PHILIPPINE RICE R&D HIGHLIGHTS 2012

Developing Technologies to Surpass the Dry Season Irrigated Lowland Rice Yield Plateau

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Developing Technologies to Surpass the Dry Season Irrigated Lowland Rice Yield Plateau

Program Leader: AT Rigor (January-June); DA Tabanao (July-December)

Rice is the major staple food of Filipinos. Most of the harvested palay (rough rice) comes from the irrigated areas that comprise 3.1 million ha of the total 4.5 million ha planted to rice in the Philippines, making it a critically important ecosystem to the country as its population continues to increase [(i.e., 93.617 million in 2010 and 109.683 million in 2020) (BAS, 2009; PhilRice, 2010)]. Rice consumption is projected to increase at a rate corresponding to the population growth. The continuous development of high-yielding inbred and hybrid varieties resistant to pests and diseases with excellent grain qualities is essential to keep up with the increasing demand for rice.

Raising rice yield to its maximum potential under irrigated condition, particularly during the dry season (DS), was the main purpose of the program. To achieve this, location-specific adaptability of rice varieties and use of new breeding tools and methodologies were pursued. The use of hybrid rice technology as a key approach to attaining high yield was one of the major strategies implemented. These approaches were expected to enable PhilRice to appropriately respond to the needs of Filipino rice farmers and consumers, and significantly create a major impact in attaining and sustaining rice self-sufficiency in the country. Furthermore, the application of improved agronomic management technologies for seed production and commercial cultivation of varieties that PhilRice developed were fine-tuned. These technologies were tested under local conditions toward the promotion of location-specific recommendations and subsequent adoption by farmers.

The program were comprised of the following major components: (1) Breeding of new and superior inbred rice for transplanted irrigated lowland areas; (2) Development of inbred varieties for direct wet-seeding; (3) Development of hybrid varieties; and (4) Development of seed production technologies and crop management strategies. During the year, the National Seed Industry Council (NSIC) approved the commercial cultivation of two inbred varieties: NSIC Rc298 (Tubigan 23) and NSIC Rc300 (Tubigan 24). NSIC Rc298 is the first PhilRice-bred variety developed purposely for direct wet-seeded cultivation. It has an average yield of 5t/ha; intermediate reaction to anaerobic germination stress, lodging, bacterial blight, and green leafhopper; and moderate resistance to yellow stemborer (white heads) and brown planthopper. It has good milling recovery and comparable eating quality with IR64. NSIC Rc300 is adapted to both transplanted and direct-seeded culture. As a transplanted crop, its average yield ranged from 5.6 to 5.9t/ha, and its maximum attainable yield was recorded at 10.4t/ha. It is moderately resistant to blast, bacterial blight, sheath blight, yellow stem borer, brown plant hopper, and green leafhopper. In adaptability tests of inbred and hybrid varieties conducted in multiple sites across the country (33 sites during DS and 47 sites during WS), the highest yields were attained by Mestiso 19 (14.0t/ha) and NSIC Rc240 (13.2t/ha) during DS, and by Mestiso 20 (11.0t/ha), Mestiso 29 (12.0t/ha), and NSIC Rc240 (12.0t/ha) during WS. During field days, farmers have indicated their interest on these hybrids which led to the implementation of DA-funded hybrid seed production project and planting of public hybrids in 50,000 ha in 2013. Genetically pure nucleus and breeder seeds of parent lines of 12 public hybrids, namely, Mestizo 1, Mestiso 3, 7, 19, 20, 21, 25, 26, 29, and 38 were continuously produced and distributed by PhilRice CES, PhilRice Isabela, and PhilRice Los Baños.

With all these accomplishments, is the program has a great potential to support the national goals of achieving rice self-sufficiency and competitiveness in the country. There is, therefore, a need for a strong national funding support for breeding, seed production research, and new initiatives of the program to continuously improve and develop technologies for the irrigated lowland rice areas.

I. Breeding of New and Superior Inbred Rice for Transplanted Irrigated Lowland Areas

Thelma F. Padolina

The success of a breeding strategy relies heavily on the crop genetic diversity and the method of evaluation and selection of populations. Thus, the rice breeding scheme categorizes its activities into: 1. Evaluation and identification of donor germplasm with identified yield enhancing and stabilizing traits for breeding improvement, 2. Line development phase to select the best progenies in the segregating generations, and 3. Performance trials where advanced breeding lines are subjected to yield trials on station and in multi-environments. Continuous improvements on its breeding approaches and methodologies are being done for the dynamic breeding requirements and changing environmental conditions. The additions of two phases in multi-environment trials and early generation screening for low input technology are innovations from of the project. This is to ensure availability of new and superior irrigated rice varieties in the near future.

Evaluation of donor germplasm

EC Arocena, JA Orcino, and LR Pautin

An extensive source of donor germplasm was achieved through cooperation with international nurseries (e.g. INGER, IIRON, IRBN, IRFAON, and IRBPH). A regular crossing block was established in staggered planting dates to provide pollen source to hybridization works while the donor germplasm are being characterized.

Highlights:

- Seven diverse germplasm from four countries were identified as donor materials for yield enhancing traits and desirable grain size from INGER. These will be included in the crossing block for use as parents in the hybridization this 2013DS (Table1).

- A total of 879 accessions were assembled this year (Table 2). Successful characterization of these materials was met with a total of 200 accessions characterized with yield-enhancing and stabilizing traits. This led to the identification of 49 donor parents for hybridization. Characterized donor germplasm can be seen in Table 3. Selected accessions from indica panel (ORYTAGE + K2 subset) with upcoming genotypic results will be added to the crossing block next season.

Table 1. List of donor germplasm identified in the International Observation Nurseries, 2012.

Designation	Origin	Desired Characteristics
B 11143 D-MR-1-PN-4-MR-3-SI-3-1-PN-2	India	Long and dense panicle
WAS 173-B-B-5-3	Senegal	Extra long grain
WAS 169-B-B-4-2-3	Senegal	Extra long grain
CT 18539-5-3-2VI-2-1P	CIAT	Good grain filling and fertility
IR 10M144	IRRI	Good ripening color; moderate resistance to BLB
IR 06M138	IRRI	Long and dense panicle
IR 76494-28-1-2-2	IRRI	Very Long panicle

Table 2. Characterization and selection of donor germplasm.

HARVEST INDEX (0.5-0.6)	PANICLE LENGTH (28 cm)	FILLED GRAINS (214-231 grains)	GRAIN FERTILITY (93-94%)	1000 GRAIN WEIGHT (32-34 grams)	SLOW SENESCENCE
• PR38732-B-B-1	• PR36930-B-7-3	• PR35766-B-24-1	• D4098	• PR37088-B-5-2-2-3-1-3-1	• PR 40168-B-B-B-20
• PR37251-5-4-1-1-2	• PR41421-B-8	• PR36457-B-B-11	• PR30997-5B-24-3-2-1	• PR36248-HY-2-5-1	• IRBB 54 A
• PR40476-B-B-B-1-1	• PR35765-B-13-1-1-4-4	• PR 36248-HY-2-3-3	• HHZ 1-SAL 9-Y1	• PR36243-HY-2-3-2	• IRBB 62 A
• HHZ 5-SAL8-DT3-SUB1				• PR37994-B-20-2-2-1	• TME80518
• PR 35765-B-46-2-1-2-1-2-1-2				• PR37994-B-21	• ZHONGHU A 1
• PR36930-B-7-3					

Table 3. Selected characterized donor germplasm with yield enhancing traits. 2012WS

	DRY SEASON Assembled / Evaluated	WET SEASON Assembled / Evaluated	TOTAL	Expected Outputs
1.1 Assembled accessions (CB)	438	441	879	**200** germplasm accessions assembled per year
1.2 Characterized accessions	160	40	200	**100** germplasm accessions characterized per year
1.3 Selected desirable accessions	8	41	49	**10** donor parents with one or more yield enhancing traits annually

Line development phase: Hybridization and pedigree nursery
EC Arocena, JA Orcino, LA Pautin, GM Osoteo, AQC Sabanal, RC Braceros, JC Duque

The targeted number of desirable breeding materials for this phase was achieved through continued hybridization and selection. The selection was improved by incorporating two treatments in the Hybrid population for selection (HPS) in the modified bulk method (0 and 120 kg/ha Nitrogen fertilization). Such treatments would identify early generation breeding lines with a potential for low input technology. Identified crosses were currently advanced to F5 generations for further evaluation.

Highlights:

- A total of 168 new crosses were accomplished during the dry and wet season of 2012. Single-way crosses and three-way crosses were used in developing F1 generations which were targeted for high yield and resistance to insect pest and diseases particularly green leaf hopper, tungro virus bacterial leaf blight, and blast. One hundred sixty five of these crosses were selected for generation advance in the Hybrid Population for Selection (HPS) using the modified bulk method and Non-Selection (HPNS) as in classical bulk. In addition, 19 crosses were identified for shuttle breeding to PhilRice Agusan and Midsayap. Discarded crosses were based on poor plant type, high sterility, and susceptibility to field pest and diseases. F2 generations in the Hybrid population for Non-Selection (HPNS) were composed of 120 evaluated crosses (c), 42 of which were selected through panicle selection and identified for HPS and Pedigree nursery (PNIL). (Table 4)

- The PNIL, HPS, and HPNS contributed to the F3 generations in the breeding scheme. A total of 2429 derived lines (dl) were identified for the pedigree nursery and 18 c was advanced. Similarly, the F4 generations composed of crosses (HPS & HPNS) and derived lines (PNIL) were assembled from the same nurseries. F5 to F11 entries were in the pedigree nursery with most of the derived lines from the F5 and F6 generations. The selected F5 generations (3,312 dl) were tested with 0 and 120kg/ha Nitrogen fertilization with many of Japonica x indica background. Among the 3,154 lines in the PNIL during the WS, 254 were identified for the Advanced Observation Nursery (AON) next 2013 DS. The detailed extent of the breeding materials during the crop year 2012 is shown in Table 5.

Table 4. Summary of breeding materials in the line development phase, 2012.

	NURSERY	TOTAL ENTRIES ASSEMBLED	TOTAL ENTRIES ADVANCED/ SELECTED	EXPECTED OUTPUTS
F1		168c	165c (40c for HPS, 2c for RTR, 17c for Mid, 106c for HPNS)	80 true-to-type F1s per year
F2	HPNS	120c	42c (25c for HPS , 17c/253dl for PN)	80 F2 populations with at least 1000 individuals per cross planted and 6,000 F3 lines selected per year
F3	PNIL	242 dl	64 dl for PN	6,000 F3 lines planted and 2,000 F4 selected per year
	HPS	23c	20c/2365dl for PN (0N)	
	HPNS	83c	18c for gen.adv., 85c for HPNS, 4c/44dl for PN	
F4	PNIL	1105dl	215dl for gen. adv. (PN)	2,000 F4 lines planted and 1,000 F5 selected per year
	HPS	28c	38c/2046dl, 1314dl(0N), 937dl(120 N)	
	HPNS	17c	1c/3dl for PN	
F5	PNIL	3448dl	754dl (0N), 1182dl (120N) 1376dl (JapxInd)	1,000 F5 lines planted and 500 F6 selected per year
F6	PNIL	956dl	132dl(63dl rtv), 79dl 353dl(japxindica)	
F7	PNIL	322dl	118dl for gen.adv.	
F8	PNIL	102dl	9dl for gen.adv.	
F9	PNIL	39dl	5dl for gen.adv.	
F10	PNIL	5dl	0	
F11	PNIL	1dl	0	

c-crosses, dl- derived lines, p-panicles, 0N- 0 kg/ha Nitrogen, 120N- 120 kg/ha, jap x ind- Japonica x Indica cross, RTR-PhilRice Agusan, Mid-PhilRice Midsayap, gen.adv.- Generation Advance

Table 5. Extent of breeding materials in the line development phase, 2012 DS & WS

	NURSERY	TOTAL ENTRIES ASSEMBLED	TOTAL ENTRIES ADVANCED/ SELECTED	EXPECTED OUTPUTS
F1		168c	165c (40c for HPS, 2c for RTR, 17c for Mid, 106c for HPNS)	80 true-to-type F1s per year
F2	HPNS	120c	42c (25c for HPS , 17c/253dl for PN)	80 F2 populations with at least 1000 individuals per cross planted and 6,000 F3 lines selected per year
F3	PNIL	242 dl	64 dl for PN	6,000 F3 lines planted and 2,000 F4 selected per year
	HPS	23c	20c/2365dl for PN (0N)	
	HPNS	83c	18c for gen.adv., 85c for HPNS, 4c/44dl for PN	
F4	PNIL	1105dl	215dl for gen. adv. (PN)	2,000 F4 lines planted and 1,000 F5 selected per year
	HPS	28c	38c/2046dl, 1314dl(0N), 937dl(120 N)	
	HPNS	17c	1c/3dl for PN	
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F8	PNIL	102dl	9dl for gen.adv.	
F9	PNIL	39dl	5dl for gen.adv.	
F10	PNIL	5dl	0	
F11	PNIL	1dl	0	

c-crosses ,dl- derived lines, p-panicles, 0N- 0 kg/ha Nitrogen, 120N- 120 kg/ha, jap x ind- Japonica x Indica cross RTR-PhilRice Agusan, Mid-PhilRice Midsayap

Performance Trials: MET1 (AON, PYT), MET2 (MYT, GYT), MET3 (NCT1)
EC Arocena, JA Orcino, LA Pautin, GM Osoteo, AQC Sabanal, RC Braceros, JC Duque

Advanced and uniform lines were further subjected under performance evaluation trial. Field performances of these lines were closely observed for the following parameters: yield, reactions to insect pests and diseases, and grain quality.

Highlights:

- Table 6 shows the extent of breeding materials that were evaluated and advanced in this stage. A total of 610 lines were evaluated in the Advanced Observational Nursery (AON) and 101 were advanced for preliminary yield testing. In the PYT, 90 out of 361 evaluated entries were selected for further purification and recommendation to multi-location testing. For 2013 DS, entries were also advanced for the establishment of MET 0, which is an initial phase in preparation for MET 1. In the MET trials, evaluation of 161 promising lines led to 100 selected entries that were advanced to MET stage 2. A new set of entries was assembled during the wet season for further testing for two seasons. A newly established MET stage 2 was also composed of 45 entries with continued evaluation until 2013.

- The box plot (Figure 1) shows the dispersion of the yield from the AON and PYT entries during the DS and WS. Yield performances of lines in AON ranged from 4-8t/ha with 50% of entries having greater than 7t/ha. Outlying low yielding entries yielded 4 and less than 2t/ha. A more varied but generally low yield was observed from the WS trial. The top entries yielded 8t/ha. In the PYT, 75% of entries fell below 8t/ha. Top entries yielded 9t/ha while outlying low yielders were below 5t/ha. WS results showed lower yield from 5-2t/ha.

- Figure 2 shows the top yield performers in AON and PYT. In comparison with the checks (PSB Rc82 and PSB Rc18), 10 entries were identified as top yielders during the WS in AON. These entries had yield advantages ranging from 3-33% with the breeding line PR40200-B-8-8-75-2 as the best. While in PYT, 20 top entries had 1-22% yield advantage over the check varieties with these two lines PR39421-51-27-1-1 and PR39434-57-31-1-1 in the lead.

- Continued trial of a new set (100 entries) of IRRI and PhilRice elite lines against various environments was done with an additional test site in Bohol. Results for the multi-environment trial (MET 1) will be completed after two-season testing. Among the test locations (Figure 3), Nueva Ecija had the highest yield (9t/ha) while Bohol had the least (5t/ha).The top 10% of the entries in MET 1 yielded from 6-7t/ha (Table 7).

- On the other hand, newly established MET 2 trial was composed of Advanced MET 1 entries. In preparation for these two-season trial in MET 1 and 2, data were summarized and checked for the multi-environment performance (overall rank), yield stability index (YSI) and AMMI stability values (ASV). With these parameters as basis, 14 promising lines from early and late maturing groups are identified for national testing. These entries ranked 3-16 across sites, with location specificity in one or more test sites as shown in Tables 8 and 9.

- In the most advanced stages of breeding, five new elite lines were in for the first-season multi-adaptation testing. These inbreds were PR35784-B-16-3-3, PSB Rc72H-20KR-6-19(A), PR37274-6-33-9-1-2(AR), PR35785-B-1-3, PR37171-1-1-3-4-1-1-1(AR), PR37240-14-2-2-1(AR), and PR35789-B-1-1-1. Data from 20 testing sites nationwide are being consolidated for analysis. Further evaluation will still be done to complete its Three-season trial requirement.

- NSIC Rc300 (Tubigan 20), known in the NCT as PR31379-2B-10-1-2-1-2, is a cross of PSB Rc62/PSB Rc66. This advanced breeding line which passed the five-season testing at NCT is adapted to both transplanting and direct seeding culture. It passed the standards for yield, pest resistance, and grain quality parameters. As a transplanted crop, yield was stable across seasons and locations with a range of 5.6 to 5.9t/ha. Maximum attainable yield was recorded at 10.4t/ha. It matured in the range of 112 to 117 days, growing from 91 to 101cm, and 13 to 16 productive tillers. It was generally moderate to blast, bacterial leaf blight, and sheath blight but susceptible to tungro. For insects, it was also moderate to yellow stemborer, brown plant hopper, and green leaf hopper but susceptible to white stemborer. It had very good milling attributes: premium milling recovery (72.2%), Grade 1 head rice (48.9%) with long and intermediate grain size, and intermediate amylose ranging from 19.8 to 20.9%. Sensory qualities for raw and cooked rice were comparable to IR64.

- NSIC Rc304SR (Japonica 3), a japonica type variety, was evaluated in the NCT as PR34126-B-1 with parents: PJ9/PR27137-CR153. This is intended to tropical conditions in irrigated lowland areas. It exhibited high yield advantage of 34.2% during the WS against the check variety MS11. It matures in the range of 112 to 115 days or 113 days on the average. It has intermediate reaction to BLB in all test sites and sheath blight in four out of six sites. Blast resistance was observed in Isabela, Laguna, and North Cotabato but not in Leyte. Typically, japonica short and bold grain type, it exhibited good milling and head rice recovery, low amylose content, and good eating quality. Its glossy, cohesive, tender and smooth texture, and tastiness contributed to its high preference.

Table 6. Evaluated and advanced breeding materials in the performance trials (2012 DS and WS)

PROJECT /STUDY	DRY SEASON		WET SEASON		TOTAL	TOTAL
	EVALUATED	ADVANCED	EVALUATED	ADVANCED	**EVALUATED**	**ADVANCED**
Advanced Observation y)	155	68	455	33	**610**	**101**
reliminary Yield Trial)	141	52	220	38	**361**	**90**
Multi- Environmental Trial)	161	100	100	On going	**261**	**-**
age 2: Advanced Breeding	45	--	45	On going	**45**	**-**
TOTAL	*341*	*220*	*820*		*1277*	*191*

Table 7. Top 10% high yielding advanced lines in MET 1. 2012 WS

METNo	Fixed Name	Module	Average*5 sites	Yield (t/ha)
MT4542	PR37956-3B-44-1	1	1693.10	5.88
MT5101	Elite66	1	1666.82	5.79
MT5076	PR37942-3B-5-1-2	1	1665.33	5.78
MT4580	PR37165-2-2-1-1-1	1	1663.51	5.78
MT4577	PR37942-3B-5-1-1	1	1651.90	5.74
MT5096	Elite26	1	1642.49	5.70
MT4570	PR38001-3B-5-2-1	1	1638.89	5.69
MT4551	PR38729-B-B-1-1	1	1611.47	5.60
MT4558	PR38677-2-1	1	1602.64	5.56
MT4582	PR37957-B-3-3-1-1	1	1590.23	5.52
MT4532	PR37251-1-5-1-3	1	1570.60	5.45
MT5112	SPSI 36	1	1569.30	5.45
MT5074	PR 37790-26-1-2-2-1-B-B	1	1564.23	5.43
MT4563	PR37285-17-31-12-1-21-1-2	1	1562.29	5.42
MT5182	PR37920-B-28-1-2-1-1	2	1805.48	6.27
MT5192	PR 37598-9-3-2-3-1-3-B-B	2	1796.63	6.24
MT4859	PR36905-B-1-11-2-1-1-1	2	1765.92	6.13
MT5171	12DS-GMET-3	2	1756.87	6.10
MT4824	PR37046-B-13-5-1-1	2	1681.45	5.84
MT5202	PR40077-2B-28-1	2	1706.72	5.93
MT5183	PR37139-3-1-3-1-2-4-2-1	2	1704.51	5.92
MT4852	PJ(G) 6-2-4-5-4	2	1702.39	5.91
MT4901	IRRI 104 PSB Rc10		1705.43	1.71
MT4902	IRRI 123 PSB Rc82		5080.75	5.08
MT4903	IRRI 154 NSIC Rc222		5458.15	5.46
MT4904	IRRI 105 PSB Rc18		3228.80	3.23
MT5432	NSIC Rc124H (MESTIZO 4)		3426.80	3.43

Module 1-Early maturing group, Module 2-Late maturing group

Table 8. Overall Field Performance Evaluation of Multi-Environment Trial (MET 2), Module 1. 2012 WS

Module	Fixed Name	Yld/ha. **Nueva Ecija**	PnD	Observation	bases on the following criteria for selection	Elevated **2013DS**
Early						
1	PR30245-10-414	5215	bls	uniform, SEFL	OA=15+YSI=9	
2	PR37139-3-1-3-1-2-1	3504	bls, blb, Ptip	uniform, BVLEFL	OA=14+AGSN=3+??	
3	PR37246-2-3-2-1-1-2-2	4824	bls, blb	uniform, VE, EFL	ASV=7 only	
4	PR37273-5-16-5-2-1-2-1	4890	Bls, blb	uniform, LEFL	LB only=4	
5	PR37942-3B-5-3-2	4935	bls,Blb	uniform, LEFL	OA=3+ASV=10+YSI=1+NE=15 +ISA=12	**CNCT**
6	PR37951-3B-37-1-2	4290	BLB, BLB	uniform, BEFL	OA=2+NE=2+Agsn=2	**CNCT**
7	PR38046-PB-10-9-4-2-1	2893	bls, blb	uniform, BEFL BS	OA=20+YSI=5+LB=3	
8	PR40078-B-12-2	4988	Bls, BLB	VB	ISA=11+BHL=14	
9	PR37866-1B-1-4	5097	bls, blb	uniform, ELEFL	OA=16+IAS=5+AGSN=8	**CNCT**
10	PR37939-3B-1-2	4860	bls, Blb	uniform, BEFL	ASV=20+YSI=10+AGSN=6+Bhol =7	**CNCT**
11	PR37951-3B-37-1	3662	bls, blb	uniform, w/ awn, BEFL	NE=7+AGSN=15+	
12	PR35769-B-1-1-2-3-4	5753		uniform, clean, good	ASV=8 only	
13	PR35805-B-9-2-3-2-3	3501	Bls, BLb	uniform, LEFL	OA=4+NE=4	**CNCT**
14	PR37952-B-1-1-2	2886	bls,blb	w/ awn, late, LEFL	ASV=6only	

OA-rank in overall yield (5 sites), YSI-rank in Yield stability index, ASV- rank in AMMI stability values, NE-rank in Nueva Ecija, Isa –Isabela, BHL-Bohol, AGSN-Agusan,LB-Los Banos CNCT –conditional NCT test entry

Table 9. Over-all Field Performance Evaluation of Multi-Environment Trial (MET 2), Module 2. 2012 Wet Season

Module	Fixed Name	Yld/ha.	PnD	Observation	bases on the following criteria for selection	Elevated
1	PR34859-B-4-1-1-2-1(G)	3146	Bls, Blb	uniform, BEFL BS	OA=17+NE=9+LB=12	
2	PR35251-2B-5-5-3-1-1	3847	bls, blb	uniform, EFL	OA=14+NE=1+ISA=13+BHL=20	CNCT
3	PR36831-31-1-1-1-1-1	3932	bls, blb	uniform, BEFL, BS	OA=8+ISA=3+AGSN=11+Bhol=8	CNCT
4	PR36933-B-1-36-1-1-1	4210	bls, Blb	NVU ,LEFL	OA=11+YSI=13+NE=6+ISA=9+Agsn=2	CNCT
5	PR37246-2-3-2-1-1-2-1	5337	bls	uniform, good	OA=2+ASV=13+YSI=3+NE=5+ISA=6+LB=6+Agsn=4+Bhl=3	CNCT
6	PR37704-2B-6-1-2-1-1	3541	Blb, Bls	NVU,LEFL	OA=1+YSI=9+ISA=1+LB=4+Agsn=5+Bhol=4	CNCT
7	PR37921-B-3-2-2	3874	bls, blb	uniform, LEFL, w/ awn	OA=7+NE=3+ISA=7+Bhl=1	CNCT
8	PR37952-B-4-1-3	4939	bls	uniform	OA=4+YSI=7+NE=10+ISA=5+AGSN=3+Bhol=6	CNCT
9	PR37921-B-3-4-2-1-2	2673	bls, blb	uniform, EFL, BS	OA=3+YSI=10+NE=4+ISA=2+LB=11+Agsn=10+Bhol=7	CNCT
10	PR38012-3B-3-1	4092	Bls, Blb	uniform, BEFL	YSI=1+ASV=2+LB=2+ISA=10	CNCT
check	**IRRI 104 BPI Ri10**	**1882**		**S to all**		
check	**IRRI 123 PSB Rc82**	**4321**	**bls, blb**	**uniform, EFL**		
check	**IRRI 154 NSIC Rc222**	**5005**		**ok uniform**		
check	**IRRI 105 PSB Rc18**	**3125**		**NVU**		
check	**NSIC Rc124H (MESTIZO 4)**	**3439**		**good ok**		

OA-rank in overall yield (5 sites), YSI-rank in Yield stability index, ASV- rank in AMMI stability values, NE-rank in Nueva Ecija, Isa –Isabela, BHL-Bohol, AGSN-Agusan,LB-Los Banos; CNCT –conditional NCT test entry

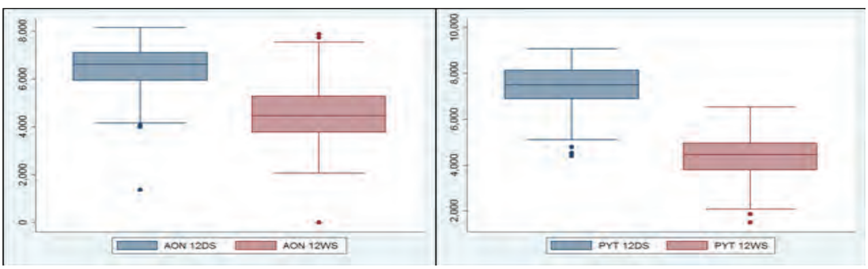

Figure 1. Yield performance of entries in the AON & PYT, 2012 DS and WS

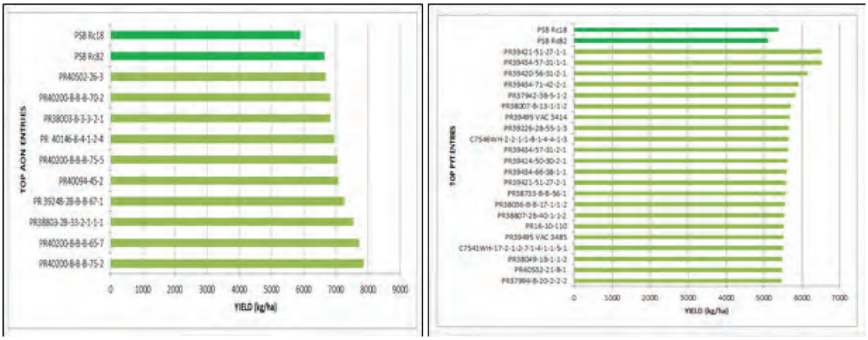

Figure 2. Top AON & PYT entries versus check varieties, 2012WS.

