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COMBINING ABILITY AND HETEROSIS IN DRY AND SEMI-DRY PADDY

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Combining ability analysis was made in rice through line X tester analysis for major yield and yield components. Considerable degree of genetic variability was observed in the parents. The combining ability variances were significant and indicated the importance of both additive and non-additive gene action in the expression of yield characters. Chithariyan was an outstanding general combiner for all the five characters under study. Poongar/IR—8 and Chitharivan/Kannagi were found to be the best cross combination with significant s c a effects for important yield components. The crosses that involved Chithariyan as one of the parents were also found with high heterosis.

Improvement of photo-period sensitive, lodging susceptible and low yielding traditional varieties of paddy grown under dry and semi-dry system of rice culture is a long felt need. These varieties are, otherwise well adapted for moisture and fertility stress environments combined with ability to compete with weeds. A knowledge about the combining ability would help in choosing parents for effecting improvement in segregating populations. The present study was carried out with the objective of evaluating the combining ability of traditional local cultivars of paddy grown as a dry or semi-dry crop. It involved seven local cultivars as lines and four improved strains as testers.

MATERIAL AND METHODS

The material consisted of 28 hybrids obtained in a line X tester mating of seven local cultivars with four improved strains. The parents were also included in the study. Dry seeds of the hybrids and parents were dibbled in well prepared beds of 2. 0 m wide under puddled conditions, spaced at 30 cm. between seeds and 60 cm between rows. Each hybrid and parent was grown in single row in a randomised replicated trial with two replications. Observations on the duration for first flowering, plant height, productive tillers, grains per panicle and plant yield were recorded in five randomly selected plants. Estimates of combining ability were computed as suggested by Kempthorne (1957)

RESULTS AND DISCUSSION

The hybrids and parents were found to be highly variable for all the five characters. As regards local cultivars, all of them excepting Nootripathu were tall in height. Chandikar, Poongar and Nootripathu were early maturing while Ariyan and Chithariyan were very late in maturity. Kuruvaikalayan and Norungan were found to be medium in duration. In addition to

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being medium in duration, Kuruvaikalayan was found to produce maximum tillers, grains per panicle and plant yield. Of the two late maturing types. Ariyan was comparatively poor in tillering capacity (Table 1). A detailed study of the hybrids indicated the half-sibs derived from the crosses Kuruvaikalayan as female with the four different male parents, Norungan with Kannagi and IR.5, Chandikar with IR.8, Nootripathu with MDU.1 and Chithariyan with IR.8 to be promising with scopes for further improvement. These progenies were found to be medium in duration and height coupled with high tillering capacity, plant yield and more grains per panicle. The variance due to parents and hybrids were significant for all the five characters and this would indicate the existence of different genotypes in parents as also hybrids. The component parents Vs hybrids was significant for plant height. The combining ability variances due to lines, testers and line X tester interactions were found to de highly significant for all the characters under study indicating the importance of both additive and non-additive gene action in the expression of characters. The operation of both additive and epistatic forces has been reported by Sivasubramanian and Madhava Menon (1973), Singh and Nanda (1976) and Rao *et al.* (1978) in rice. Under these genetic situations, a detailed understanding of the combining ability effects of the parents would help in designating suitable breeding methods.

Effects of general combining ability:

Among the lines, Chithariyan was the best combiner for all five characters. The female parents Poongar, Kuruvaikalayam, Norungan and Nootripathu besides IR.8 as male parent showed the desirable negative and significant g c a effects for plant height as this would help selection of comparatively medium tall types. As regards testers, both Kannagi and IR.5 were good combiners for plant yield and first flowering days, in addition to IR.5 being a good combiner for plant height and Kannagi for grains per panicle. The best parents, namely MDU.1 and Kuruvaikalayan for productive tillers and Ariyan for first flowering days, were found to be good combiners for these characters.

Effects of specific combining ability :

The cross Poongar/IR.8 was the only cross combination that showed positive and significant s c a effect for all the five characters. Both the parents of this cross had, however, negative and significant g c a effects Chithariyan X Kannagi was the next best cross combination with positive and significant s c a effects for plant height, grains per panicle and plant yield. An another cross that could be counted upon for significant s c a effects for grains per panicle was Ariyan/MDU-1, in which Ariyan was found to be a good general combiner. Eight crosses, namely,Chandikar, Kannagi, Chandikar/IR.5, Ariyan/IR.5, Kuruvaikalayan/IR.8, Norungan/Kannagi, Norungan/IR.5, Norungan/MDU.1 and Nootripathu/MDU.1 was found promising with significant s c a effects for first flowering. Of these, the cross. Ariyan/IR-5 parents were good combiners with positive and significant g c a effects.

