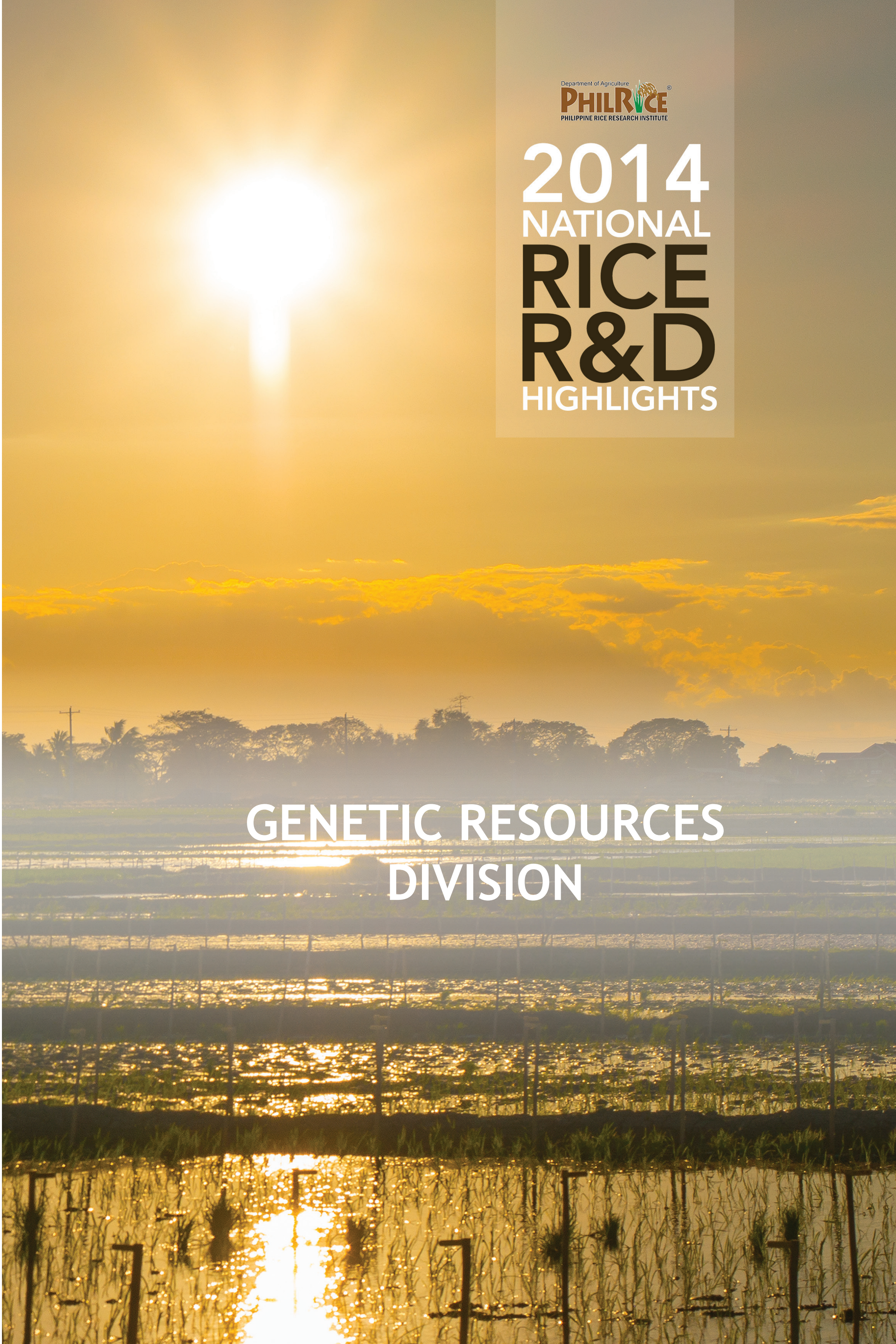

Department of Agriculture
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

2014 NATIONAL RICE R&D HIGHLIGHTS

GENETIC RESOURCES DIVISION

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GENETIC RESOURCES DIVISION

Division Head: LM Perez

Executive Summary

The importance of genetic resources in crop improvement has been recognized in the past years. Breeding programs has been dependent on this vast reservoir of traits from genebank collections. The genetic resources division primarily aims to enhance research, breeding and genetic improvement of rice varieties for specific traits which leads to the development of new varieties. The current projects under the division focuses on three major functions: germplasm conservation, characterization (agro-morphological, molecular and biochemical) and utilization with emphasis on different approaches. As part of the division's increasing scope, the division started catering other crops and important biota that is equally important in the rice environment such as Azolla spp. and other beneficial microbes with biocontrol ability and could act as biofertilizer.

In order to assure availability of diverse germplasm for current and future breeding programs, the genebank conventionally implements: conservation, characterization of traditional rice varieties using international standards. Information from these activities opens breeders and researchers to gain insight on the available materials that could help increase genetic variability for broadening the gene pool of existing rice cultivars. A total of 2204 accessions/ collections (new and regenerated collections) have been processed for conservation and storage. Five hundred fifty-six accessions/ collections were processed for conservation and subjected to slow drying condition in a container with silica gel at 15 oC with approximately 40% R.H. while 1648 accessions/ collections were vacuum-packed in foil packets and stored in the medium and long term storage.

As part of the division's support in offering breeders possible donors with known resistance to major pest diseases and tolerance to various abiotic stresses; rice germplasm collections were assessed. Eighty four entries were found resistant to blast; nine entries showed intermediate reactions to bacterial leaf blight; seven entries were moderately resistant to brown planthopper; 27 were intermediate to green leafhopper; 35 were resistant to stemborer; while all materials were susceptible to tungro. In terms of abiotic stresses: Six genotypes showed drought tolerance based on biomass weight at 12% soil moisture content; while three accessions were identified with zinc tolerance.

The division recognizes the application of modern biotechnology tools in advancing gene discovery and genetic diversity assessment research of rice germplasm. One of the approaches is the use of simple sequence

repeat (SSR) on the development of multiparent advanced generation inter crosses (MAGIC). This allows genetic studies and locating multiple QTLs for important traits. Another biotechnology tool used for gene discovery is the used of next-generation sequencing wherein three Philippine traditional varieties were selected and analysis are still on-going. One key trait being addressed in the gene discovery is on fragrance genes. Three marker systems relating to fragrance are being used. Initially, 22 accessions had the fgr1 allele. The division has also benchmarked into the ethnobotanical and ethnomedicinal use of Philippine traditional rice varieties through ethnoguided surveys, documentation and collection of varieties with folk medicinal background.

As part of the division's continuous improvement, germplasm conservation procedures are still being improved. The information technology age has catapulted fast-tracking everything through digitizing. The development of various softwares has led to ease in digitizing. In the genebank, digital characterization has commenced with a software dashboard, auto cropping default from scanner source reference collection/ seed file dashboard and an additional features such as the import excel data to seed file dashboard. The optimized conservation would later support classification of the germplasm into their ecotypes. A total of 4893 accessions' ecotype was classified into Indica (3660), Japonica (82) and intermediate (1151).

As aforementioned, GRD has started in the conservation of other types of genetic resources important in the rice environment which included: 75 azolla accessions maintained in PhilRice Los Baños; 22 biocontrol agents including 11 strains Beauveria bassiana, 9 Metarhizium anisopliae, 1 Peacilomyces sp. and 1 Nomurea rileyi currently conserved and managed in PhilRice Agusan; four pure microbial isolates of Trichoderma sp., Streptomyces mutabilis, Magnaporthe grisea and Rhizoctonia solani.

One of the constraints in the utilization of germplasm by breeders, researchers and farmers is the access. Access has been the focus of the move in upgrading the division's data management through the Genebank Management System (GEMS). Aside from the increase in efficiency in doing its decision-support that helps genebank managers through their tasks of germination testing, health testing, inventory management, regeneration, characterization and distribution; interested parties could now easily request for seeds and data from the database. The traditional "GRD Walk-through Visit/Field Tour" being conducted in PhilRice, sponsored mainly by the Genetic Resources Division ushered in lots of curiosity among high school students and significantly increased utilization of traditional rice varieties by farmers during the 2014 PhilRice Lakbay Palay.

Lots of things are yet to be done, increasing inter-disciplinary approaches to facilitate fast, reliable and accurate screening method for pest and disease, current and future abiotic stresses such as phosphorus and aluminum, salinity and heat tolerance seems both promising and necessary. The division is also on the move to explore increase collaboration with various institutions in the field of bioinformatics, DNA/RNA sequencing, protein profiling. The value of these germplasm could not be replaced with just research alone without involving indigenous people who were the first users of such vast collection. The division has also engaged in discussions and formal agreements with provincial and local governments in strengthening the use of these traditional varieties especially those with strong ties in the particular geographical origin.

Among these valuable accomplishments, the PhilRice genebank with its underutilized reserve collection with large potential could consider to be promising in the quest of breeders for more resilient, high-yielding, pest and disease resistant and abiotic stress tolerant varieties that could help in increase food production and alleviate hunger in the long run.

I. Conservation, Characterization, and Distribution of Rice Germplasm

Project Leader: MC Ferrer

The Genetic Resources Division (GRD) serves as the national repository for rice germplasm. Preservation and documentation of these germplasm is of paramount importance because they may possess useful genes and serve as building blocks for the improvement of rice varieties. Collection and conservation of these rice germplasm will facilitate protection of genetic wealth, thus safeguarding Philippine rice germplasm rich diversity. Rice germplasm must be efficiently harnessed and properly assessed through agromorphological characterization to identify potential donor parents in breeding to meet the demand for rice consumption.