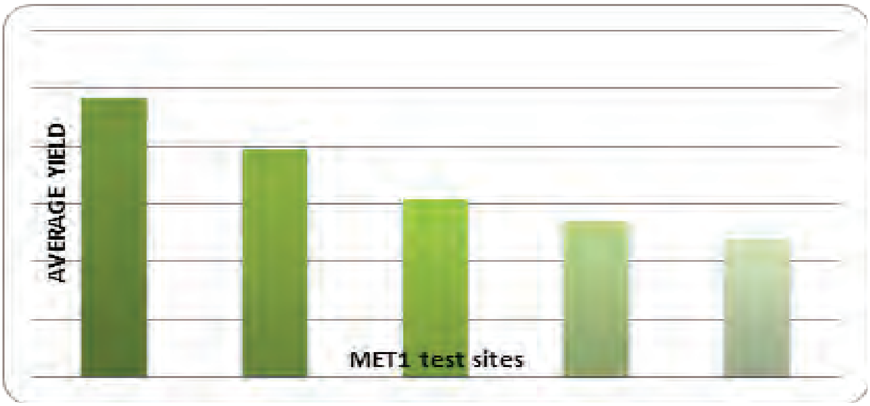

Figure 3. Average yield of Top entries per MET 1 sites. 2012WS

Figure 4. PR31379-2B-10-1-2-1-2 at full heading, kernel and grain quality.

Figure 5. PR34126-B-15 at early heading stage and kernel quality

Screening for resistance to major insect pests
GC Santiago

Breeding is a long-term project and priorities may change in time. A new selection needs to be tested in a range of environments and has to be grown using several cultural techniques. In most breeding programs, there are successive stages of testing: seedlings are initially screened and only the most promising lines go on to further testing. Most of the important sources of resistance to major insect pests were incorporated into lines that have improved plant type. Some lines were considered promising enough to be named varieties while others had proved to be good parents in the new crosses. Focusing on a system to facilitate screening for resistance will hasten the development of a new variety and save on resources.

Highlights:

- Under the transplanted irrigated lowland project (ILTPR), advanced breeding materials in the Preliminary Yield Trials (PYT) and the National Cooperative Tests (NCT) were thoroughly screened against the major pests.

- Field condition (stemborer). Based on the susceptible check with 30.17% damage in the field, screening to stemborer at reproductive stage was valid. There were 17 advanced lines with resistance to stemborer (whiteheads). Among these, two were in the NCT: 1) PR35412-3-9-2-3-1and 2) PR30996-3B-2-4-5-1-3-2-1. In the PYT, 15 entries including PSB Rc18 exhibited resistant reaction (Table 10). Overall, however, 39% of the 270 entries evaluated had resistant to intermediate reactions and the rest (59%) were susceptible to whiteheads. In 2012 WS, the evaluation of 211 ILTPR entries (15 in

NCT, and 196 in PYT) against stemborer (whiteheads) was not valid. There was low pressure of stemborer with only 6.134% damage in the susceptible check.

- Screenhouse condition (hoppers). Under the screen house condition against green leaf hoppers and brown plant hoppers, there were promising entries which exhibited moderate reactions to both GLH and BPH across two seasons (Table 11). These entries were PR37241-3-1-2-1-1and PR37251-5-4-1-1-2 while eight others were only moderate to BPH and/or GLH in either WS or DS. These entries were PR36720-17-1-2-1, PR35412-3-9-2-3-1, PR30996-3B-4-5-1-3-2-1, PR37088-B-19-1-1, PR37241-1-1-1-1, PR35891-3-2-4-3-5-3, PR37251-5-4-11-2, and PR35768-B-15-4.

Table 10. Advanced breeding lines with resistant reaction to stemborer (field condition) 2012 DS.

Trial	Advanced line
NCT	PR35412-3-9-2-3-1
	PR30996-3B-2-4-5-1-3-2-1
PYT	PR37557-3B-11-1-1
	PR37921-B-3-4-2-1-2
	PR38007-B-13-1-1-2
	PR38733-B-B-34-3-2-2-3
	PSB Rc18
	PR37139-3-1-3-1-2-4-2-1
	PR39414-37-21-2-1
	PR39417-19-6-2-1
	PR39420-14-10-1-2-1
	PR39420-14-10-1-3-1
	PR39420-14-10-2-1-1
	PR39420-14-10-2-3-1
	PR39420-16-12-1-1-1
	PR39420-56-31-2-1
	PR39421-51-27-1-1

Table 11. Advanced lines with moderate reaction to BPH and GLH under induced method in the screenhouse, 2012 DS and WS.

Advanced breeding line	BPH		GLH	
	DS	WS	DS	WS
PR36720-17-1-2-1	MR	MR	MR	MR
PR37251-5-4-1-1-2	MR	MR	MR	MR
PR35891-3-2-4-3-5-3	MR	MR	MR	MR
PR35768-B-15-4	-	-	MR	-
PR37241-3-1-2-1-1	MR	-	-	-
PR35412-3-9-2-3-1	-	MR	-	MR
PR30996-3B-4-5-1-3-2-1	-	MR	-	-
PSB Rc82	-	-	-	MR
PR37088-B-19-1-1	-	-	-	MR
PR37241-1-1-1-1	-	-	-	MR
PR37241-1-1-2-1	-	-	-	MR

BPH- brown plant hopper, GLH- green leaf hopper, MR- moderately resistant

Evaluation of new and superior inbred rice for disease resistance
JP Rillon and MSC Duca

Rice diseases pose a major threat to rice production. Developing rice varieties resistant to major rice diseases is the most economically and environmentally sound management approach in breeding program. Disease resistance is the best control but often not available or breaks down after varietal release and requires constant effort to improve and maintain. Diseases cause significant yield and quality reductions that cause farmers income loss. One way to increase yield is to reduce losses to disease. The role of disease screening is important in identifying rice lines that will show resistance to the major rice diseases. Rice lines resistant to major diseases can be used as new varieties. A continuous screening for disease resistance nationwide is therefore needed to prevent disease resistance break down from one year to the next.

Highlights:

- Promising rice lines under the irrigated lowland transplanted project were evaluated for resistance to major rice diseases [blast, bacterial leaf blight (BLB), sheath blight (ShB), and rice tungro virus (RTV)] through induced methods. For the rice tungro virus, the modified field screening method was employed with the TNI susceptible variety as source of inoculum. The same rice lines planted in the breeding nurseries were also rated against the prevailing rice diseases.

- During 2012 WS and DS, resistance to BLB was evident in majority of the promising entries in the NCT, five advanced lines had at least two resistances to either blast and/or BLB and/or ShB and were susceptible to RTV (Table 12). Breeders must exert more effort in developing blast, tungro, and sheath blight resistance.

- Out of the 270 lines evaluated in the PYT (2012 DS), an introduced rice line from Vietnam, OM2513, was the lone entry with blast resistance; two lines PR37984-B-3-1-2-1 and PR38791-2B-17 showed intermediate to resistant reaction to tungro induce; 129 lines resistant to BLB; and 17 to sheath blight. In the WS, eight lines were resistant to blast and 60 lines to BLB.

- Under natural field condition, none of the ILTPR lines showed incidence of field diseases during the DS. However in the WS, prevalence of BLB and sheath blight were recorded. There were 27 lines with resistance to BLB and 20 lines to ShB.

Table 12. Advanced breeding lines with intermediate reaction to major rice diseases (induced and modified field screening, 2012.

	Advanced Line	B	BLB	ShB	RTV
1	PR35766-B-24-1	I	I	S	S
2	PR36723-B-13-3-3-3	I	I	S	S
3	PR37241-1-1-2-1	I	S	I	S
4	PR37251-5-4-1-1-2	I	I	S	S
5	PR35412-3-9-2-3-1	S	I	S	S
6	PR30996-3B-2-4-5-1-3-2-1	S	I	I	S
7	PR37264-1-5-1-2-1	S	I	S	S
8	PR37241-3-1-2-1-1	S	I	S	S
9	PR36720-17-1-2-1	S	S	I	S
10	PR37275-5-16-5-2-1-2-1	-	I	S	S
11	PR35891-3-2-4-3-5-3	-	I	S	S
12	PR36930-B-7-3	-	I	S	S

B-blast; BLB-bacterial leaf blight; ShB-sheath blight; RTV- rice tungro virus, I-intermediate; S-susceptible

Grain quality evaluation of new and superior inbred lines for transplanted irrigated areas

KB Bergonio, CT Estonilo, JD Adriano, and TF Padolina

Rice varietal development for irrigated ecosystem plays a crucial role in helping attain rice self-sufficiency in the country as it contributes at least 60% of the total rice production. Breeding strategies for irrigated ecosystem are being implemented to develop inbred varieties with higher yield, better resistance to pests and diseases, and better adaptability to biotic and abiotic stresses. However, their grain quality remains to be improved. Grain quality properties of rice determine its suitability for specific end-use, thus, greatly influences consumer's preference for rice. Hence, grain quality screening must be integrated in the early generation stages of the varietal development for transplanted irrigated ecosystem. Early generation screening enables the selection of lines to be discarded or advanced for further trials to save resources and the identification of lines with properties suited for special purposes.

This year, 588 entries in the AON, PYT, GYT, and MET submitted by breeders in 2011 WS and 2012 DS and WS were screened for grain quality. The milling quality (milling recovery as percent brown rice, milled rice, and head rice), appearance quality (physical attributes), and apparent eating quality as predicted by the starch physicochemical properties of the milled rice were determined and evaluated.

Highlights:

- Milling recovery evaluation revealed that 529 out of 588 entries satisfied the total milled rice recovery standard (grade 1 to premium), 284 entries of which passed the head rice recovery requirement of at least 48% (grade 1 to premium). For each varietal development stage, three entries from AON 2011 WS, and 131 entries from PYT 2011 WS, 13 entries from GYT 2012DS, 49 entries from AON-R 2012DS, 75 entries from PYT-R 2012DS, and 12 entries from PYT 2012WS passed the standards for milling quality (Table 13).

- Majority of the entries were found to have a preferred dimension of at least long grain length and slender shape, but most entries have high level of undesirable chalky grains. Eleven of 38 entries from AON 2011 WS, 22 of 190 entries from PYT R, two of 32 entries from GYT 2012 DS, 93 of 151 entries from PYT-R 2012 DS, and one out of 38 entries from PYT 2012 WS satisfied the chalkiness requirements of less than 5%.

- Most entries met the preferred amylose content of 12-23% which is low to intermediate in classification. As to gelatinization temperature (GT) type, majority of the entries were low to high intermediate (<70°C -74°C GT). Grain quality clustering by amylose-gelatinization temperature type showed that most entries are presumably soft to intermediate/medium–textured upon cooking. This indicates good eating quality and acceptability of most of the entries evaluated.

- Generally, grain quality screening revealed that one of 73 entries from AON 2011 WS, 17 of 190 entries from PYT-R 2011 WS, and two of 32 entries from GYT 201 2DS satisfied all the requirements for milling, physical, and (apparent) eating qualities as set by the National Seed Industry Council (Figure 6). No entry from PYT 2012 WS satisfied the grain quality requirements. MET entries were noted to have acceptable (apparent) eating quality but the milling and appearance qualities should further be determined.

Table 13. Grain quality properties of 2011WS and 2012 DS and WS inbred rice lines.

<u>**Grain Quality Property**</u>		<u>**Number of Entries**</u>						
meter/ Level/ Classification		**AON 2011WS (N=73)**	**PYT 2011WS (N=190)**	**MET 2012DS (N=26)**	**GYT 2012DS (N=32)**	**AON-R 2012DS (N=78)**	**PYT-R 2012DS (N=151)**	**PYT 2012WS (N=38)**
covery and Physical Attributes								
Brown Rice								
>80%	Good	0	10	n.a.	0	0	0	17
75.1-79.9%	Fair	45	168	n.a.	32	76	148	20
<75%	Poor	28	12	n.a.	0	1	3	1
Milled Rice								
>70.1%	Premium	0	122	n.a.	0	5	4	0
65.1-70.0%	Grade 1	71	66	n.a.	31	71	134	25
60.1-65.0%	Grade 2	1	2	n.a.	1	1	13	13
55.5-60.0%	Grade 3	1	0	n.a.	0	0	0	0
<55.5%	Below Standards	0	0	n.a.	0	0	0	0
Head Rice								
>57%	Premium	1	62	n.a.	0	16	11	0
48.0-56.9%	Grade 1	3	69	n.a.	13	33	64	0
39.0-47.9%	Grade 2	32	40	n.a.	18	19	48	6
30.0-38.9%	Grade 3	35	16	n.a.	1	9	25	17
<30.0%	Below Standards	2	3	n.a.	0	0	3	15
Chalkiness								
0.1- 2.0%	Premium	0	5	-	0	-	35	0
2.1- 5.0%	Grade 1	11	17	-	2	-	58	1
5.1- 10.0%	Grade 2	14	35	-	10	-	42	11
10.1-15.0%	Grade 3	6	34	-	14	-	14	15
>15.0%	Above Standards	7	99	-	6	-	2	11
emical Properties								
Amylose Content								
0.0- 2.0%	Waxy	29	1	0	0	0	0	0
2.1- 10.0%	Very Low	10	10	0	0	0	0	0
10.1-18.0%	Low	29	105	11	0	17	15	4
18.1-25.0%	Intermediate	5	74	15	30	49	102	34
>25.0%	High	0	0	0	2	12	34	0
Gelatinization Temperature by Alkali-Spreading Value								
74.5-80.0°C	High	0	1	0	0	0	0	0
70.0-74.0°C	High Intermediate	29	40	14	0	0	0	5
70.0-74.0°C	Intermediate	12	93	11	18	49	97	15
<70.0°C	Low	32	56	1	14	29	54	18
Cooked Texture								
Grain Quality Cluster Type								
Cluster 1	Soft	73	190	26	17	51	91	21
Cluster 2	Medium/Intermediate	0	0	0	13	26	42	17

Note: -, analysis not required as of SYP Program Workshop dated June 13, 2012; n.a., not applicable as samples are submitted in milled rice form

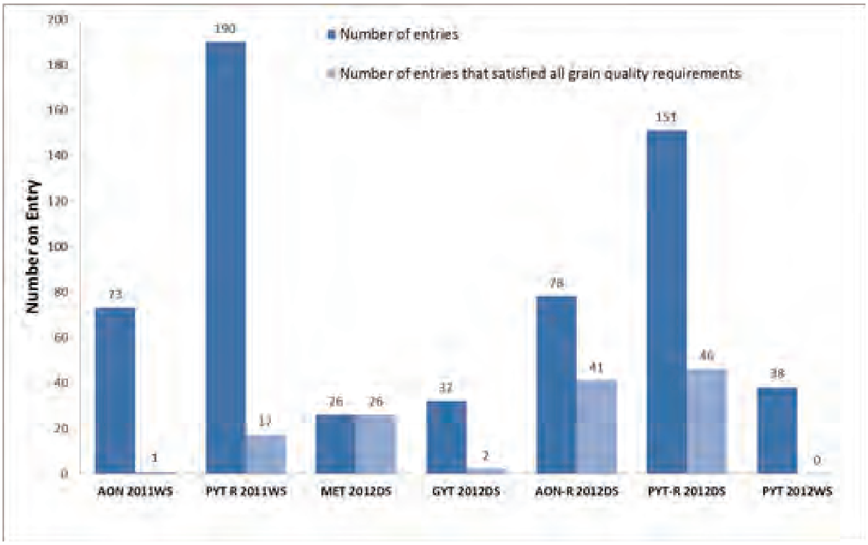

Figure 6. Number of entries for each of the varietal development stages/ breeding trials that satisfied all the grain quality requirements as set by the National Seed Industry Council.

II. Development of Inbred Varieties for Direct Wet-Seeding

Oliver E. Manangkil

In the Philippines, rice varieties are mainly bred for transplanting due to its various advantages such as early (1) seedling establishment for weed competition, low seed requirement, and controlled plant density. Nowadays, direct seeding as an alternative method of establishing rice is gaining more acceptance to the farmers due to (2) reduced cost of farm inputs, labor, and capital compared to transplanted rice. Yield is almost similar to the transplanted rice however, there are limited varieties suited for direct seeding. Knowing the requirements and environmental conditions of direct seeded rice, there is a need to focus on breeding better rice varieties for this method of crop establishment.

This project aimed to develop rice varieties adapted to direct seeded system. This project addresses these two important constraints in wet direct seeded rice through variety improvement. As main breeding objective, we will emphasize early seedling vigor, anaerobic germination resistance, and lodging resistance on top of yield contributing traits that are important for irrigated lowland rice.

Development of direct wet-seeded rice varieties

OE Manangkil, WV Barroga, and PN Marcelo

The development of rice varieties for direct wet-seeded system is one of the major areas of concerns in rice research today. Recent trend in rice production is marked with the shift from transplanting to direct seeding because the latter benefits to the farmers by reducing the cost and time of production. Direct wet-seeded rice (DWSR) should be improved for anaerobic germination, very good seedling vigor, lodging resistance, and contributing traits on top of yield that are important to irrigated lowland rice. Hybridization process was based on the traits preferred for direct wet-seeded rice (DWSR) cultivation. Parents used possess resistance to major pests and diseases, high yield, and good grain qualities. Crosses with backgrounds of good anaerobic germination, seedling vigor, heat tolerance, disease resistance, and good grain quality are generated. F1 materials are harvested for advance evaluation in the F2 nursery. F2 and Observational Nursery (ON) entries are submerged in 5cm water depth in seedbed for seven days to evaluate the germination performance of the populations under anaerobic condition. Entries with good anaerobic germination were found among entries. PR34159-13-1 which was recommended by the RTWG for variety release is awaiting approval from the NSIC.

Highlights:

- A total of 96 new single crosses were generated with backgrounds of good anaerobic germination, good seedling vigor, disease resistance, and good grain quality. and the crosses will constitute the 2012 DS F1 nursery. Ninety two F1 materials were harvested for advance evaluation in the 2013 DS F2 nursery. Table 14 presents the number of selections in the Pedigree Nurseries (PN) and Yield Trials.

Table 14. Selections in the Pedigree Nurseries and Yield Trials.

Nursery	Entries	Selections
F2	93	1817 plants
F3	1623	245 Lines (L)
F4	453	103 L
F5	336	57 L; 24 Bulk (B)
F6	264	31 L; 21 B
F7	96	18 B
F8	3	1B
ON	110	52 (46 will be re-evaluated in 2013DS, 15 of which will also be evaluated in MET in 2013DS; six will be evaluated in PYT)
PYT	24	
GYT	32	
NCT	6	On-going trial
MAT	6	With four seasons data in NCT1, awaiting results in RTWG meeting

Screening of breeding lines for early seedling vigor and anaerobic germination tolerance
OE Manangkil, WV Barroga, and PN Marcelo

Rice plants which suffer from the oxygen deficiency during germination imposed by partial or total submergence is the main cause of high mortality rate in direct seeded system. However, some plant species have developed strategies to avoid or withstand severe oxygen shortage and, in some cases, the complete absence of oxygen (tissue anoxia) for considerable periods of time. Advanced lines produced in the development of direct wet-seeded rice varieties are further screened in ON to check if the anaerobic germination tolerance and seedling vigor under submergence are still obtained by the plant despite the series of selection in the pedigree nursery. Lines that passed the screening will constitute the yield trials and finally, will be entered to higher yield tests in different localities.

The following were the study's objectives : screen introduction and lines for early seedling vigor and anaerobic germination tolerance; identification of lines and introduction with anaerobic germination tolerance and high seedling vigor; assembly of donor lines with desirable traits; and screen advance lines prior to yield trials.

Highlights:

Observation Nursery

- A total of 78 F2 populations and 30 ON entries were submerged in seedbed for 7 days. Eleven (F2 = 7; ON = 4) entries had excellent germination under anaerobic condition (Figure 7).

- Eighty two breeding lines from ON, Preliminary Yield Trial, and General Yield Trial were seeded in muddy soil and covered with garden soil. Materials were submerged 5cm in steel tray for 14 days to identify entries with good anaerobic germination. Nine checks were used to compare the performance of the breeding lines. Five breeding lines were identified resistant. One of the lines was used as donor parent in crossing work.

Figure 7. Field anaerobic germination tolerance screening.

Preliminary Yield Trial

- A total of 93 F2 populations and 110 ON breeding lines were dry seeded and submerged in seedbed for 10 days. Sixty-eight F2 populations and 106 breeding lines survived after 10 days of submergence. Six from F2 and 15 from ON had excellent germination.

- Sixty-nine breeding lines were seeded in muddy soil and covered with garden soil. Materials were submerged 5cm-deep in steel tray for 14 days to identify entries with good anaerobic germination. Nine breeding lines were found resistant and 11 were intermediate to anaerobic condition. Twenty-two entries had higher biomass compared with Khao Hlan On.

- In Preliminary Yield Trial (PYT), 22 advanced Direct Seeded Rice (DSR) lines and two check varieties (PSB Rc82 and Rc18) were evaluated for grain yield in PhilRice CES under unprotected condition. During 2012 DS, check varieties PSB Rc82 and PSB Rc18 yielded 6.5t/ha and 5.6t/ha, respectively. Yield data of DSR lines ranged from 4.3t/ha to 7.2t/ha and average yield of 5.9t/ha. Based on the results, three DSR lines were identified with yield advantage of 5% to 10% over PSB Rc82 and 17% to 28% over PSB Rc18 (Table 15).

Table 15. DSR lines with yield advantage of 5% to 10% over PSB Rc82 and 17% to 28% over PSB Rc18 (PYT), 2012 DS. PhilRice CES

DSR Line	Yield (t/ha)
PR37801-13-1-2-3-1-B-B	7.2
PR37825-18-3-2-3-1-B-B	6.8
PR37787-5-3-2-3-2-B-B	6.5

- For other agro-morphological characteristics, maturity ranged from 97 days after sowing (DAS) to 111DAS. Plant height was 94 to 115cm with productive tillers ranging from 450 to 634.

- In 2012 WS, check varieties PSB Rc82 and PSB Rc18 yielded 3.8t/ha and 3.0t/ha, respectively. Yield data of DSR lines ranged from 2.6t/ha to 4.4t/ha with an average yield of 3.5t/ha. Results showed that six DSR lines attained 4% to 18% yield advantage over PSB Rc82 and 1% to 50% over PSB Rc18 (Table 16).

Table 16. DSR lines with 4% to 18% yield advantage over PSB Rc82 and 1% to 50% over PSB Rc18 (PYT), 2012 WS. PhilRice CES

DSR Line	Yield (t/ha)
PR37060-35-1-3-3-2-1-2-2-B	4.5
PR38269-39-1-3-2-B	4.4
PR37825-18-3-2-3-1-B-B	4.3
PR38269-6-2-2-3-B	4.1
PR37787-5-3-2-3-2-B-B	4.0
PR37533-8-1-1-1-3-2-1-3-B-B	3.9

- For other agro-morphological characteristics, maturity ranged from 105 days after sowing (DAS) to 118 DAS. Plant height is 93 to 125cm with productive tillers ranging from 309 to 455.

General Yield Trial

- For General Yield Trial (GYT), 30 DSR lines and two check varieties (PSB Rc82 and Rc18) were evaluated for grain yield during the 2012 DS and WS at PhilRice CES under unprotected condition. For DS cropping, check varieties PSB Rc82 and PSB Rc18 yielded 6.0t/ha and 5.3t/ha, respectively. Yield data of DSR lines ranged from 5.0t/ha to 6.8t/ha with an average yield of 5.7t/ha. Four DSR lines attained a yield advantage of 2% to 14% over PSB Rc82 and 14% to 27% over PSB Rc18 (Table 17).

Table 17. DSR lines with 2% to 14% yield advantage over PSB Rc82 and 14% and 27% over PSB Rc18 (GYT), 2012 DS. PhilRice CES

DSR Line	Yield (t/ha)
PR37062-27-4-2-1-2-3-1-2	6.8
PR37062-27-4-2-2-3-2-2-3	6.2
PR37801-15-1-1-3-B	6.1
PR37801-15-1-1-2-B	6.1

- For other agro-morphological characteristics, maturity ranged from 97 days after sowing (DAS) to 112 DAS. Plant height is 96 to 109cm with productive tillers ranged from 433 to 603.

