

## Combining ability of rice genotypes under coastal saline situation

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**Abstract :** Six lines and five testers were crossed in line x tester fashion and  $F_1$ 's were evaluated under coastal situation. The ratio between the estimates of additive and dominance variance indicated preponderance of non-additive gene action for all characters studied namely plant height, productive tillers, boot leaf length, panicle length, grain weight/panicle and grain yield/ plant. Among the parents, ADT 45 recorded significantly superior grain yield/plant and panicle length. This was followed by Swarna and Paiyur I for grain yield /plant. Line parent TKM 11 recorded superior mean for boot leaf length, panicle length and grain weight/panicle. Among the line parents ADT 45 and TKM 11 showed good combining ability for grain yield/plant, panicle length and grain weight/ panicle. It indicates the existence of relationship between *per se* and *gca* of parents to certain extend. Among the hybrids, ADT 45 X Vandana, ADT 45 X Nootripathu, ADT 45 X Norungan, ADT 45 X PMK 2, TKM 11 X Vandana, TKM 11 X Nootripathu, TKM 11 X Norungan, TKM 11 X MDU 5, TKM 11 X PMK 2 and Paiyur 1 X PMK 2 recoded significantly superior grain yield/ plant and grain weight/ panicle. With regard to specific combining ability effect, all the superior hybrids recorded additive gene action except ADT 45 X Nootripathu for which additive type epistasis observed. Hence these crosses could be subjected to pedigree breeding to evolve high yielding genotypes for coastal saline situations.

**Key words:** Rice, coastal salinity, combining ability, gene action.

### Introduction

The productivity of rice is being affected by biotic and abiotic factors. Among the abiotic factors, salinity is an important yield limiting factor in coastal saline areas. Hence it is necessary to evolve saline resistant and high yielding varieties of rice for the coastal saline regions, Combining ability analysis is useful for selecting best parents for any plant breeding programme. The line X tester analysis has been widely used by plant breeders to assess the combining ability of parents. This analysis also provides valuable information on the nature of gene action, in addition to the combining

ability of parents and hybrids. In the present study an attempt was made to assess the combining ability of rice genotypes under coastal saline situation.

### Materials and Methods

Six lines namely IR 66, Swarna, ASD 20, ADT 45, TKM 11 and Paiyur I and five testers namely Vandana, Nootripathu, Norungan, MDU 5 and PKM 2 were crossed in line x tester fashion. The 30  $F_1$ 's and 11 parents were evaluated in RBD replicated twice in a plot size of 1.0m<sup>2</sup>. The experiment

**Table 1. Mean of parents for various characters**

Parents	Code	Plant height (cm)	No.of Productive tillers	Boot leaf length (cm)	Panicle length (cm)	Grain weight/ panicle (g)	Grain yield/ plant (g)
<b>Lines</b>							
IR 66	L1	57.3	11.4	21.3	22.8	2.5	22.9
Swarna	L2	74.4	11.0	16.2	17.8	3.4	33.9
ASD 20	L3	48.2	21.4	21.3	22.3	2.1	30.8
ADT 45	L4	67.8	14.4	27.8	22.9	2.2	36.6
TKM 11	L5	113.8	8.7	37.3	25.4	3.3	30.6
Paiyur 1	L6	123.8	9.6	27.8	23.3	2.4	34.0
<b>Testers</b>							
Vandana	T1	125.7	31.0	28.3	22.4	2.6	26.8
Nootripathu	T2	128.3	29.0	28.1	23.5	2.5	25.3
Norungan	T3	121.8	27.8	27.4	22.6	2.5	26.0
MDU 5	T4	88.6	13.4	27.3	19.1	3.5	26.7
PMK 2	T5	68.1	13.8	25.7	21.8	2.1	26.9
S.E.		4.3	1.5	2.0	0.9	0.1	0.9
C.D (P=0.05)		12.3	4.1	5.6	2.5	0.2	2.4

was conducted at the farm of the Annamalai University, Annamalainagar during June-July 2004. The experiment field was under saline condition with pH of 7.8 and EC of 4.3 dSm<sup>-1</sup>. Observations were recorded for plant height, productive tillers, boot leaf length, panicle length, grain weight /panicle and grain yield/ plant from five plants per replication per entry. The data were subjected to line x tester analysis as suggested by Kempthorne (1957).

