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SHORT COMMUNICATION

Rice breeding for adverse soils and irrigated areas through diallel analysis

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ABSTRACT

OM2490, a mid-duration genotype (>130 days) derived from IR50404 / OM723-11 with high SCA value on filled grain number per panicle has been predominatly noticed since preliminary yield trial. Attentions were paid to filled grain number per panicle and 1000 grain weight characters among segregants. The fixed line OM2490 obtained the highest yield and sigificantly higher than IR42 check in brackish water areas.

OM2492, an early growth duration genotype (<110 days) derived from IR64 / OM850 with high SCA value on tillering ability. Attentions were paid to tiller number per sqm among segregants. The fixed line OM2492 obtained significantly higher yield than OM997 check in irrigated areas.

Key words: GCA (general combining ability), SCA (specific combining ability), diallel analysis

INTRODUCTION

The success of rice breeding will be limited if rice selection is only based on breeders' practices under field conditions without biometrical analysis. Quantitative genetic analysis should be dealt to have more effect in rice selection. Gregorio at al (1993) conducted 8x8 diallel set analysis on salt tolerance in rice. The authors suggested that rice selection for salt tolerance must be delayed and replicated to later generations when dominance gene effects are dissipated, and selection must be done under controlled conditions to minimize environmental effects. Modified bulk and single-seed descent (SSD) would be suitable to breeding methods to develop salinity tolerant rice varieties. GCA (general combining ability) and SCA (specific combining ability) values would be need for good combiners and proper choice of male and female parent in hybridization programs and rice selection. Gonzales and Ramirez (1998) indicated that panicle length, panicle weight were not significantly correlated with grain yield under saline condition so that selection based on these characters would be ineffective. Thakur (1981) reported that in medium rice genotypes grown under semi-deepwater areas, spikelet fertility of individual tillers obviously contribute to grain yield. The results of investigation also indicated that in deepwater areas the major contribution to grain yield comes from the aquatic tillers (34-88%). The varieies capable of producing aquatic tillers at an early growth stage are desirable, improvement of this trait should be intensified. Mehetre at al (1994) revealed that filled grain number per panicle, panicle length are characters contributing to grain yield under salinity and arid condidion. Tao and Buu (1992) assessed the breeding materials from salt tolerant deepwater rice genotypes in F_2 population and indicated that selection for improving filled grain number per panicle would be more efficient. Puckridge and HilleRisLambers (1990) reported that 10 promising medium rice varieties selected by Cantho University depended on healthy panicles

This study aimed to prove the success of rice selection for adverse condition and irrigated areas through analysis of quantitative genetic parameters

MATERIALS AND METHODS

Genetic components of combining ability estimates of grain number per panicle and tillering ability in rice were invetigated using a six-parent complete diallel analysis. The parents with high grain number per panicle and low tillering ability involved OM723-11, OM850 and OM997). The parents with low grain number per panicle and high tillering ability were used as IR64, IR50404, IR59656. The hybridization model was followed by Mather and Jinks (1982) presented in diagram 1

Diagram 1 The 6x6 complete diallel hybridization system

♀	♂					
	1	**2**	**3**	**4**	**5**	**6**
1-OM723-11	**1x1**	1x2	1x3	1x4	1x5	1x6
2- OM850	2x1	**2x2**	2x3	2x4	2x5	2x6
3 -IR64	3x1	3x2	***3x3***	3x4	3x5	3x6
4 -IR50404	4x1	4x2	*4x3*	**4x4**	4x5	4x6
5 -OM997	5x1	5x2	5x3	5x4	**5x5**	5x6
6 -IR59656	6x1	6x2	6x3	6x4	6x5	**6x6**

The experiment was conducted in completely randomized block design with three replications. Tillering ability and filled grain number per panicle were recorded for combining ability analysis (Griffing 1956) of early duration genotypes under irrigated area condition and mid-duration genotypes under salt stress condition

Among the crosses, 40 elite lines with medium duration and 50 promising lines with early duration were selected for estimating correlation coefficient and path analysis (Singh 1985).

Mid-duration rice genotype OM24900 derived from IR50404/OM723-11 and early genotype OM2492 derived from IR64/OM850 were assessed in two preliminary yield trials in completely randomized block design with three replications. Statistical analysis was followed by Gomez and Gomez (1982).

