	1.25	0.05	0.28
CSR-1	-5.79**	5.40**	-1.01**	-3.06**	-0.02	7.03**	-0.20**	- 1.32**
IR4595-4-1-1-3	-2.19**	-2.48*	0.66**	-1.30**	-0.44**	1.43	-0.41**	-1.94**
IR4630-22-2-5-13	-1.46**	2.23*	-0.57**	-1.62**	0.18*	4.26**	0.09	-0.79*
IR10198-66-2	-0.79**	0.81	0.55**	0.67	-0.07	1.47	- 0.27**	0.70*
IR54717-C10-43-1-2-2-2	1.81**	-4.64**	-0.37*	0.36	0.19*	-2.15	0.20**	0.29
IR54717-C10-94-3-2-3-2	6.21	-0.67	-0.08	1.92**	-0.06	-11.88**	0.09	-0.67*
IR54717-C10-113-1-2-2-2	2.21**	-0.67	0.82**	3.03**	0.22**	-0.17	0.25**	3.72**
SE	0.22	0.99	0.16	0.48	0.08	1.48	0.05	0.33

Significant at five per cent level **Significant at one per cent level

Table 3. Specific combining ability effects of hybrids

Hybrids	Days to 50% Flowering	Plant height	No.of Productive tillers / plt	Ear length	Ear Weight	No.of Filled Grains / ear	100 Grain weight	Grain yield/Plant
L1 X T1	-5.54**	7.38**	-0.35	1.68	0.35*	5.61	0.15	3.84**
T2	3.86**	2.15	1.78**	-1.07	0.39*	5.04	0.18	2.63**
T3	-3.88**	-4.69*	0.54	1.07	-0.03	-2.89	-0.02	-0.63
T4	-6.21**	1.32	-1.51**	-1.22	-0.74**	-6.68*	- 0.56**	-7.22**
T5	11.19**	-0.48	0.67	-0.89	-0.01	-5.39	0.18	2.45**
T6	6.79**	-8.35**	-2.42**	-0.47	0.19	6.24	0.10	-4.66**
T7	-6.21**	2.67	1.29**	-1.55	-0.16	-1.93	-0.03	3.59**
L2 X T1	6.93	-16.27**	0.78*	1.51	0.002	-2.21	-0.11	-2.48**
T2	-3.33**	-3.67	-0.62	-1.05	-0.09	-5.92	-0.13	-2.09**
T3	2.93**	6.04**	0.61	-1.67	0.18	-4.60	0.29	2.62**
T4	-4.07**	1.11	3.35**	1.77	0.10	5.04	-0.06	4.39**
T5	-11.33**	3.46	-3.33**	-0.99	-0.52**	3.63	0.14	-3.36**
T6	1.60	4.99	-0.29	-1.38	0.11	3.38	-0.08	-0.63
T7	7.27**	4.35	-0.51	1.82	0.22	0.68	0.23	1.55*
L3 X T1	-6.59**	15.16**	-0.29	-0.81	-0.12	-6.23	0.17	-0.20
T2	-5.52	5.39	0.11	0.51	-0.14	-4.57	0.02	1.21
T3	-3.59**	-15.51**	0.27	2.68*	0.12	26.38**	-0.48**	1.08
L3 X T4	10.74**	-1.51	-2.31**	-1.46	0.11	-10.56**	0.24	-4.24**
T5	-0.86	3.09	3.01**	-1.33	0.24	-5.21	0.17	4.27**
T6	-0.26	-5.11*	-1.29**	-0.59	-0.21	-0.89	-0.11	-1.89*
T7	6.08**	-1.51	0.49	1.00	0.01	1.09	-0.03	-0.23
L4 X T1	-0.59	0.02	-1.52**	-3.39**	-0.25	1.28	-0.19	-1.91**
T2	2.48**	-7.98**	0.68	1.19	0.06	10.67**	-0.04	1.53*
T3	5.74**	15.93**	-0.23	-3.79**	-0.35*	-13.35**	0.11	-0.28
T4	0.74	-3.32	1.38**	-1.19	0.19	9.54**	0.11	6.09**
T5	-0.19	-7.86**	0.17	4.09**	0.59**	3.19	0.16	0.41
T6	-2.26**	13.85**	0.41	4.41**	-0.09	-6.89*	-0.09	-0.93
T7	-5.92**	-10.63**	-0.88*	-1.313	-0.15	-4.44	-0.06	
L5 X T1	5.79**	-6.28**	1.38**	1.01	0.02	1.55	-0.02	0.75
T2	2.52**	4.11	-1.95**	0.41	-0.21	-5.22	-0.03	-3.28**
T3	-1.21*	-1.76	-1.19**	1.72	0.08	-5.53	0.09	-2.78**
T4	-1.21*	2.39	-0.91**	-0.34	0.33	2.66	0.27*	0.98
T5	1.19*	1.79	-0.53	-0.89	-0.29	3.77	- 0.37**	-3.78**
T6	-5.88**	-5.37*	3.58**	-1.96	-0.002	-1.83	0.17	8.11*
T7	-1.21	5.12	-0.38	0.05	0.08	4.60	-0.11	-0.011
SE	0.50	2.23	0.35	1.07	0.18	3.30	0.12	0.73