GRD collects and conserve rice genetic resources to ensure the future generations of available materials needed to build better rice plants. Currently, GRD holds 14,314 collections and 7,129 of which are assigned as accessions, identifying them as unique among the registered collections. Given the sheer number of germplasm, highest management practices are to be pursued. Continuity and long-term program is essential to conservation and maintenance of rice germplasm. Conservation efforts at different research station of PhilRice were implemented in synchrony with the activities and procedures done at PhilRice Genebank for better management and enhanced utilization. In all these undertakings, with the advent of the Plant Variety Protection Act, legal instrumentalities such as the Standard

Material Transfer Agreement (SMTA) will be instituted for the protection of the Philippine rice genetic resources.

Collection and acquisition of new germplasm materials

MC Ferrer, IG Pacada, LM Perez

Plant germplasm is a vital resource in generating plant types having desired traits that help in increasing food production and thus improve the level of malnutrition. Traditional varieties prove greater genetic variability and can furnish useful traits to broaden the genetic base of crop species. However these traditional genetic resources are gradually disappearing due to the introduction of improved varieties, socio-economics changes in agriculture, rapid urbanization and etc. Germplasm collections exist to conserve the genetic diversity of these crop species and their wild relatives.

PhilRice through GRD collects and conserve rice genetic resources. Rice improvement programs rely on the vast genepool represented in genebanks for the source of genes and novel alleles needed to build better rice. The wider selection and diversity of materials can be utilized for varietal improvement if more rice germplasm accessions and information available. Collecting activities prioritized the underrepresented provinces and tribal area and stored at PhilRice's own Genebank. The Institute also acquired rice germplasms through donations from its own breeders/researchers, thesis students and farmers.

Highlights:

- In 2014, GRD had acquired 1,025 germplasm. Among the collected materials, 87 are breeding lines, 59 foreign, 241 are modern, 506 traditional, and 132 wild species (Figure 1).

- The origin of newly acquired rice germplasm was shown in Figure 2. Wherein 174 are collections from PhilRice Isabela and 106 are PhilRice Batac' collections forwarded to PhilRice GRD for safety duplication.

- 100% seed files of acquired rice varieties for genebank collection were prepared for future reference.

- As of December 2014, PhilRice Genebank has 14, 314 collections and 7,129 of which are assigned as accessions, identifying them as unique among the registered collections.

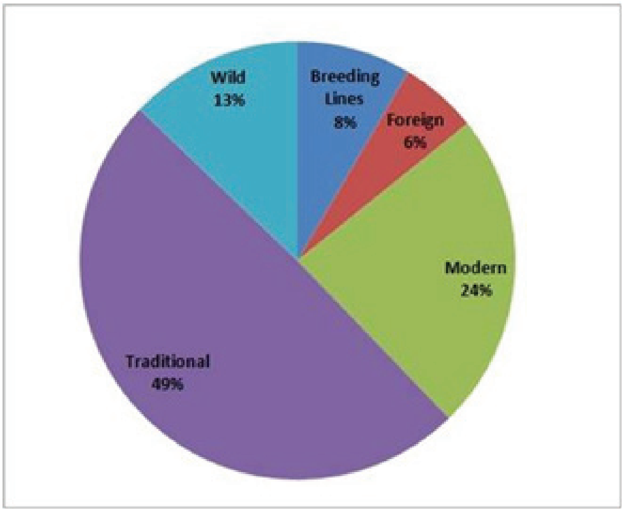

Figure 1. Types of rice germplasm acquired in 2014

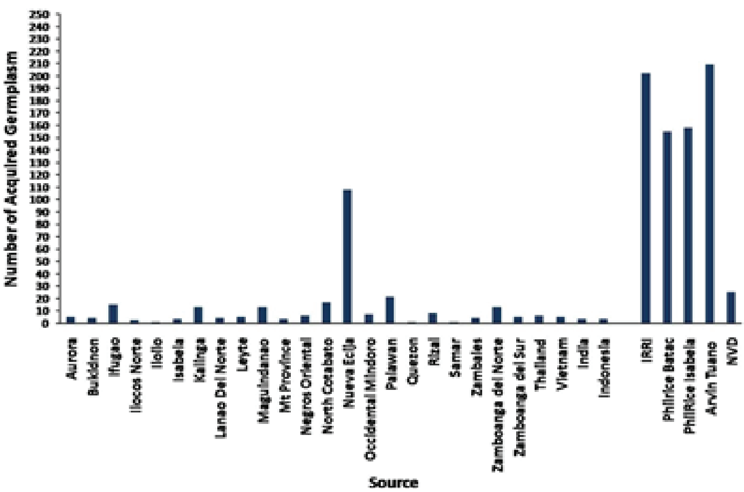

Figure 2. Sources of 2014 rice germplasm acquisition.

Regeneration and conservation of rice germplasm

MIC Calayugan, CQ Cortaga, MC Ferrer, MVG Embate, MD Duldulao and LM Perez

Increase in modern variety use has caused narrowing of genetic diversity among rice cultivars that possess valuable traits of for survival to environment changes. The Ex-situ conservation provides a safe storage system for these germplasm materials under optimal storage conditions that is efficiently managed and accessible to users. Conservation of these genetic stocks requires a continuous supply of genes of interest to the users as breeding activity progresses; therefore there is a need to conserve rice cultivars for future use. Regeneration of genebank collections is necessary due to decreasing seed viability as well as diminishing amount of seeds overtime through active distribution. Regeneration aims to increase the quantity of seed accession and restore the maximum viability of seed collection. Seed multiplication is the best way to revitalize stocks to maintain the genetic integrity of germplasm collection. Germplasm conservation plays a key role on the integration of technological developments in the field of molecular genetics, genomics, cryopreservation and geographic information system to further facilitate conservation and utilization of genetic stocks. The study aims to conserve rice germplasm resource for medium and long term storage and rejuvenate low stocks and low viability rice germplasm for conservation and distribution.

Highlights:

Regeneration

- 1,795 collections were selected for regeneration in 2014 cropping seasons (Table 1).
- Germination rate of the germplasm sown was 73.87% (1,326) entries, however only 88.56% (1,138) produced sufficient harvest in the two cropping seasons.
- The data obtained will serve as basis for regeneration of rice germplasm in the next cropping season to achieve sufficient harvest.

Conservation

- From 2013 to 2014, exactly 942 new collections were processed for conservation (Table 2).
- Regenerated materials from 2013 cropping seasons and 2014DS composed of 1,669 accessions/ collections were processed for conservation.

- A total of 2,611 accessions/ collections were tested for viability (Table 3). Ninety percent (2,086) had high viability (≥85%), while 10% (244) had low viability (< 85%).

Table 1. Summary of regenerated rice germplasm in 2014 dry and wet season.

Season	Germplasm type	Total sown	Live	Harvests	Sufficient harvests >500g
2014 dry season	New collections	55	55	702	643
	Low viability/depleting stocks	938	647		
2014 wet season	New collections	307	175	583	495
	Low viability/depleting stocks	495	449		
TOTAL		1795	1326	1285	1138

Table 2. Summary of processed rice accessions/ collections in 2014.

Type of Seeds Stock	Year/ Season	No. of Acc/ Coll vacuum packed and stored
Original/ New collections	2014	540
	2013	402
Regenerated materials	2014 DS	701
	2013 WS	777
	2013 DS	191
	TOTAL	2,611

Table 3. Summary results of viability tests conducted in 2014.

YEAR	SEASON	HIGH VIABILITY (> 85%)	LOW VIABILITY (< 85%)
2014	Original/ New	231	216
	Original/ New	556	0
2013	DS	775	19
	WS	524	9
TOTAL		2086	244
OVERALL TOTAL			2,330
% HIGH / LOW VIABILITY		*90%*	*10%*

Germplasm distribution and information management

MD Duldulao, CQ Cortaga, MC Ferrer and MIC Calayugan

Genebank Documentation System (GEDS) was a relational database management system developed to document, manage, and centralize the large quantities of data of all germplasm conserved in the genebank. This includes germplasm data on passport; agro-morphological characterization; grain quality, biotic and abiotic stresses evaluations; viability conditions; and inventory. The GEDS maintains accurate, reliable and up-to-date rice germplasm information, thus, facilitates ease of data search and retrieval for better access and use of germplasm.

PhilRice genebank regulates the release of seeds that can be used in research, breeding methods and genetic improvements to support the utilization of rice genetic resources. This is accompanied with Standard Material Transfer Agreements (SMTAs) that defines the terms and conditions for use of germplasm agreed upon between PhilRice and receiving party and vice versa. Germplasm data request is offered to rice breeders, researchers, and individuals for their germplasm/ traits of interest.

Highlights:

- 104 seed requests covering 1,801 rice accessions/ collections have been distributed to both PhilRice and non-PhilRice individuals. The purposes of the requests were mostly intended for seed increase and breeding/ genetics studies (Figure 3).

- In terms of request for germplasm information, 15 data requests have been catered and provided to PhilRice and non-PhilRice individuals for research and education purposes (Table 4).

- To properly document release and receipt of rice germplasm, 11 SMTA's and 8 PMTA-GUD's have been issued covering 346 rice varieties. SMTA is being used to protect intellectual properties or rights over the rice varieties being provided to non-PhilRice staff. PMTA-GUD serves as an attachment to the SMTA for additional conditions on the transfer of breeding lines.