RESULTS AND DISCUSSION

Combining ability analysis

Estimates of general combining ability (GCA in bold) and specific combining ability (SCA above diagonal) of filled grains per panicle are presented in Table 1. Among the parents tested, IR50404 was considered as the best combiner. Highly desirable possitive GCA values of OM723-11, OM850 which makes them good combiners were found. These good combiners could produce progenies with highly filled grain number per panicle as crossing with other parents. Significant reciprocal effects suggest the need for proper choices of male and female in hybridization programs to improve the trait. The largest SCA value was obtained in case of OM723-11 / IR50404, OM723-11 / IR59656. Then 40 promising lines with mid-duration genotypes derived from this cross were selected

Table 1: General combining ability, specific combining ability and reciprocal effects of filled grains per panicle in 6x6 diallel cross (Can 1998)

♀	♂					
	1	**2**	**3**	**4**	**5**	**6**
1-OM723-11	**4.12****	1.90 ns	-8.50 ns	17.70**	-16.90**	13.70**
2- OM850	-8.00ns	**0.29** ns	-3.40 ns	-6.50 ns	9.30 ns	-4.40 ns
3 -IR64	-0.70 ns	1.65 ns	**-0.45** ns	-3.40 ns	1.20 ns	11.90
4 -IR50404	-0.65 ns	0.80 ns	-1.15 ns	**0.83** *	5.50 ns	-5.20 ns
5 -OM997	11.50**	-30.30 **	4.15 ns	-16.00**	**-1.55** *	-0.55 ns
6 -IR59656	7.00 ns	3.30 ns	-0.65 ns	7.00 ns	6.30 ns	**-2.79***

Below diagonal values in Table 1 shows the reciprocal effect. Maternal effect was not significantly recognized except OM997 in term of filled grains/panicle

Table 2: General combining ability, specific combining ability and reciprocal effects of tillering ability in 6x6 diallel cross (Can 1998)

♀	♂					
	1	**2**	**3**	**4**	**5**	**6**
1-OM723-11	**-0.18ns**	1.24ns	-1.46ns	-2.90ns	0.74ns	1.98ns
2- OM850	-2.85*	**0.15ns**	4.34**	0.19ns	-1.09ns	-1.45ns
3 -IR64	-0.45ns	-5.70**	**0.56***	3.63*	-6.60**	1.89ns
4 -IR50404	-1.50ns	3.65**	-0.80ns	**0.36ns**	2.34ns	-0.56ns
5 -OM997	0.80ns	1.30ns	1.85ns	-3.35*	**1.00***	1.30ns
6 -IR59656	0.85ns	0.55ns	-0.20ns	-1.85ns	0.65ns	**-1.89****

ns. non significant, * significant at 5% level, ** significant at 1% level

Table 2 shows significant GCA value for tillering ability which was noticed in IR64, OM997 , the maternal effect in IR50404. High SCA values were obtaine from OM850 / IR64, IR64 / IR50404. The promising early lines derived from OM850 / IR64 were selected to test in preliminary yield trial

Path analysis and correlation coefficient

Based on combining ability analysis for the target characters, 40 mid-duration lines derived from IR50404 / OM723-11 in F_6 generation nursery were selected. Path coefficient analysis indicated that filled grains per panicle, 1000-grain weigth obtained the largest direct effect on yield. Other characters did not show any direct effect on yield (table 3). Their correlation coefficient to grain yield are almost equal to their direct effects, so the correlation explains the true relationship and a direct selection through filled grains per panicle and 1000-grain weight will be effective. Plant height obtained negative correlation, and negative direct effect receives the same conclusion. Selection will be effective to have shorter plant type, and higher grain yield.

Table 3: Path coefficient analysis and correlation with grain yield in mid-duration genotypes

	Plant height	Growth duration	Tiller No. /m^2	Filled grains / panicle	Unfilled grain %	1000-grain weight	Correlation with yield
Plant height	**-0.460**	-0.002	-0.040	-0.183	0.130	-0.218	-0.74**
Growth duration	-0.009	**-0.110**	0.003	-0.120	-0.088	0.306	0.09ns
Tiller No/m^2	-0.165	0.036	**-0.010**	0.165	0.037	-0.342	-0.28ns
Filled grains/panicle	0.138	0.002	-0.003	**0.610**	-0.041	-0.201	0.61*
Unfilled grain %	-0.161	0.026	-0.001	-0.067	**0.370**	-0.130	-0.04ns
1000-grain weight	0.170	-0.057	0.006	-0.207	-0.081	**0.59**	0.42*

Based on combining ability analysis for the target characters, 50 early-duration lines derived from IR64/OM850 in F_6 generation nursery were selected. Path coefficient analysis indicated that panicles / sqm, filled grains per panicle, unfilled grains / panicle, plant height obtained the largest direct effect on yield (table 4). The correlation coefficient of plant height and panicles / sqm to grain yield are almost equal to their direct effects, so the correlation explains the true relationship and a direct selection through these two characters will be effective. Correlation of unfilled grains / panicle to grain yield was negative but its direct effect was positive and high, so a restricted simultaneous selection model is to be followed, *i.e*. restrictions are to be imposed to nullify the undesirable indirect effects in order to make use of the direct effect.