## Results and Discussion

### *Analysis of variance:*

The analysis of variance for combining ability revealed the existence of significant

difference among lines and testers for combining ability effect for all characters except for grain yield per plant. For grain yield per plant, significant difference of combining ability was observed among lines alone. With regard to specific combining ability effect, significant difference was observed for all characters except plant height and productive tillers. The variances due to the estimates of additive and non additive components indicated the predominance of non additive gene action for all the characters indicating the usefulness of heterosis breeding for the improvement of these characters.

Predominance of additive gene action was reported by Yadav *et al.*, (1999), Lavanya

**Table 2. General combining ability of parents**

Parents	Code	Plant height (cm)	No.of Productive tillers	Boot leaf length (cm)	Panicle length (cm)	Grain weight/ panicle (g)	Grain yield/ plant (g)
<b>Lines</b>							
IR 66	L1	-8.0**	-2.9**	5.2**	1.5**	-0.18**	-2.2**
Swarna	L2	-7.6**	3.4**	-3.7**	-0.4	-0.09**	-0.01
ASD 20	L3	-11.8**	2.5**	-5.7**	-1.2**	-0.02	-1.8**
ADT 45	L4	-1.8	-2.0*	-7.4**	0.9*	0.12**	1.9**
TKM 11	L5	12.2**	-2.6**	1.5	1.5**	0.10**	1.9**
Paiyur 1	L6	17.0**	1.5*	10.1**	-2.3**	0.07**	0.4
<b>Testers</b>							
Vandana	T1	3.6	-0.6	2.6**	0.3	-0.05*	0.2
Nootripathu	T2	6.9**	-6.1**	-2.0*	1.2**	-0.04	-0.1
Norungan	T3	0.1	5.7**	5.7**	0.7	0.02	-0.0
MDU 5	T4	-8.0**	-1.4*	-3.1**	-0.9*	0.03	0.4
PMK 2	T5	-2.6	2.3**	-3.3**	-1.2**	0.04	0.4
S.E.		2.3	0.7	1.0	0.4	0.02	0.3
C.D (P=0.05)		2.1	0.7	0.9	0.4	0.02	0.3

\*, \*\* Significant at 5 and 1 per cent respectively.

(2000), Kalitha and Upadhaya (2000), Bidhan Roy and Mandal (2001) for plant height; Yadav *et al.* (1999), Kalitha and Upadhay (2000), Lavanya (2000) for panicle length and Meenakshi and Amirthadevarathinam (1999), Selvarani and Rangasamy (1999), Lavanya (2000), Sathyanarayanan *et al.* (2000), Bidhan Roy and Mandal (2001) for grain yield plant. However, more of non additive gene action was also reported by Anand *et al.* (1999), Acharya *et al.* (2000), Munhot *et al.* (2000), Sathyanarayanan *et al.* (2000) for plant height; Anand *et al.* (1999), Muruganandam (1999)

Saravanan (2000) for no. of productive tillers; Munhot *et al.* (2000), Acharya *et al.* (2000), Sathyanarayanan *et al.* (2000), Bidhan Roy and Mandal (2001) for panicle length and Acharya *et al.* (2000), Annadurai and Nadarajan (2001) for grain yield/plant.

