

OM1350-12, A MID DURATION RICE GENOTYPE ADAPTED TO ADVERSE SOILS IN THE MEKONG DELTA

Nguyen Thach Can and Nguyen Thi Lang

ABSTRACT

Twelve promising lines were derived from cross of IR42/IR64. These lines were in the observational nursery. They were selected to test in yield trails. The results indicated that the most promising line (OM1350-12) exhibited its mid growth duration and high yield potential. Yield testing has been conducted during five seasons at Cuu Long Delta Rice Research Institute's experimental field and on four salt-stress locations. It showed that OM1350-12 obtained the highest yield as compared to local checks as OM1348, OM1352, OM1351 and IR42 in Ben Tre, Long An, Tra Vinh and Ca Mau locations, respectively. OM1350-12 was also growing well in salt solution level of 0.3% and 0.5% at seedling stage. Grain quality was commercially accepted to export. OM1350-12 was approved as new rice variety for rice-shrimp farming system in Mekong Delta, especially in the coastal areas.

INTRODUCTION

There are roughly 700,000ha of rice cultivation in Mekong delta under salty affected and phosphorus deficiency condition in Mekong Delta. It are distributed in provinces along coastal areas such as Ben Tre, Long An, Tra Vinh and in the surrounding areas of Ho Chi Minh City. Many years ago, farmers in saline areas cultivated traditional rice such as Nang Quot, Tieu Chum, Soi Da ... but their grain yield are too low (2.5t/ha). Therefore, improved rice varieties with mid growth duration, good grain quality were need for rice export (BTSC 2006). Some provinces along coastal areas have been cultivating the rice-shrimp pattern (cultivation of shrimp in dry season when salinity degree in the field was more than 0.5% and rice in wet season when salinity degree was less than 0.3%). This pattern gave high economic efficiency to the farmers. The rice varieties for salty affected areas must be long duration (Khush et al. 1994) and salinity tolerance. In order to increasing grain yield for salinity areas, improved rice with mid duration and salinity tolerance were released to the farmers.

Currently, Cuu Long Delta Rice Research Institute (CLRRI) has released improved rice with mid duration, salt tolerance and high yield potential to the farmers such as OM1348, OM1352. Can et al. (2002) reported that OM1352 obtained high grain yield (6-7 t/ha) and salt tolerance but its grain

quality are quite poor. The improvement for better grain quality is very importance for rice exportation. Therefore, the study aims at selecting the mid duration rice with salinity tolerance and better grain quality

MATERIALS AND METHODS

1. Materials: Cross of IR42/IR64 was performed in 2000 wet season and named OM1350. F₁ generation was planted in green house, then 1,200 lines of F₂ and 750 lines of F₃ were selected in 2001. Based on phenotypic acceptability, grain yield potential and major pest, disease resistance; 350 lines of F₄ were selected. Salt tolerance screening was carried out among F₄ progenies in 2002. Subsequently, 72 lines of F₄ with good salt tolerance were pinpointed. Finally, 25 lines of F₅ generation with high yield potential, good salt tolerance and resistance to major pests and diseases were identified for multi-locational yield trials. Schematic 1 is presenting the selection program for mid duration rice genotype (OM1350-12) tolerant to salt stress adapted to rice – shrimp farming in Mekong delta

2 Methods: Agronomic characters' assessments were scored by MARD (2002) and IRRI (1982). Salt stress screening was conducted as the protocol by Senadhira et al. (1993). Germination seeds were planted in Yoshida's solution. Ten days after planting, the solution was treated with different salt levels (0%, 0.3% and 0.5%). IR20 was