- Exactly 43 SMTA's from IRRI for the seeds requested by PhilRice researchers were accepted by PhilRice through the GRD Head were monitored. Some of these germplasm transfers from IRRI have additional IRRI-MTA attachments such as OMTA and CMTA for materials classified as non-sensitive and sensitive germplasm respectively.

- Development of new database management system that features barcoding system for seed inventories and distribution (Figure 4) was the new milestone of germplasm conservation and management. The system operates under Filemaker Pro 12 Advanced after its successful system upgrade and data migration from old database system.

- The GEDS containing important rice germplasm data was updated: passport data (2382 collections), characterization data (476 entries from 2013DS and 614 entries from 2013WS), IRGC-based characterization data (737 accessions), grain quality data (774 collections/ accessions), salinity evaluation data (86 collections/accessions) and inventory data (2,794 accessions).

Table 4. Germplasm data requests received and processed in 2014.

2014-GBDR-	REQUESTED BY/ AGENCY	DESCRIPTION OF DATA REQUESTED	PURPOSE OF REQUEST
0001	Gervin S. Tandingan/ NEUST	Accession basic info, biological status, and collecting location data of traditional rice varieties collected in Nueva Ecija	For related literature for the study on "Promotion and commercialization of traditional varieties in Nueva Ecija
0002	Arnold Allen S. Chin/ PBBD	Accession basic info , GQ, reactions to different rice diseases and abiotic stresses, and maturity of 19 commercial and traditional varieties	For breeding on abiotic stress tolerance
0003	Noriel Angeles/ PhilRice LB	Accession basic information, morpho-agronomic descriptions at harvest and post-harvest stage, reaction to different rice diseases, GQ, and plant height of 101 traditional varieties	For the study "Compatibility of modern and traditional rice varieties on biofertilizers in upland conditions (cultivar mixtures in upland rice)"
0004	Arvin Tuaño/ PhilRice LB	Scented and lightly scented germplasm with accession basic info, passport data, characterization data, and abiotic and biotic stresses evaluations data	Study on Fragrance/ aroma in rice
0005	Arvin Tuaño/ PhilRice LB	Accession basic info and collecting location data	Study on AC and GT in rice
0006	Arnold Allen Chin/ PBBD	Accession basic info, collecting location, abiotic and biotic stresses evaluations data, and maturity date of traditional varieties	For hybridization study
0007	Arlen A. dela Cruz/ PBBD	Reaction to tungro of traditional varieties	For genetic/ tungro studies
0008	Rosa Mia F. Cabanting/ GRD	Accession basic info, collecting location data, and seed coat color of traditional varieties	For the study "Ethnoguided survey and collection of

Table 4. Germplasm data requests received and processed in 2014. (Cont...)

			Philippine medicinal TRV's"
0009	Josel Reyes/ Catanduanes DA/ LGU	Accession basic info and collecting location data of traditional rice varieties available	For selection of available traditional rice varieties in Genebank
0010	Arnold Allen S. Chin/ PBBD	Accession basic info; morpho-agronomic descriptions at vegetative, reproductive, harvest, and post-harvest stages; reaction to different rice diseases and physio-chemical stresses; maturity; grain length and width; varietal group; endosperm type; seedcoat color; and plant height of 5 traditional and modern varieties	For research in breeding drought-tolerant varieties
0011	Arnold Allen S. Chin/ PBBD	Accession basic info; morpho-agronomic descriptions at vegetative, reproductive, harvest, and post-harvest stages; and reaction to different rice diseases and physio-chemical stresses of Genebank materials with maturity below 90 DAS	Early maturing varieties and its morpho-agronomic data for research in breeding drought-tolerant varieties
0012	Sailila E. Abdula / PhilRice-Midsayap	Germplasm with more or less 500 spikelets per panicle and 8 to 12 productive tillers.	For the study proposal "Development of next generation plant type to break yield plateau".
0013	Christopher C. Cabusora/ PBBD	Morpho-agronomic descriptions at vegetative, reproductive, harvest, and post-harvest stages; reaction to different rice diseases and physio-chemical stresses.	For research "Breeding Drought-tolerant Rice Varieties".
0014	Alvin Palanog / PhilRice-Negros	List of all rice germplasm collected in Negros Oriental and Negros Occidental and its passport data.	For the proposed study "Germplasm Collection and Management in PhilRice-Negros"
0015	Kervin N. Salarda	Maturity data of traditional and improved rice varieties.	For the study "Ratooning Ability of Irrigated Lowland Rice Genotype"

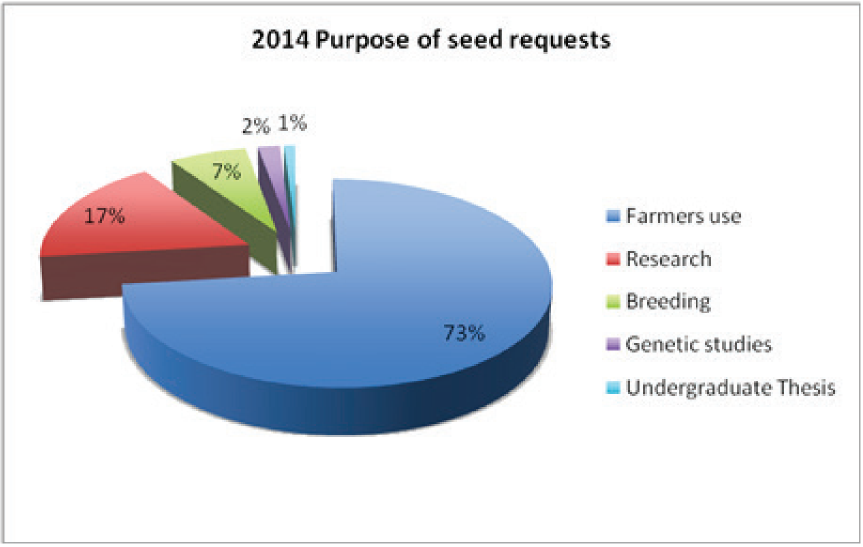

Figure 3. Purpose of seed requests distributed in 2014

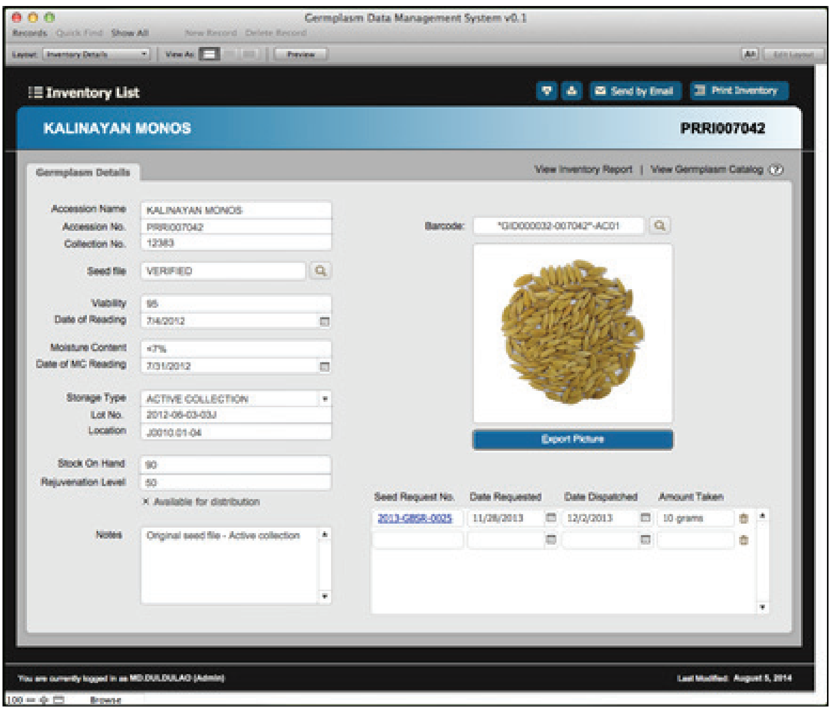

Figure 4. User interface (UI) of the Genebank Documentation System for seed inventories and distribution.

Germplasm Inventory

MC Ferrer, MIC Calayugan, CQ Cortaga, MD Duldulao and LM Perez

Germplasm banks play a crucial role in the conservation and use of biodiversity. Preservation of genetic integrity and prolonging the longevity is the main goal of germplasm conservation. Conservation of plant genetic resources (PGR) is not limited to attaining and physically possessing the materials (collection and storage) but also includes ensuring the existence of these under viable conditions and with their original genetic characteristics intact.

GRD as national repository for rice germplasm, collects and conserve rice genetic resources to ensure the future generation of available materials needed to build better rice plants. To improve the seed quality of conserved genetic resources, the genebank has prioritized the seed identity verification and viability monitoring of its germplasm collection. Every new seedlot produced after a cycle of regeneration should be screened and compared against its parent or most original sample, to assure maintenance of genetic integrity. A detailed inventory system was done to ensure the germplasm's genetic integrity is preserved with sufficient viable stocks through the application of standard conservation techniques.

Highlights:

- In 2014, stocks for Accessions PRRI003000 to PRRI07129 were extracted from different storage location (drying room, medium-term, and long-term storages) for inventory. From the 4129 accessions listed in the data base, only 3880 accessions were obtained from the storage while 249 accessions were missing.

- To ensure that the conserved germplasm are still the same as the original collection, seed identity were verified through cross-checking with available seed files, planting plans and panicle files. Comparison between the seed lot and the seed file was done to verify the identity of the seed lot and the status of the seed quality (ie mix, mismatch, infected and etc) were also noted. Based from the 3880 accessions handled, it was noted that 3013 accession were match with the original seed files, 65 were mismatch, while 802 were without seed files and still need re-authentication (Figure 5).