- During WS cropping, check varieties PSB Rc82 and PSB Rc18 yielded 4.1t/ha and 3.5t/ha, respectively. Yield data ranged from 3.2t/ha to 4.2t/ha with an average of 3.8t/ha. There were five DSR lines superior with 1% to 3% yield advantage over PSB Rc82 and 1% to 20% over Rc18 (Table 18).

Table 18. DSR lines with 1-3% yield advantage over PSB Rc82 and 1-20% over PSB Rc18 (GYT), 2012 WS. PhilRice CES

DSR Line	Yield (t/ha)
PR37628-6-3-2-2-B	4.2
PR37814-71-3-2-1-B	4.2
PR37605-2-1-1-3-B	4.1
PR37579-7-2-2-1-B	4.1
PR37625-8-3-2-2-1-B	4.1

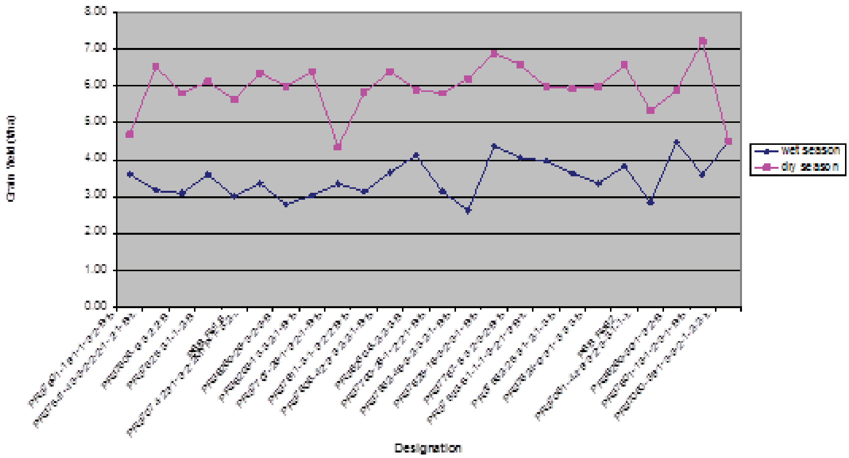

Figure 8. Advanced lines difference in grain yield under direct sowing cultivation (PYT nursery).

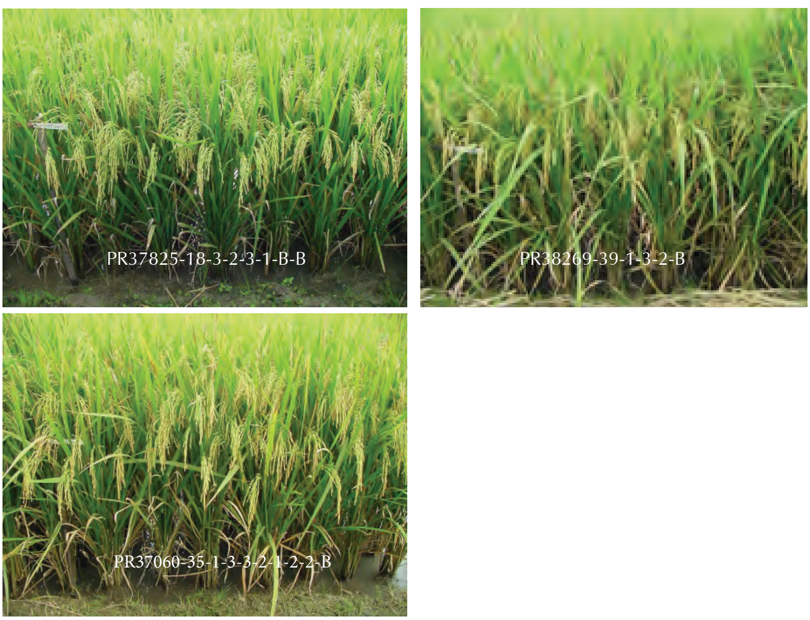

Figure 9. Top three advanced lines in Preliminary Yield Trial nursery.

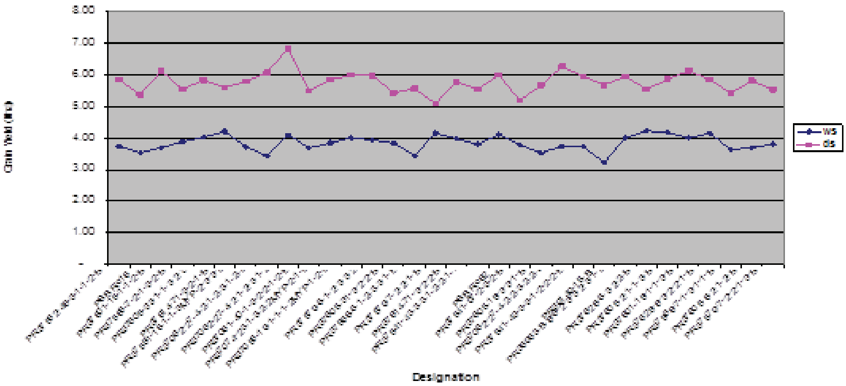

Figure 10. Advanced lines difference in grain yield under direct sowing cultivation (GYT nursery).

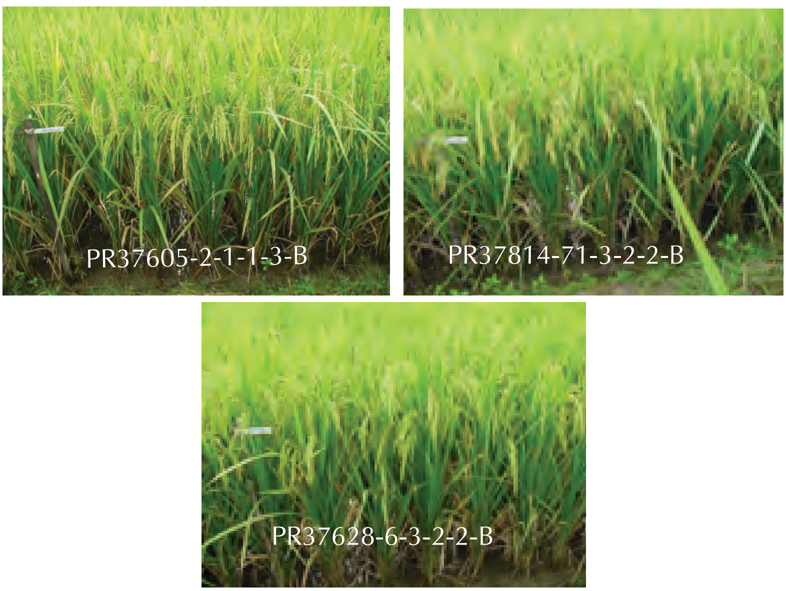

Figure 11. Top three advanced lines in General Yield Trial nursery.

On-farm yield trial and participatory varietal selection

- Ten selected promising Direct Seeded Rice (DSR) lines and four check varieties (PSB Rc82, Rc18, NSIC Rc298, and Rc160) were evaluated for grain yield, crop adaptation to a specific local environment, and farmer's acceptability at wet agro-climatic condition in a farmer-managed and pilot-testing site in two locations in Rizal and Laur, Nueva Ecija.

- In Rizal, Nueva Ecija, check varieties PSB Rc82 and Rc18 yielded 4.2t/ha and 4.7t/ha, respectively while NSIC Rc298 and Rc160 yielded 4.1t/ha and 3.8t/ha, respectively. Yield data of lines tested ranged from 2.6 t/ha to 4.7 t/ha with an average yield of 3.8 t/ha. Five DSR lines were found comparable to all checks (Table 19)

Table 19. DSR lines comparable to four check varieties (PSB Rc82, Rc18, NSIC Rc298, and Rc160). On-farm yield trial, 2012. Rizal, Nueva Rcija.

DSR Line	Yield (t/ha)
PR37787-5-3-2-3-2-B-B	4.4
PR37062-27-4-2-1-2-3-1-2	4.2
PR37801-13-1-2-3-1-B-B	4.1
PR37825-18-3-2-3-1-B-B	3.8
PR37062-27-4-2-2-3-2-2-3	3.8

- For other agro-morphological characteristics, maturity ranged from 102 to 115 days after sowing (DAS). Plant height is 104 to 123cm with productive tillers ranging from 270 to 430.

- Participatory Varietal Selection (PVS) among 41 farmers was conducted at 101 DAS age of the rice crop. Top three most preferred DSR lines were PR37541-43-3-2-2-2-1-2-1-B-B, PR37825-18-3-2-3-1-B-B, and PR37062-27-4-2-1-2-3-1-2 with preferential analysis of 0.561, 0.366, and 0.024, respectively. These lines are early-maturing, with long, compact type of panicle, higher number of culm and spikelets per panicle, and with strong and sturdy plant architecture (lodging resistant).

- Least preferred plots with preferential analysis of -0.439, -0.341, and -0.049 were PR37598-9-3-2-3-2-B, PR37801-13-1-2-3-1-B-B, and PSB Rc18, respectively. This was due to the following characteristics: late-maturing, tall plant height, lower number of culm, and spikelets per panicle, discrepancy on grain type and lodging susceptibility.

- In Laur, Nueva Ecija, check varieties had the following yield: PSB Rc82 with 2.4t/ha, PSB Rc18 with 3.2t/ha, NSIC Rc298 with 2.5t/ha, and Rc160 with 1.9t/ha. Yield data of lines tested ranged from 1.4t/ha to 3.3t/ha with an average yield of 2.4t/ha. Promising DSR line PR37787-5-3-2-3-2-B-B had the highest grain yield of 3.3t/ha. Five DSR lines were found comparable to all checks (Table 20).

Table 20. DSR lines comparable to four check varieties (PSB Rc82, Rc18, NSIC Rc298, and Rc160). On-farm yield trial, 2012. Laur, Nueva Rcija.

DSR Line	Yield (t/ha)
PR37541-43-3-2-2-2-1-2-1-B-B	3.1
PR39411-11-2-2-B	3.0
PR37801-13-1-2-3-1-B-B	2.5
PR37598-9-3-2-3-2-B	2.5
PR37062-27-4-2-1-2-3-1-2	2.2

- For other agro-morphological characteristics, maturity ranged from 106 to 121 DAS. Plant height is 98 to 108cm with productive tillers ranging from 210 to 425. Decreased in yield was observed due to poor seedling emergence and rat infestation at 5 DAS and ripening phase.

- Thirty-nine participated in the Participatory Varietal Selection (PVS) done at 102 DAS. Top three most preferred plots were PR37787-5-3-2-3-2-B-B, PR37801-13-1-2-3-1-B-B, and PSB Rc18 with preferential analysis of 0.385, 0.128, and -0.128.. These lines are earl-maturing, with long and compact type panicle, higher number of culm and spikelet per panicle, resistant to local pests and diseases, and with strong and sturdy plant architecture (lodging resistant).

- Least preferred plots were PSB Rc18, NSIC Rc298 and PR37825-18-3-2-3-1-B-B with preferential analysis of -0.128, 0.026, and -0.103, respectively.This was due to their late maturity, tall plant height, susceptibility to local pests and diseases, and lodging.

- According to PVS participants, generally, all DSR lines tested were of high quality and have passed their standards. However, some plots (e.g. plot 1, 6, and 5) were not chosen due to frequent bird and rodent attacks and mixtures observed in the plots.

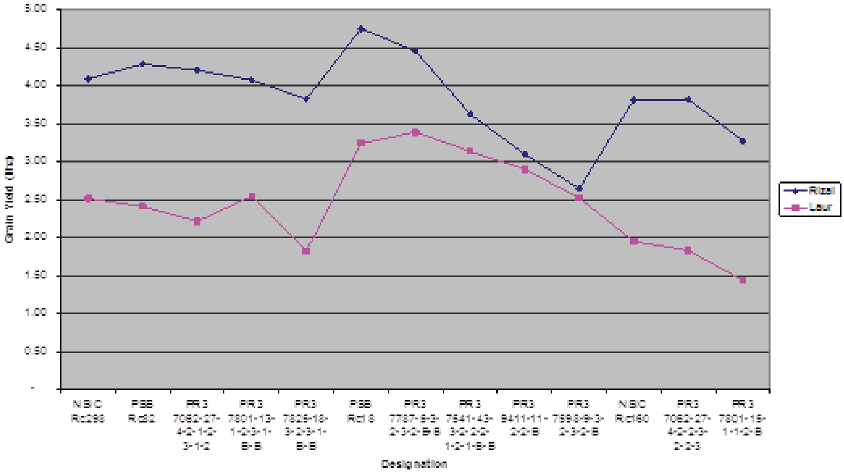

Figure 12. Difference in grain yield under direct sowing cultivation of Rizal and Laur testing site.

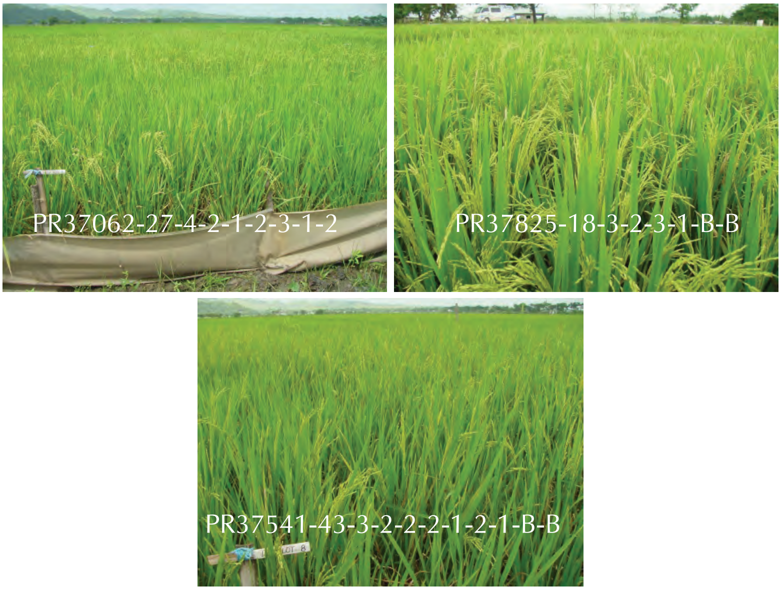

Figure 13. Top three most preferred DSR lines in Rizal, Nueva Ecija.

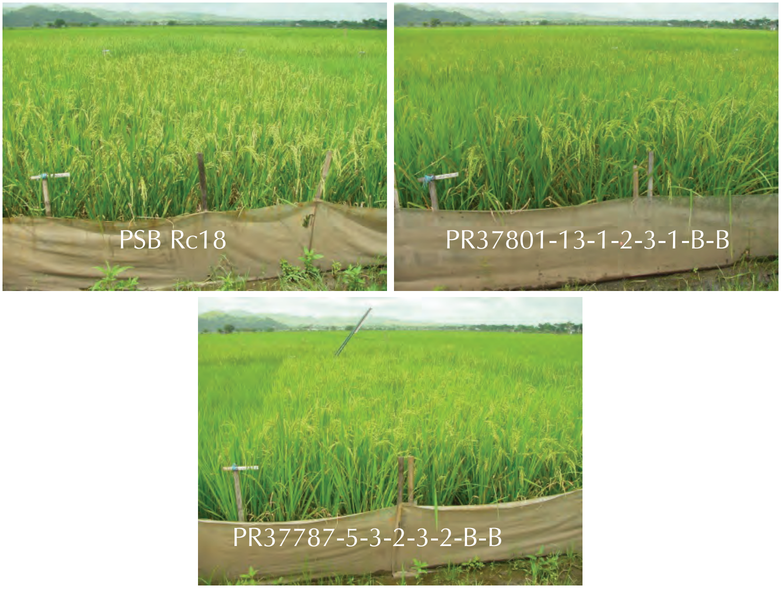

Figure 14. Top three most preferred DSR lines in Laur, Nueva Ecija.

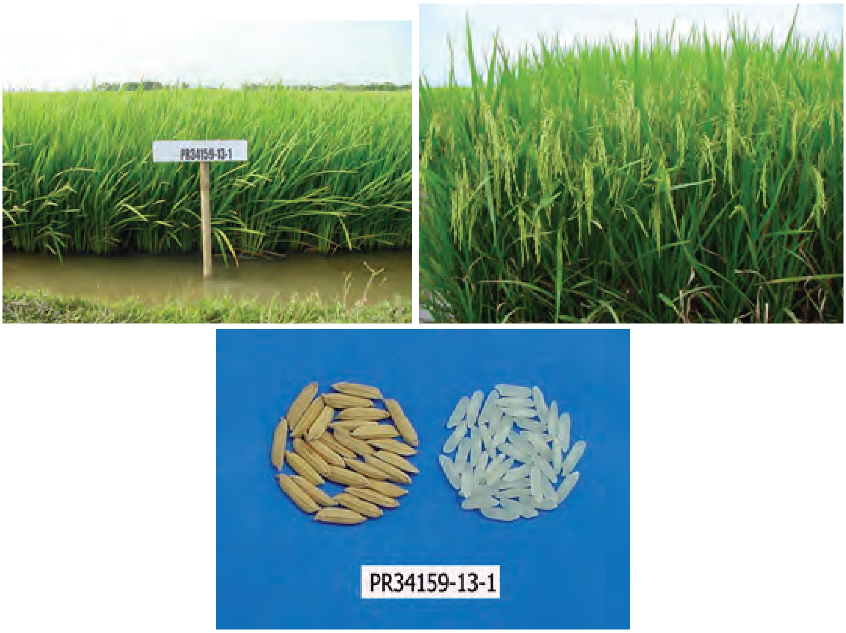

Figure 15. The first direct seeded variety, NSIC Rc298.

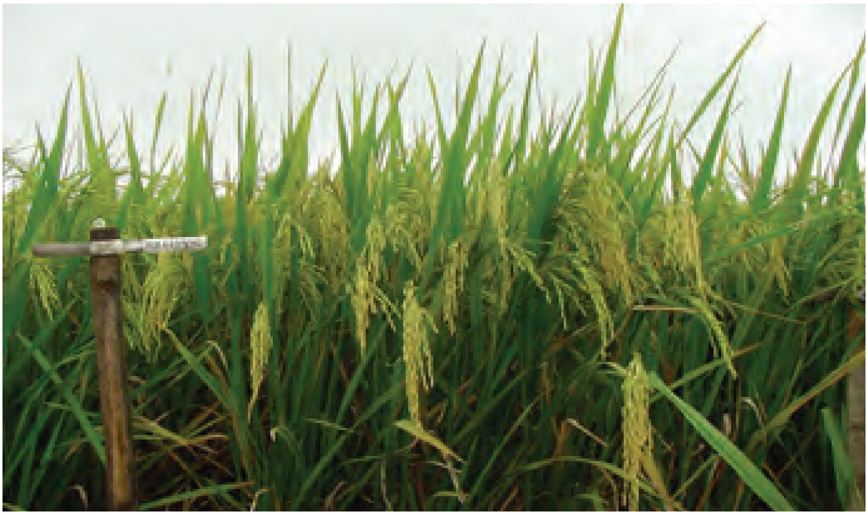

Figure 16. PR39144-25-1-3-3-1-B. Promising line in Observational Nursery.

Evaluation of breeding lines for lodging tolerance
OE Manangkil, WV Barroga, and PN Marcelo

Lodging is a major problem in surface seeded rice owing to shallow root anchorage of the rice plant. High percentage in yield loss is attributed to lodging. Lodging is likely to occur between grain filling to ripening stage. The gaining weight of the upper part of the rice plant is the main cause of lodging. Rice cultivars with non-sturdy stem are the ones that are prone to lodging. However, there are rice cultivars that are known to be lodging-tolerant. This is an important trait for modern varieties to optimize their potential under direct seeding environment. Advanced lines must possess this trait prior to advanced yield trials.

Therefore, the objectives of this project were to develop a lodging protocol for screening breeding material, focusing on when to apply the artificial lodging treatment, and the optimum seeding rate for inducing stem lodging. This project also sought to determine the effect of stem size on lodging in rice plants.

Highlights:

- During 2012 DS, 22 advanced direct wet-seeded lines and two check varieties (PSB Rc82 and Rc18) were evaluated in the PYT nursery for lodging tolerance by determining quantitative force resistance among breeding lines using a force gauge meter. Pushing resistance ranged from 0.99kgf to 1.59kgf. Check varieties PSB Rc82 and PSB Rc18 can withstand 1.27kgf and 1.50kgf, respectively. PR37562-48-3-2-3-2-1-B-B has 1.59kgf and apparently showed a higher pushing resistance than the check varieties. Five lines have a higher kgf than PSB Rc82. These were the following: PR37562-48-3-2-3-2-1-B-B (1.59kgf), PR37801-13-1-2-3-1-B-B (1.45kgf), PR38293-13-3-2-1-B-B and PR37061-44-5-3-2-3-3-1-1-B-B (1.36kgf), PR37541-43-3-2-2-2-1-2-1-B-B (1.34kgf), and PR37606-9-3-2-2-B (1.28kgf). Pushing resistance reflects the anchoring ability of the plant. Results suggest that the anchoring ability estimated by the pushing resistance was significantly related to the degree of root lodging tolerance in each line. Whereas in WS, 48 advanced direct wet-seeded lines and two check varieties (PSB Rc82 and Rc18) were evaluated for lodging resistance by determining quantitative resistance among breeding lines using a force gauge meter. Pushing resistance ranged from 0.92kgf to 1.38kgf. Check varieties PSB Rc82 and PSB Rc18 can withstand 1.17kgf and 1.11kgf, respectively. PR37074-23-1-3-2-2MYP-2-1-B (1.38kgf), PR37605-33-1-1-3-2-3 (1.34kgf), PR37606-42-3-3-2-2-1-B-B and PR37586-7-2-1-3-2-B (1.33kgf), PR37061-40-1-3-2-2-1-2-B (1.32kgf), PR37625-3-1-1-2-B (1.31kgf), and PR37825-18-3-2-3-1-B-B (1.30kgf) apparently showed a higher pushing resistance than both check varieties. Six advanced lines have a comparable kgf to PSB Rc82. These were the following: PR37562-25-3-1-2-1-3-B (1.20kgf), PR37605-2-1-1-3-B (1.20kgf), PR37787-5-3-2-3-2-B-B (1.19kgf), PR37074-23-1-3-2-2MYP-1-3-2-B (1.18kgf), PR37541-97-2-3-2-B (1.17kgf), and PR37562-48-3-2-3-2-1-B-B (1.17kgf). There was a degree of variability among treatments and inequality among replications.

- In GYT nursery, 30 advanced direct wet-seeded lines and two check varieties (PSB Rc82 and Rc18) were evaluated for lodging tolerance by determining quantitative force resistance among breeding lines using a force gauge meter. Pushing resistance ranged from 1.00kgf to 1.48kgf. Check varieties PSB Rc82 and PSB Rc18 can withstand 1.33kgf and 1.26kgf, respectively. PR37605-33-1-1-3-2-3 (1.48 kgf), PR37568-7-1-3-1-1-B (1.43 kgf), PR37551-18-1-1-3MYP-2-3-3-B (1.42 kgf), PR37625-8-3-2-2-1-B (1.41 kgf), and PR36963-B-8-6-2-3-3-2-3-1-B (1.36 kgf) apparently showed a higher pushing resistance than the check varieties. Pushing resistance reflects the anchoring ability of the plant. Results suggest that the anchoring ability estimated by the pushing resistance was significantly related to the degree of root lodging tolerance in each line.

- Database management through generation of fieldbook using ICIS (International Crop Information System) software was implemented in the project. Information of DWSR breeding lines was stored in the ICIS software. This information is useful not only to breeders within the institute but also to other scientists who would like to get information about the materials used. ICIS software is userfriendly and can generate crosses and selections of the breeder. The information generated in this software can be stored in the local database within the institute and shared in the central data base outside PhilRice like IRRI.

- For disease and pest screening, breeding lines in the ON were submitted to CPD to determine the reaction on major pest and diseases. In 2013 DS, 10 entries of PVS were submitted for blast and tungro resistance screening in Benguet and Midsayap stations, respectively.

III. Development of Hybrid Rice Varieties
Alex T. Rigor (January-June), Dindo A. Tabanao (July-December)

The success of hybrid rice technology lies mainly in the development of high yielding varieties adaptable to local conditions. Between 1994 and 2011, the National Seed Industry Council has approved 44 hybrid varieties for commercial cultivation in the Philippines. Seventeen of these varieties were bred and developed by the public sector, six of which were bred by PhilRice with its partners UPLB and PhilSCAT. To date, PhilRice breeders at its Central Experiment Station and branch stations in Los Baños (in collaboration with UPLB) and San Mateo have maintained specialized breeding activities despite the intensified participation of private sector in this enterprise.

The continuous development of high-yielding hybrid varieties resistant to pests and diseases and possess excellent grain quality is essential to keep up with the increasing demand for rice and the changing environment. As such, there is a need for a strong national public breeding and research on hybrid rice.

The main purpose of the project was to increase rice productivity in the irrigated lowland ecosystem. This project covered the development of parent lines and F1 hybrids, breeding methodology and seed production research, and screening and testing of hybrids in various target environments.

Development of hybrid parent lines
LS Baldedara, LV Gramaje, MSF Ablaza, EP Rico, VP Luciano, IG Pacada, IA dela Cruz, MM Rosario, AT Rigor, and DA Tabanao

One of the challenges in hybrid breeding is the selection, development, and improvement of suitable parental lines that can be used for developing hybrids. In hybrid rice breeding, the cytoplasmic male sterile (CMS) line is considered as the heart in the development of F1 hybrids because failure in its purity will result in poor hybrid. Therefore, CMS line development is a very essential component in the development of hybrid rice. Because of its great role and importance, diverse CMS lines with good qualitative and quantitative traits must be developed. Introduced CMS lines often are not adapted to local conditions, with very low resistance to biotic stresses and poor grain quality.