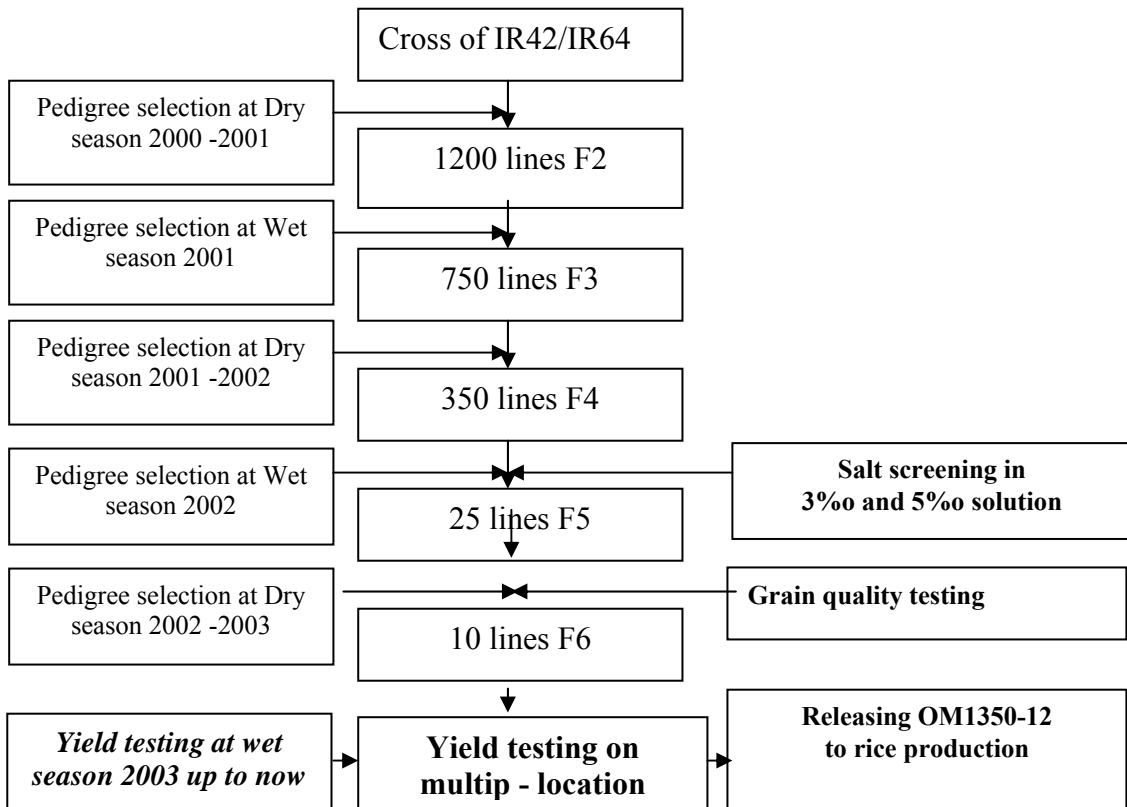
considered as susceptible check and Pokkali as resistant check. After 7 day treating, relative index (RI) of agronomic characters were evaluated (Table 1). Grain quality testing was carried out as the protocol by Tang et al. (1991), Sadavisam et

al. (1992). The yield testing experiments were in randomized complete plot design with three replications on salty affected areas. Statistical procedures were followed by Gomez and Gomez (1982)

$$RI = \frac{\text{Dried weight of root or shoot (3‰ and 5‰)}}{\text{Dried weight of root or shoot (0‰)}} \times 100$$

Table 1. Evaluation of salt tolerance on rice

<i>RI</i>	<i>Evaluation</i>
More than 80%	Very salt tolerance
70-80%	Salt tolerance
60%-70%	Medium salt tolerance
50%-60%	Poor salt tolerance
Less than 50%	Very poor salt tolerance



Schematic 1: The selection and breeding on mid growth duration genotype OM1350-12

RESULT AND DISCUSSION

1: Evaluation of promising lines on observational nursery

Evaluation of 10 promising lines selected from IR42/IR64 on observational plot showed that all of promising lines exhibited growth duration from 128- 135 days and plant height from 101.5 – 93.8cm. It means that these promising lines will grow well in saline areas where rice-shrimp system in Mekong delta has been developed

recently. Some lines expressed their resistance to major pests and diseases such as OM1350-12, OM1350-20, OM1350-8 (reaction score 3 for brown plant hopper - BPH and 5 for blast -Bl), and OM1350-11, OM1350-19 (score 5 for BPH and 3 for Bl). As compared to OM1352 a check, OM1350-12 grew better in saline areas, and exhibited better resistance to pests and diseases (table 2).