- From the 3880 verified accessions, 10311 seed packets were handled. Seed samples from each stock were tested for germination and moisture content. Out of the 10311 packets, 6478 packets (65.4%) had <80% germination, 2161 packets (21%) had >80% germination while 1402 packets (13.6%)

doesn't had data thus will be prioritize for viability testing in 2015DS (Figure 6). Accessions identified with 0 to 3% viability will be prioritized for embryo rescue this 2015DS. While accessions assessed with less than 3 to 80% viability and low stocks (>100g) will be set for regeneration.

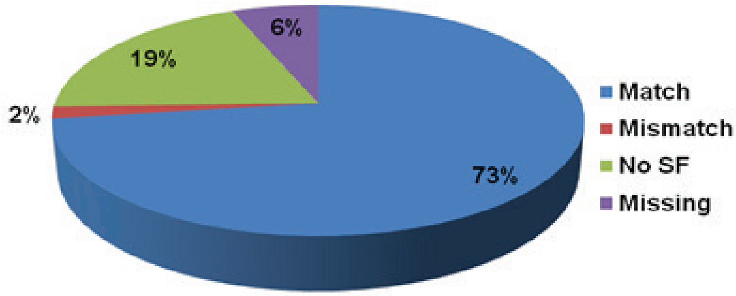

Figure 5. Inventory status of accessions PRRI003000 to PRRI007129.

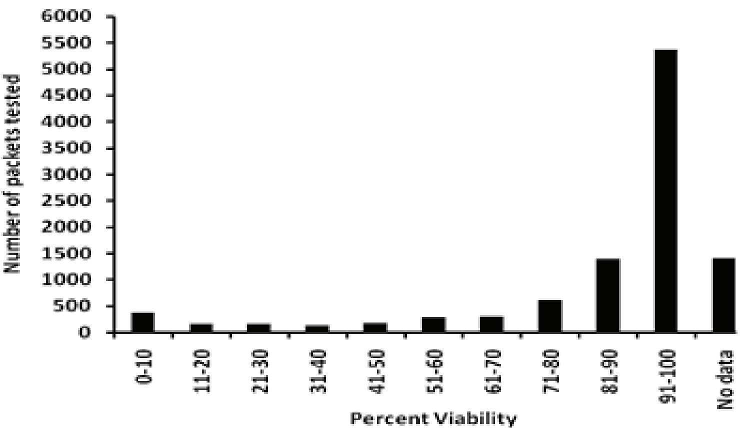

Figure 6. Seed viability status of 10311 packets of accessions tested in 2014.

Germplasm characterization
MIC Calayugan, MC Ferrer, MVG Embate and LM Perez

Characterization of each germplasm is done to establish genetic identity based on its agro-morphological characters. Germplasm characterization aims to describe each accession to establish genetic identity to avoid genetic erosion; classify collection using sound criteria; identify potential traits; develop interrelationship between or among environmental groups of cultivars and estimate range of variation. Standard descriptors for rice (Bioversity International) were used to characterize and identify the materials to efficiently harness, properly assess and identify potential parents in breeding to produce quality traits of the varieties to help meet rice self-sufficiency. Characterization and systematic study of germplasm is not only important in identifying potential donors for crop improvement but also important in protecting the unique traits for present use.

Highlights:

- 720 entries were characterized in 2014 cropping seasons using 58 quantitative and qualitative agro-morphological traits (Table 5).
- In 2013DS, a total of 175 entries were characterized in vegetative stage, 165 in reproductive stage, and 106 in post-harvest characterization. Some varieties were transferred to the screenhouse because those are late maturing and photoperiod sensitive (PPS).
- In 2014WS, 545 collections were characterized in vegetative stage, 474 in reproductive stage, and 474 in post-harvest characterization.
- The data obtained were uploaded in the Genebank Documentation System (GEDS) to be accessible for researchers to support breeding programs in PhilRice and genetic diversity analysis.

Table 5. Summary of characterized rice germplasm in 2014 dry and wet season.

Season	Entries	Vegetative	Reproductive	Post-Harvest
2014DS	175	175 collections	165 collections	106 collections
2014WS	545	545 collections	474 collections	474 collections
TOTAL		**720**	**638**	**580**

Conservation and Management of Rice Genetic Resources in Philrice Los Baños
WB Abonitalla, LV Guittap, TM Masajo, TH Borromeo, S Bon

Germplasm conservation and maintenance at Los Baños is a joint activity of PhilRice Los Baños and UPLB. Materials are processed and stored in the Seed Processing and Seed Storage facility at the branch. Germplasm materials are characterized using the standard descriptors prescribed for rice. Seeds are multiplied and accessions with low viability are rejuvenated. Seed processing and packaging in aluminum sachet is an ongoing activity. Duplicate samples are shared with the germplasm bank at CES. Main users of the collection are breeders at UPLB and the hybrid breeding project at LB branch. The collection should also be available to staff at CES and the branches on request.

The germplasm materials maintained at the station is close to about 2400 accessions consisting of 70% varietal collections (mostly traditional varieties) and 30% selections and elite lines. Wide hybridization derived lines, TGMS lines, promising hybrid pollen parents, and highly selected NCT lines are in the collection. Also stored at PhilRice Los Baños are the parentals of public released hybrids. The accessions are maintained in short-term storage at 15ºC and 50% to 60% RH mainly kept in the cold storage room. The seeds are currently being processed for medium-term storage in freezers.

It is essential to develop/upgrade the system of handling germplasm materials since breeding depends on good seed management, with seed and data retrieval system properly in place. Conservation and maintenance guarantee seed availability anytime for the use of breeders. Similarly, original seeds should be securely kept to serve as check in case problems in identity arise and as back-up seed file. Moreover, breeders require not only the seeds but also information presented in a manner that will allow them to identify lines potentially useful to programs. Data on characterization and evaluation are the essential link between conservation and use of stored germplasm.

Continuity and long-term program is essential to the conservation and maintenance of germplasm. Germplasm work at PhilRice Los Baños is now on the process of being implemented in synchrony with the activities and procedures done at CES genebank. It is essential that PhilRice's management of the germplasm resources at CES and the branches are integrated.

Highlights:

- A total of 117 accessions were added to the collection of PhilRice Los Baños in 2014 (Table 6). During the dry season (DS), 57 lines were collected while 60 materials were assembled in wet season (WS). The newly assembled materials were composed of 68 NCT lines, 20 traditional varieties, 17 SN lines, and 5 hybrid parentals. SN lines are mainly used as pollen parents in TGMS two-line hybrid breeding at Los Baños, while the 5 hybrid parentals are the new parents of public released three-line hybrids (IR81949H and PR36474H). A dwarf and a glutinous variety were also donated by UPLB which will be utilized in some research activities. F1 hybrids of released three-line hybrids were also requested from PhilRice CES three-line hybrid breeding group to be used as seed file.

- As of December 2014, a total of 225 germplasm materials were manually cleaned and sorted (Table 7). During DS, 65 SN lines, 36 NCT lines and 20 ON materials previously donated by the TGMS breeding group at LB and 34 hybrid parentals from IRRI and CES were processed. Additionally, 70 ON accessions were processed in the WS of 2014. Seed files of the processed materials have been packaged and are currently stored at the cold room of PhilRice LB. The processed accessions of SN lines are now available for request by interested researchers/breeders while NCT lines and ON lines are currently being processed. Also, viability testing of the processed accessions was done during the year. Results showed that all of the lines tested had more than 85% germination rate except in some ON lines which had a germination rate ranging from 40% to 85%.

- During the season, 72 SN accessions and hybrid parentals with germination rate of 85% and higher and with sufficient amount of seeds were packaged at GRC, IRRI. Three (3) packets (at 10 grams each packet) for base collection and 2 packets (at 30 grams each packet) for active collection were packaged for final storage. Moisture content of processed seeds has been lowered to about 6% prior to packaging and storage. The base collections were stored at the freezer inside the PhilRice LB building and the active collections were stored inside the cold storage facility. Slow drying of seeds for processing is continually being done using activated silica gels with its corresponding desiccants.

- Initial seed multiplication and morpho-agronomic characterization of 50 TGMS breeding lines was done as requested by the TGMS breeding group at PhilRice LB. Characterization of post-harvest and grain characters of the different entries is on-going. Information collected will be summarized to serve as reference for the breeders. Also, 19 accessions requested were supplied to UPLB breeders for evaluation purposes.

- The facilities at PhilRice Los Baños including the cold storage and freezers are being monitored regularly. Condition at the cold storage is being maintained at a temperature ranging from 14°C to 16°C and relative humidity from 40 to 50%.

Table 6. List of new germplasm materials collected in 2014.

Accession	Quantity
NCT Line	
DWSR	32
TPR	36
Traditional varieties	20
Dwarf	1
Glutinous	1
TGMS-hybrid parental	
SN Lines	17
CMS-hybrid parental	
CMS-line	1
Maintainer-line	1
Restorer line	3
F1 hybrids	5
TOTAL	117

Table 7. Summary of lines processed and tested for viability in 2014.