Maintainer and restorer lines are very essential components in the development of hybrid rice as well. Without maintainer and restorer lines, multiplication of CMS lines and production of F1 are not possible. Continuous research on the identification of inbred cultivars that can either maintain the sterility or restore the fertility of CMS lines plays an important role in developing high-yielding germplasm pools. Therefore, there is a need to develop new maintainer and restorer lines and improve existing ones. The study aimed to: (1) develop new diverse and stable CMS lines with good morphological traits and flowering behavior; (2) to develop and improve maintainer lines with good maintaining ability and desired plant morphology and grain quality; (3) to develop and improve restorer lines with desirable morphological traits, moderate resistance to pest and diseases and acceptable grain quality; and (4) to develop new TGMS (S) line with good agronomic traits, flowering behavior, moderate resistance to pest and diseases, adaptable to local condition, and good grain quality.

Highlights:

- For CMS conversion, 87 inbred lines with the desired traits were assembled. These potential maintainer lines were assembled from plant selections made at IRRI, and from the optimized plant morphology (OPM), tropical japonica (TJ), and elite breeding materials of the irrigated lowland inbred rice breeding project. Thirty-four entries were used for re-testcrossing to CMS lines and included in the backcross nursery to further evaluate their maintaining ability. Boots were collected for pollen sterility evaluation under the microscope before backcrossing. Pollen sterility of the F1 was evaluated in the following season. Eight of 50 BC1F1, eight of 18 BC2F1, four of five BC3F1, and two of four BC4F1 were found to have 100% sterility and were advanced to the next generation. However, BC5F1 entries exhibited poor pollen sterility, hence, were discarded. Progeny lines are to be repeatedly backcrossed up to the fifth generation. Outcrossing rate and floral characteristics will be further studied. New CMS lines with stable sterility and good agronomic characters will then be declared and soon be used as new testers in the Source Nursery. Upcoming CMS lines with PR35746-HY-6-6-2-1-1-1 background will be further studied and evaluated in 2013.

- A total of 111 selected maintainer lines with desirable morphological traits were assembled (Figure 1). Through hybridization, 69 new BxB crosses were generated. Further, 106 F1 crosses were evaluated, bulked, and tagged for generation advance. A total of 772 entries (59 F2 populations and selected 713 lines) were established and will be advanced to F3 generation for further evaluation. Twenty uniform maintainer lines from hybrid rice breeding germplasm were used as new parent and crossed to CMS lines to further evaluate their maintaining ability (Figure 17).

- Through hybridization, 15 new RxR crosses were generated. A total of 53 F1 crosses (26 in the dry season and 27 in the wet season, Table 21) were evaluated and bulked, and will be forwarded to the Bulk Nursery. Out of 53 F1, 48 entries were found to be true-to-type crosses; hence 728 phenotypically acceptable plants were obtained. These selections will be forwarded to the Pedigree Nursery (F3-F4) for further evaluation and selection. Evaluation in the Pedigree Nursery (F4-F7) involved 1,977 progeny lines. Further progeny selection in F5-F6 generations was made from 900 entries. After evaluation, 223 lines were found stable, uniform, and ready for utilization as new parent lines for hybridization in 2013 DS.

- A set of 142 entries (three TGMS lines and 139 inbred parental lines) was established in the source nursery (SN). Through hybridization, 411 TGMS-based hybrids were generated. Field performance of these new F1 hybrids will be evaluated in 2013 DS in the Test Cross Nursery (TCN). From the 16 F2 populations established, 180 completely sterile lines with good and desirable morphological traits were selected. Sterile plants were ratooned and planted in the Male Fertile Environment (MFE) site in Kayapa, Nueva Vizcaya for evaluation and seed multiplication (Figure 19). These lines will be evaluated both at MSE (PhilRice CES) and MFE (Gabaldon, Nueva Ecija, and Kayapa, Nueva Vizcaya) sites for pollen sterility and fertility. In addition, Sagada, Mountain Province was identified as a new possible site for S line multiplication. Out of 134 entries in the TCN, 23 were identified as potential pollen parent lines (P). Potential pollen parents were used in generating experimental TGMS-based hybrids. A total of 20 promising hybrid combinations were identified in the ON and for PYT inclusion in 2013 DS. Two heterotic two-line hybrids in the Preliminary Yield Trial (PYT) were selected for inclusion in Multi-location Yield Trial (MYT) in the 2013 DS for further evaluation on yield performance. The three TGMS lines were grown in the MFE site for seed multiplication and evaluation, producing a total seed yield of 31kg (4kg for PR41919S, 13kg for PR41918S, and 14kg for PR41917S). From the three lines, a total of 30,960 anthers (18,360 from PR41917S; 9,900 from

PR41918S; and 2,700 from PR41919S) were cultured in 172 plates at 180 anthers per plate. Callus formation was observed with 53 PR41917S 116 PR41918S anthers while no callus was formed with PR41919S anthers (Table 22).

- After six generations, 10 advanced lines were already uniform. Initial pollen sterility of F1 progenies using three cytoplasmic sources showed different reaction to iodine staining. Four pollen classifications were observed: unstained withered sterile (UWS), unstained spherical sterile (USS), stained round (light) sterile (SRS), and stained round (dark) fertile (SRF). This implies the occurrence of sterility inducing factor present in the cytoplasm or in the nucleus of both parents. Phenotyping and genotyping profiles of parentals and the result of marker aided selection (MAS) in F2 segregating population showed the presence of two (Xa4+xa5; Xa4+Xa7) and multiple genes (Xa4+xa5+Xa7). Final confirmation of these Xa genes is still in progress. Preliminary evaluation of grain qualities of these advance lines exhibited acceptable value. Four of these lines have low amylose that ranged from 13.2% to 15.0% while the other two has intermediate amylose content (22.9% and 24.5%). Good cooking characteristics was also observed, cooking time varied from 13:04 to 16:19min, standard cooking time is 15min. The lower the cooking time, the more efficient it is in terms of fuel and energy consumption during cooking. Another set of improved maintainer lines are already in the pipeline which is now in the F7 and F6 generation. From these results, with appropriate CMS source and proper selection, the development of next generation CMS lines in the background of improved maintainer line having resistance gene plus good eating quality is possible.

Table 21. Restorer line improvement entries evaluated and selected in 2012 WS and to be advanced to 2013 DS

Generation	Number of Entries		
	Evaluated	Selected	To be Advanced
F1	27	27	27
F2	52	48	480
F3	320	120	360
F4-F6	655	199	597
F6			27*

*Selected uniform lines for Source Nursery in 2013DS

Table 22. Anther culture of three thermosensitive-genic male sterile lines

TGMS Line	Number of Anthers Cultured	Number of Anthers Forming Callus
PR41917S	18,360	53
PR41918S	9,900	116
PR41919S	2,700	0

Figure 17. Maintainer lines used in maintainer line development.

Figure 18. Cytoplasmic male sterile and maintainer lines, sterile pollen, emasculation.

Figure 19. Seed multiplication site for TGMS lines in Kayapa, Nueva Vizcaya.

Development of F1 hybrids

MM Rosario, VP Luciano, EP Rico, IA dela Cruz, AT Rigor, and DA Tabanao

Rice has a special significance in Asia, where about 90% of the rice is produced and consumed as a staple food. Due to the growing world population and the decreasing land and water resources for rice cultivation, it has been projected that we need to produce 50% more rice (world food grain) by 2030 to cope with the demand (Khush, 2003). Experience in China (Lin and Yuan 1980, Ma and Yuan 2003), India (Mishra et al 2003), Vietnam (Hoan and Nghia 2003), the Philippines (Redoña et al 2003), and several other countries clearly indicates that hybrid rice technology offers a viable option to meet this challenge. The rice crisis that the country recently experienced strengthened its resolve to embark on a rice self-sufficiency program.

The three-line system in hybrid breeding is a key approach to help attain rice self-sufficiency in the country. Hybrid rice is a promising technology to attain 15-20% yield advantage over inbreds. Heterotic hybrids also offer high income opportunities to the farmers. This is either through F1 cultivation or parental seed production. The success of hybrid rice breeding depends on a great extent of quality and diversity of elite lines used as parents in developing new hybrids. New approaches such as the use of excellent inbreds and promising lines from Optimum Plant Morphology (OPM), Tropical Japonica (TJ) breeding, and doubled haploidy (DH), are essential in discovering promising new hybrid combinations. Thus, the main goal of the study was to identify superior F1 combinations and to determine the combining ability of newly developed parent lines. Specifically, the study aimed to (1) identify potential maintainer lines (B) or restorer lines (R) from the early generation and elite breeding lines of irrigated lowland inbred rice breeding project; (2) to develop F1 hybrids from a cross between cytoplasmic male sterile (CMS) lines and OPM and TJ lines from the inbred rice breeding project; (3) to convert potential B lines into new A lines and utilize potential R lines in further enhancing the restorer line genepool of hybrid breeding program of PhilRice; and (4) to integrate DH and molecular marker technologies to select for high grain yield and yield components in hybrid rice breeding.

Highlights:

- Breeding lines from Irrigated Lowland (IL), Optimum Plant Morphology (OPM), and Tropical Japonica (TJ) breeding, were assembled in the Source Nursery (SN). As shown in Table 23, 954 lines were testcrossed with four CMS lines: PR2A, IR68897A, IR58025A, and TG101S. Cross combinations involving IL lines generated 1059 test crosses (Figure 20), and those involving OPM and TJ lines produced 1381 test crosses. A set of 2440 experimental hybrids were evaluated in the testcross nursery (TCN). Of these, 124 were potential restorer and pollen parent (R/P) and 62 were potential maintainer (B). Figure 21 shows the percent identified B and R lines over the assembled breeding lines. In addition, 32 experimental hybrids performed better than the check varieties Mestizo 1, Mestiso 7, and Mestiso 29 with a yield ranging from 137g to 427g (Table 24). Based on their F1 performance, selected entries will be testcrossed again with at least eight CMS lines to determine their combining ability.

- Rice boots were collected from 50 genotypes and subjected to anther culture (AC). Of these, 15 generated 114 DH plants (Figure 22). For the source nursery (SN), 56 DH lines (DHL) were testcrossed in DS and 77 in WS. Overall, 135 DHLs were paired with available CMS lines (IR68897A, IR58025A, PR21A, PR2A).

- The perse performance of individual DHLs and their experimental hybrids was evaluated in TCN (Figure 23). A total of 172 entries consisting of 92 DHLs and 80 test crosses were evaluated. Of the 80 test crosses, 12 were superior over the check varieties (Mestizo 1, Mestiso 7, and Mestiso 29) with a plot yield ranging from 133gto 256g (Table 25). On the other hand, eight DHLs showed better performance than the checks (Table 26). Furthermore, 25 were selected based on the performance of their experimental hybrids and phenotypic acceptability. Of these, 22 were advanced to seed production for observation nursery (SPON) and three for seed production yield trial (SPYT) (Figure 24).

- In 2011 DS, 37 DHLs were selected and testcrossed with six CMS lines (IR68897A, IR58025A, PR21A, PR2A, PRH1A, and TGMS71) for their combining ability in 2011 WS. Test crosses were evaluated along with their parents (DHL) and check varieties in 2012 DS. The CMS line IR68897A got the best combining ability among the CMS lines used. Moreover, crosses were made between the selected 37 DHLs (Figure 25). Based on the number of harvested F2 seeds, eight F2 populations were selected and established for plant selection. There were 233 F2 selections, and these were established in 2012 WS and 402 F3 plants were selected.

- There were four posters presented in national scientific conferences. Of these, three were presented during the 42nd CSSP Annual Scientific Conference at A&A Plaza Hotel, Puerto Princesa City, Palawan: (1) "Prospecting for new B or R lines from early generation and elite breeding lines of irrigated lowland rice breeding germplasm", (2) "Breaking the Yield Barrier Through the Use of Optimized Plant Morphology (OPM) and Tropical Japonica (TJ) Breeding Lines in PhilRice Hybrid Breeding", (3) and "Field Performance of Experimental Hybrids Derived from Cytoplasmic Male Sterile x Doubled Haploid Lines". One poster titled "Response of Hybrid Rice Maintainer Lines to Anther Culture" was presented during the 8th PAPTCB Scientific Convention at Casa Pilar Beach Resort, Boracay Island, Malang, Aklan.

Table 23. Breakdown of entries from Irrigated Lowland (IL), Optimum Plant Morphology (OPM), and Tropical Japonica (TJ) breeding projects, PhilRice CES, 2012.

Activity	IL	OPM and TJ	Total
Source Nursery (SN)	329	625	954
Testcross Nursery (TCN)	1059	1381	2440
Potential R/P	78	46	124
Potential B	0	62	62

Table 24. Field performance of test crosses involving lines from Irrigated Lowland (IL), Optimum Plant Morphology (OPM), and Tropical Japonica (TJ) breeding projects, PhilRice CES, 2012.

Test entries	CMS line	Yield (g)*	Plant ht (cm)	Tillers	Panicle length (cm)	Filled grains
M1		177	113	16	26	148
M7		132	101	10	24	150
M29		177	100	10	27	151
PR40500-45	IR68897A	427	93	34		
PR3-1-4	PR2A	351	95	21		
PR40498-40	IR58025A	336	99	31		
IR91156-AC-138	PR2A	302	94	34		
NIPPONBARE-25Kr-AC-29-1-3-2-1	TGMS71	289	94	25		
PR37984-B-5-2-1-1	IR68897A	285	105	20		
PR37988-B-20-3-3-2	PR2A	277	89	22		
PR37984-B-2-4-2-1	IR68897A	275	108	19		
PR4-2-26	IR68897A	251	98	24		
PR13-7-84	IR68897A	245	95	22		
MET-1077	PR2A-108	231	88	25	21	145
MYT-104	PR2A-61	212	103	23	23.28	132
PYT-R-124	25A-104	208	97	25	24.94	122
MYT-33	PR2A-14	208	88	24	22.06	64
PYT-R-18	PR2A-84	207	100	24	23.03	106
Elite-28	PR2A-179	207	87	25	22.54	140
MET-3033	97A-138	204	102	12	22.84	101
Elite-27	97A-184	204	85	15	23.34	100
MET-3302	25A-154	203	110	19	24.73	110
Elite-37	97A-194	199	87	14	24.03	125
MET-1307	25A-118	197	98	25	20.83	123
MYT-83	PR2A-50	194	100	23	24.01	128
MET-3302	97A-155	193	99	13	23.94	121
Elite-13	97A-170	193	102	13	22.25	114
MYT-76	PR2A-46	192	98	25	20.7	144
Elite-24	PR2A-175	190	85	26	22.8	111
MET-1514	PR2A-122	189	96	26	23.05	130
Elite-28	97A-185	187	86	12	21.95	119
PYT-R-19	PR2A-85	184	100	23	20.03	121
TCN 300		145	105	24		
IR 62266-42-6-2	IR58025A	139	106	16		
IR 34686 R	IR68897A	137	87	24		

*Yield from 5 hills

Table 25. Field performance of test crosses derived from doubled haploid lines, PhilRice CES, 2012.

Parentage		Tester (CMS line)	Plant ht (cm)	Tillers	Panicle length (cm)	Grains	1000 grain wt (g)	Plot yield (g)*
M1 (check)			113	16	26	148	29	177
M7 (check)			101	10	24	150	25	132
M 29 (check)			100	10	27	151	27	177
CMA self	JAAS B	IR68897 A	89	38	24	211	21	256
PJ23	SLR8-1	IR68897 A	94	21	26	146	26	253
PJ23	SLR8-1	IR68897 A	100	28	25	153	26	237
CMA self	JAAS B	IR68897 A	92	26	25	171	23	235
CMA self	JAAS B	IR68897 A	98	25	23	190	22	228
CMA self	JAAS B	IR68897 A	90	27	23	163	21	214
CMA self	JAAS B	IR68897 A	96	36	25	255	20	198
PJ23	SLR8-1	IR68897 A	94	22	25	145	26	192
CMA self	JAASB	IR68897A	112	30	29	138	27	145
PR41084-HY-AC	PR41083-HY-AC	PR21A	112	26	29	120	20	143
IR34686R	PR35847-3R	IR68897A	88	29	30	158	24	142
PR41084-HY-AC	PR41083-HY-AC	JAASA	119	12	26	116	27	133

*Grain yield from 5 plants

Table 26. Field performance of generated doubled haploid lines in the Test Cross Nursery (TCN), PhilRice CES, 2012.

Parentage		Plant ht (cm)	Tillers	Panicle length (cm)	Grains	1000 grain wt (g)	Plot yield (g)*
M 1 (check)		113	16	26	148	29	177
M 7 (check)		101	10	24	150	25	132
M 29 (check)		100	10	27	151	27	177
CMA self	JAASB	100	20	19	298	20	281
CMA self	JAASB	102	18	19	260	20	223
CMA self	JAASB	103	17	21	341	20	209
CMA self	JAASB	103	17	19	288	20	202
CMA self	JAASB	104	15	19	306	19	189
PR41084-HY-AC	PR41083-HY-AC	114	12	30	152	29	166
PR41084-HY-AC	PR41083-HY-AC	115	11	32	115	27	147
PR41084-HY-AC	PR41083-HY-AC	108	12	25	103	28	133

*Grain yield from 5 plants

Figure 20. Development of experimental hybrids.

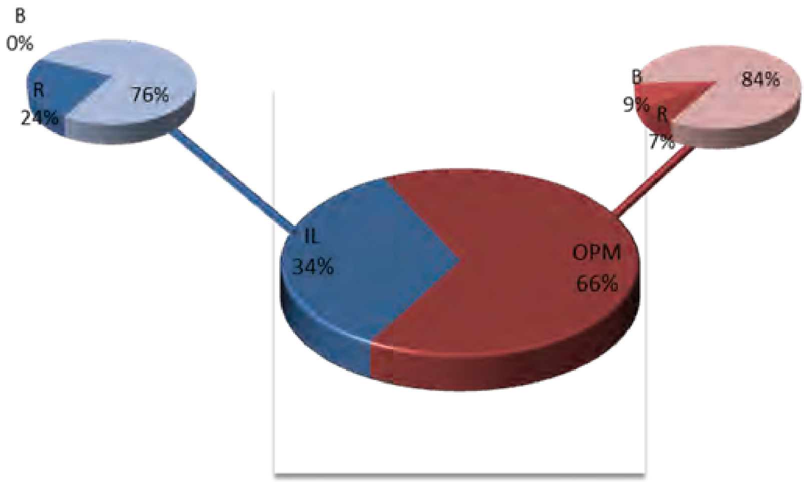

Figure 21. Percentage of identified maintainer and restorer lines from the assembled irrigated lowland (IL) and Optimum Plant Morphology (OPM) breeding lines.

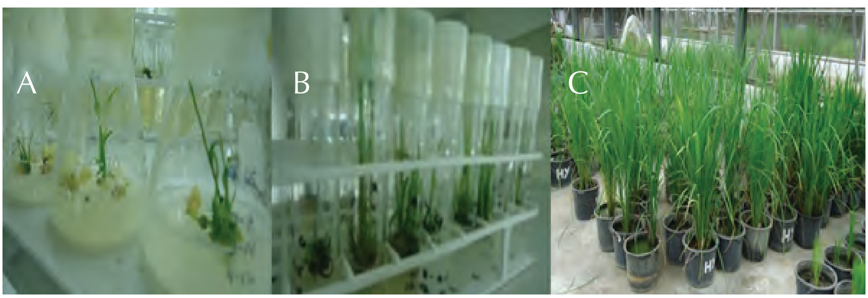

Figure 22. Anther culture of R×R crosses for restorer line development (A and B) and the regenerated doubled haploid plants in the greenhouse (C).

Figure 23. Evaluation of experimental hybrids in the Test Cross Nursery (TCN).

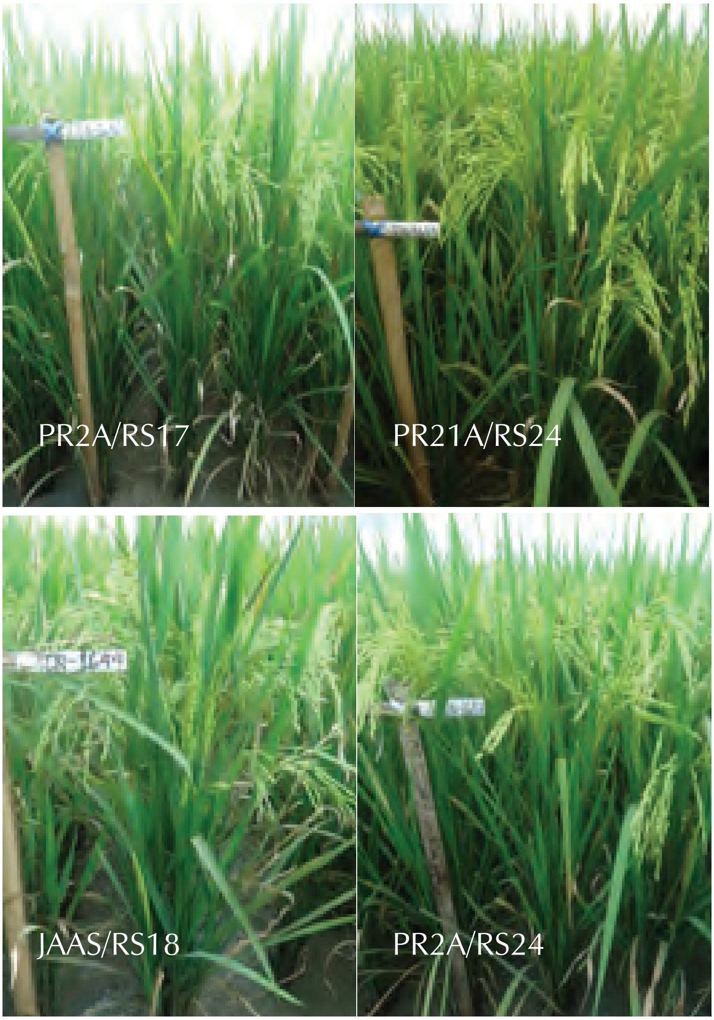

Figure 24. Selected entries in the Test Cross Nursery (TCN).

Figure 25. Some of the crosses made between doubled haploid lines.

Performance test of experimental hybrids
IA dela Cruz, MSF Ablaza, LS Baldedara, CD del Rosario, VP Luciano, AE Pocsedio, AT Rigor, and DA Tabanao

Hybrid rice breeding is a complementary strategy to negate the growing rice shortage in the country as it promises a 15% yield advantage compared to conventional varieties under the same input levels. The increases in yield are a result of hybrid vigor that breeders aim to explore.

Good hybrids identified in yield trials provide the mechanisms for scientifically investigating the performance of promising hybrids for yield, level of heterosis, and resistance to pests and diseases over designated check cultivars under local conditions. This information is important in selecting the best hybrids for multi-location national trials for hybrids under the National Cooperative Test.

The objectives of the study were: (1) to evaluate the performance of promising hybrid combinations in different nurseries for yield, reaction to biotic stresses, and other desirable traits; (2) to identify hybrids with broad range of adaption and stable performance across location; and (3) to identify location/season specific hybrids.

Highlights:

- In 2012, 518 entries (350 during the DS and 168 during WS) were established and evaluated in the Observation Nursery (ON). The experiment was laid out in an augmented design. Check varieties were replicated in each block while the test entries were not replicated but randomly assigned to the plots. The F1 entries were grown alongside each of their respective male parent to facilitate comparison during data gathering for phenotypic acceptability rating. During the dry season, 22 hybrids out of 350 entries (Table 27) were selected as they surpassed the yield levels of the inbred check varieties (Figure 25). Yield advantage of best hybrids ranged from 50 to 112% against inbred check PSB Rc82 and from 14 to 61% against PSB Rc18. During the wet season, 178 entries were established including best inbred and hybrid checks. Grain yield (kg/ha) of the five top performing entries ranged from 5,591 to 6,781 (Table 29, Figure 26).

- Promising hybrids identified in the ON were advanced to the Preliminary Yield Trial (PYT). A total of 34 entries were evaluated during the dry season, of which seven entries were check varieties while the rest were F1 hybrids. Among the 29 F1 hybrid entries, seven obtained yield advantage ranging from 22% to 35% against PSB Rc82, namely: PR41922H, PR41322H, PR41311H, PR41313H, PR41320H, PR36641H, and PR41319H (Table 28, Figure 27). For the same entries, the yield advantage against PSB Rc18 ranged from 13 to 24%. During the wet season, 38 entries consisting of 34 F1 hybrid and four check entries were evaluated. The entries consisted of three-line hybrids with either PR (PhilRice) or IR (IRRI) CMS parent lines. Among the entries with PR CMS parent lines, the top five performers were PR20A/PR36248HY-2-1-4, PR2A/PR78554-39-1-2-1, PR2A/PR37246-2-7-1-8, PR41919S/PR40589HY-1, and PR20A/IR72889-98-2-2-3 with grain yield (kg/ha) ranging from 5,591 to 6,781 (Table 29, Figure 28). On the other hand, the top five performing hybrids with IR CMS parent lines with yields (kg/ha) ranging from 5,238 to 6,003 included IR58025A/PR38849-2, IR58025A/PR40589HY-1, IR68897A/IR77140-24-2-1-2, IR73328A/IR72889-69-2-2-2, and IR73328A/PR33319-9-1-15-1. Based on variance components estimated using restricted maximum likelihood, heritability of grain yield was 0.80, indicating that the data were reliable despite some negative effects of typhoon. All identified best hybrid entries in the trial were advanced to Seed Production for National Cooperative Test (SPNCT) prior to National Cooperative Test (NCT) evaluation in the following season.

- Demonstration trial was done to obtain preliminary information on the entries from the SPNCT for their uniformity and other important data prior to evaluation for the NCT. In 2012, a total of 48 entries, 27 during the DS and 21 during the WS were evaluated. Among the set, 22 entries, 16 during DS and six during WS were found uniform. These uniform hybrids were included in the Multi-Environment Test (MET) and NCT for evaluation the following season.

Table 27. Identified best hybrids in the Observation Nursery (2012 DS).