Heterosis :

As noticed in the case of combining ability, it was found that the amount and degree of heterosis varied with the different cross combinations or the major yield and yield components (Table 3). In order to utilise the observed heterosis in practical breeding it would be useful to compare heterosis calculated on the basis of superiority of F_1s over the better parent. The crosses Chithariyan/Kannagi and Chithariyan/IR-5 showed very high heterosis for three important yield components namely, productive tillers, grains per panicle and plant yield. Chithariyan and Kannagi were the two noted parents as those possessing high g c a coupled with superior s c a effects and in view of this, the above two crosses would be preferred for further breeding. The cross Chandikar/IR-5 had shown high heterosis for plant height, productive tillers and plant yield. Though this cross combination did not figure as one having superior s c a for the above characters, the parents were found to be good general combiners for plant yield, and the substantial amount of heterosis noticed for plant yield could be exploited further in breeding programmes.

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Table-1 Potentialities of parents

Parents	Plant height (cm)		Productive tillers		Grains/ Panicle		Plant yield		Days to First Flowering	
	Mean	gca	Mean	gca	Mean	gca	Mean	gca	Mean	gca
Females										
Chandikar	139	12 1*	39.4	—2.3	150	11.4*	88	39.1*	65	—0.8
Poongar	125	—7.9*	45.4	—13.5*	121	—249*	82	—11 4*	67	—10 1*
Ariyan	166	24.7*	27.0	—9.9*	152	34.1*	78	—7.8	143	12.1*
Kuruvaikalayan	154	—11.4*	65.0	14.7*	167	2.2	122	7.2	83	6.6*
Norungan	142	—14.0*	58.2	—9.3*	158	—34.0*	112	—17 4*	85	—
Chithariyan	167	7.0*	43.6	8.4*	165	75.2*	77	13.5*	140	6.7*
Nootripathu	116	—13.0*	47.2	12.0*	134	—36.2*	80	—16.8*	62	—14.5*
SE		1.72		2.63		4.01		4.26		0.53
Males										
Kannagi	84	—2.1	43.2	—6.1*	136	18.9*	83	12.4*	63	2.8*
IR-5	89	4.7*	39.4	—2.8	168	—12.1*	75	10 1*	113	4.6*
IR-8	98	—8.5*	42.0	—6.8*	184	—11.4*	75	—12.3	144	—4.3*
MDU-1	146	2.3	65.4	15.5*	117	4.7	55	—10.3*	70	—3.2*
SE		1.21		1.86		2.84		3.01		0.37