Accession	No of processed materials	No of materials tested for viability	Germination rate (%)
SN lines	65	65	= 85
NCT lines	36	36	= 85
ON lines	90	90	40-85
Hybrid parentals	34	34	= 85
TOTAL	**225**	**225**	

Collection, conservation and management of traditional varieties in Mindanao

JM Niones, JLD Genilla, MC Ferrer , LM Perez

The traditional and indigenous varieties (TRV) are cultivated and popular in the market, consumers and farmers in Mindanao. Many areas are still untouched and undiscovered in which plenty of traditional, indigenous and even wild rice varieties may be found in the Mindanao area. PhilRice is mandated to collect, conserved and protect all traditional and indigenous rice varieties in our country. The utilization of the traditional and indigenous varieties is great help in the varietal development, deployment and promotion since these traditional and indigenous varieties are already adopted and accepted by the local farmers. Improving farmer's traditional and indigenous varieties by introgression valuable traits and characters to solved the problem and enhanced the performance, in the particular locations. The farmers adoption and production of this improved traditional variety is quick and easy because the plant type and traits like by the farmers is already present but with additions of value-added traits, such as resistance and grain quality. This study aimed to proper collection, documentation, and conservation traditional germplasm in Mindanao, and the seed duplicates of the collected germplasm materials will be send to Genetic Resources Division at PhilRice CES.

Highlights:

- A total of 1185 germplasm accessions collected at PhilRice Midsayap were inventoried, properly documented and recorded. Out of 1185 accessions 1100 have seed files (Figure 7) and stored in the plastic container box.

- Nine hundred forty eight (948) out of 1185 rice germplasm were tested for germination and viability.

- 7 traditional rice varieties were collected from Senator Ninoy Aquino, Sultan Kudarat (Figure 8).

- First batch of germplasm (500 accessions) were sent as duplicates to PhilRice CES gene bank in 2014.

Figure 7. Seed file sample at PhilRice Midsayap.

Figure 8. Seven (7) traditional rice varieties collected at Senator Ninoy Aquino, Sultan Kudarat.

Germplasm collection and management in PhilRice Batac

AY Alibuyog, JM Solero, NI Martin, ES Avellanoza, GB Agustin , BM Catudan

The Philippines is still a very rich genetic source of traditional rice varieties (TRVs) which may serve as a valuable genetic resource in developing new varieties. However, these varieties are rapidly lost with the advent of modern agriculture. In December 2010, PhilRice Batac started its TRV collection and conservation activities.

Highlights:

- As of December 2014, PhilRice Batac has a total of 197 collections. These varieties were grown in uplands, highland and lowland irrigated; submerged and saline-submerged areas. New collections were recorded at the registration book, along with passport data.

- Nineteen new germplasms were collected from Pudtol and Conner Apayao; Currimao, Ilocos Norte, and; San Emilio, Ilocos Sur. These new germplasm collections were mainly grown in an upland ecosystem. A total of 197 germplasm had been collected from 2010 to 2014 in various provinces and ecosystems.

- From the total collections, 189 had seed files in coin envelopes, 76 were packed in foil packets at 20g each, 71 TRVs with seed samples in vials for display and lecture purposes and 65 with panicle samples vacuum sealed in clear polyethylene plastic

- Seeds of these collections were tested and among of 166 TRVs, 88 TRVs had good viability, 36 had poor and 39 had zero viability and candidate for embryo rescue at PhilRice CES. From the 0 viability, 24 were submitted to PhilRice CES for embryo rescue. The TRVs collected from saline-submerged ecosystem in Aparri, Cagayan were planted in lowland and highland irrigated ecosystem for regeneration and seed purification in lowland and highland irrigated ecosystem in Manabo, Abra and BatacCity, Ilocos Norte. These TRVs were already lost in its origin due to flooding and flash flooding every after transplanting. Another 50 TRVs were planted in an upland ecosystem in Comcomloong, Currimao, Ilocos Norte, wherein only 16 TRVs survived the prolonged drought experienced by the crops from maximum tillering to maturity.

Germplasm Conservation and Evaluation of Traditional Rice Varieties in Northeast Luzon

ATIO Rebong, JV Galapon

The importance of a diverse collection of rice germplasm in any breeding program is the foundation of potentially desirable new rice genotypes. An improved variety would not exist without the numerous predecessors that contributed to its development. Thus, the conservation and eventual utilization of traditional landraces as part of a crop's genetic resources is of utmost importance.

Northeast Luzon (NE) has a vast collection of rice germplasm containing a diverse source of important and desirable traits. Evaluation of collected traditional varieties from Region 2 and CAR for abiotic stress tolerance and incorporating them in our rice breeding efforts would greatly benefit our rice farmers.

Highlights:

- Total of 23 new collections were submitted by UPTECHs, wherein 2 from Ifugao, 2 from Benguet and 19 from Kalinga (Table 8). Cleaning and re- invigoration of these materials was done. These materials were seed increased and characterized in 2014 WS.

- During 2014 DS, 17 of the 37 varieties collected in 2013 WS from CAR were established. It was noted that some of the materials had low viability thus properly processed, cleaned, re-invigorated and stored for next season establishment. Characterization data gathered were been partially encoded and some traits were presented in Table 9.

- List and seed samples of 174 rice germplasm collections of Philrice Isabela were submitted to the PhilRice Genebank as safety duplicate.

- In 2014 WS, ten entries were established in the field for characterization and seed multiplication. These materials served as demo and were viewed by professors and students visited the station (Figure 9). Some important agronomic data gathered was shown in Table 10.

- Additional TRV were submitted in the wet season and were featured as heirloom collections during the National Rice Awareness Month Celebration (Table 11). These were displayed during the Brown rice day (November 14, 2014) and the Rice Mix day (November 21, 2014).

Table 8. New collection of traditional rice seeds from CAR provinces collected in 2014.

	Cultvar Name	Place of origin
1	Diket	Ifugao
2	Sinaklot	Ifugao
3	Kintoman	Kibungan, Benguet
4	Salimbua	Kibungan, Benguet
5	Dannelog	Pasil, Kalinga
6	Kuku	Pasil, Kalinga
7	Tilin	Pasil, Kalinga
8	Dumalengan	Pasil, Kalinga
9	Bolinao red	Pasil, Kalinga
10	Gin-nanayan	Pasil, Kalinga
11	Miay	Pasil, Kalinga
12	Sinalongan	Pasil, Kalinga
13	Oyak red	Pasil, Kalinga
14	Ballanito	Pasil, Kalinga
15	Camuros	Pasil, Kalinga
16	Ugsa	Pasil, Kalinga
17	Upping	Pasil, Kalinga
18	Maylo	Pasil, Kalinga
19	Kospar	Pasil, Kalinga
20	Binol-layao	Pasil, Kalinga
21	Layag-diket	Pasil, Kalinga
22	Oknor	Pasil, Kalinga
23	Dumalengan	Pasil, Kalinga

Table 9. Partial data on the characterization of entries established during 2014DS.

Cultivar Name	Tiller count	Plant height	80% maturity	Endosperm color	Total seed produced (g)
Bongkitan Red Rice	12	154.2	127	Red	4481
Balatinaw (Tacadang)	10	135.6	120	Black	3558
Balisanga(Palina)	8	137.4	122	White	481
Balatinaw red	11	158.6	no panicles produced	Black	0
Balisanga	8	150.2	123	White	661
Mongay	6	155.4	122	Red	2653
Kalong	6	153.0	122	Red	720
Lasbacan (red rice)	7	138.0	125	Red	393
Bongkitan (glutinous rice)	8	150.0	132	White	3092
Bongkitan white	9	154.2	135	White	2265
Kabol	6	153.2	122	Red	814
Balisanga (Poblacion)	9	154.6	125	White	3413
Relip Talon Bayag	13	131.6	127	White	1119
Kaniling	5	143.2	125	Red	416
Malatikan	5	149.0	125	Red	306
Shakan Talon	15	149.4	122	Red	672
Sabangan	15	149.8	123	Red	470
Balatinaw (Palina)	14	135.0	125	Black	3012
Balatinaw (Napoeng)	14	138.4	125	Black	454
Bongkitan (Glutinous Rice)	23	99.8	130	White	3092
Lablabi	18	90.5	127	Red	125

Table 10. Morpho-agronomic data of Traditional varieties characterized in 2014 WS.

Cultivar Name	Maturity (DAS)	No.of Productive tillers	Plant ht. (cm)	No. of filled grains	No. of unfilled grains	100grain wt (g)	Crop cut wt (kg)
Balatinao	130	172	11.4	150	32	3	2.5
Binontoc	123	189	10.8	127	119	3	4.5
Waray	144	182	15.4	140	22	3	6.0
Maylo	112	154	12.6	107	24	4	3.0
Manmantha	137	166	14.2	123	16	4	6.0
Binol-layao	113	173	13.8	89	21	4	3.5
Kintoman	119	153	11.0	95	39	3	3.0
Balatinaw	119	177	11.2	94	34	3	4.0
Dumalengan	111	162	12.6	105	33	3	4.6
Pinilisa	124	141	14.8	81	17	3	3.5

Table 11. Traditional varieties collected and submitted by UPTECH staff from their sites.

	Cultivar Name	Place of origin
1	Minaangan	Ifugao
2	Ugnah	Ifugao
3	Palawan White	Ifugao
4	Lacoop w/o awn	Ifugao
5	Ingudpor	Ifugao
6	Lacoop w/awn	Ifugao
7	Palawan	Ifugao
8	LopogBalatinaw	Ifugao
9	Pinilisa	Isabela
10	Dumalengan	Tanudan, Kalinga
11	Mimis	Tabuk, Kalinga
12	Ulikan red	Kalinga
13	Uskil	Kalinga
14	Mila	Kalinga
15	Unoy-sunggo	Kalinga
16	Amore	Mt. Province
17	Sariping	Mt. Province
18	Pinili	Paracelis, Mt. Province
19	Gilgilang	Ifugao
20	Balatinao	Ifugao
21	Gobierno	Ifugao
22	Kenyo	Quirino
23	Cevilia	Nagtipunan, Quirino
24	Camelo	Nagtipunan, Quirino
25	Neri	Nagtipunan, Quirino

Figure 9. Established set up for traditional varieties during 2014 WS.