Entries	Yield (kg/ha)	Yield advantage (%)	
		PSB Rc82	PSB Rc18
PR43692H	11,689	112	61
PR43693H	11,407	107	57
PR43694H	11,306	105	55
PR43695H	10,668	94	47
PR43696H	9,606	74	32
PR41921H	9,481	72	30
PR42414H	9,290	69	28
PR43697H	9,277	68	28
PR43698H	9,242	68	27
PR43699H	9,191	67	26
PR43700H	9,055	64	25
PR43701H	8,937	62	23
PR43702H	8,743	59	20
PR43703H	8,729	58	20
PR43704H	8,728	58	20
PR43705H	8,522	55	17
PR43706H	8,421	53	16
PR43707H	8,388	52	15
PR43708H	8,374	52	15
PR43709H	8,311	51	14
PR43710H	8,298	51	14
PR43711H	8,290	50	14
PSB Rc82	5,510		
PSB Rc18	7,271		

Table 28. Identified best hybrids in the Preliminary Yield Trial (PYT) (2012 DS).

Entries	Yield (kg/ha)	Yield advantage (%)	
		PSB Rc82	PSB Rc18
PR41922H	10,073	35	24
PR41322H	9,812	32	21
PR41311H	9,283	25	15
PR41313H	9,148	23	13
PR41320H	9,175	23	13
PR36641H	9,147	23	13
PR41319H	9,128	22	13
PSB Rc82	7,455		
PSB Rc18	8,098		

Table 29. Yield performance of entries in the Observation Nursery (ON) and Preliminary Yield Trial (PYT) (2012 WS).

Entry	Yield (kg/ha)
Observation Nursery	
PR24A/PR36248HY-1-7-5	6,781
PR2A/B73	6,665
IR68897A/PR36244HY-4-4	6,046
IR73328R/IR73012-137-2-2-2R	5,627
IR73328A/PR36244HY-4-1-2	5,591
Preliminary Yield Trial PR CMS Parent Lines	
PR20A/PR36248HY-2-1-4	6,365
PR2A/PR78554-39-1-2-1	6,201
PR2A/PR37246-2-7-1-8	5,915
PR41919S/PR40589HY-1	5,551
PR20A/IR72889-98-2-2-3	5,292
IR CMS Parent Lines	
IR58025A/PR38849-2	6,003
IR58025A/PR40589HY-1	5,613
IR68897A/IR77140-24-2-1-2	5,589
IR73328A/IR72889-69-2-2-2	5,284
IR73328A/PR33319-9-1-15-1	5,238

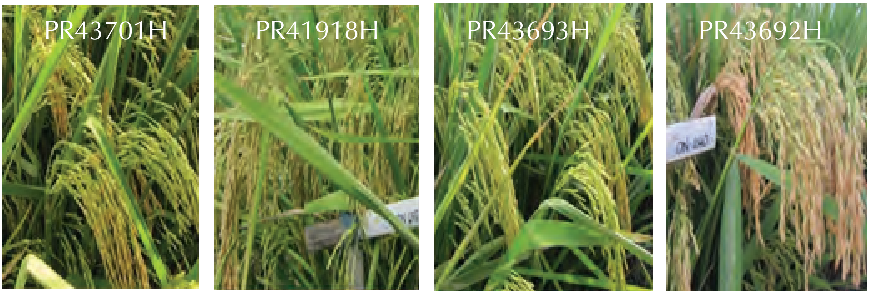

Figure 25. Some of the F1 hybrid entries in the Observation Nursery during 2012 dry season.

Figure 26. Some of the F1 hybrid entries in the Observation Nursery during 2012 wet season.

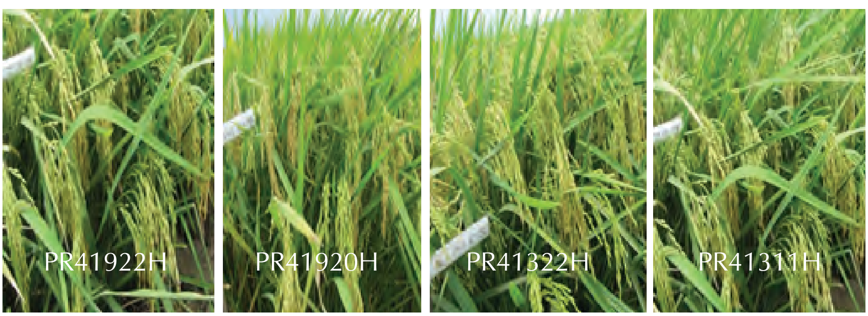

Figure 27. Best identified F1 hybrid entries in the Preliminary Yield Trial during 2012 dry season.

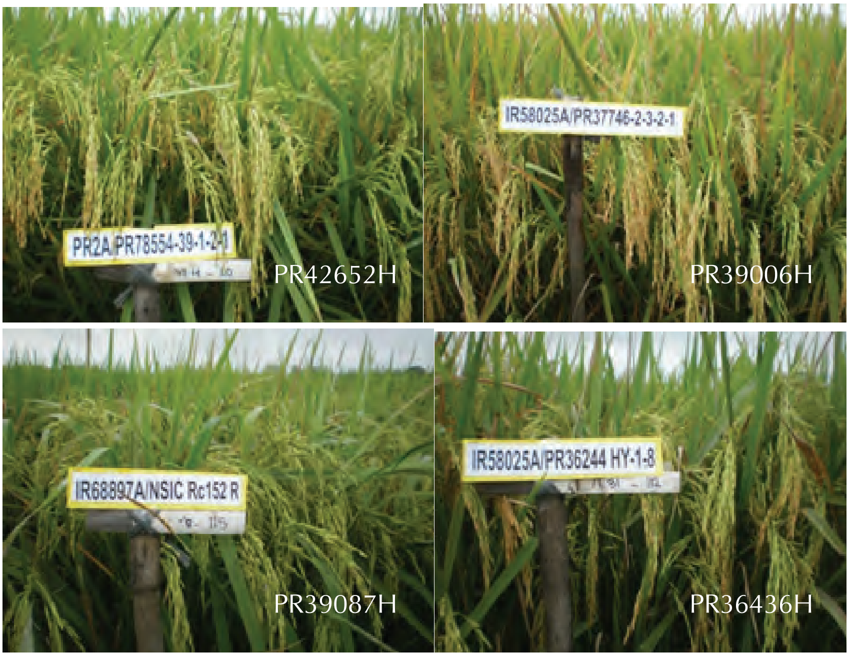

Figure 28. Best identified F1 hybrid entries in the Preliminary Yield Trial during the 2012 wet season.

Adaptability tests of newly released and promising inbreds and hybrids
RC San Gabriel, VC Garcia, FD Garcia, NO Mabayag, AY Alibuyog, GV Romares, MR Ramos, AE Pocsedio, AT Rigor, and DA Tabanao

Hybrid rice is one of the key technologies that can help the Philippines towards achieving self-sufficiency in rice. At the average, annual national rice importation level is at 600,000mt. At a conservative valuation, a yield increase of 1mt/ha through hybrid rice cultivation in the 800,000-hectare irrigated rice area in the country can result in an additional rice production of 1.6 million mt of palay which translates to 960,000mt of milled rice.

The Department of Agriculture (DA) has made the development and utilization of hybrid rice technology an integral component of its rice production program. Hybrid rice research and development (R&D), seed production, training, technology demonstration, and information dissemination activities initiated in 1998 are continuously being conducted in provinces for targeted hybrid rice cultivation in Isabela, Nueva Ecija, and Davao Oriental.

The main objective of the study was to demonstrate the performance of newly released rice varieties and promising lines, thereby, ensuring quick delivery of improved genetics in farmer fields and rapid adoption of new varieties. Specifically, the study aimed to evaluate the performance of newly released and promising hybrids and to identify high yielding and stable lines.

Highlights:

- In 2012, 32 promising and newly released hybrid and inbred rice varieties were tested in numerous sites across the Philippines: 16 entries in 33 sites during DS and 16 entries in 47 sites during WS. During the DS, each of the setup included seven entries developed by PhilRice, two entries by PhilRice and UPLB, two entries by PhilRice and CLSU, three entries by IRRI, and two entries by SL Agritech. On the other hand, six entries bred by PhilRice, two entries by PhilRice and CLSU, two entries by PhilRice and UPLB, two entries by IRRI, one entry by SL Agritech, two entries by Pioneer (PHB73 and PHB77), and one entry by Bayer (INH10001) comprised the setup during the WS.

- The entries were established in an area measuring at least 1,000m2. The test sites were in areas with an established reputation for hybrid rice production in both plant performance and economic aspects. However, new sites for hybrid rice trials were also explored to make way for possible expansion of hybrid rice cultivation in other regions currently not considered as hybrid rice areas. Convergence areas that DA identified were also considered. Cultural management practices were done according to the Palay Check System for irrigated lowland rice ecosystem (Figure 29 c & d). Farmers' Field Days (FFD) were conducted before harvest to showcase the performance of all the entries participated by different rice stakeholders (Figure 29 e & f). During the field days, a participatory evaluation was conducted to allow the participants to select the most preferred varieties/entries based on the overall crop stand.

- A total of nine entries; six during the DS (NSIC Rc240, PhilSCAT 6-1H, PhilSCAT 3-1H, SL18H, Mestiso 20, and Mestizo 1) and three during the WS (NSIC Rc240, PHB77, and Mestiso 20) were preferred by most of the FFD participants in most of the sites (Tables 30 and 31). The high phenotypic acceptability of these entries to the farmers can be attributed to their long panicles, bold and dense grains, early to medium maturity, and high tillering ability.

- Results during the DS indicated that Mestizo 1 obtained its highest yield (4.8t/ha) in Region III, Mestiso 19 (14t/ha) in Region III, Mestiso 20 (13t/ha) in Region III, Mestiso 29 (10t/ha) in Region

X, Mestiso 38 (9.8t/ha) in Region II, SL18H (9.9t/ha) in Region I, SL115H (7.5t/ha) in Region IX, and NSIC Rc240 (13.2t/ha) in Region XI (Table 32). Yields in Taytay, Palawan were affected by tungro and bacterial blight infections. Likewise, tungro infection was noted in Gabaldon, Nueva Ecija while brown spot and bacterial blight were observed in Dingras, Ilocos Norte. During the WS, Mestiso 19 obtained its highest yield (9.7t/ha) in Region III, Mestiso 10 (11t/ha) in Region 11, Mestiso 29 (12t/ha) in Region XI, Mestiso 38 (11t/ha) in Region XI, NSIC Rc240 (12t/ha) in Region 11, NSIC Rc238 (8.4 t/ha) in the Cordillera Autonomous Region, PR35664H (10.1t/ha) in Region 1, PR36474H (11.9t/ha) in Region I, PR31379 (9.9t/ha) in Region III, PHB77 (11t/ha) in Region XI, and IR79643 (9.9t/ha) in Region III. The hybrid entries performed well in San Mateo, Isabela; Banaybanay, Davao Oriental; and Hagonoy, Davao del Sur. High yield values were also recorded in Cagayan, Kalinga, Mountain Province, Ifugao, Ilocos Provinces, and Benguet. It was observed that bacterial blight was prevalent in Dingalan, Aurora, affecting Mestiso 38 in particular. Highest yields of inbred entries were obtained in San Jacinto Pangasinan followed by San Mateo, Isabela and Banaybanay, Davao Oriental.

Table 30. Entries preferred by farmers in each location during 2012 DS.

Location	Farmers Preferred Variety		
	1st	2nd	3rd
Mangatarem, Pangasinan	NSIC Rc240	PhilSCAT3-1H	PhilSCAT 6-1H
San Jacinto, Pangasinan	PhilSCAT 6-1H	NSIC Rc238	NSIC Rc240
Mabini, Pangasinan	PhilSCAT 6-1H	PhilSCAT 3-1H	PR36465H
Pilar, Bataan	NSIC Rc240	PR31379	PR36440H
Morong, Bataan	NSIC Rc240	Mestizo 1	Mestiso 19
Victoria, Tarlac	SL18H	PhilSCAT 3-1H	PhilSCAT 6-1H
Dingras, Ilocos Norte	Mestiso 19	SL115H	Mestiso 20
Banaybanay, Bukidnon	PhilSCAT 3-1H	SL18H	Mestiso 20
Burgos, Isabela	NSIC Rc240	Mestiso 20	SL18H
Tabuk, Kalinga	PhilSCAT 6-1H	SL18H	NSIC Rc240
Solana, Cagayan	Mestiso 20	PhilSCAT 3-1H	PhilSCAT 6-1H
Iguig, Cagayan	Mestizo 1	Mestiso 20	SL18H
Abulug, Cagayan	NSIC Rc240	Mestizo 1	SL18H

Table 31. Entries preferred by farmers in each location during 2012 WS.

Location	Farmers Preferred Variety		
	1st	2nd	3rd
Victoria, Tarlac	NSIC Rc240	PHB73	Mestiso 29
Mangatarem, Pangasinan	INH10001	PHB77	Mestiso 38
Maramag, Bukidnon	NSIC Rc238	Mestiso 38	INH10001
Casiguran, Aurora	NSIC Rc238	PR31379	Mestiso 20
Sta. Cruz, Zambales	NSIC Rc240	Mestiso 29	Mestiso 38
Vintar, Ilocos Norte	SL18H	NSIC Rc240	Mestiso 20
Dingras, Ilocos Norte	NSIC Rc216	NSIC Rc240	INH10001
Laoag, Ilocos Norte	NSIC Rc238	SL18H	PHB77
San Nicolas, Ilocos Norte	NSIC Rc216	INH10001	PHB77
San Mateo, Isabela	Mestiso 20	NSIC Rc240	Mestiso 19
Burgos, Isabela	Mestiso 20	NSIC Rc240	Mestiso 19
Iguig Cagayan	NSIC Rc 240	Mestiso 20	Mestiso 38
Abulug, Cagayan	NSIC Rc 240	Mestiso 20	NSIC Rc238
Aritao, Nueva, Vizcaya	Mestiso 20	NSIC Rc240	Mestiso 19
Magsaysay, Kalinga	PR31379	INH10001	NSIC Rc240
Laya East, Kalinga	Mestiso 38	INH10001	NSIC Rc240
Paracelis, Mt. Province	PHB77	Mestiso 19	NSIC Rc238
Kiangan, Ifugao	PR31379	INH10001	SL18H
Sablan, Benguet	PHB77	INH10001	NSIC Rc240

Table 32. Varieties with the two highest grain yields recorded in each region.

Region	2012 DS		2012 WS	
	Variety	Grain yield (t/ha)	Variety	Grain yield (t/ha)
I	Mestiso 19	10.4	PR35664H	10.1
	SL18H	9.9	PR36474H	11.9
II	Mestiso 38	9.8	Mestiso 20	9.8
	SL18H	9.6	NSIC Rc240	10.2
			PHB77	9.8
CAR	Mestiso 19	6.9	Mestiso 20	8.4
	Mestiso 29	6.9	Mestiso 29	8.4
	Mestiso 38	6.9	NSIC Rc238	8.4
	SL18H	6.9	NSIC Rc240	8.6
	SL115H	7.4		
III	Mestiso 19	14.0	IR79643	9.9
	Mestiso 20	13.0	Mestiso 19	9.7
	NSIC Rc240	13.0	PHB77	9.7
			PR31379	9.9
IVB	Mestiso 38	5.9		
	SL18H	5.1		
IX	Mestiso 38	7.1		
	SL115H	7.5		
X	Mestiso 29	10.0	IR79643	10.7
	NSIC Rc240	11.9	Mestiso 29	8.2
XI	Mestiso 19	12.9	Mestiso 20	11.0
	NSIC Rc240	13.2	Mestiso 29	12.0
			Mestiso 38	11.0
			NSIC Rc240	12.0
			PHB77	11.0
XII	Mestizo 1	4.8		
	Mestiso 19	4.8		
	Mestiso 20	4.7		
	Mestiso 29	4.7		
	Mestiso 38	4.7		
	SL18H	4.7		
XIII	Mestiso 29	7.6	Mestiso 19	8.1
	SL18H	8.3	NSIC Rc240	8.3

Figure 29. (A and B) Seedling pulling of test entries; (C and D) Monitoring growth and performance of test entries; (E and F) Farmers' field day evaluation

Seed production of experimental and released hybrids
LV Gramaje, CD del Rosario, VP Luciano, LS Baldedara,
IA dela Cruz, AT Rigor, and DA Tabanao

Hybrid rice variety development needs enough pure seeds to cover various experiments. F1 seed production plays an important role in the Observation Nursery (ON), Preliminary Yield Trial (PYT), National Cooperative Test (NCT), and Technology Demonstration of released hybrids because their success will depend on the availability of the seeds for the study and commercial production. The production of hybrid seeds differs from that of inbred rice seed. It involves two steps: the multiplication of the cytoplasmic male sterile line (CMS) through AxB seed production and the production of hybrid seeds through AxR seed production. The genetic purity of the CMS (A), maintainer (B), and restorer (R) lines, which are the hybrid parent lines, is essential in the development and commercialization of hybrid varieties since the yield of hybrid rice will decrease by 100kg/ha when the purity of hybrid seeds decreases by 1% percent.

The main objective of the study was to produce enough pure seeds for experimental and released hybrids and scout and validate suitable areas for seed production.

Highlights:

- A total of eight AxB combinations with generated paired crosses ranging from 15 to 66 completely sterile (CS) plants were seed produced for nucleus seed multiplication during the DS and WS of 2012 (Table 33, Figure 30). Two of these combinations (PR20A/PR20B and PR40591A/PR40591B) will be forwarded for breeder seed production in 2013 DS. Six CMS lines were seed produced and purified as nucleus seeds having seed yields ranging from 0.1 to 12.3kg. Two combinations during the 2012 DS (IR79123A/IR79123B and IR80151A/IR80151B) were seed produced as breeder seeds with a total yield of 610 and 432kg/ha. The seed yield will be used for AxR seed production of experimental hybrids entered in ON, PYT, and NCT.

- A set of 96 combinations of AxR was seed produced having a minimum yield of 50g in each combination. The progenies were evaluated in the ON of 2012 WS, 51 of which were selected to be advanced to the ON of 2013 DS. Nine promising hybrids (five during the 2012 DS and four during the 2012 WS) were seed produced for NCT and Adaptability Trials with seed yields ranging from 447 to 783 kg/ha (Table 34).

- In 2012 WS, 0.50ha was used for foundation seed production of IR68897A, which yielded 609.2kg/ha and 200kg pure R lines. These

CMS line seeds will be used for AxR seed production of Mestiso 29 in different parts of Luzon, Visayas, and Mindanao in 2013 DS (Figure 30C). For F1 seed production, a total of 1,050kg/ha of M29 F1 seeds were produced in 2012 WS (Table 33). The seeds were distributed to PhilRice branch stations and seed growers for a 28-ha commercial cultivation, demonstration farms, and adaptability trials in 2013 DS (Figure 30D).

- A poster titled "Identification of Superior Two-Line Hybrids in the Preliminary Yield Trial at PhilRice Central Experiment Station" was presented during the 42nd Annual Scientific Conference on April 16-21, 2012 in Puerto Princesa City, Palawan.

Table 33. Number of paired crosses, amounts of nucleus, breeder, and foundation seeds, and F1 seeds produced.

Evaluated Paired Crosses		Seed Production		
Cross Combination	Number	Nursery	Parentals	Seed Yield
IR79123AxIR79123B	66	Nucleus	IR79123AxIR79123B	12,230 g
IR80151AxIR80151B	24		PR20AxPR20B	1,000 g
IR70369AxIR70369B	20		IR80151AxIR80151B	6,760 g
PR40590AxPR40590B	50		IR70369AxIR70369B	1,600 g
PR20AxPR20B	32		PR40590AxPR40590B	700 g
PR9AxPR9B	64		PR40591AxPR40591B	100 g
IR68897AxIR68897B	50	Breeder	IR79123AxIR79123B	610 kg/ha
PR40591AxPR40591B	15		IR80151AxIR80151B	432 kg/ha
		Foundation	IR68897AxIR68897B	609 kg/ha
		F1	IR68897AxPR34302R	1,050 kg/ha

Table 34. F1 seeds of experimental hybrids produced for National Cooperative Test and Adaptability Trials.

Entry	Season	Yield (kg/ha)
PR35564H	DS	783
PR36474H	DS	678
PR36248H	DS	635
PR36542H	DS	780
IR36420H	DS	650
PR39342H	WS	533
PR35696H	WS	447
PR39019H	WS	670
PR36474H	WS	504

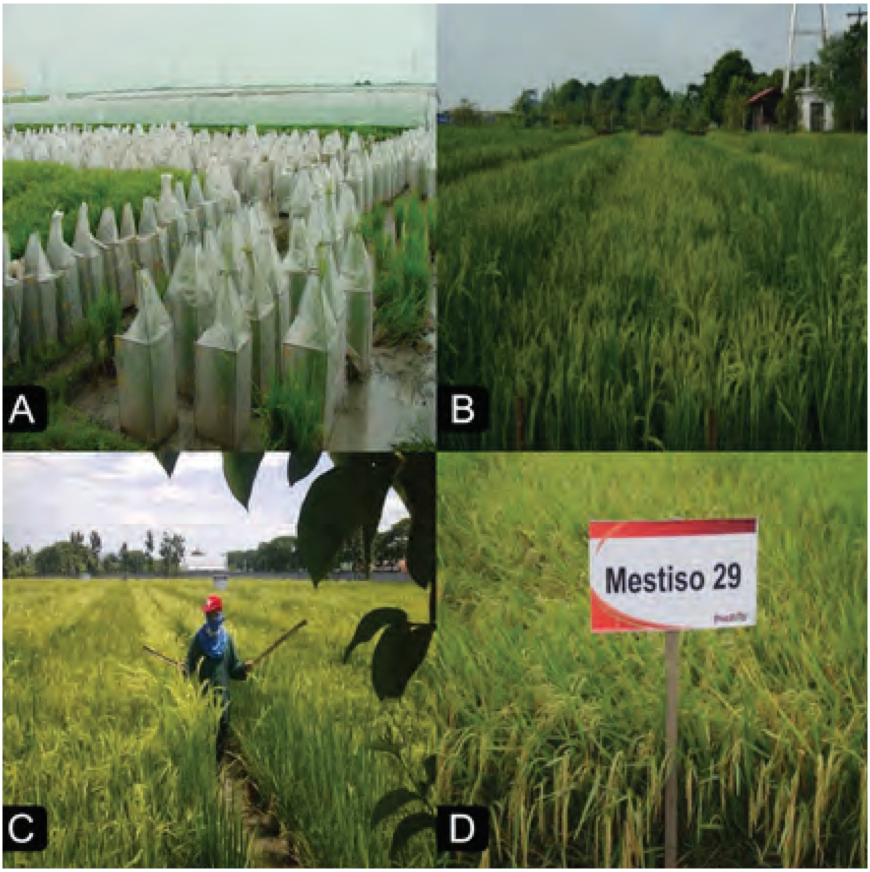

Figure 30. (A) Evaluation of paired crosses for nucleus seed multiplication. (B) Breeder and foundation seed production of parental lines. (C) F1 seed production of experimental and released hybrids. (D) Adaptability trials and commercial cultivation.

Developing hybrid parent lines and hybrids at PhilRice Isabela
DB Rebong II, JRF Mirandilla, JL Ordonio, NNA Baliuag, and ATIO Rebong

The 15% to 25% yield advantage of hybrid over inbred rice variety should be enhanced to contribute significantly to the country's rice self-sufficiency bid. Rice breeders should continue to develop new and better hybrids that would outperform the existing commercial hybrids and inbreds. PhilRice Isabela, being the institute's hybrid rice center, is mandated to contribute in this aspect. The project aimed to develop and improve superior restorer lines, new maintainer lines, and new CMS lines to ensure exploitation of higher heterosis, hence, higher grain yield in the F1 hybrids of rice.

Highlights:

Development of parent lines

- In 2012 DS, 214 elite lines were established and characterized at the source nursery (SN). A total of 286 AxR testcrosses were generated with at least 24 seeds from the SN and will be evaluated in 2012 WS under the Testcross Nursery (TCN).

- Six populations out of 11 possible CMS (A-lines) and 45 selections from the F5 R-line populations were selected for further evaluation.

- In 2012 WS, there were 422 lines evaluated at the source nursery, 45 of which were selected from the rainfed breeding group's materials. Selected lines were crossed to IR68897A, IR73328A, IR58025A, and PR2A. A total of 368 AxR testcrosses were produced from the selected entries at SN and will be evaluated at the TCN.

- Two populations out of six possible CMS lines were selected for pollen sterility. Complete sterile plants were backcrossed to their respective maintainer lines. For R line development, 42 plants from F6 populations were selected for further uniformity and stability testing.

- Chinese materials acquired from Jiangxi Academy of Agricultural Sciences (JAAS) were seed increased and evaluated in 2012 WS. Further evaluation will be conducted in 2013 DS.

Evaluation of experimental hybrids

- Experimental rice hybrids were evaluated in comparison to check varieties to identify those which are commercially usable. This was done by stepwise evaluation of experimental hybrids in a series of yield trials: observational (Stage 1), preliminary (Stage 2), advanced (Stage 3), and multi-location yield trials. In 2012 DS, among 200 experimental hybrids, 24 were selected in the TCN trial based on high yield potential, high spikelet fertility, resistance to pest and diseases, and good overall crop stand.

- Male parents of three experimental hybrids were identified as possible maintainers with completely sterile rating at pollen evaluation. These materials were used in backcrossing for possible CMS and maintainer line development.

- In the observational yield trial (OYT/Stage 1), eight test entries were selected based on high yield potential, resistance to pest and diseases, and good overall crop stand to advance in preliminary yield trial (PYT/Stage 2) after reconstructing the crosses. Yield ranged from 6.5 to 7.8t/ha. In the PYT, six entries were selected from 13 test entries to advance in the multi-location yield trial after seed increase. Yield ranged from 5.9 to 7.3t/ha with an average of 7.1t/ha.

- In 2012 WS, 56 out of 241 experimental hybrids were selected in the TCN. Of these, 24 male parents were identified for backcrossing for possible CMS and maintainer line development based on their high sterility upon pollen evaluation.

- In the OYT or Stage 1, eight of 84 test entries were selected to advance to PYT/Stage 2 for further evaluation based on high yield potential, high spikelet fertility, resistance to pest and diseases, and good overall crop stand. Yield ranged from 3.9 to 6.0t/ha with an average of 5.2t/ha.