The first and foremost criterion on the choice of parents is the *per se* performance. Among the parents, ADT 45 alone recorded significantly superior grain yield per plant (Table 1). This was followed by Swarna and Paiyur 1. Parents ADT 45, Swarna and Paiyur

**Table 3. Mean performance of crosses for various characters in L X T analysis.**

Parents	Plant height (cm)	No.of Productive tillers/plant	Boot leaf length (cm)	Panicle length (cm)	Grain weight/panicle (g)	Grain yield/plant (g)
L1 x T1	124.08	32.25	55.92	31.66	2.16	27.63
L1 x T2	123.42	31.00	41.75	31.16	2.33	29.14
L1 x T3	122.08	34.58	62.42	30.59	2.43	29.32
L1 x T4	91.17	22.59	31.54	26.54	2.55	27.84
L1 x T5	98.33	31.59	28.59	24.66	2.59	29.93
L2 x T1	130.67	33.33	39.00	29.25	2.44	30.80
L2 x T2	121.25	33.33	31.41	28.59	2.49	30.77
L2 x T3	108.00	47.25	46.17	28.84	2.57	30.55
L2 x T4	104.92	30.25	33.04	25.84	2.56	31.48
L2 x T5	96.25	39.58	26.00	22.66	2.47	30.82
L3 x T1	120.00	37.42	31.33	27.88	2.60	28.97
L3 x T2	98.92	29.91	20.75	20.91	2.58	29.48
L3 x T3	112.58	45.92	41.08	27.84	2.53	29.09
L3 x T4	93.67	38.50	36.00	26.66	2.57	28.84
L3 x T5	115.13	27.59	36.63	27.66	2.58	29.52
L4 x T1	113.83	21.34	26.96	24.91	2.74	34.21
L4 x T2	123.42	20.50	31.50	29.00	2.69	34.22
L4 x T3	115.00	38.25	32.58	30.66	2.71	32.48
L4 x T4	119.25	37.17	33.25	28.34	2.71	30.66
L4 x T5	118.92	39.58	32.83	28.50	2.73	32.72
L5 x T1	122.08	31.09	45.08	29.50	2.71	33.62
L5 x T2	154.83	38.25	54.83	32.50	2.67	32.80
L5 x T3	130.50	29.75	30.25	26.50	2.72	32.88
L5 x T4	118.25	25.00	35.46	27.13	2.64	32.84
L5 x T5	134.83	29.59	36.34	28.71	2.71	32.44
L6 x T1	130.00	41.25	50.17	22.88	2.63	32.11
L6 x T2	138.58	10.50	40.92	29.25	2.54	28.64
L6 x T3	131.33	38.42	55.08	24.16	2.71	31.61
L6 x T4	144.08	37.92	45.50	24.34	2.71	31.90
L6 x T5	140.42	46.08	53.25	24.84	2.72	32.92
S.E.	5.05	1.61	2.24	0.91	0.05	0.68
C.D. (P=0.05)	14.63	4.66	6.49	2.64	0.15	1.98
C.D. (P=0.01)	19.70	6.27	8.74	3.55	0.02	2.66

**Table 4. Specific combining ability of crosses for various characters in L X T analysis.**

Parents	Plant height (cm)	No.of Productive tillers/plant	Boot leaf length (cm)	Panicle length (cm)	Grain weight/panicle (g)	Grain yield/plant (g)
L1 x T1	8.68	2.40	9.32**	2.46*	-0.21**	-1.36
L1 x T2	4.72	6.67**	-0.30	1.07	-0.04	0.53
L1 x T3	10.21	-1.52	12.63**	0.96	-0.01	0.57
L1 x T4	-12.68*	-6.39**	-9.45**	-1.46	0.11*	-0.52
L1 x T5	-10.93*	-1.16	-12.21**	-3.03**	0.14*	0.78
L2 x T1	14.86**	-2.87	1.32	1.93*	-0.02	-0.30
L2 x T2	2.16	2.66	-1.72	0.38	0.02	0.05
L2 x T3	-4.27	4.80**	5.30*	1.10	0.05	-0.32
L2 x T4	0.67	-5.08**	0.97	-0.27	0.03	1.02
L2 x T5	-13.42*	0.49	-5.87*	-3.14**	-0.08	-0.45
L3 x T1	8.36	2.10	-4.38	1.40	0.07	-0.43
L3 x T2	-16.02**	0.12	-10.42**	-6.45**	0.05	0.47
L3 x T3	4.47	4.35*	2.18	0.94	-0.06	-0.08
L3 x T4	-6.42	4.06*	5.90*	1.40	-0.04	0.07
L3 x T5	9.61	-10.62**	6.72**	2.70**	-0.03	-0.04
L4 x T1	-7.83	-9.48**	-7.02**	-3.65**	0.07	1.14
L4 x T2	-1.54	-4.79**	2.07	-0.45	0.02	1.52*
L4 x T3	-3.14	1.18	-4.58	1.68	-0.02	-0.36
L4 x T4	9.14	7.22**	4.88*	0.98	-0.03	-1.78*
L4 x T5	3.38	5.87**	4.66*	1.44	-0.03	-0.53
L5 x T1	-13.60*	0.90	2.14	0.35	0.07	0.49
L5 x T2	15.86**	13.59**	16.44**	2.46*	0.03	0.05
L5 x T3	-1.66	-6.69**	-15.89**	-3.07**	0.01	-0.01
L5 x T4	-5.88	-4.31*	-1.88	-0.82	-0.08	0.33
L5 x T5	5.28	-3.49*	-0.81	1.07	-0.02	-0.86
L6 x T1	-10.47*	6.96**	-1.37	-2.50*	0.02	0.46
L6 x T2	-5.18	-18.26**	-6.07*	2.99**	-0.08	-2.63**
L6 x T3	-5.61	-2.12	0.36	-1.63	0.03	0.19
L6 x T4	15.17**	4.50**	-0.43	0.17	0.02	0.88
L6 x T5	6.08	8.91**	7.52**	0.97	0.02	1.10
S.E.	5.05	1.61	2.24	0.91	0.05	0.68