II. Evaluation of PhilRice Germplasm Collection for Tolerance to Biotic and Abiotic Stresses and Grain Quality

Project Leader: JM Niones

Philippine Rice Research Institute Genebank was considered as one of the international repository of rice genetic resources, which currently holds about 12,000 accessions. It conserves a diverse pool of rice germplasm collected from different parts of the country particularly from the upland and rainfed areas. These germplasm possess desirable genes and traits that serve as building blocks for the development of improved and new rice varieties. They may also have inherent genes for key traits such as high yield, good eating quality, pest and disease resistance, and tolerance to abiotic stresses. Identifying promising rice germplasm with useful traits is an important pre-breeding activity in rice improvement. The significant value of these genetic resources, however, depends on the available information about these accessions. To date, available information on morphological and agronomic traits, reaction to biotic and abiotic stresses as well as grain quality characteristics are less sufficient. Rice germplasm therefore, must be efficiently harnessed and properly evaluated in order to identify potential genetic donors for use as parents in breeding program. This continuing project is aimed at establishing resistance of the germplasm entries to abiotic stresses, disease and insect pests. Also, generating grain quality descriptors of the PhilRice germplasm collection and efficiently providing quality data through a computerized database system.

Evaluation of Rice Germplasm for Resistance to Diseases and Insect Pests
JP Rillon, GDC Santiago, MSV Duca

Rice germplasm possesses useful genes for key traits such as resistance to insect pests and diseases. These rice germplasm needs to be continuously screened for resistance to blast, bacterial leaf blight (BLB), sheath blight (ShB), rice tungro virus (RTV), green leafhoppers (GLH), brown planthoppers (BPH) and stemborer.

In severe infections of blast, coalescence lesions cause dried leaves and whole plants are stunted and killed. Rice tungro causes yellow orange leaf, stunted growth, reduced number of tiller and incomplete panicle insertion. Bacterial leaf blight water-soaked lesion start near the leaf tip and margin, extends downward, enlarge and turn yellow to gray and the affected parts die. Sheath blight lesions gradually extend to upper leaf sheath and leaf blades and coalesce causing lodging because of leaf sheath death.

Green leafhoppers and brown planthoppers are insect pests of important concern because they spread viral diseases in the rice fields. Both nymphs and adults infest the rice crop at all stages of plant growth. As a result of feeding at the base of the tillers, plants turn yellowish and dry up rapidly. Stemborer injured the rice stem causing deadheart during vegetative stage and whiteheads during reproductive stage.

Stability of resistant accessions is dependent on many factors such as the environment and cultural management used. Resistance may breakdown at any point or it may remain the same. Resistant accessions will be used as parent materials for new crosses of potential rice varieties.

Highlights:

- Two hundred PhilRice germplasm accessions were evaluated for resistance to blast, bacterial leaf blight, sheath blight, rice tungro virus, green leafhopper, brown planthopper and stemborer. Evaluation was done for blast at 30-35 DAS; BLB/ShB at 2 weeks after inoculation; RTV at 3 to 4 weeks after inoculation; GLH/BPH at 10 days after infestation; stemborer at 35 and 50 DAT for deadheart damage and 10 days before harvest for whitehead damage.

- In Table 12, of the 200 accessions evaluated, 84 entries were found resistant to blast while 39 entries having intermediate reactions and 77 entries were susceptible to the disease. For evaluation to bacterial leaf blight, 9 entries showed intermediate reaction and the rest were susceptible to the disease. Accession number PRRI000319 and PRRI000327 showed resistant reactions to blast and intermediate reaction to bacterial lead blight while accession number PRRI000069, PRR1000148 and PRRI000214 had intermediate reactions to blast and bacterial leaf blight. All entries were susceptible to sheath blight and rice tungro virus.

- Out of 200 accessions, 7 were moderately resistant while 42 showed intermediate reactions to BPH and 27 were intermediate to GLH. Majority of the accessions showed moderately resistant during the dry season and susceptible during the wet season to GLH and BPH. The data obtained under stemborer evaluation showed a valid data with 31.46% in dry season and 12.23% in wet season on susceptible check TN1. Out of these entries, 34 were resistant, 29 were moderately resistant, 20 intermediate and the rest were moderately susceptible to susceptible to the test insect.

Table 12. Summary table of reactions of PhilRice germplasm accessions to major insect pest and diseases in 2014.

Reaction	No. of Accessions						
	Blast	Bacterial Leaf Blight	Sheath Blight	Rice Tungro Virus	Brown Planthopper	Green Leafhopper	Stemborer
Resistant	84	0	0	0	0	0	34
Moderately Resistant*	–	–	–	–	7	0	29
Intermediate	39	9	0	0	42	27	20
Moderately Susceptible*	–	–	–	–	98	80	14
Susceptible	77	191	200	200	45	84	104

* for insect pest only

Evaluation of grain quality of traditional varieties conserved at the PhilRice Genebank

APP Tuaño, MC Ferrer, MIC Calayugan, LM Perez, BO Juliano

The PhilRice Genebank, considered as one of the international repository of rice genetic resources, currently holds about 12,000 accessions. The value of these genetic resources depends on the available information about these accessions. To date, information on morphological and agronomic traits, reaction to biotic and abiotic stresses as well as grain quality characteristics are lacking. Grain quality in particular, dictates consumer acceptability and marketability of rice, hence considered an important component in the rice breeding program. This continuing project is aimed at generating grain quality data of the PhilRice germplasm collection and efficiently providing grain quality data through a computerized database system handled by the Genetic Resources Division.

Highlights:

- Rice accessions (n=443), with missing apparent amylose content (AC) and gelatinization temperature (GT) data in the germplasm database, were analyzed from 15 to 20g rough rice samples. AC assay using ammonium buffer (Juliano et al. 2012, Cereal Foods World 57:14-19) was employed and GT type was determined using the alkali spreading value (ASV; Little et al. 1958, Cereal Chemistry 35:11-126).

- Of the 443 samples, 235 had low AC (10.1 to 17.0%), 139 had intermediate AC (17.1-22.0%) and 62 had AC less than 10% (considered as very low AC to waxy) and only 7 had high AC (>22.0%). GT type distribution was as follows: a) high-AC rices: 6 intermediate GT (ASV 4-5) and 1 low GT (ASV 6-7); b) intermediate-AC rices: 21 high GT (ASV 2-3); 84 intermediate GT (ASV 4-5) and 34 low GT (ASV 6-7); and c) low-AC, very low-AC and waxy rices: 248 high GT (ASV 2-5) and 49 low GT (ASV 6-7).

- 442 accessions from the GRD 2014 dry season regeneration plots, were analyzed for milling potentials, grain length and shape, percent chalky grains, AC, GT and Instron hardness of freshly cooked rice. Of these, 384 were nonwaxy and 58 were waxy rices (Table 13). The group of waxy rices in this report included samples with AC less than 10% and percent chalky grains greater than 80%. Mean head rice yield of this set did not exceed 60% while milled rice recovery range was in the acceptable range (64 to 75%).

- Majority of the samples had medium to long grain lengths and slender shape. Instron hardness of freshly cooked rice had a very wide range for the nonwaxy rices. Mean Instron hardness value obtained for the 58 waxy rices was 1.06kg cm^{-2}, though values range from 0.73 to 1.42kg cm^{-2}, which was probably due to some nonwaxy grains in impure waxy samples as indicated also in the range of AC values in this group.

Table 13. Ranges and mean values of grain quality properties of PhilRice germplasm accessions harvested from the GRD regeneration plots, 2014 dry season.

Property	Nonwaxy accessions (n = 384)		Waxy accessions (n = 58)	
	Range	Mean	Range	Mean
Brown rice, %	73 - 82	79	72 - 82	78
Total milled rice, %	65 - 75	71	64 - 73	70
Head rice, %	16 - 72	59	14 - 70	56
Grain length, mm	3.9 - 7.3	6.1	4.8 - 7.0	5.9
Grain shape, length/width	1.4 - 3.7	2.7	1.7 - 3.1	2.3
Chalky grains, %	2 - 94	22	82 - 100	95
Apparent amylose content, %	10.6 - 26.9	20.3	2.2 - 9.0	3.7
Alkali spreading value	3.0 - 7.0	4.6	3.0 - 7.0	4.7
Instron hardness, kg cm^{-2}	1.17 - 4.19	2.46	0.73 - 1.42	1.06

Evaluation of Philrice Germplasm Collections for Drought Tolerance
JN Niones, MCN Julaton, RR Suralta

Line-source sprinkler system (LSS) was conceptualized to impose and create a continuous variable water application across a research field plot (Hanks et al., 1976; Bauder et al., 1975; Willardson et al., 1987; Hanks et al., 1980). The LSS configuration provides a linearly decreasing irrigation application rate perpendicular to the sprinkler line. This system has been utilized to study crop response to different soil moisture gradients and intensities. This study aimed to evaluate and screened PhilRice germplasm collections under different intensities of drought stress using the line source sprinkler system.