Table 4: Path coefficient analysis and correlation with grain yield of early duration genotypes

Agronomic character	Growth duration	Plant height	Nº Tiller /m^2	Nº filled grain / panicle	% unfilled grain	1000-grain weight	Correlation with yield
Growth duration	**-2.09**	-0.38	3.27	-0.49	-0.16	-0.30	-0.16
Plant height	0.63	**1.28**	-2.12	0.58	0.06	0.08	0.52*
Nº Tiller/m^2	-1.54	-0.61	**4.42**	-0.47	-0.70	-0.51	0.57*
Nº filled grain /panicle	1.09	0.79	-2.21	**0.94**	-0.21	-0.11	0.30
% unfilled grain	0.27	0.06	-2.51	-0.16	**1.22**	0.61	-0.51*
1000 grain weight	0.71	0.12	-2.56	-0.12	0.84	**0.88**	-0.13

Promising lines derived from the crosses with better genetic parameters

Selection was implemented to gain 40 best lines with mid-duration (>130 days) derived from IR50404 / OM723-11 with high SCA value on filled grains per panicle . Attentions were paid to filled grains per panicle and 1000-grain weight. Line OM2490 was tested in a completely randomized block design with 3 replications in dry season 2000-2001. OM2490 yielded the highest (7.4 t/ha) among the treatments, over than IR42 (check) significantly (table 5).

Table 5: Yield trial on mid-duration genotypes

No	Designation	Cross	Growth duration (days)	Plant height (cm)	Yield (t/ha)
1	OM2490	IR50404/OM723-11	137	104.2	7.4
2	OM1352-8	IR42/OM80	134	115.3	7.2
3	OM2065	IR36/OM1825	135	108.5	6.8
4	OM1348-9	IR42/OM736	135	105.3	6.8
5	OM1351-2	IR42/PUSA4-33	134	106.4	6.5
6	OM1849-1	OM723/IR68	136	105.6	6.4
7	OM1346-2	IR42/OM739	135	105.3	6.4
8	OM1352-5	IR42/OM80	134	108.6	6.4
9	OM2406	IR841/MCR-01	137	103.3	6.2
10	OM1851-10	OM850/OM16B	135	103.6	6.2
11	IR42 (check)		134	101.6	5.6
	CV(%)		-	-	6.7
	LSD 0.05		-	-	0.8

OM2492 is an early rice variety selected from 50 promising lines derived from IR64/OM850 with high SCA value on tillering ability. OM2492 obtained the highest yield among the treatments. OM2492 significantly overyielded than OM997 (check) in dry season 2000-2001 (table 6). Attentions were paid to panicle number / sqm in case of the genotype based on the result of path analysis.

Table 6: Yield trial in early duration genotypes (Tam 2001)

No	Designation	Cross	Growth duration (days)	Plant height (cm)	Yield (t/ha)
1	OM2001	CS7/OM1475	101	111	5.8
2	OM3317	IR69113/OM997	101	104	5.8
3	OM2492	IR64 / OM80	96	98	5.8
4	OM2847	OM997/IR50404//OM997	102	103	5.7
5	OM1827	BA NGUON/LUA GIAU	101	113	5.7
6	1600	OM80/IR36	104	115	5.7
7	OM2198	OM1815/OM1801	102	114	5.6
8	OM997 (Check)	COLOMBIA/OM89	101	105	5.5
9	OM3003	IR34364/IR68	104	109	5.5
10	CSR-89IR	IR10110/KDML105//19657	117	96	5.5
11	OM3001	BE TUM / TUNG SA	101	109	5.4
	CV (%)		-	-	8.9
	LSD 0.05		-	-	0.8

CONCLUSION

The two crosses with high SCA values on filled grains per panicle and tillering ability were considered for continuous offspring selection. Attentions were paid to filled grains per panicle, 1000-grain weight in terms of mid-duration genotypes, and panicle number per sqm in terms of early duration genotypes. When the correlation of any target trait to grain yield is almost equal to its direct effects, so the correlation explains the true relationship and a direct selection through this trait will be effective.

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SUMMARY IN VIETNAMESE

Trên cơ sở phân tích diallel về khả năng phối hợp, và phân tích hệ số đường dẫn với ảnh hưởng trực tiếp đến năng suất, giống lúa OM2490 đã được chọn cho bộ giống trung múa và giống lúa OM2492 đã được chọn cho bộ giống lúa sớm.

Cặp lai OM50404/OM723-11 có SCA cao về tính trạng số hạt chắc trên bông. Ảnh hưởng trực tiếp và hệ số tương quan giữa hạt chắc trên bông và năng suất đều có ý nghĩa và cùng chiếu dương. Kết qủa tập trung chọn lọc theo tính trạng này, giống OM2490 đã cho thấy hiệu qủa ưu việt của nó về năng suất, cao hơn IR42 có ý nghĩa, có triển vọng phát triển ở vùng khó khăn do mặn xâm nhập.

Cặp lai IR64 / OM80 có SCA cao về tính trạng khả năng đẻ nhánh. Ảnh hưởng trực tiếp và hệ số tương quan giữa tính trạng số bông / m^2, chiếu cao cây, với năng suất hạt đều có ý nghĩa và cùng chiếu dương. Kết quả tập trung chọn lọc theo những tính trạng này, giống OM2492 cho kết qủa tốt về năng suất và rất có triển vọng đối với canh tác vùng có nước tưới

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