*—Significant at 5%; ** significant at 1%

Table 2. Mean and *sca* of crosses

Female/Males	Plant height (cm)		Protuctive tillers (Nos.)		Grains/ panicle (Nos)		Plant yield (gm)		First flowering (Days)	
	Mean	sca	Mean	sca	Mean	sca	Mean	sca	Mean	sca
Chandika/Kannagi	170	13.4*	42.5	—19.1*	147	—12.2	127	—7.2	85	5.9*
,, IR-5	164	3.2	57.6	11.6	172	44.0*	146	13.5	85	4.5*
,, IR-8	132	18.0*	41.0	—1.0	111	—17.3	108	—2.1	72	—0.2
,, MDU-1	160	1.4	53.8	—10.5	130	—14.6	108	—4.1	63	—10.1*
Poongar/Kannagi	139	5.0	34.8	3.1	122	—25.5*	65	—25.3*	65	—5.0*
,, IR-5	136	—10.8	39.8	4.8	97	—17.1	76	—12.0	70	—1.0
,, IR-8	149	21.2*	46.2	15.2*	168	53.0*	103	38.0*	67	4.3*
,, MDU-1	125	—13.4*	34.0	—22.9*	121	—10.5	67	—0.6	65	1.6
Ariyan/Kannagi	166	26.8*	31.0	—4.3	211	6.7	93	0.8	85	—6.4*
,, IR-5	173	—0.8	32.8	—5.8	125	—47.9*	74	—17.6	103	9.8*
,, IR-8	155	5.0	53.0	18.4*	184	9.6	84	16.8	81	4.1*
,, MDU-1	180	—13.4*	48.9	8.1	221	31.3*	75	3.8	86	0.6
Kuruvaikalayan/Kannagi	123	—7.5	41.2	—18.7*	157	—10.8	115	6.1	84	—2.5
,, IR-5	131	—6.3	41.4	—21.8*	126	—10.6	91	—15.0	87	1.5
,, IR-8	146	—21.5	72.0	12.8*	134	—3.5	94	10.6	82	2.8
,, MDU-1	129	—5.9	109.4	27.9*	179	24.8*	82	—3.4	82	1.7
Norungan/Kannagi	120	—10.2*	37.8	—1.9	149	12.4	98	14.3	88	7.9*
,, IR-5	124	11.4*	41.6	2.4	115	9.4	84	2.2	86	4.9*
,, IR-8	111	—11.2*	29.6	—5.6	80	—25.9*	37	21.8	67	—6.0*
,, MDU-1	163	30.6*	58.8	—1.3	126	3.8	66	5.2	67	3.3*
Chithariyan/Kannagi	158	8.9*	64.8	11.2	282	34.4*	162	46.8*	87	0.4
,, IR-5	168	12.1*	64.4	7.5	210	4.2	125	12.1	78	—9.8*
,, IR-8	127	15.5*	31.2	—21.7*	201	—5.3	59	—30.9	80	1.1
,, MDU-1	150	—3.7	71.2	3.0	206	25.2*	64	—28.1*	89	8.4*
Nootripathu/Kannagi	116	—12.8*	64.2	7.0	129	+5.2	51	—33.9*	65	—0.4
,, IR-5	144	8.2	61.6	1.1	129	25.8*	99	16.4	60	6.6*
,, IR-8	127	4.4	38.9	—17.7*	93	10.9*	51	—9.2	60	2.1
,, MDU-1	135	1.6	88.4	9.6	110	—10.0	88	26.8*	64	4.8*
SE		2.98		4.56		6.96		7.38		0.91

* Significant (p = 0.05)

** Significant (p = 0.01)

Table- 3 Estimaes of Heterosis in percentage expressed over better parent

Females/Males	Plant height (cm)	Productive tillers (Nos)	Grains/panicle (Nos.)	Plant yield (gm)
Chandikar/Kannagi	101.9	-1.3	-2.0	45.0
IR-5	83.2	46.2	2.5	65.0
IR-8	34.4	-2.4	-39.3	22.7
MDU-1	9.3	-23.3	-33.1	22.7
Poongar/Kannagi	65.8	-12.3	-10.6	-20.7
IR-5	51.4	1.8	-41.9	-7.3
IR-8	52.1	-47.4	-8.5	26.2
MDU-1	-14.0	-28.2	0 0	-18.3
Ariyan/Kannagi	97.1	-16.8	39.1	12.0
" IR-5	92.8	26.2	-25.1	-5.6
" IR-8	58.6	-25.2	0.0	7.1
" MDU-1	23.0	-36.6	45.9	-4.3
Kuruvaikalayan/Kannagi	46.8	-52.2	-5.8	-5.7
" IR-5	46.5	-36 3	-24.5	-24.9
" IR-8	48.5	-10.8	-26.8	-22.2
" MDU-1	11.4	-70.3	6.9	-32.0
Norungan/Kannagi	42.6	-35.1	-5.9	-11.9
" IR-5	38.1	-28.5	-31.5	-24.5
" IR-8	13.0	-49.1	-52.1	-66.2
" MDU-1	11.4	-10.1	-20.3	-40.3
Chithsriyan/Kannagi	88.1	48.6	70.1	95.0
" IR-5	87.3	47.7	25.4	77.0
" IR-8	29.7	-28.4	9.3	-22.6
" MDU-1	2.3	19.6	25.5	-16.4
Nootripathu/Kannagi	38 7	36.0	-5.4	-38.5
" IR-5	60.9	30.5	-23.2	-23.8
" IR-8	29.9	-17.6	-49.4	-33.7
" MDU-1	-7.6	35.2	-18.4	11.2