Twenty-eight germplasm collections were transplanted and conducted in the watertight experimental bed with line source sprinkler system under a rain-out shelter. Each line was planted at 20cm between rows and 45cm between hills in RCBD with two replications. IR64, KDML 105 and NSIC Rc160 served as control genotypes. Fertilizer rate was 120-60-60kg NPK/ha applied in two splits (basal and maximum tillering stage). Supplemental fertilization of 10 kg/ha ammonium sulfate was done at 50DAT to correct sulfur deficiency. Draining of water started at 14DAT after the plants have recovered. Soil moisture sensors were placed at both sides of the seedbed at varying distance from line source sprinkler (10cm, 40cm, 80cm, 120cm, 160cm), respectively (Figure 10). Re-irrigation was done when the soil moisture at 80cm distance was below 30%VMC. Each entry was final sampled and terminated 3 weeks after heading with reference to the hill planted near the line source (10cm). Agronomic data (plant height, number of tillers and biomass) and root data (number of nodal roots (NRN), Total Root Length (TRL), Total nodal root length (TNRL), Total Lateral Root Length (TLRL), Root Dry Weight (RDW) were gathered.

Highlights:

- Twenty six (26) genetic resource materials were evaluated for potential source drought tolerance in 2014 (Figures 11). Five (5) germplasms: KDML 105, Piniling belto (PRRI000052), Capis (PRRI000586), Balibod na Pula (PRRI000595), and Kinalangkang (PRRI000615) were photoperiod sensitive (PPS).

- Six (6) genotypes Binarit (PRRI000620), Gininto (PRRI000589), Goberno (PRRI006023), Minindoro (PRRI000580), Nagsalay Coll 1434 (PRRI000625), Quinizon (PRRI000607) showed drought tolerance based on biomass weight at 12% soil moisture content (Figure 12). These genotypes exhibited up to 10% increase in shoot biomass in reference with the plants nearest the sprinkler even at a distance of 90cm away from the line source. This may be attributed to the capability of these genotypes to adapt to limited water supply.

- Genotypes Minindoro (PRRI000580), Capis (PRRI000586), Balibod na Pula (PRRI000595) and Kinalangkang (PRRI000615) showed were among the genotypes which have higher canopy temperature than IR64 at 10cm – 50cm however, at 70cm distance showed comparable with IR64 but lower temperature from 90cm – 150cm (Figure 13).

- Binarit (31.7%) and Quinizon (13.6%) genotypes showed less shoot biomass reduction at 12% SMC (drought stress) in relation to control (~25% SMC) and check genotypes.

- Roots scanning and analysis of 26 genetic resource materials is on-going.

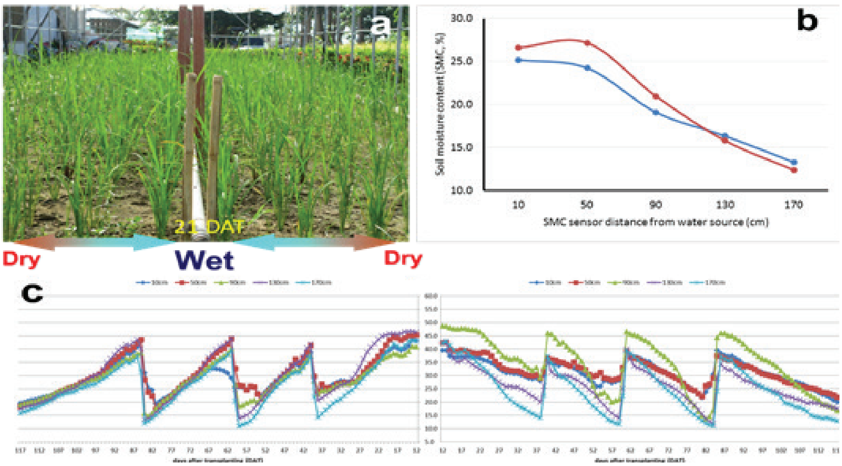

Figure 10. Soil moisture (%VMC) reading of line source sprinkler system in 2014

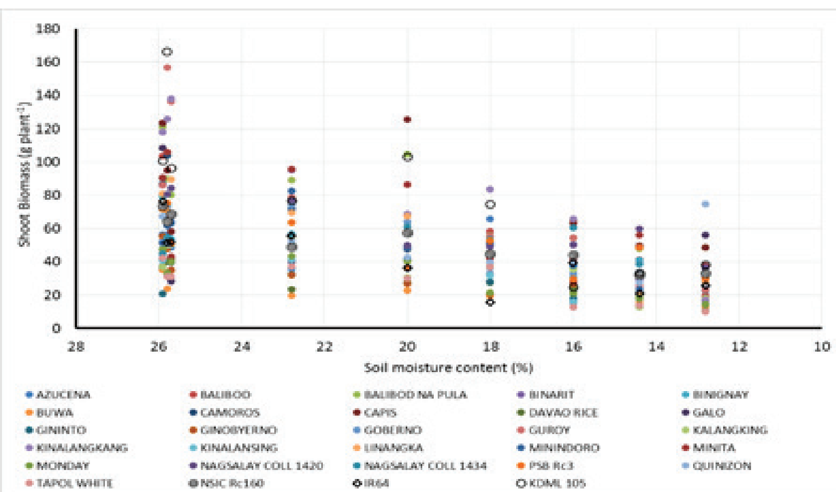

Figure 11. Shoot Biomass production of 26 germplasm materials evaluated under different water stress intensities in 2014.

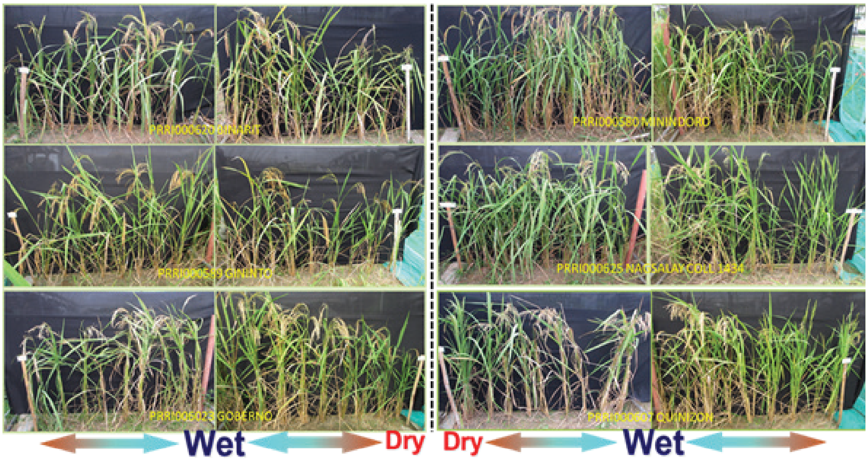

Figure 12. Genotypes selected with good response to different intensities of drought.

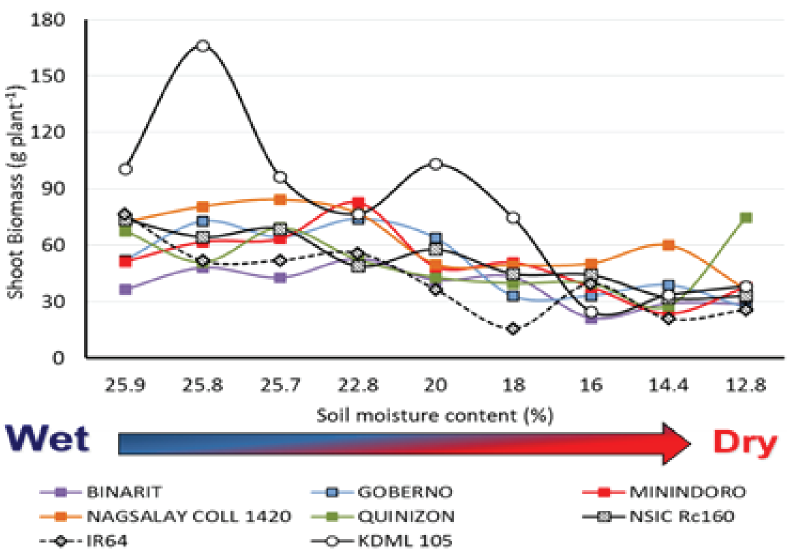

Figure 13. Six genotypes showed high shoot growth in response at different intensities of progressive drought stress in 2014.

Evaluation of Rice Germplasm Collections for Submergence and Zn Deficiency Tolerance in CARAGA Region
HM Jimenez

Biotic and abiotic stresses are among the factors affecting rice production in Caraga region. Most important of the abiotic factors are low solar radiation, flooding and soil-zinc deficiency. Using tolerant varieties is an efficient and sustainable management option to counter these problems. Genetic variability in tolerance to stresses exists which can be explained by various physiological mechanisms underlying certain adaptations to unfavorable conditions. These will serve as bases in varietal selection and development of improved rice varieties.

Zinc (Zn) deficiency is currently a widespread micronutrient deficiency in Caraga Region causing low rice yields. Zinc deficiency can be corrected by adding Zn compounds to the soil or plant. However, the high cost associated with applying Zn fertilizers in sufficient quantities to overcome Zn deficiency places considerable burden on resource-poor farmers and it has therefore been suggested that breeding efforts should be intensified to improve the tolerance to Zn deficiency in rice cultivars.

Highlights:

- 24 traditional varieties were screened and evaluated with and without zinc oxide and zinc sulfate application using the Standard Evaluation System in zinc deficiency scoring based on its signs and symptoms and phenotypic performance. Of these, only 3 germplasm including Awot (12800A), RED RICE (DON BOSCO, 12835-A) and BLACK RICE (DON BOSCO, 12836) showed tolerance to soil zinc deficiency (Table 14).