- In the PYT, five of 11 entries were selected to advance in the multi-location yield trial after seed increase. Yield ranged from 6.3 to 7.9t/ha with an average of 6.8t/ha. The other six entries were retained in PYT for further evaluation. Selected hybrids will be reconstructed in 2013 DS and will be evaluated starting 2013 WS.

Seed production of experimental hybrids and parent lines

- In 2012 DS, 108 hybrid entries were seed produced to obtain enough seeds for PYT/ Stage 2 yield trial of 2012 WS. An average of 149g per entry was produced. Poor synchronization caused low seed yields in some entries. Three sets of CMS lines were seed increased: IR73328A/IR73328B (380g), IR68897A/IR68897B (260g), and PR2A/PR2B (165g).
- In 2012 WS, 24 hybrid entries were seed produced for evaluation at OYT/ Stage 1 trial in 2013 DS. An average of 56.3g per entry was produced. A total of five hybrid entries were seed produced for 2013DS PYT/Stage 2 evaluation with an average of 58.2g per entry. Four sets of CMS lines were seed increased: IR58025A x IR58025B (4.5kg), IR73328A x IR73328B (3.8kg), IR68897A x IR68897B (3.5kg), and PR2A x PR2B (1.2kg).

Nucleus and breeder seed production of PSB Rc72H, NSIC Rc204H, and their parent lines at PhilRice Isabela

DB Rebong II, JL Ordonio, and FM Ramos

PhilRice Isabela is one of three PhilRice stations engaged in nucleus and breeder seed production to provide seeds of high purity for the government's hybrid rice program. To ensure the success of the program, genetically pure and quality seeds in adequate amount should be made available to seed growers that eventually produce the F1 hybrids for commercial cultivation of farmers. Hence, to maximize the potential of hybrids and fast track its adoption, the production of high quality seeds is necessary because in every 1% decrease in purity of the hybrid seed, the eventual yield loss in the F1 hybrids would be about 100kg/ha. Lack of purity in parental lines and improper isolation conditions in seed production are the major causes of poor hybrid seed quality. Also, parent lines get contaminated and deteriorate during the process of handling of foundation seed growers. Therefore, it is necessary to produce nucleus and breeder seeds every season under the strict supervision of plant breeders. This project was conducted to produce large amount of pure nucleus and breeder seeds of parental lines of released hybrids to cater to the needs of the HRCP program.

Highlights:

Nucleus seed production of IR58025A

- For nucleus seed production, 34 paired crosses of IR58025A/B generated from 2011 WS were established in 2012 DS. A total of 1,030 plants constituted the 34 paired crosses. Pollen samples of the whole population of IR58025A plants were evaluated under the microscope. Results indicated that 17.8% of the populations are completely sterile (CS), 35.1% are sterile (S), 38.7% are partially sterile (PS), 6.4% are partially fertile (PF), 1.2% are fertile (F), and 0.8% fully fertile (FF). All FF, F, PF, and PS plants were discarded or removed in the experimental field to ensure high purity. Completely sterile and sterile plants were labeled and pollinated with IR58025B. A total of 1,767.6g of seed yield were harvested from CS (751.9g) and S (745.7g) population.

- In the base population, 205 paired crosses of IR58025A/B of Mestizo 1 parent lines were generated with at least 50 seeds per cross. All fertile, partially fertile, and partially sterile plants were removed from the experimental field and discarded. Out of 1,200 plants, only 230 completely sterile A lines (19%) were selected and harvested.

- Evaluation and multiplication nursery were done simultaneously by individual or plant-by-plant evaluation. Only 100 of 205 effective paired crosses (for ease in management) from 2012 DS were established for pollen sterility and phenotypic (uniformity and true-to-type) evaluation. A total of 3,048 plants constituted the 100 paired crosses with 36 vigorous seedlings per paired cross. Results of the intensive pollen evaluation indicated that there were 20.1% CS, 41.3% S, 37.7% PS, 0.3% PF, and 0.7% FF. All completely sterile and sterile plants were retained and harvested separately. These constituted the nucleus seeds. All plants classified as PS, PF, and F were immediately removed from the experimental plots to avoid contamination and mixtures/off-types at later generations. A total of 10kg of nucleus seeds were generated from the CS (4kg) and S (6kg) population.

- From the base population, 140 completely sterile 58025A lines were paired with IR58025B which produced more than 50 seeds per pair. Out of 500 plants, only 170 completely sterile CMS lines (34%) were selected and harvested.

Breeder seed production of IR58025A

- In 2012 DS, a total of 160kg of IR58025A (10.7 bags at 15 kg/bag) was harvested from 1,733 m2 and classified by the National Seed Quality Control Services (NSQCS) of the Bureau of Plant Industry as Breeder Seeds (BS).
- During the 2012 WS, 165kg of IR58025A (11 bags at 15kg/bag) was harvested from the same area and also classified as Breeder Seeds by the BPI-NSQCS. Breeder seeds were sold to AxR seed growers of Region 2 and the PBDO of PhilRice Isabela.

Figure 31. Breeding activities: a) Pollen evaluation; b) emasculation; c) pollination; and d) harvested naked F1 seeds.

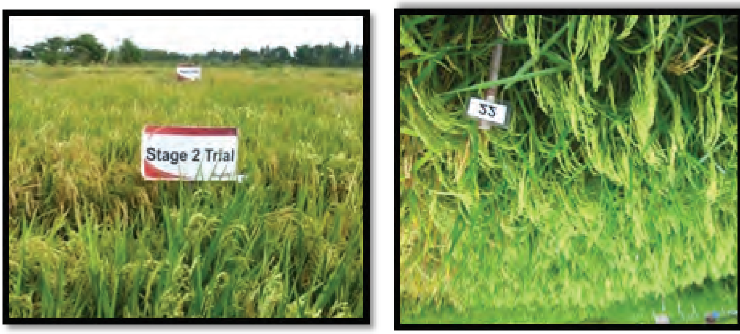

Figure 32. Yield or Stage trials set-ups at the station, 2012WS.

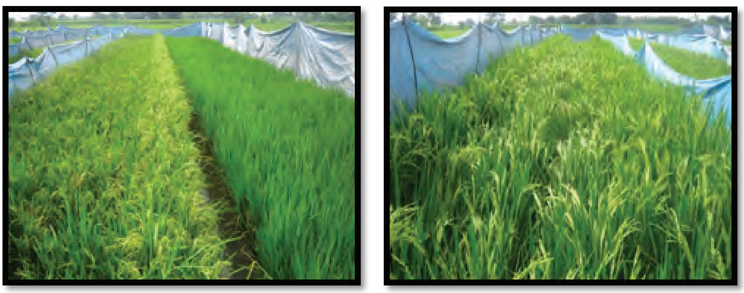

Figure 33. CMS seed increase set-up at the station, 2012 WS: a) PR2A/B; and b) IR73328A/B.

Development of improved thermo-sensitive genetic male sterile (TGMS) lines and TGMS-based two-line hybrids at PhilRice Los Baños
SH Escamos, JC Descalsota, EM Evangelista, MAT Talavera, DJ Lalican, and TM Masajo

The discovery of thermo-sensitive genetic male sterility in rice provided new avenues to further explore heterosis using the two-line system. TGMS are genic male sterile genotypes whose fertility/sterility behavior is conditioned by temperature regimes (Virmani, 1996). This system is useful in the Philippines where temperature differences exist due to elevation, latitude and time of year. The increased chances of finding high yielding hybrids and the more straightforward seed production of TGMS lines makes this system more economically viable.

With the release by the National Seed Industry Council (NSIC) of two TGMS-based hybrid rice varieties, the collaborative project between UPLB and PhilRice has demonstrated that breeding and use of TGMS lines to develop two-line hybrids can be successfully done in the Philippines. The project aimed to develop stable and improved TGMS lines with added focus on earliness and shorter stature and two-line hybrids with at least 15% yield advantage over the best inbred variety, pest resistant, and with acceptable grain quality. Earliness, shorter stature, and lodging resistance are emphasized in developing new hybrids.

Highlights:

Development of new and diverse TGMS lines through hybridization and selection

- Research activities on the development of improved and stable TGMS lines through hybridization and selection both at male sterile environment (MSE) and male fertile environment (MFE) were continued during the year. At MSE (Los Banos), TGMS and pollen parents were assembled and planted for making crosses during the dry and wet seasons. Planted and evaluated at MSE were 122 F1 populations (42 and 80 during DS and WS, respectively) and 54 F2 populations (23 during the dry and 31during the wet season). A total of 1,320 lines from F3 to F6 were also planted (Table 35).

- At MSE, 1,312 male fertile plants (503 during the dry and 809 during the wet season) were selected in the F2 populations during the year for evaluation as F3 at MSE while 1,591 male sterile plants were selected, ratooned, and brought to MFE in the same period. Three hundred eighty-two plants were brought to Tublay, Benguet during DS and 828 to Carranglan, Nueva Ecija during WS. Majayjay, Laguna was considered as new MFE site where 453 plant selections were grown for evaluation and seed multiplication (Table 36). Selected also during the wet season were 513 (in the F3), 52 (F4), 26 (F5), 36 (F6), and 10 (F7) male sterile plants.

- Table 37 shows the summary of materials planted at MFE during the period. Three hundred eighty six male sterile plants selected from 2011 WS pedigree nurseries were grown in Carranglan, Nueva Ecija while 688 plants selected from DS pedigree nurseries were evaluated and multiplied in Tublay, Benguet.

- Seeds of nine promising lines identified in the TGMS observation nursery were multiplied at MFE for further evaluation of stability in sterility.

Development of new and diverse TGMS lines through recurrent selection

- Development of superior TGMS lines is essential to a successful two-line hybrid breeding. To reinforce TGMS breeding work at PhilRice Los Banos, an initiative to develop TGMS lines through recurrent selection was added. Recurrent selection as a breeding method is generally used in cross-pollinated crops but could also be employed in self-pollinated crops like rice using genetic male sterility system (TGMS) to facilitate natural cross pollination. The main purpose of the method is to concentrate on fewer individuals in the population with desirable traits through recurrent cycles of intercrossing and selection. Compared to the generally used hybridization and pedigree selection, intercrossing among individuals in recurrent selection keeps plants in heterozygous conditions, allowing for more chances of genetic recombination.

Composite population

- Two TGMS composite populations, TPP1 and TPP2, were established during 2012 DS and WS for recurrent selections. The two populations were in the fourth cycle of recombination in 2012 DS and in the fifth cycle last WS. Selected new male fertile lines were introduced to reinforce the breeding populations during the 2012 DS.

- From each population, 300 sterile plants were selected each season and brought to MFE sites for evaluation and seed increase. Selections during the 2012 DS were harvested and processed for further evaluation and selection in F2 pedigree nursery this 2013 DS. Furthermore, seeds of selections made during the 2012 WS are being multiplied in MFE sites for inclusion in the pedigree nurseries in 2013.

- Seeds from selected sterile and fertile plants were collected and processed separately from each population and will be used to compose another cycle of recombination in 2013. Plant type, stability infertility/sterility behavior, lodging resistance, growth duration, panicle and grain characteristics, and freedom from disease and pest damage were the main selection criteria

Pedigree nursery

- A total of 268 plant selections were established in 2012 WS pedigree nursery at MSE site for evaluation and selection. From nursery, 816 plants were selected. Selected plants were brought to MFE sites to increase seeds for evaluation. Selections will be evaluated in pedigree nursery at MSE site in 2013 DS.

Identification and development of pollen parents for two-line hybrids

Essential to hybrid development programs for both two-line and three-line system is the availability and identification of potentially good-performing pollen parents. Characters such as yield, plant height, lodging resistance, maturity, resistance to pest and diseases, grain acceptability, tolerance to abiotic stresses, and pollen–shedding ability are traits considered in the selection of pollen parents. Ability to combine well and produce superior progenies when crossed with female parents is the final measure.

Drawing pollen parents from existing inbred variety development programs has been the common practice in hybrid breeding. But lately, with growing interest on hybrids and increased demand for pollen parents, finding suitable and diverse inbreds as male parents of hybrids has become increasingly difficult. Furthermore, access and use of improved germplasm developed and introduced from elsewhere are covered by PVP and MTA and provisions therein could be rather restrictive. While the TGMS project at Los Banos will continue to identify and source pollen parents from available materials, it is doing breeding work purposely to develop better pollen parents for TGMS hybrids.

Evaluation of selections as potential pollen parents

- A total of 272 entries from various sources were evaluated in 2012 DS. Entries were selections from MET, NCT, wide hybridization derived lines, and other sources. Twenty-eight entries were identified as potential pollen parents. Selections identified in 2011 WS as potential pollen parents were used in generating experimental hybrids during 2012 DS.

Development of pollen parents through recurrent selection

- Three composite populations, namely PPI1, PPI2, and PPI3, were established in 2012 WS for identification and selection of potential pollen parents. Genetic male sterility (ms) is employed to encourage intercrossing in the populations. From each population, 100 fertile plants were selected and processed separately. Some of the seeds from this selection were collected for evaluation in pedigree nursery and the remaining seeds were bulked for each population and will be used in the maintenance of the composite population. Also, seeds from selected sterile and fertile plants from each population were collected to establish the next recombination cycle in 2013 DS.

Evaluation and identification of superior pollen parents in pedigree nurseries

- A total of 1,404 F3s were evaluated in pedigree nursery in 2012 WS. Most of these selections came from the 286 F2 populations established during the 2012 DS. Some were acquired from various F2 nurseries. A total of 993 lines were selected and will be advanced to the next trial in pedigree nursery in 2013. Selections include potential breeding materials, pollen parents, and entries for national trials. Seed quality and pollen shedding ability will be included in the evaluation of the lines in 2013.

Converting TGMS hybrid pollen parents from green- to purple-base genotypes

- Two highly selected TGMS hybrid pollen parents are being morphologically tagged with purple coloration at the leaf sheath base through backcrossing. The two BC3 populations were established during 2012 DS. BC3 plants with almost similar characteristics as their recurrent parents and with distinct purple base coloration were selected and used in making the BC4s. Thirty BC4 crosses for each of the backcross populations were made. F1 seeds were collected for evaluation and for making the BC5 in 2012 WS.

- In 2012 WS, selected BC4s from the two backcross populations were established. A total of 30 BC4s were evaluated in pedigree nurseries. From each line, three plants with distinct purple coloration at the leaf sheath base were selected. Selected 10 plants from each population were used in generation of BC5. Also, selected individuals with distinct and darker purple colorations of the leaf sheath from the pollen parent pedigree nursery were also used in generation of backcrosses. Thirty-three BC5 crosses were made in 2012 WS. Collected F1 seeds will be evaluated in 2013 DS. Test crosses will also be conducted in 2013 for initial evaluation. Concurrently, selected BC3F2 plants are being evaluated in pedigree nursery as F3 lines.

Development of two-line experimental hybrids

- Two-line experimental hybrids were generated through handcrossing and by isolation-free method using 15 and 19 promising TGMS lines during the DS, and 93 and 157 pollen parents during the WS. Promising lines from the NCT, the UPLB breeding nurseries, NSIC released varieties, and wide hybridization derived lines were used as male parents. Two hundred ten in DS and 226 new experimental hybrids in WS were produced. Performance of new hybrids produced during the DS was evaluated in the hybrid observation nursery (HON) during WS while those generated during the WS will be evaluated in the 2013 DS.

Evaluation and field performance testing of promising hybrids

Hybrid observation nursery (HON)

- One hundred eighty four experimental hybrids were evaluated in the Hybrid Observational Nursery (HON) during DS using Mestiso 19 and Mestiso 20 as hybrid checks, and PSB Rc82 and PSB Rc18 as inbred check varieties. Ninety-seven hybrid entries had grain yield better than the higher yielding check PSB Rc82 (5.83t/ha). Fifty-nine of these hybrids yielded more than 1.0t over PSB Rc82. The highest yielding hybrid (HON 1126) gave 8.20t/ha or 40.1% yield advantage (YA) over PSB Rc82 (Table 39a). This was followed by HON 1119 which yielded 7.9t/ha or 35.4% YA over PSB Rc82. Maturity of the hybrids ranged from 107 to 121 days. F1 seeds of the good performing hybrids were produced to further evaluate them in the preliminary yield trial.

- Meanwhile, 200 experimental hybrids were included in the 2012 WS HON, 105 of which performed very well in the trial. Highest yield was obtained with HON 1352 which gave 8.56t/ha yield followed by HON 1358 which yielded 8.12t/ha (Table 39b). Yield advantage (YA) of these hybrids over PSB Rc82 were 85.2% and 75.2%, respectively. Ten hybrids yielded between 7 to 8t/ha (YA over PSB Rc82 ranged from 54.8% to 67.5%). F1 seeds of the good performing hybrids will be produced during the 2013 DS for further evaluation.

Hybrid preliminary yield trial (HPYT)

- In the hybrid prelimininary yield trial, 18 two-line hybrids were evaluated during the DS using PSB Rc82 and PSB Rc18 as inbred check varieties and Mestiso 19 and Mestiso 20 as hybrid checks. No hybrid outyielded the higher yielding check PSB Rc82 (6.14t/ha). However, one hybrid outyielded the other check PSB Rc18 (Table 40a). Highest yield obtained was 6.72t/ha with a yield advantage of 20.1% over PSB Rc18 and 9.45% over PSB Rc82.

- The 2012 WS, HPYT consisted of 20 hybrids. Four hybrids yielded one ton higher than the higher yielding check, PSB Rc82 with YA ranging from 21.8% to 30.2% (Table 40b). These hybrids even outyielded the hybrid check Mestiso 19 by 19.3% to 27.5%. Highest yield (6.00t/ha) was obtained with HPYT 327 followed by HPYT 316 (5.82t/ha). Maturity of the hybrids ranged from 115 to 118 days. Promising hybrids identified will be further evaluated in the advance yield trial (AYT) in the coming season.

Advanced yield trial (AYT)

- Ten (10) promising hybrids each comprised the advance yield trial conducted during the 2012 DS and WS. During the DS, grain yield of test hybrids ranged from 6.29 to 7.62t/ha (Table 41). Six hybrids outyielded both checks PSB Rc82 and PSB Rc18. HAYT 55 which yielded 7.62t/ha had a yield advantage of 17.8% and 25% over PSB Rc82 and PSB Rc18, respectively. F1 seeds of the good performing hybrids were produced during the wet season for possible testing in the NCT.

- During the wet season, three hybrid entries outyielded the inbred check, PSB Rc82 by more than 15%. HAYT 71 obtained the highest yield (5.42t/ha) followed by HAYT 73 which yielded 5.25t/ha and HAYT 77(4.91t/ha). Maturity of the entries ranged from 118 to 123 days.

Promising hybrids for entry to National Cooperative Test (NCT)

- The study has identified four promising hybrids for possible entry to NCT. Table 42 shows the performance of these hybrids from 2010 DS to 2012 WS. Three were early and one was medium-maturing. Seeds of these hybrids were multiplied for entry in the 2013 WS NCT. Three of these hybrids will be included in the Multi-Environment Trial (MET) during the 2013 DS and one will be included in the yield potential study.

TGMS hybrid seed research

- A study on determination of flowering behavior is ongoing at MSE using 10 TGMS lines and five pollen parents. Monthly planting of the lines and observations were continued during the period. Flowering duration on a panicle and tiller basis in the TGMS lines was observed. Flowering duration in a panicle ranged from 4 to 9 days among TGMS lines while the on-tiller-basis ranged from 16 to 21 days (Table 43a).

- On pollen and spikelet sterility, it was only in TGMS lines established in October and November 2011 that partial reversion to fertility of some TGMS lines were observed. Spikelet fertility of six TGMS lines (TGMS 60, TGMS 71, TGMS 78, TGMS 131, and TGMS 132) established in October ranged from 2.3% to 22.5% (Table 43b). Backtracking of temperature records during critical stages of the TGMS lines that set seeds indicate that temperature-sensitive phase of these lines coincided with the beginning of the cold period in December. Mean minimum temperatures experienced by all the lines ranged from 23°C to 23.8°C. However, only six of the 10 lines tested reverted to partial fertility. Higher mean maximum (30.3 to 32.5) and mean (27 and 27.1°C) temperature was experienced by the lines that remain completely male sterile (TGMS 7, 11, 31, and 134) except for TGMS 130 which exhibited partial pollen fertility despite the higher mean temperature (27.3°C) it experienced during its critical period. This indicates that it has a higher critical sterility point than the other TGMS lines. TGMS 134 remained completely male sterile at mean temperature of 26.4°C indicating it has a lower critical sterility point than the other TGMS lines. TGMS 130 and TGMS 131 also exhibited partial fertility when established in

November. Mean temperature during the sensitive phase of these two lines were 26.5 and 26.4 °C. All TGMS lines established in July to September 2011 and December 2011 to August 2012 exhibited complete male sterility.

- For the pollen parents, duration of flower opening within a panicle is 6 to 9 days while on-a–plant-basis duration was from 14 to 18 days. Pollen evaluation showed only a few sterile pollens in all the lines.

- A study to determine length of stigma receptivity using five selected TGMS lines was conducted using split plot design in RBCD with three replications. Stigma receptivity was determined by counting seeds that set at different number of days of pollination after clipping. All TGMS lines tested showed the same behavior in terms of percent seed set in response to days of pollination after clipping, except one (TGMS 132). It was observed that the stigma was most receptive on the first three days after clipping. High seed set was obtained on the first three days of pollination but decreased significantly when pollination was delayed to the fifth day. No more seed set was observed when pollination was delayed until the sixth day.

Other accomplishments

- Project staff served as resource persons and facilitators in the series of trainings conducted by PhilRice on "Seed Production and Certification of TGMS-based Hybrids". Seven trainings (five in Mindanao, one in Visayas, and one in Luzon) were conducted during the year. The participants included laboratory seed analysts, seed inspectors, and seed growers. The trainings were done in collaboration with BPI, RFUs, and ATI.

Table 35. Summary of materials planted by generation at MSE, 2012 DS and 2012 WS

Season	Generation					Total number of population/lines planted
	F2	F3	F4	F5	F6	
2012 DS[1]	23	560	-	-	-	23/560
2012 WS[2]	31	685	52	15	8	31/760
Total	54	1245	52	15	8	54/1320

[1]No harvest from Tublay, 2011 WS.

[2]High tungro incidence during 2011 WS

Table 36. Number of plants selected by generation, 2012 DS and 2012 WS.

Season	Generation							Total no. of fertile/male sterile plants selected
	F2		F3	F4	F5	F6	F7	
	Fertile	Sterile						
2012 DS[1]	503	382	188	-	-	-	-	503/570
2012 WS[2]	809	1209	324	52	26	36	10	809/1657
Total	1312	1591	513	52	26	36	10	1312/2227

[1]570 planted in Tublay
[2]1,204 planted in Carranglan, Nueva Ecija and 453 in Majayjay, Laguna

Table 37. Summary of materials planted by generation at MFE, 2012.

Season	Generation[1]						Total number of plants planted
	F2	F3	F4	F5	F6	F7	
2012 DS[1]	221	131	29	-	5		386[1]
2012 WS[2]	324	312	31	14	7		688[2]
Total	545	443	60	14	12		1074

[1]Selected from 2011 WS pedigree nurseries, grown in Carranglan, Nueva Ecija
[2]Selected from 2012 DS pedigree nurseries, grown in Tublay, Benguet

Table 38. Number of entries and plant selections taken from the different pollen parent pedigree nurseries during the 2012 DS.

Pedigree Nursery	No. of Lines	Plants Selected
PPI1	60	334
PPI2	65	330
TBP1	16	87
TBP2	78	364
PPI4	11	48
PPI5	56	108
Total	286	1271

Table 39a. Yield and agronomic traits of good performing hybrids in the hybrid observation nursery (HON), 2012 DS.

Index No.	Grain yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Tiller/hill (no)	Plant height (cm)
HON 1126	8197	40.1	75.6	120	12	110
HON 1119	7900	35.4	51.9	118	11	108
HON 1100	7771	33.2	49.4	111	12	97
HON 1228	7728	32.4	48.6	121	12	111
HON 1049	7670	31.5	47.5	115	14	99
HON 1256	7663	31.4	47.3	114	19	90
HON 1118	7519	28.9	44.6	111	11	80
HON 1236	7512	28.8	44.4	108	12	93
PSB Rc 18	5201	-	-	117	12	105
PSB Rc 82	5834	-	-	112	13	97
M19	6301	-	-	107	12	99
M20	6455	-	-	115	11	118

Table 39b. Yield and agronomic traits of good performing hybrids in the hybrid observation nursery, 2012 WS.

Index No.	Grain yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Tiller/hill (no)	Plant height (cm)
HON 1352	8555	85.2	141.6	121	12	109
HON 1358	8122	75.8	129.4	118	9	114
HON 1411	7740	67.5	118.6	116	10	110
HON 1293	7583	64.1	114.2	118	14	114
HON 1348	7375	59.6	108.3	121	8	122
HON 1399	7273	57.4	105.4	114	11	106
HON 1385	7261	57.2	105.1	86	11	114
HON 1470	7247	56.9	104.7	116	8	102
HON 1339	7219	56.3	103.9	114	8	113
HON 1420	7151	54.8	102.0	118	9	106
PSB Rc 18	3541	-	-	130	13	107
PSB Rc 82	4620	-	-	121	13	105
M19	5282	-	-	108	11	108
M20	5849	-	-	118	10	116

Table 40a. Yield and agronomic traits of some selected hybrids in the preliminary yield trial, 2012 DS.

Index No	Grain Yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Plant height (cm)	Tiller/hill (no)
HPYT 294	6715	9.45	20.1	109	101	11
HPYT 287	6381	4.0	14.1	106	116	11
HPYT 293	6315	2.9	12.9	108	101	10
HPYT 285	6167	0.05	10.3	107	108	10
HPYT 288	6060	-0.01	8.4	107	111	10
PSB Rc 18	5592	-	-	117	105	12
PSB Rc 82	6135	-	-	112	97	13
M19	6314	-	-	107	99	12
M20	7029	-	-	115	108	11

Table 40b. Yield and agronomic traits of some good hybrids in the preliminary yield trial, 2012 WS.