Table 2. Agronomic characters and pest, disease reaction of promising lines on salinity areas (2003 wet season)

No	Designation	Growth duration (days)	Plant height (cm)	Reaction score (1-9)	
				BPH	Bl
1	OM1350-12	132.8	96.8	3	5
2	OM1350-6	134.7	95.2	5	5
3	OM1350-14	135.2	97.3	5	7
4	OM1350-8	129.6	102.2	3	5
5	OM1350-16	130.4	93.8	5	5
6	OM1350-11	128.7	95.7	5	3
7	OM1350-18	132.6	101.5	3	5
8	OM1350-20	134.1	98.3	3	7
9	OM1350-19	128.5	99.2	5	3
10	OM1350-7	132.4	97.8	5	5
11	OM1352 (Check)	134.5	98.1	5	5

BPH: brown plant hopper; Bl: blast

Yield component evaluation of 10 promising lines and OM1352 (check) indicated that panicle number per square meter ranged from 402.1 for OM1350-19 to 324.7 for OM1350-20. Number of grain per panicle of OM1350-7 obtained the highest level of 104.6 and OM1350-20 of 87.6. As compared to check OM1350; the number of panicle per square meter and the number of grain per panicle were similar. It means that all of rice

genotypes in observational plot were improved plant types. They can be released to meet the demand of saline areas' rice production. In the observational nursery, it revealed that yield of OM1350-12 (28.3gr/hill) gained the highest level as compared to all evaluated rice progenies. OM1350 -12 also gave higher yield than check variety (OM1352) (table 3).

Table 3. Yield and yield components of promising lines under saline soil conditions (2003 wet season)

No	Designation	Panicle/m ² (p)	Grains/pan.(g)	1,000-grain weight(gr)	Yield (gr/hill)
1	OM1350-12	389.5	98.7	25.6	28.3
2	OM1350-6	401.3	97.6	25.8	28.1
3	OM1350-14	395.6	100.3	26.1	27.6
4	OM1350-8	367.5	96.8	25.7	27.3
5	OM1350-16	396.2	102.1	26.4	25.4

No	Designation	Panicle/m ² (p)	Grains/pan.(g)	1,000-grain weight(gr)	Yield (gr/hill)
6	OM1350-11	357.8	98.3	25.5	25.4
7	OM1350-18	341.6	95.7	26.3	25.1
8	OM1350-20	324.7	87.6	26.7	25.0
9	OM1350-19	402.1	101.3	25.1	24.0
10	OM1350-7	347.3	104.6	26.8	24.0
11	OM1352 (check)	384.6	89.1	25.5	27.8

2. Yield evaluation of OM1350-12 in multi-locations and five seasons: Yield evaluation for yield in 5 seasons at CLRRI were presented in table 4. It indicated that OM1350-12 significantly gained the highest yield (5.5 t/ha) and higher than

OM1352, OM1351 and IR42 as local check in Long An, Tra Vinh and Ca Mau provinces, respectively. OM1350-12 will be tested in saline soils through multi-locational yield trials in Mekong Delta

Table 4. Grain yield of OM1350-12 in 5 seasons at CLRRI's experiment field

No	Designation	2004-2005 Dry season	2005 Wet season	2005-2006 Dry season	2006 Wet season	2006-2007 Dry season	Mean (t/ha)
1	OM1350-12	6.1	4.2	6.4	4.3	6.4	5.5*
2	OM1348	6.2	4.1	5.8	4.2	6.3	5.3
3	OM1352	6.1	4.3	6.2	3.8	5.7	5.2
4	OM1351	6.0	4.0	5.9	4.2	5.9	5.2
5	IR42	5.7	3.8	6.1	4.1	5.7	5.1
	CV%	12.3	10.6	9.7	10.4	11.2	10.8
	LSD5%	0.4	0.3	0.5	0.3	0.4	0.35

Yield testing in four provinces indicated that OM1350-12 obtained the highest mean yield (6.0t/ha) while local check rice varieties were lower as OM1352 (5.7t/ha), OM1348 (5.7t/ha), IR42 (5.6t/ha) and OM1351 (5.4t/ha). However,

OM1350-12 was higher yield than other at non-significant difference level. Stability index of OM1350-12 was the best as compared to other local rice varieties ($b_i = 1.038$, $s_{di}^2 = 0.002$) (Table 5)

Table 5. Grain yield of OM1350-12 in multi-locational yield trials in Mekong delta (2007-2008 Dry season)