\*, \*\* Significant at 5 and 1 per cent respectively.

1 also recorded superior performance for panicle length, grain weight/ panicle and panicle length respectively. Parent TKM 11 recorded superior *per se* for boot leaf length, panicle length and grain weight/ panicle. The testers namely Vananda, Nootripathu and Norungan were alone recorded superior performance for no. of productive tillers. The desirable plant height was recorded by ASD 20 and IR 66. Among the tester parents MDU 5 and Nootripathu alone recorded superiority for grain weight per panicle and panicle length. Hence based on the *per se* performance the parents ADT 45, Swarna, Paiyur 1 and TKM 11 were considered as superior.

The second criterion in the choice of parents is general combining ability. Among the parents ADT 45 and TKM 11 recorded desirable combining ability effect for grain yield / plant, panicle length and grain weight/ panicle (Table 2). The parent Swarna recorded desirable combining ability for plant height and productive tillers. The line parent Paiyur 1 recorded desirable combining ability effect for no. of productive tillers, boot leaf length and grain weight/panicle. Among the tester parents, Vandana for boot leaf length; Nootripathu for panicle length; Norungan for no. of productive tillers and boot leaf length; MDU 5 for plant height and PMK 2 for no. of productive tillers recorded desirable *gca* effect. Considering the *per se* and *gca* effect together, the parents ADT 45 and TKM 11 were considered as desirable parents.

#### Choice of hybrids:

The first criterion in the choice of hybrids is the *per se* performance. Among the crosses, ADT 45 X Vandana, ADT 45 X Nootripathu, ADT 45 X Norungan, ADT 45 X PMK 2, TKM 11 X Vandana, TKM

11 X Nootripathu, TKM 11 X Norungan, TKM 11 X MDU 5, TKM 11 X PMK 2 and Paiyur 1 X PMK 2 recorded significantly superior grain yield/plant and grain weight / panicle (Table 3). In general, high x average combiners produce high yielding hybrids. This might be due to additive gene action. The second criterion in the choice of hybrid is the specific combining ability effect. In the present study, all the superior hybrids recorded additive gene action except ADT 45 X Nootripathu for which additive type epistasis was observed (Table 4).

Summarizing, 10 crosses were selected with high *per se* with good combining ability effect. All these hybrids recorded additive type of gene action. Hence, these crosses can be subjected to pedigree breeding to evolve high yielding genotypes for coastal saline situations. The cross ADT 45 X Nootripathu recorded additive type of epistasis and hence selection may be postponed to later generations. The parents ADT 45 and TKM 11 were good combiners and can be used for saline tolerance breeding programme.

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