L1 : CNA 4121 ; L2 : CNA 4206 ; L3 : IR59788-37-1-1-2-1; L4 : IR 61457-8-3-3-1 ; L5 : IR 64

Significant at five per cent level ** Significant at one per cent level

T1 : CSR-1; T2 : IR4595-/4-1-1-3; T3 : IR 4630-22-2-5-13; T4 : IR 10198-66-2; T5 : IR54717-C10-43-1-2-2-2

T6 : IR54717-C10-94-3-2-3- 2; T7 : IR54717-C10-113-1-2-2-2.

which are having high *sca* effects for grain yield, only six hybrids, *viz.*, IR 64 x IR 54717-C10-94-3-2-3-2, CNA 4121 x IR 54717 - C10-113-1-2-2-2, IR 61457-8-3-3-1 x IR 10198-66-2, CNA 4121 x CSR-1, CNA 4206 x IR10198-66-2 and CNA 4121 x IR 4595-4-1-1-3 showed high *per se* performance and high heterosis (Table 4).

The cross combinations : CNA 4121 x IR 54717-C10-113-1-2-2-2 and IR 61457-8-3-3-1 x IR 10198-66-2 had high heterosis and the parents of these crosses were good general combiners. Such results might be due to interaction of dominant genes contributed by the parents. By resorting pedigree breeding technique, these cross combinations may be exploited to obtain early desirable segregants for gain yield. The hybrids CNA 4121 X CSR-1, CNA 4206 X IR 10198-66-2 and CNA 4121 X IR 4595-4-1-1-3 resulted from one good and one poor general combiners. Dominant x recessive type of interaction might have yielded these combinations with non-additive, non-fixable genetic component for grain yield.

Table 4. *Per se* Performance, heterosis, *sca* effects of hybrids and *gca* effects of parents involved in crosses

Cross	*Per se* performance	Heterosis over		*sca* of cross	*gca* of parents
		mid parent	better parent		
IR 64 X IR 54717-C10-94-3-2-3-2	32.37	41.33	38.94	8.11	-0.30 -0.67*
CNA 4121 X IR 54717-C10-113-1-2-2-2	34.15	31.38	24.44	3.59	1.59** 3.72**
IR 61457-8-3-3-1 X IR 10198-66-2	34.57	28.73	14.37	6.09	2.54** 0.70*
CNA 4121 X CSR - 1	29.35	27.11	19.58	3.84	1.59** -1.32**
CNA 4206 X IR 10198-66-2	27.64	37.69	17.68	4.39	- 2.69** 0.70*
CNA 4121 X IR 4595-4-1-1-3	27.53	12.58	12.15	2.63	1.59* -1.32**

* Significant at five per cent level ** Significant at one per cent level

These crosses would serve as a source population for producing transgressive desirable early segregants in later generations and could be exploited by random mating and selection among the segregants. The cross IR 64 X IR 54717-C10-94- 3-2-3-2 resulted from poor combining parents exhibited high *sca* effects and heterosis. This cross combination would produce transgressive segregants and there is a possibility to obtain desirable segregants if cyclic or biparental breeding programme are adopted.

From the study, it was concluded that the parents CNA 4121, IR 61457-8-3-3-1, IR 10198-66-2 and IR 54717-C10-113-1-2-2-2, and the crosses IR 64 X IR 54717-C10-94-3-2-3-2, CNA 4121 x IR 54717-C10- 113-1-2-2-2, IR 61457-8-3-3-1 x IR 10198-66-2, CNA 4121 x CSR-1, CNA 4206 x IR 10198-66-2 and CNA 4121 x IR 4595-4-1-1-3 which performed better under normal field condition could be used for breeding saline tolerance after further testing under saline condition.

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CORRELATION AND PATH ANALYSIS IN THE F_2 GENERATION OF FINGER MILLET

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ABSTRACT

Correlation and path analysis were carried out in the F_2 generation of the four crosses of finger millet (*ragi*) (*Eleusine coracana* Gaertn.) namely Co9 x Co13, Co9 x Indaf9, Co9 x Co7 and MS 2863 x MS 2655 for grain yield and its components. Grain yield was found to be positively associated with its component traits in the order of ear weight, number of productive tillers, finger number, finger length, plant height, days to 50 per cent flowering and 100 grain weight. Ear weight, number of productive tillers and finger length showed positive direct effect on grain yield.

KEY WORDS : Finger millet, yield components, correlation coefficients, path analysis