No	Variety	Ben Tre	Long An	Bac Lieu	Ca Mau	Mean (t/ha)	b_i	s_{di}^2
1	OM1350-12	6.1	5.8	5.9	6.1	6.0	1.038	0.002
2	OM1352 (Check 2)	5.8	6.2	5.7	5.1	5.7	0.873	0.014
3	OM1348 (Check 1)	5.9	6.1	5.4	5.4	5.7	1.126	0.004
4	IR42 (Check 4)	5.5	5.7	5.8	5.2	5.6	0.932	0.023
5	OM1351 (Check 3)	5.7	5.3	5.4	5.1	5.4	0.814	0.014
	CV%	9.1	10.4	12.5	11.2	11.3		
	LSD5%	0.4	0.5	0.6	0.7	0.7		

Check 1: Ben Tre local variety, Check 2: Long An local variety. Check 3: Tra Vinh local variety and Check 4: Ca Mau local variety.

3. Salt screening experiment: Evaluation of relative index (RI) for root and shoot dry weight was carried out in Yoshida's solution at 0.3% and 0.5% salt stress. It showed that OM1350-12 exhibited the highest values for both root (RDW) and shoot (SDW) dry weight. These values were more than 50%. This mean that OM1350-12 was moderately tolerant to salt stress (RDW=67.6%, SDW=59.3% in 0.3% salt solution; then RDW=

52.7%, SDW=46.5% in 0.5% salt solution). As compared to other varieties such as OM1348, OM1352, salt tolerance of OM1350-12 was better. Survival days (SD) in 0.3% and 0.5% of salt solution were recognized as 12.3 and 8.7 days, respectively. This means that OM1350-12 can grow well in saline areas as Ben Tre, Long An and the surrounding areas of HCM city (table 6)

Table 6. Development of OM1350-12 in Yoshida's solution with 2 salt stresses

No	Designation	Yoshida's solution with 0.3% salt stress		
		SD	RDW (%)	SDW (%)
1	OM1350-12	12.3	67.6	59.3
2	OM1348	10.1	61.5	64.7
3	OM1352	11.6	58.7	56.5
4	IR20 (Susceptible check)	6.5	28.4	21.5
5	POKKALI (Tolerant check)	18.7	82.7	80.5
		Yoshida's solution with 0.5% salt stress		
1	OM1350-12	8.7	52.7	46.5
2	OM1348	7.6	47.8	51.3
3	OM1352	8.3	42.6	39.6
4	IR20 (Susceptible check)	2.5	15.6	13.4
5	POKKALI (Tolerant check)	10.4	67.5	66.1

SD : Number of survival day, RDW : Root dry weight, SDW : Shoot dry weight

4. Grain quality testing

4.1. Milling quality: Testing for milling quality on some salt tolerant genotypes indicated that OM1350-12 expressed its good milling quality. It exhibited its high ratio of brown rice, whiteness rice of head rice as 81.8%, 68.5%, and 52.1%, respectively.

Milling quality of OM1350-12 was better than other salt tolerant genotypes such as OM1348, OM1352, OM1351, and also similar to OM3536 (grain quality check). Some other grain quality properties of OM1350-12 such as grain length (6.4mm) and chalkiness (1.3%) were also acceptable by standard market for export (Table 7).

Table 7. Milling quality of salt tolerant genotypes in Mekong delta

no	Designation	Brown rice (%)	Whiteness rice (%)	Head rice (%)	Length grain (mm)	Width grain (mm)	Chalkiness (% of score 9)
1	OM1350-12	81.8	68.5	52.1	6.4	2.8	1.3
2	OM1348	80.5	67.8	48.3	6.5	3.0	2.4
3	OM1352	80.1	67.1	51.5	6.7	2.7	1.8
4	OM1351	81.3	68.2	50.4	6.4	2.9	1.6
5	OM3536 (Check)	80.3	61.2	48.9	7.1	2.9	0.3
	CV%	10.8	11.3	9.7	12.1	10.5	11.5
	LSD5%	1.3	0.9	1.1	0.2	0.1	0.4

4.2. Cooking quality: Cooking quality was very importance to evaluate the soft of cooking rice. Amylose content of OM1350-12 was 24.6%. Other cooking quality properties as gelatinization temperature obtained score 4, gel consistency gained 38.7 mm length. It belonged to medium group of cooking quality rank. As compared to other varieties as OM1348, OM1352 and

OM1351, cooking quality of OM1350-12 was similar. However, as compared to OM3536 – a well-known rice variety with good cooking quality in Mekong Delta with its amylose content of 20.8%, gelatinization temperature of score 4 and gel consistency of 45.7 mm long, OM1350-12 was considered as worse one (Table 7).