Index No	Grain yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Plant height (cm)	Tiller/hill (no)
HPYT 327	6002	30.2	35.1	117	121	12
HPYT 316	5823	26.3	31.1	117	125	11
HPYT 318	5690	23.4	28.1	118	120	11
HPYT 320	5615	21.8	26.4	118	124	10
HPYT 314	5447	18.1	22.6	116	118	10
PSB Rc 18	4443	-	-	-	115	13
PSB Rc 82	4612	-	-	120	117	11
M19	4708	-	-	117	114	12
M20	5108	-	-	120	123	10

Table 41a. Yield and other agronomic traits of promising hybrids in the advance yield trial, 2012 DS.

Entry	Grain Yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Tiller (no)	Height (cm)
HAYT 55	7617	17.8	25.0	121	11	104
HAYT 53	7207	11.5	18.2	113	12	98
HAYT 51	6925	7.1	13.6	117	14	97
HAYT 52	6861	6.1	12.5	115	11	103
HAYT 56	6721	4.0	10.2	113	15	99
HAYT 54	6616	2.4	8.5	112	12	108
PSB Rc 18	6096			124	14	105
PSB Rc 82	6464			119	12	92
Mestiso 19	6444	-	-	115	11	99
Mestiso 20	7383	-	-	121	12	118

Table 41b. Yield and other agronomic traits of promising hybrids in the advance yield trial, 2012 WS.

Entry	Grain Yield (kg/ha)	% YA over PSB Rc82	% YA over PSB Rc18	Maturity (days)	Tiller (no)	Height (cm)
HAYT 71	5424	28.0	73.8	118	13	105
HAYT 73	5253	23.9	68.3	122	13	107
HAYT 77	4909	15.8	57.3	118	11	109
HAYT 74	4772	12.6	52.9	123	10	109
HAYT 76	4767	12.5	52.7	121	10	102
PSB Rc18	5075	-	-	131	13	108
PSB Rc 82	4238	-	-	121	12	109
M19	5075	-	-	121	12	105
M20	5553	-	-	126	10	119

Table 42. Summary of the performance of promising hybrids in PYT and AYT trials, 2010 DS to 2012 WS.

	Dry season		Wet season			
	Grain yield (kg/ha)	% YA over PSB Rc82	Grain yield (kg/ha)	% YA over PSB Rc82	Maturity (days)	Plant height (cm)
Hybrid 1	6823	13.8	3622	43.5	108	100
Hybrid 2	7285	22.4	3290	68.3	110	98
Hybrid 3	6441	29.5	3524	29.9	120	108
Hybrid 4	6431	14.3	3971	32.5	109	105

Table 43a. Duration of flowering (panicle and tiller basis) of TGMS lines, July 2011 to August 2012.

Entry	Duration of flowering (days)			
	Panicle basis		Tiller basis	
	Mean	Range	Mean	Range
TGMS 7	6	4-9	17	16-21
TGMS 11	5	4-8	17	16-24
TGMS 31	6	4-9	17	9-22
TGMS 60	6	4-9	17	12-20
TGMS 71	5	4-9	17	15-21
TGMS 78	5	4-8	15	13-19
TGMS 130	6	4-9	18	14-18
TGMS 131	6	4-9	17	13-21
TGMS 132	6	4-9	17	13-20
TGMS 134	5	4-8	17	14-21

Table 43b. Pollen and spikelet sterility of TGMS lines seeded on October 1, 2012

Entry	Pollen sterility (%)	Spikelet fertility (%)	Critical stages	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Mean temperature (°C)
TGMS 7	CS	0	Nov 30-Dec 9	30.3	23.8	27.1
TGMS 11	CS	0	Nov 30-Dec 9	30.3	23.8	27.0
TGMS 31	CS	0	Nov 30-Dec 9	30.3	23.8	27.0
TGMS 60	PS	10.2	Dec 19-Dec 28	29.6	23.0	26.4
TGMS 71	S	6.1	Dec 6-Dec 15	29.9	23.7	26.8
TGMS 78	S	2.3	Dec 2-Dec 11	29.7	23.7	26.3
TGMS 130	PS	10.6	Nov 29-Dec 8	30.7	23.8	27.3
TGMS 131	PS	6.8	Dec 4-Dec 13	32.6	23.7	26.6
TGMS 132	PS	22.2	Dec 18-Dec 27	29.3	23.3	26.3
TGMS 134	CS	0	Dec 19-Dec 28	32.5	23.3	26.4

IV. Development and Improvement of Seed and Seed Production Technologies

Susan R. Brena

The continuous development of new rice varieties requires corresponding recommendation in terms of water management, fertilizer application, and pest management to attain the maximum benefit such as highest seed yield. Moreover, the increasing number of hybrid varieties released yearly is not only limited to CMS based hybrids but more on the TGMS based. This needs evaluation of production sites in the country to program seed production activities that will supply the seed requirement of the Filipino rice farmers.

Aside from the development of production protocols, seeds that are not utilized for planting after each season are stored in storage. For inbred, storage is normally done in warehouses under ambient condition, however, hybrid parental lines require conditioned storage to maintain seed quality longer. While in storage, there is a need to regularly monitor seed viability and vigor. The studies under this project addressed many issues to increase seed yield and preserve quality of both hybrid and inbred varieties.

Seed storage research of inbred and hybrid

SR Brena, J Manangkil, AR Sagun, and A Sanchez

The success of hybrid rice seed production depends on the quality of the seeds used for planting. PhilRice Los Baños is tasked to produce and maintain parental lines of released varieties of public hybrids. After cleaning and fumigation of each parental line every cropping season, they are maintained in air conditioned storage in PhilRice LB at 160C. Every year these parental lines are sampled and tested for germination.

In germination test, rules prescribed by the International Seed Testing Association rules for seed testing were strictly followed. Four replications of 100 seeds per replicate were seeded in moist paper towel. The in-between paper method of seeding was followed. First counting was done 5 to 7 days after seeding and seeds which did not germinate during the first test were allowed to germinate for 7 more days before the second counting. Only normal seedlings were reported in germination test.

Parental lines tested in 2012 were IR58025A, IR58025B, IR68897A, IR68897B, PRUP TG101M, PRUP TG102M, and all R lines of various released public hybrids. These parental lines were tested twice in 2012 but others were tested only once. Results of the germination test in 2012 were:

Highlights:

- IR58025A, the A line or the female parent of PSB Rc72H stored in conditioned storage, was harvested in 2009 DS and 2011 DS. Those harvested in 2009 DS had high germination even after three years of storage. Those harvested in 2011 DS had 98% germination.

- IR58025B in storage which is used in the AxB seed production to produce the A line (IR 58025A) was produced in the dry seasons from 2009 to 2011. Regardless of production season, all samples had higher than 90% germination in two testing periods (June and September 2012).

- IR68897B stored in storage which is used in the production of A line during the AxB seed production of IR68897A and IR68897B was harvested in four consecutive seasons starting from 2008 DS. Samples harvested in 2008 DS showed only 81% and 82% germination in two tests. These samples were below the 85% national standard but can still be used for planting with adjustment in seeding rates.

- The same parental lines harvested in 2010 and 2011 DS had more than 90% germination in 2012 (Table 44).

- Other parental lines tested once for germination were 42 bags PRUP TG101M, 22 bags 102M, and 178 bags of assorted R lines. These lines had more than 90% germination and were distributed for planting after testing.

Table 44. Percentage germination in parental lines stored in conditioned storage in PhilRice Los Baños.

Parental lines	Production season	Number of bags tested	First test in 2012		Second test in 2012	
			% Germn	Date Tested	% Germn	Date Tested
IR58025A	DS 2009	12	89	June 12	92	Nov 12
	DS 2011	31	98	June 18	98	Nov 9
IR58025B	DS 2009	6	93	June 14	96	Sept 18
	DS 2010	57	98	June 14	96	Sept 18
	DS 2011	53	93	June 14	93	Sept 18
IR68897B	DS 2008	19	81	June 7	82	Sept 24
	DS 2009	25	89	June 7	84	Sept 24
	DS2010	87	97	June 11	97	Sept 24
	DS 2011	23	96	June 11	94	Oct 12

Identification of best location and time of the year/season optimum for seed production and quality
SR Brena, D dela Cruz, I Boholano, NO Mabayag, and MJ Osano

In 2012, this study focused on thermo-sensitive genetic male sterile (TGMS) hybrid seed production with the main objective of establishing SxP seed production with optimum yield and quality. During seed production of the two released TGMS hybrids, NSIC RC202H and NSIC RC204H, the S lines produced in the male fertile environment (MFE) were planted in the male sterile environment (MSE) with a mean temperature of around 27 to 35 oC. The area must be isolated by 100m from possible source of pollen contamination, 21-day time isolation, or through natural barriers such as fruit trees. Based on previous trials, the best locations identified for SxP seed production are the provinces in Mindanao (Davao area) and Visayas (Negros area). Generally, seed production in the northern part of Luzon is discouraged due to the long cold spell experienced in the region during DS cropping which results in selfing. Thus, during DS, F1 seed production in the Visayas and Mindanao areas should be timed such that flowering will coincide in the second week of April. In SxP seed production, control plot is established to determine the degree of selfing of the S lines in the seed production plot. All other management practices are almost similar in AxR seed production.

There were three sites evaluated in the Visayas:Kananga, Leyte; Negros Occidental; and San Jorge, Western Samar. In Mindanao, SxP seed production was established in Musuan, Bukidnon; Agusan; Midsayap; North Cotabato Davao del Sur; Davao del Norte; Davao Oriental; and South Cotabato. The only site tested in Luzon was Los Baños. The TGMS seed production in several PhilRice stations was detailed in the findings.

Highlights:

- TGMS seed production can be done in PhilRice stations in Agusan, Los Baños, Midsayap, and Negros. The long cold spell experienced in Bukidnon from December until the early part of March resulted in selfing. The whole area was rejected (Table 45). The very low yield obtained in PhilRice Midsayap was attributed to late planting which resulted in high incidence of pests. In PhilRice Agusan, SxP seed production of Mestiso 19 yielded 345kg. Timing of planting should be adjusted during DS in Agusan to maximize seed yield.

- Regardless of season, seed yield of Mestiso 19 in PhilRice Negros was lower than Mestiso 20. Low tillering capacity was observed in PRUPTG101M (P line). Seed contractors in Mindanao also observed this. Likewise, the pollen load noted in M19 was less than those observed in Mestiso 20.

- Seed yield of more than 1 ton per hectare was observed during dry season in Davao del Sur, Del Norte, and Davao Oriental. However, it was only in Davao del Norte where seed yield was also more than 1 ton during WS. The susceptibility of the S –lines to kresek which can only be controlled by copper – based bactericide resulted in lower seed yield during WS.

- In Mindanao provinces where high seed yield was attained during DS, transplanting was done during the last week of January. At this time, the cold in Mindanao is already finished before the onset of panicle development, particularly stages 2 to 4 which are sensitive to low temperature.

Table 45. Average yield obtained in SxP seed production sites during 2012 cropping seasons.

SxP sites	Production Season	Average Yield (kg/ha)	
		Mestiso 19	Mestiso 20
PhilRice – Agusan	2012 DS	345	
PhilRice – Bukidnon	2012 DS	Selfing observed	
PhilRice– Los Baños	2012 DS	495	968
PhilRice – Midsayap	2013 WS	130	
PhilRice – Negros	2012 DS	485	603
		325	458
Kananga, Leyte	2012 DS	270	
	2012 WS	216	
San Jorge, Western Samar	2012 DS	240	
Davao del Sur	2012 DS	1,228	
	2012 WS	702	
Davao del Norte	2012 DS	1,296	
	2012 WS	1,116	
Davao Oriental	2012 DS	1,062	
	2012 WS	846	
South Cotabato	2012 DS	417	

Characterization of commercial CMS lines for stability in pollen sterility

LV Guittap, EE Sajise, GT Sulte, TM Masajo, FM Xie, and JL Lales

The use of hybrid rice is a proven technology in increasing yield in the Philippines and elsewhere. To date, 25 hybrids have been released as commercial varieties by the National Seed Industry Council (NSIC) where the majority is based on the cytoplasmic male sterility (CMS) system. Among the released hybrids, eight are public hybrids utilizing five different CMS or A lines as female parents. These are IR58025A (A line of Mestizo 1), IR68897A (A line of Mestiso 3, 7, and 25), IR73328A (A line of Mestiso 21 and 26), PR2A (A line of Mestiso 17), and PR3A (A line of Mestiso 18). However, instability in pollen sterility expression in the A lines was noted on the CMS lines. Stability of sterility in the A line is an important factor in CMS-based system because of its effect on seed genetic purity of F1 commercial seed. Knowledge of stability of sterility in commercially used CMS lines will be very helpful in monitoring purity and quality in AxB and AxR seed production. Stability can also be used as basis for selection in breeding and improvement of CMS lines. The study aimed: to (1) characterize commercially used CMS lines for stability in pollen sterility; (2) characterize the CMS lines for their important agro-morphological traits with emphasis on blooming habits; and (3) observe and identify other traits and behavior of the A lines that can be useful in improving seed multiplication and management of the CMS lines.

Highlights:

- Stability of completely sterile (CS), sterile (S), and partially sterile (PS) CMS lines were checked by comparing the progenies of backcrossed individuals with different pollen sterility category to its corresponding B lines. Populations of commercially used CMS lines (IR58025A, IR68897A, and IR73328A) were established for the study. At the onset of flowering, each CMS line was checked for sterility through microscopic evaluation of the pollen and about 20 plants from each category was backcrossed to the B line. Backcrossing will continue for four generations to monitor and compare stability in pollen sterility of the A line in each BC generation.

- In 2012 dry season, 19 CS, 20 S, and 15 PS individuals of IR58025A were backcrossed to IR58025B. Same was done on IR68897A where 12 CS, 19 S, and 16 PS individual plants were crossed to their corresponding B lines. Part of the seeds of BC1 was used to raise plants for pollen sterility observation and for crossing with the B line to generate BC2. The number of seeds produced from each of the BC1 and BC2 ranged from 23 to 147. BC1 and BC2 seeds were kept and stored in a conditioned room for comparison later.

- Stability study on IR73228A, the CMS line of the recently released three-line hybrids of IRRI, commenced in 2012 WS. For this line, 17 CS, 16 S, and 11 PS individuals were crossed with IR73228B. On the other hand, backcrossing activities for PR2A and PR3A were not done due to unavailability of pure seeds.

- Starting April 2012, monthly planting of the CMS lines were established to observe stability of pollen sterility with reference to the month it was planted. The CMS lines were also characterized for important agronomic and flowering characteristics.

- Initial data showed that days to 50% heading (50% DTH) of IR58025A ranged from 85 to 92 days. On the other hand, heading dates of IR73328A and IR68897A were almost the same. Earliest recorded 50% DTH was 76 days after sowing while 85 days was the longest. For PR2A and PR3A (CMS of PhilRice-bred hybrids) days to 50% heading varied considerably with month of planting (77 to 89 days).

- Duration of anthesis for all CMS lines was about two hours starting at 9:00 AM to around 11:30 AM. Anthesis of IR68897A, PR2A, and PR3A commenced earlier at 9:00 AM while IR58025A and IR73328A begins flowering at around 9:30 AM.

Differential effect of GA3 grade, time, and frequency of application
JC Descalsota, LV Guittap, and TM Masajo

Among the cultural practices to encourage higher rates of out-crossing is the application of GA3 (gibberelic acid). In hybrid rice seed production, increasing the height of the male parent by spraying GA3 allows for better pollen dispersal over the female parent. In addition to increase height and better panicle exsertion, GA3 application also prolongs floret opening and stigma receptivity promoting higher seed set and seed yield. While GA3 has become an indispensable input among hybrid rice seed growers, different grades of GA3 in terms of source and concentration were reported as ineffective. Thus, the study aimed to confirm the claims that different sources and grades of GA3 do differ in effectiveness as reported, or if such varying responses could be attributed to genotypic differences and not to GA3 alone.

- Five sources of GA3 were tested from the following sources: (a) Certified Chemical Company; (b) Bay, Laguna; (c) Los Banos, Laguna; (d) PhilRice CES; and (e) IRRI Los Baños and tested to four male sterile genotypes: PRUP TG101, PRUP TG102, IR58025A, and IR68897A. Split application of the GA3 was done to determine their effects on the flower opening duration, plant height, and panicle exsertion of the four male sterile lines. A total of

24 treatment combinations were established in three replications). Seeding and transplanting dates of the four male sterile lines were adjusted such that heading would commence approximately on the same date. Two split applications of GA3 were done following the rate being used by PhilRice in F1 seed production. Plant height and panicle exsertion was measured from five plants taken at random. Duration of flower opening was observed on plant basis.

Highlights:
2012 DS

- For all genotypes, increased in plant height were observed with GA3s from Chemical Company, PhilRice-CES, IRRI, and Bay, Laguna. At least 3-cm increase in plant height was observed. PRUP TG101, PRUP TG102, and IR68897A showed the highest increase in plant height when applied with GA3 from PhilRice CES while IR58025A with analytical grade GA3 from a chemical company. Highest increase in plant height was observed on IR68897A applied with GA3 from PhilRice CES with 11.3cm.
- Data on panicle exsertion showed no significant increase using any source of the GA3. Differences in panicle exsertion were observed between TGMS lines and CMS lines. Higher degree of exsertion was recorded among TGMS lines compared with those of the CMS lines.
- Similar to panicle exsertion, duration of flower opening for all genotypes were similar regardless of GA3 sources.
- Data showed that GA3 from Los Baños is not effective for hybrid rice production purposes.

2012 WS

- Plant height gathered from TG101M showed that there was significant increase in the height of TG101M from a rate of 150g/ha GA3 to 200g/ha. In PRUP TG 101, no significant differences were observed on panicle exsertion and plant height using any treatment.
- No significant difference in weight was observed in TG101M and PRUP TG101when applied with different GA3 grades and splitting methods.

Table 46. Plant height of the different male sterile lines treated with GA3 from different sources*.

Genotype	Plant Height (cm)						Mean
	T1	T2	T3	T4	T5	T6	
IR58025A	96.0	93.3	90.3	87.7	95.3	87.3	91.7[a]
IR68897A	96.0	99.0	94.7	89.0	96.3	87.7	93.8[a]
PRUP TG101	97.7	104.3	104.3	94.0	97.3	96.3	99.0[b]
PRUP TG102	106.7	109.3	106.7	96.7	101.7	98.7	103.3[c]
Mean	99.1[a]	101.5[a]	99.0[a]	91.9[b]	97.7[a]	92.5[b]	

*T1 – Analytical Grade GA3, T2 – PhilRice CES, T3 – IRRI, T4 – Los Banos, Laguna, T5 – Bay, Laguna, T6 - control

Table 47. Panicle exsertion of different male sterile lines applied with GA3 from different sources*.

Genotype	Panicle Exsertion (%)						Mean
	T1	T2	T3	T4	T5	T6	
IR58025A	74.5	71.7	72.9	70.8	72.5	71.2	72.3[a]
IR68897A	71.1	75.6	71.9	71.5	73.3	72.3	72.6[a]
PRUP TG101	78.5	76.5	76.3	73.8	79.3	73.3	76.3[b]
PRUP TG102	76.7	76.8	78.7	75.6	81.1	81.8	78.5[b]
Mean	75.2	75.2	75.0	72.9	76.6	74.7	

*T1 – Analytical Grade GA3, T2 – PhilRice CES, T3 – IRRI, T4 – Los Banos, Laguna, T5 – Bay, Laguna, T6 - control

Table 48. Duration of flowering opening of the four genotypes treated with GA3 from different sources*.

Genotype	Duration of Opening (min)						Mean
	T1	T2	T3	T4	T5	T6	
IR58025A	161.0	147.0	159.0	180.0	166.0	151.0	160.7[a]
IR68897A	150.3	158.3	158.0	155.3	150.7	156.3	154.8[ab]
PRUP TG101	158.7	167.7	163.7	170.7	163.0	150.7	162.4[a]
PRUP TG102	141.7	131.0	161.3	158.3	137.3	155.3	147.5[b]
Mean	152.9[ab]	151.0[b]	160.5[ab]	166.1[a]	154.3[ab]	153.3[ab]	

*T1 – Analytical Grade GA3, T2 – PhilRice CES, T3 – IRRI, T4 – Los Banos, Laguna, T5 – Bay, Laguna, T6 – control

Table 49. Plant height of TG101M after application of different rates of GA3 at different splits.

GA3 rate (g/ha)	Plant height (cm)				Mean
	1-1	2-1	3-1	0-0	
200	158.33	151.87	152.23		154.14ab
150	154.17	158.90	156.57		156.54a
100	148.53	152.40	146.37		149.10bc
50	144.23	148.13	144.00		145.46c
Control				106.80	106.80d
Mean	151.32a	152.83a	149.79a	106.80b	

Table 50. Height of PRUP TG101 applied with different splits and rates of GA3

GA3 rate (g/ha)	Plant height (cm)				Mean
	1-1	2-1	3-1	0-0	
200	87.73	89.50	87.37		88.20a
150	89.60	88.27	85.47		87.78ab
100	88.07	88.93	87.27		88.09a
50	87.50	85.93	83.87		85.77b
Control				79.45	79.45c
Mean	88.23a	88.16a	85.99b	79.45c	

Table 51. Panicle exertion upon application of different GA3 rates at different splits.

GA3 rate (g/ha)	% Exsersion				Mean
	1-1	2-1	3-1	0-0	
200	72.66	73.14	74.31		73.37a
150	73.58	73.85	70.78		72.73a
100	72.99	72.56	73.38		72.98a
50	72.32	73.44	73.77		73.18a
Control				72.98	72.98a
Mean	72.89a	73.25a	73.06a	72.98a	

Table 52. Seed yield using different GA3 rates at different splits

GA3 rate (g/ha)	Yield (ton/ha)				Mean
	1-1	2-1	3-1	0-0	
200	0.473	0.492	0.653		0.540ab
150	0.618	0.470	0.280		0.456ab
100	0.608	0.797	0.609		0.671a
50	0.640	0.648	0.467		0.585a
Control				0.264	0.264b
Mean	0.585a	0.602a	0.502ab	0.264b	

Seed increase of basic parental stock of promising PhilRice and UPLB-bred hybrids
EE Sajise, SH Escamos, LV Guittap, G.T. Sulte, and TM Masajo

Hybrid rice breeding broadly covers the development of parental lines, seed production of parental lines and experimental hybrids, and evaluation of hybrids. A hybrid rice breeding program needs a well-organized seed production and storage system to have a reliable and sufficient supply of pure parental seeds of the hybrids that are being evaluated. This will ensure that F1 and parental seeds of hybrids identified as promising are available for testing until they are released as varieties. Seed production and seed maintenance activities are essential in hybrid development work. The project aimed to (1) produce and maintain sufficient supply of hybrid parental seeds of the hybrids being developed by PhilRice and UPLB; (2) provide needed seeds to reconstruct the hybrids for field testing; and (3) gather important agro-morphological data needed in developing F1 seed production protocols for the promising hybrids.

Highlights:

- The TGMS parents of four promising two-line hybrids in the advance yield trial identified as possible entries to NCT were planted in 2012 DS for initial seed increase. Grown at the male fertile environment (MFE) site in Tublay, Benguet were TGMS 31 and TGMS 71 which are PhilRice-UPLB bred TGMS parent lines. TGMS 31 is the female parent of one of the hybrids while TGMS 71 is the parent of the three other promising hybrids.

- For TGMS 31, remnant seeds from 30 individual plant selections confirmed sterile in the 2011 WS Evaluation Nursery at Los Banos, a male sterile environment (MSE), were bulked and planted for nucleus seed production at MFE. Amount of nucleus seeds of TGMS 31 produced was 6.9kg. TGMS 71 was likewise grown at MFE to raise seeds needed by breeders for F1 seed production activities. A total of 42kg dry and clean seeds of TGMS 71 were produced. F1 seeds of promising hybrids are needed for nomination to NCT.

- The four pollen parents of the promising hybrids were also seed increased in 2012 WS. Among the lines planted were SN 722, SN 776, SN 769, and SN 812. About 1kg each of seeds of the pollen parents lines were harvested and processed.

- Seeds produced were supplied to breeders keeping about 250kg for each line in storage to serve as file and as source for future seed multiplication, if needed.

Yield potential determination of promising lines and new rice varieties
MD Malabayabas, TF Padolina, SR Brena, CR Esaga, FM Ramos, and NO Mabayag

The use of rice varieties with high yield potential is one of the key factors in achieving higher productivity and rice self-sufficiency. Along with genotype, crop management like nitrogen application and location has large contribution to the attainment of yield potential. Thus, the maximum yield potential of new varieties and promising lines and the associated N management must be determined before recommendation to farmers and other stakeholders.

The study was conducted at PhilRice CES in 2012 DS and WS. There were five new inbred varieties namely NSIC Rc216, Rc224, Rc226, and Rc240; promising line, IL-035; and three hybrids, NSIC Rc202H (M19), Rc204H (M20), and Rc244H (M29). PSB Rc18 and Rc82 were used as check varieties. N management treatments were (N1) Leaf Color Chart (LCC)-based N topdressing of 35kg N/ha and 23kg N/ha during DS and WS, respectively, when LCC was below four. Basal application was based on PalayCheck recommendation of six bags 14-14-14 during DS and four bags during WS. N (N2) application was at 200kg N/ha during DS and 150kg N/ha during WS. The experiment was laid out in split plot design in RCBD with three replications, where nitrogen management was the main plot and variety as sub-plot.

Highlights:

- The yield of new varieties/promising line in PhilRice-CES ranged from 8.0 to 9.6t/ha during DS (Table 53) while 7.4 to 9.3t/ha during WS (Table 54). NSIC Rc240 gave significantly higher yield than the checks Rc18 and Rc82 but not significantly different from Rc216, Rc224, M20, and IL-035 during DS. Other varieties had comparable yields with Rc18 and Rc82. During WS, Rc240, Rc224, and Rc226 significantly out yielded both check varieties.

- In Tabuk, Kalinga, grain yield of new varieties ranged from 5.95 to 6.74t/ha during DS (Table 53). NSIC Rc226, M20, and M29 showed significantly higher yield than the checks while the yield among new varieties were comparable. The yield ranged from 6.64 to 7.82t/ha during WS (Table 54), relatively higher than the DS yield. New varieties showed comparable yield with Rc18 and out yielded Rc82 except M29.