Table 7. Cooking quality of salt tolerant genotypes in Mekong delta

No.	Designation	Amylose content (%)	Gelatinization temperature (1-9)	Gel consistency (mm)
1	OM1350-12	24.6	4	38.7
2	OM1348	24.5	3	40.2
3	OM1352	25.0	3	32.8
4	OM1351	24.3	3	34.5
5	OM3536 (check)	20.8	4	45.7
	CV%	12.6	-	14.7
	LSD5%	2.5	-	8.7

CONCLUSION

OM1350-12 is a mid duration genotype with salt tolerance and accepted grain quality. Currently, it has been growing in saline areas in Mekong Delta such as Ben Tre, Long An and outstanding areas of HCM City. OM1350-12 was derived from cross of IR42/IR64. During yield testing in many seasons and locations in Mekong Delta, OM1350-12 obtained the highest yield as compared to local check varieties such as OM1348, OM1352 and OM1351 in Ben Tre, Long An and Tra Vinh, respectively. Additionally, it exhibited its better salt tolerance than local checks at 0.5% salt stress solution. Its grain quality properties were commercially accepted to export. The Scientific Board of Ministry of Agriculture and Rural Development approved OM1350-12 as a new rice variety adapted to rice-shrimp farming system in Mekong Delta

REFERENCES

Can NT, NT Lang and BC Buu. 2002. OM1352- a mid duration rice variety adapted well to salty affected areas in Mekong Delta. Report for Approving OM1352 to be new rice variety on salty affected areas in Mekong Delta (Vietnamese) - 2002 in HCM city

BTSC. 2006. Evaluation report on mid duration in Ben Tre province- Department of Agriculture and Rural Development of Ben Tre province (2006) – Vietnamese

Gomez KA and AA Gomez. 1982. statistical procedure for agricultural field experiment-IRRI, Los Banos, Manila, the Philippines

IRRI. 1982. Evaluation and Utilization system for rice 1982, IRRI Los Banos P.O.Box 933 Manila Philippines

Khush GS, D Senadhira. 1994. Strategies for breeding improved rice varieties with tolerance of adverse soil condition in rice problem soils in south and Southeast Asia. 4: 145-154. IRRI PoBox 933 Malina Philippines

MARD. 2002. Evaluation and Utilization system for rice 2002, DANIDA project – MARD Vietnam (Vietnamese). Agricultural Publisher - Hanoi 2002

Sadasivam S, A Manikam. 1992. Biochemical methods for agricultural science Wiley Eastern Lmt. India

Senadhira D, CN Chaubey. 1993. Salt tolerant screening method in rice. International Rice

Research Institute. P.O.Box 933 Manila Tang SX, GS Khush, BO Juliano. 1991. Genetics of Gel Consistency in Rice . J. Gen.70: 69-78
Philippines

OM1350-12, giống lúa trung mùa chống chịu tốt trong điều kiện bất lợi ở đồng bằng sông Cửu Long

Mười hai dòng triển vọng được rút ra từ cặp lai IR42/IR64. Những dòng này đưa vào thí nghiệm quan sát. Kết quả có một dòng triển vọng nhất cho dạng hình cũng như năng suất cao nhất và được đặt tên OM1350-12. Trắc nghiệm năng suất trên 5 vụ tại Viện Lúa ĐBSCL và 4 địa phương. Kết quả cho thấy những dòng này đều đạt năng suất cao hơn các giống đối chứng địa phương (OM1348 cho Bến Tre, OM1352 cho Long An, OM1351 cho Trà Vinh và IR42 cho Cà Mau). Thử tính chịu mặn trong dung dịch Yoshida có độ mặn 3‰ và 5‰ cho thấy OM1350-12 có khả năng chịu mặn tốt nhất so với đối chứng địa phương. Kiểm tra chất lượng hạt thì chất lượng xay trà là tốt hơn các giống đối chứng địa phương. Nhưng chất lượng cơm thì tương đương. Do có những đặc tính tốt như vậy mà Hội Đồng Khoa Học của Bộ Nông Nghiệp và PTNT công nhận giống lúa này là giống mới và cho phép sản xuất thử tại vùng nhiễm mặn có canh tác lúa tôm ở ĐBSCL