- In Banaybanay, grain yield of new varieties ranged from 7.40 to 9.12t/ha during DS (Table 53). M20 and Rc224 showed comparable yield with PSB Rc82. M19 had significantly the lowest yield among the new varieties and was comparable with Rc18. Rc226, Rc240, IL-035, and M29. During WS, the yields ranged from 6.63 to 7.8t/ha (Table 54). There was no significant yield difference among the new varieties including the checks.

- Yield potential in PhilRice-CES and Banaybanay during DS was significantly higher with N application of 200kg N/ha (Table 55). On the other hand in Kalinga, there was no significant difference in yield among N treatments because the area is located in low lying area where water is difficult to manage, hence, the experimental area was changed in WS. During WS, there was no significant difference in yield potential of test varieties with LCC-based N topdressing and N application of 150kg N/ha in all three locations. The amounts of N applied based on LCC differed with varieties and locations.

Table 53. Grain yield of promising line and new varieties, DS 2012.

Variety/line	Location		
	PhilRice-CES	Tabuk, Kalinga	Banaybanay, Davao Oriental
PSB Rc18 (check)	8.03 bc	5.35 c	7.50 de
PSB Rc82 (check)	7.43 c	5.51 bc	8.38 abc
NSIC Rc216	8.57 abc	6.37 ab	8.28 bcd
NSIC Rc224	8.82 ab	5.95 abc	8.56 ab
NSIC Rc226	8.44 bc	6.74 a	8.13 bcde
NSIC Rc240	9.64 a	6.18 abc	8.20 bcde
IL-035	8.81 ab	6.46 ab	8.13 bcde
NSIC Rc202H (M19)	8.04 bc	6.21 abc	7.40 e
NSIC Rc204H (M20)	8.78 ab	6.68 a	9.12 a
NSIC Rc244H (M29)	8.18 bc	6.51 a	7.55 cde

In a column, means with the same letter are not significantly different at 5% level of significance by LSD

Table 54. Grain yield of promising line and new varieties, WS 2012.

Variety/line	Location		
	PhilRice-CES	Tabuk, Kalinga	Banaybanay, Davao Oriental
PSB Rc 18	7.83 bc	7.13 ab	6.99 a
PSB RC 82	7.29 c	5.57 c	7.40 a
NSIC RC 216	7.42 bc	6.93 ab	7.56 a
NSICRc 224	8.21 abc	6.87 ab	6.97 a
NSIC Rc 226	8.46 ab	7.32 ab	6.63 a
NSIC Rc 240	9.33 a	6.72 ab	7.76 a
IL-035	8.09 bc	6.77 ab	6.98 a
NSIC Rc202H (M19)	7.42 bc	7.32 ab	7.29 (2 reps)
NSIC Rc204H (M20)	7.38 bc	7.82 a	7.01 a
NSIC Rc244H (M29)	7.48 (rep 1)	6.64 bc	7.67 a

M29 was planted only in one replication in PhilRice-CES while M19 was planted only in two replications in Banaybanay due to lack of seedlings.

Table 55. Grain yield of promising line and new rice varieties at 2 N management, 2012 DS.

Nitrogen rate	PhilRice CES	Tabuk, Kalinga	Banaybanay, Davao Oriental
LCC-based N application (N1)	7.89 b	6.28	7.76 b
200 kg N/ha (N2)	9.06 a	6.11	8.49 a

In a column, means with the same letter are not significantly different at 5% level of significance by LSD.

Nucleus and breeder seed production studies of new recommended hybrid varieties

EE Sajise, LV Guittap, GT Sulte, TM Masajo, JL Lales, and FM Xie

The hybrid rice technology has proved to be effective in increasing production of rice in the country. To date, 28 hybrids have been released by the National Seed Industry Council (NSIC), 13 of which are public hybrids developed by IRRI, PhilRice, UPLB, or collaboration among them. Upon release of a hybrid variety, seed purification and production of parental and F1 seeds follow to popularize and commercialize the hybrid. Likewise, protocols on basic and F1 seed production methods have to be studied and established to give proper recommendation to hybrid seed growers for the two new hybrids developed by IRRI, IR82363H (NSIC Rc 214H or Mestiso 25) and IR82372H (NSIC Rc 216H or Mestiso 26).

The study had the following objectives: (1) check purity and genetic identity of component (parental) lines of NSIC Rc 214H (Mestiso 25) and NSIC RC 216H (Mestiso 26); (2) characterize the two new NSIC hybrids and their component parent lines based on agro-morphological and grain characters; (3) develop the protocol on the method of basic seed production of the parents and the F1 of Mestiso 25 and Mestiso 26; (4) conduct field test to evaluate the seed production protocols developed; and (5) conduct initial seed increase of the parents to prepare for their popularization and commercialization.

Highlights:

- Seed purification and multiplication of the parent lines of Mestiso 25 and Mestiso 26 were done in 2012. Since the seeds of IR68897A and B (A and B line of Mestiso 25) and IR73328A and B (A and B line of Mestiso 26) are already available, only the breeder seeds of the R-lines of the new released hybrids were requested from IRRI. These were SRT 3R and IR73885R, the R-line of Mestiso 25 and Mestiso 26, respectively.

- About 500 panicles each of SRT3R and IR73885R (from the initial seed multiplication in 2011 WS) were planted head-to-row for purification and selection in 2012 DS. For SRT3R, 277 entries were selected and bulked harvested producing a total of 110kg of nucleus seeds. On the other hand, only 25kg of IR73885R was produced from the 217 entries selected from the head-to-row plot. It was noted that head-to-row of SRT3R was quite uniform, unlike those of IR73885R where four different lines were observed within the population. True-to-type IR73885R were identified and selected with the help of an IRRI technician who is familiar with the line.

- Nucleus seeds from the DS were planted in the wet season to produce the breeder seeds. During the period, 100kg SRT 3R and 86kg IR73885R were processed and submitted to NSQCS for certification.

• Data on important agro-morphological characteristics and blooming habits of the parentals of Mestiso 25 and Mestiso 26 were gathered to develop a protocol for the parental and F1 seed production of the said hybrids.

  - Five-day difference in heading dates of the A and R lines of Mestiso 25 was noted based on the observations in 2012 WS. Days to 50% heading of IR68897A was 81 while SRT 3R was 86 days. On the other hand, it was observed that there is a significant height difference between IR68897A and SRT 3R. Recorded plant height of the A line was 83cm and SRT 3R was 104cm. The shorter difference in days to flowering and the height advantage of the R line over the A line is considered ideal for F1 seed production.

  - For Mestiso 26, recorded days to 50% heading of the IR73328A (A-line of M26) was 86 days while IR73885R (R-line of M26) was 96 days. A ten-day seeding differential is needed in establishing the F1 seed production to synchronize the flowering of the parents. It was also noted that IR73885R was shorter than IR73328A by about 10cm. Plant height of the R line was 104cm while IR73328A was 115cm. The shorter R line and the wider difference in the heading dates of the A and R lines may cause difficulty in attaining higher yield in F1 seed production. Management practices such as increasing GA3 concentration for application to AxR field to lessen the ef0fect of taller A line in terms of seed production yield will be studied this 2013.

- Recorded tiller number of Mestiso 25 parent lines was 19 for IR68897A and 14 for SRT 3R. Panicle length of the A and R lines was 25cm while panicle fertility of the SRT 3R was about 80%. For Mestiso 26 parentals, tiller number of IR73328A and B was 17 while IR73385R was 16. Panicle length of the A line and R line was 26cm and 27cm, respectively. Recorded panicle fertility of IR73885R was 78%. Both R lines of Mestiso 25 and Mestiso 26 exhibited rigid culm and non-shattering panicles.

- Likewise, characterization of important grain characters of the parentals and F1 hybrids was done. The brown rice of the parent lines and F1 of Mestiso 25 were all classified as long grain (7.3-7.5 mm). On the other hand, length of both A and B line seeds of Mestiso 26 was 6.3 mm and categorized as medium-grained. SRT 3R was classified as extra-long grain (7.6mm) while the F1 of Mestiso 26 fell under the long grain (7.4mm) category. All parent lines and F1 hybrids of the newly released hybrids were classified as slender with grain shape ratio of more than 3.0.

• Further observation is needed on number of days to flowering of the parent lines to recommend the best differential seeding for Mestiso 25 and 26.

Hybrid nucleus and breeder seed production

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Successful commercial exploration of hybrids in highly autogamous cereal crops like rice depends on the extent of superiority of hybrids over existing popular inbred varieties and the ease at which F1 seeds could be economically produced. It would take good-performing hybrids and an organized and efficient system of seed production and distribution to popularize and commercialize hybrid varieties. Like all hybrids involving inbred parental lines, genetic purity of the parents must be maintained to produce quality hybrid seeds in commercial quantities every time required. Pure, true-to-type, and high quality seed is essential for the successful implementation of government’s hybrid rice commercialization program. This project at PhilRice Los Baños was implemented to produce and distribute basic seeds of released public hybrids. The study involved hybrids bred by IRRI, PhilRice, and UPLB; tested in the NCT; and released as varieties by the National Seed Industry Council (NSIC). The project was implemented by PhilRice Los Baños in collaboration with UPLB and IRRI.

Highlights:

Generation of paired crosses and S line plant selections

- Pair crossing (AxB) was undertaken in 2012. During DS, 396 crosses were generated: 196 IR58025AxB and 200 IR68897AxB. IR58025A and B are the parent lines of Mestizo 1 while IR68897A and B are parent lines of Mestiso 3, 7, and 25. On the other hand, 193 pairs of IR73328A x B, the parent lines of Mestiso 21 and 26 were also generated in the wet season. In summary, total crosses made during the year were 589 for the six CMS based NSIC released hybrids.

- In the case of TGMS parents for the two-line hybrids (Mestiso 19 and 20), about 1,000 S line plants each of PRUP TG101 (Mestiso 19) and PRUP TG102 (Mestiso 20) were selected at male fertile environment (MFE) in Tublay, Benguet. The panicle fertility of each plant selections will be evaluated for trueness and sterility at Los Baños, a male sterile environment site (MSE).

A and S line evaluation and nucleus seed production

- Evaluation nurseries were established to check the trueness, uniformity and sterility of the A line (from pair crosses) and the S line (from plant selections at MFE). For 2012, a total of 3,530 entries of A and S lines were checked in the evaluation nursery broken down as follows: 314 IR58025A, 341 IR68897A, 293 IR73328A, 1000 PRUP TG101, and 1582 PRUP TG102.

- From the evaluation nursery, 139 IR58025A, 214 IR68897A, 35 IR73328A, 610 PRUP TG101, and 437 PRUP TG102 entries were identified as completely sterile and true-to-type, thus, they can be used to raise nucleus seeds.

- For nucleus seed production, 14kg of IR58025A and 8kg each of IR68897A and IR73328A were produced during 2012 DS. Corresponding amounts of the B lines were also harvested and processed. Likewise, during the period PRUP TG101 was grown in Tublay, Benguet in 2012 DS for seed increase where 18.5kg of nucleus seeds were harvested.

Breeder seed production

- For the project, total target amount of female parental breeder seeds of public released hybrids to produce was about 2.7 tons per year. This was calculated as sufficient to supply the breeder seed for F1 cultivation of 150,000 ha or 50% share of the market for hybrid. The area for breeder seed production is adjusted every year to take into account the amount of seed stock in storage.

- In 2012, 442kg of processed A line, 497kg of B line, and 283kg of R line breeder seeds of CMS-based hybrids were produced and applied for NSQCS seed certification (Table 56). Among the parental lines produced were 253kg IR58025A, 139kg R68897A, and 54kg IR73328A. The needed amount of B line to pair with the A lines were also harvested and processed.

- For the R line breeder seed production, only the restorer lines of the newly released hybrids (Mestiso 21, 25, and 26) were produced. Total R line processed and bagged was 283kg broken down as follows: 97 kg IR34686R, 100kg SRT 3R (R-line of Mestiso 25), and 86kg IR73885R (R line of M26).

- For the parents of TGMS hybrids, breeder seeds produced in 2012 were the S and P lines of Mestiso 19 and 20. During the DS seed increase at the MFE site in Tublay, Benguet, about 42kg of PRUP TG 101 and 28kg PRUP TG102 were harvested and certified as breeder seeds. At Los Banos, 448kg of the P line were produced in 2012 which includes 133kg of TG101M and 315kg of TG 102M.

Seed distribution and storage

- Amount of breeder seeds of hybrid parents produced and distributed from January to December 2012 is also shown in Table 56. Breeder seeds of CMS-based hybrid parentals distributed were mainly for foundation seed production while the S and P lines dispatched were for SxP or F1 seed production of Mestiso 19 and 20. S and P foundation seed production at PhilRice Los Baños is in support of the Department of Agriculture's TGMS hybrid promotion program.

- Sufficient amount of breeder seeds of hybrid parentals of public released hybrids are kept in the cold rooms at Seed Processing and Storage Facility at Los Banos. They are distributed to accredited hybrid seed growers on request. Total hybrid parental breeder and F1 seeds in storage are as follows: 2,402kg of A-line; 2,068kg of B line; 784kg of R line; 2,345kg of S-line; 1,967kg of P line; and 373kg of F1 seeds. All seeds in storage have high germination (> 85%) and are certified by the NSQCS.

Table 56. Summary of amount (kg) of breeder and F1 seeds produced, distributed and those currently in store in 2012 at PhilRice Los Banos (as of December 13, 2012).

Hybrid/ Parental	Amount of Breeder and F1 Seeds produced (kg)	Amount of Seeds Dispatched (kg)	Amount of Breeder Seeds in Store (kg)
Mestizo 1			
IR58025A	253	306	994
IR58025B	191	90	948
IR34686R	97	37	47
PSB Rc72H	-	26	9
Mestiso 3/7/25			
IR68897A	139	100	1378
IR68897B	191	18	1120
IR60819R (R-line of M3)	-	15	146
IR71604R (R-line of M7)	-	10	401
SRT 3R (R-line of M25)	100	-	-
NSIC Rc116H (F1 of M3)	-	1	-
NSIC Rc136H (F1 of M7)	-	5	6
Mestiso 19			
PRUP TG 101	42	3847	2,244
TG-101M	133	642	727
NSIC Rc202H	123	644	109
Mestiso 20			
PRUP TG 102	28	45	100
TG-102M	315	75	1240
NSIC Rc204H	849	16	108
Mestiso 21			
IR73328A	54	-	30
IR73328B	115	-	-
IR60912R (R-line of M21)	-	-	190
IR73885R (R-line of M26)	86	-	-
NSIC Rc206H (F1 of M21)	-	26	141
TOTAL			
A-line	446	406	2,402
B-line	497	108	2,068
R-line	283	62	784
S-line	70	3,892	2,345
P-line	448	717	1,967
F1	972	718	373

Assessing quality, purity, and genetic identity of hybrid parental lines and certified F1 seeds of public released hybrids produced at PhilRice

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Low genetic purity of F1 seeds is still a problem and a major concern in hybrid rice commercialization program. Despite the efforts of NSQCS on seed certification and PhilRice on hybrid seed production training, complaints regarding purity of certified hybrid seed and parentals are still present. Mixtures and lack of uniformity in the crop discourage farmers from growing hybrids. Good performing hybrids and availability of pure high quality seed in commercial quantities are the requirements for successful hybrid programs.

"Grow-out test" is an effective method to check the purity of the hybrid parentals and F1 seeds. However, NSQCS does not conduct this due to resource limitations and the relatively long period of evaluation required. Thus, this study was conducted to assess the genetic purity and determine trueness of the hybrid parent lines and certified F1 seed produced at PhilRice.

Highlights:

- Breeder and F1 seeds of Mestiso 1, 19, and 20 were among those included in the 2012 grow-out tests. Seeds that were checked for purity were produced by the Nucleus and Breeder Seed Production (NBSP) Project, Philrice Los Baños IGO, PhilRice Isabela, PhilRice Negros, and PhilRice CMU.

- Breeder seeds of the female parents of hybrids such as PRUP TG101 (S line of Mestiso 19), PRUP TG102 (S line of Mestiso 20), IR58025A, IR68897A, and IR73328A were assessed for purity and trueness in 2012.

    - CMS lines in the wet season grow-out had uniform crop stand, heading is within the range and other agro-morphological features (i.e. height, leaf angle, etc.) did not varied. Very few offtypes were noted in all the lines and seed sources tested (only in few isolated cases where off-types approached 2%) (Table 57).

    - Uniform crop stand was recorded in the 2012 DS and WS grow-out test of PRUP TG101 and PRUP TG102 basic seeds produced by PhilRice Los Baños in the MFE sites in Lucban, Quezon; Majayjay, Laguna; Carranglan, Nueva Ecija; and Tublay, Benguet. Crop raised from seeds from different MFE sites have uniform plant type and are true-to-type with minimum variation in heading dates. Very few off-types were noted on seeds from the three locations. Purity of PRUP TG101 ranged from 98.5% to 99.9% (Table 58).

    - Breeder seeds of PRUP TG101 produced by PhilRice CMU at Pangantukan, Bukidnon in 2011 DS had very high purity (99.8%). However, the foundation seeds produced in La Fortuna, Bukidnon in 2012 DS had only 91.5% and 96.3% purity. On the other hand, the PRUP TG 101 harvested at DS Benedicto, Negros Occidental was 99.2% pure while those produced at Tabuk, Kalinga had purity that ranged from 90.1% to 99.4% (Table 59). Discarding of seed lots coming from sources that has <98% purity is recommended.

- Seeds of PRUP TG102 produced from two different MFE sites in D.S. Benedicto, Negros Occidental and Dupax, Nueva Viscaya were assessed for purity during the period. Off-types present on seeds produced at DS Benedicto, Negros Occidental was about 2.3% and 2.5% on seeds harvested at Dupax, Nueva Viscaya. More than 2% off-types present in seed production plots were very obvious and required more labor for roguing, thus, were not recommended for dispatch to seed growers.

- Seeds of all male parents tested were more than 99% to 100% pure, crop stand was even, and with uniform heading dates and in other agromorphological characters. Minor differences observed were within the range normally shown by pureline inbred varieties. Among parentals checked were the pollen parents (TG101M and TG102M), the restorer lines (IR60912R, SRT 3R, IR73385R, and IR34686R), and the maintainer lines (IR58025B, IR68897B, and IR73328B). All the male parent lines tested were produced at PhilRice Los Banos.

- All F1 seeds tested during the DS and WS were highly pure with purity ranging from 98.37% to 100%. Uniformity within and among the hybrids checked was also observed based on agro-morphological character, heading, and plant type. Among the F1's tested were hybrids produced at PhilRice Los Banos (Promsing hybrids, Mestizo 1, Mestiso 19, and Mestiso 20), PhilRice CMS (Mestiso 19), PhilRice Isabela (Mestiso 20), and PhilRice Negros (Mestiso 19 and 20).

- It is interesting to note that although recorded "selfed seeds" in the control plot of the SxP seed production of PhilRice CMU was more than 1.0kg, very few sterile individuals (S line plants) were noted in the grow-out test of the said sample. Most of the offtypes noted in the grow-out test of Mestiso 19 from PhilRice CMU were inbreds and P line. Results indicate that the control plot was not properly isolated.

Table 57. Purity assessment of CMS lines (A-lines) produced by PhilRice Los Banos through grow-out test, 2012 WS, PhilRice, Los Baños.

Parent Line	Seed Class*	Season Harvested	DTH	Purity (%)	Pollen Sterility Category (%)		
					CS	S	PS
IR58025A	NS	2012DS	94	99.2	21	70	9
IR58025A	BS	2012DS	94	98.4	3	87	10
IR68897A	NS	2012DS	82	99.2	11	84	5
IR68897A	BS	2012DS	83	98.0	29	67	4
IR73328A	NS	2012DS	89	98.0	16	77	7

*NS - Nucleus seeds, BS – Breeder seeds

Table 58. Purity assessment of TGMS lines (S-lines) produced by PhilRice Los Baños through grow-out test.

Parent Line	Seed Class*	Season Harvested	Source	DTH	Purity (%)	Pollen Sterility Category (%)	
						CS	S
2012 DS Test							
PRUP TG101	BS	2011DS	Carranglan, N.Ecija	91	99.1	91	9
PRUP TG101	BS	2011DS	Tublay, Benguet	90	99.6	86	14
PRUP TG101	BS	2011DS	Carranglan, N.Ecija	91	98.5	83	17
PRUP TG101	BS	2011DS	Carranglan, N.Ecija	91	99.7	81	19
PRUP TG101	BS	2011DS	Tublay, Benguet	90	99.8	87	13
2012 WS Test							
PRUP TG101	BS	2012DS	Tublay, Benguet	95	97.0	91	9
PRUP TG101	FS	2012DS	Lucban, Quezon	95	99.2	93	7
PRUP TG101	FS	2012DS	Carranglan, N.Ecija	95	99.5	82	18
PRUP TG101	FS	2012DS	Carranglan, N.Ecija	94	99.5	80	16
PRUP TG101	FS	2012DS	Carranglan, N.Ecija	96	98.9	89	11
PRUP TG101	FS	2012DS	Majajay, Laguna	95	99.9	83	17
PRUP TG101	FS	2012DS	Majayjay, Laguna	95	99.9	93	7
PRUP TG102	NS	2012DS	Tublay, Benguet	92	98.43	89	11
PRUP TG102	BS	2012DS	Tublay, Benguet	91	98.71	93	7

*NS - Nucleus seeds, BS – Breeder seeds, FS - Foundation seeds

Table 59. Purity assessment of TGMS lines (S-lines) produced at different PhilRice Stations through grow-out test.

Parent Line/ Responsible Station	Seed Class*	Season Harvested	Source	DTH	Purity (%)	Pollen Sterility Category (%)	
						CS	S
PRUP TG101							
PhilRice CMU	BS	2011DS	Pangantukan, Bukidnon	91	99.8	90	10
	FS	2012DS	La Fortuna, Bukidnon	95	91.5	76	21
	FS	2012DS	La Fortuna, Bukidnon	95	96.3	83	16
PhilRice Negros	FS	2012DS	D.S.B., Negros Occ.	95	99.2	99	1
PhilRice Isabela	FS	2012DS	Tabuk, Kalinga	95	99.4	97	3
	FS	2012DS	Tabuk, Kalinga	95	92.9	89	10
	FS	2012DS	Tabuk, Kalinga	95	90.1	82	18
	FS	2012DS	Tabuk, Kalinga	95	96.8	81	19
PRUP TG102							
PhilRice Negros	BS	2011DS	DSB Negros Occ.	89	97.70	73	27
PhilRice Isabela	BS	2011 DS	Dupax, N.Viscaya		97.50	66	24

Maintenance of elite lines and working materials in hybrid rice breeding

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Hybrid rice breeding at PhilRice Los Baños, implemented jointly by PhilRice and UPLB, was initiated as far back as 1999. Focused mainly on the development of thermo-sensitive genetic male sterile (TGMS) based two-line hybrids, the project had already bred and selected about 30 elite TGMS lines and identified more than 200 prospective male parents through years of project implementation. There are also materials from wide crosses useful in hybrid breeding and a sizeable number of introduced A, B, and R lines that are kept and studied in test crosses for their potential in TGMS and CMS-based hybrid breeding. More breeding lines are being developed or introduced to further enrich the collection and strengthen the hybrid breeding project. Development of hybrid parents continues and more lines are being bred through the project. It is essential, therefore, to develop and upgrade the system of handling these materials since hybrid breeding depends on good seed management, with seed and data retrieval system properly in place. Proper conservation and handling guarantee their availability anytime for the use of breeders. Likewise, original seed stocks of parents of public released hybrids should be securely kept and viability monitored. These stored seeds will serve as reference in case problems in identity arise and as back-up seed files for regenerating the parents or hybrids if this becomes necessary.

Effective germplasm utilization requires not only the seeds but also information about the seeds presented in a manner that will allow users to identify a line of potential use in breeding. Characterization and evaluation therefore serve as the essential link between conservation and germplasm utilization. The project aimed to conserve and maintain all elite germplasm and working materials used in hybrid breeding, regenerate and/or multiply seeds including those of experimental hybrids, characterize existing germplasm pool, and develop sound seed and data retrieval system useful to the breeders.

Highlights:

- In 2012, a total of 542 lines were added to the collections of hybrid breeding working materials at Los Banos. The new collections were composed of 36 elite TGMS lines, 66 irrigated lowland entries from the NCT, 432 elite breeding lines, and eight varieties/parent lines.

- Assembled lines for maintenance with insufficient amount of seeds were planted for seed increase. During the dry season, 15 TGMS lines and 30 NCT lines were planted for seed multiplication. On the other hand, seed production activities in the wet season were done concurrently during the evaluation of the elite inbred lines by the breeders. Part of the harvests of the 430 potential hybrid breeding materials were taken for storage.

- All TGMS lines planted for seed increase at the MFE site has been characterized for basic agro-morphological characters. Postharvest characterization will continue when the harvested seeds have been processed. Information collected will be summarized to serve as reference for breeders.

- Manual cleaning and sorting of 109 working materials multiplied in 2011 have been completed and seeds are now ready for storage and/or distribution (Table 60).

Table 60. Summary of hybrid working materials manually processed in 2012 for conservation or distribution.

Hybrid working materials	Number of Lines Submitted
Pollen parents (UPLB/PhilRice TGMS Development Group)	20
Restorer lines from IRRI	32
Original seeds of IR73885R (Mestiso 26)	1
Original seeds of SRT 3R (Restorer line of Mestiso 25)	1
Elite lines from MET	14
NCT for inbred rice	14
Lines derived from wide hybridization (OWC)	27
TOTAL	109

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
$mtha^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

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We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologies so farmers can produce enough rice for all Filipinos.

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 58 agencies and 70 seed centers strategically located nationwide. To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-sufficiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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CERTIFICATION INTERNATIONAL

ISO 9001:2008 CIP/4360/Q/09/10/668
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OHSAS 18001:2007 CIP/4360/HS/09/10/668

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PinoyRice Knowledge Bank
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