- At the early stage of the crop, almost all test entries exhibited the following symptoms: rust, stunted growth, poor tillering and most of the plants eventually died. Between late vegetative and early reproductive stages, it was noticed that some of the test entries without zinc sulfate application recovered very fast and the signs and symptoms of zinc deficiency disappeared showing a normal growth comparable to the control varieties with treated with zinc sulfate.

Table 14. Evaluation of 24 rice germplasm to soil zinc deficiency in 2014 WS.

Collection No.	Cultivar Name	Zinc Score 25 DAT		Remarks @ 25 DAT		Zinc Score 40 DAT		Remarks @ 40 DAT	
		W/ Zn	W/O Zn	W/ Zn	W/O Zn	W/ Zn	W/O Zn	W/ Zn	W/O Zn
12383	KALINAYAN (MONOS)	7	filler	rust, poor tiller	filler	7	filler	poor tillering, not uniform (NU)	filler
12655	MALIDO	7	filler	rust, stunted	filler	5	filler	GS, clean	filler
12677-A	BINERNAL RED	7	9	rust, stunted	rust, stunted	5	9	rust, not uniform (NU)	Stunted, Rust, susceptible
12678	BRILLANTE	7	9	rust, stunted	rust, stunted	7	9	clean, NU	NU, poor tiller, rust
12679	BINERNAL WHITE	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	NU, stunted, rust
12700	KASAGPI	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	stunted, rust
12731	PALAWAN	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	stunted, rust
12744-C	GALO	7	9	rust, stunted	rust, stunted	5	9	GS, clean	stunted, rust
12745-A	GALO (GASPANG-1)	9	9	rust, stunted	rust, stunted	7	9	poor stand, NU	stunted, rust
12795	MARIA GAKIT	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	NU, stunted, rust
12796	SPEAKER	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	stunted, rust
12799-A	HINUMAY	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	NU, stunted, rust
12800-A	AWOT	5	7	good stand, Rust	rust, stunted	5	5	GS, clean	GS, clean, Tolerant
12801-A	DINORADO	7	9	rust, stunted	rust, stunted	7	9	NU, poor tillering	stunted, rust
12802-D	AWOT	9	9	rust, stunted	rust, stunted	9	9	NU, poor tillering	stunted, rust
12808	MALAY 2	5	7	good stand, Rust	rust, stunted	5	7	GS, uniform, clean	stunted, rust
12835-A	RED RICE (DON BOSCO)	3	5	good stand, Rust	good stand, Rust	3	5	GS, clean, uniform	GS, clean, Tolerant
12836	BLACK RICE (DON BOSCO)	5	5	good stand, Rust	good stand, Rust	5	5	GS, clean, uniform	GS, clean, Tolerant
12846-A	KINAMUROS	7	9	rust, stunted	rust, stunted	5	9	GS, clean	stunted, rust

Evaluation of Rice Germplasm Collections for Tungro Resistance in Philrice Midsayap

JM Niones, JLD Genilla, LM Perez

Disease infection significantly contributes to reduction yield in rice production in Mindanao region. Rice tungro virus (RTV) is the most economically important disease in rice in the Philippines. RTV significantly affect the rice plants at any developmental growth stages. Currently, ARC 11554, Utri merah, Utri Rajapan, and Habiganj DW8 rice varieties are the source of resistant donors for RTV breeding program at PhilRice, but little attention has given in searching new sources of resistance from our PhilRice germplasm. In this study focused on screening and characterized PhilRice germplasm collection against RTV under field condition. Five hundred PhilRice germplasm each season were screened at PhilRice Midsayap field. Disease rating of RTV was done at 30, 45 and 60 DAT.

Highlights:

- A total of 955 (453 WS and 502 DS) germplasm materials were evaluated for rice tungro disease reactions under field condition in 2014 (Figure 14).

- At 30DAT evaluation, 61 germplasm materials showed to be resistant (R), 338 germplasm materials showed intermediate (I) and 552 germplasm materials were susceptible. However at 45 and 60DAT evaluation, 955 germplasm materials showed susceptibility against RTV (Figure 15).

- Nineteen (19) rice germplasm showed slight recovery and good phenotypic performance (based on phenotypic acceptability score of 1 to 5) after 60DAT.

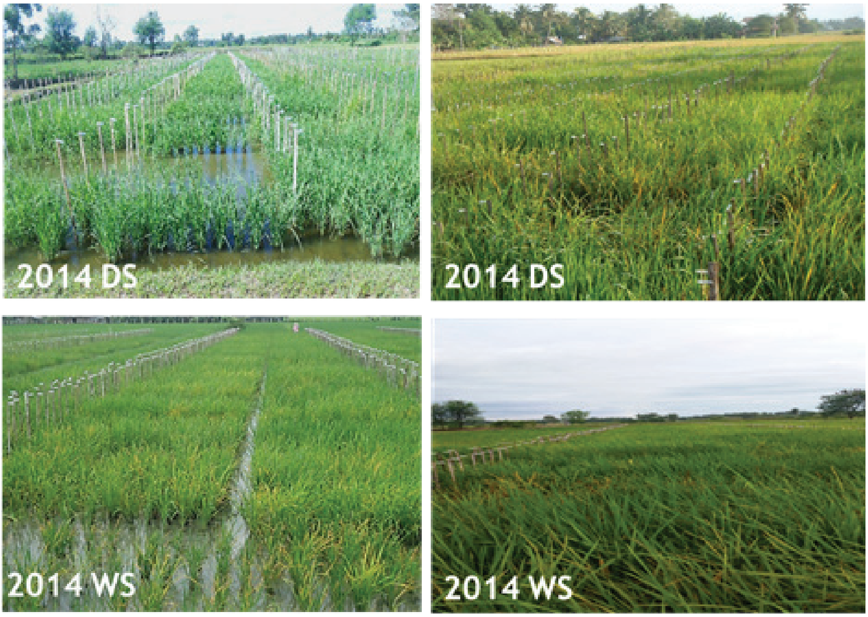

Figure 14. Field screening for tungro disease of Germplasm materials in PhilRice Midsayap.

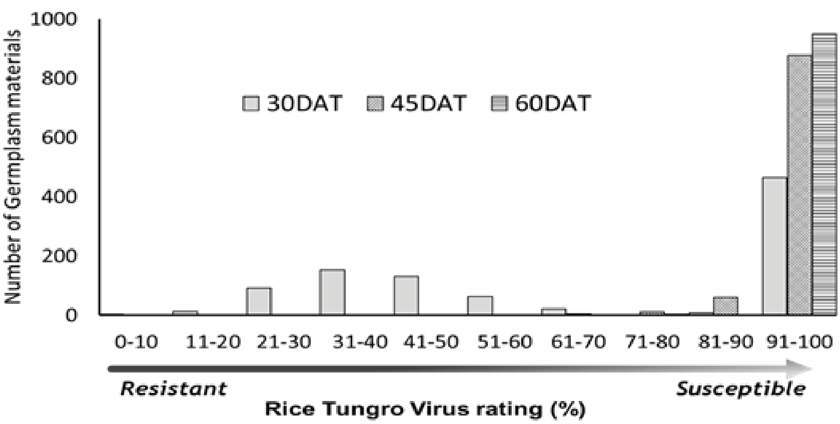

Figure 15. The infection distribution of germplasm materials at 30, 45, 60 days after transplanting (DAT) of rice tungro disease in 2014.

III. Genetic Resources Research

Project Leader: LM Perez

Genetic resources serve as the source of novel traits and genes for increasing heterosis and widening of the genepool of cultivated vareities. The 12,000 accessions of diverse pool of rice germplasm collected possess desirable genes and traits such as high yield, good eating quality, pest and disease resistance, and abiotic stresses tolerance. The genetic resources research was design to identify promising rice germplasm with useful traits as part of pre-breeding activities. The project also aims to identify potential genetic donors for use as parents in various breeding programs. The project covers a wide range of tools use in exploring the traits, genes and other important aspects of rice science such as application of molecular marker technologies, expolaration of germplasm as possible source of male sterile cytoplasms for two-line breeding, employing next generation sequencing for in silico gene discovery, examination of ethnobotanical and medicinal use of germplams, and investigating aromatic rice and fissure resistant rice.

MAGIC (Multiparent Advanced Generation Inter Crosses) in PhilRice Genetic Resources

MIC Calayugan, TE Mananghaya, VG Dalusong, RP Mallari, LM Perez

MAGIC is an experimental method with which genetic markers are linked to quantitative trait loci (QTL) (IRRI, 2011). It was introduced by Mott et al. (2000) in mice as an extension to the advanced intercross (AIC) procedure of Darvasi and Soller (1995). MAGIC populations are established by several rounds of intercrossing multiple founder lines and the resulting populations are, hence, genetically diverse essential for the detection of multiple QTLs at the same time. As part of the preliminary investigation, the focus is to determine potential founder lines in the PhilRice genetic resources. Decision of founder lines to be included in the MAGIC population will be done with the breeders and in consideration with unique agronomic traits suitable to the need of rice farmers in the Philippines. Phenotyping as well as molecular characterization of the founder lines will be explored by establishing the traits and methodologies as well as appropriate genetic marker systems for the molecular analysis.

Highlights:

- In 2014 dry season the 28 single intercrosses was successfully completed.

- Polymorphism survey of MAGIC founder lines were conducted with 263 SSR markers surveyed (Table 15).

- Evaluation of MAGIC founder lines to rice blast shows MGC 5 AZUCENA as intermediate while the rest were susceptible (Table 16).

- In 2014 wet season 4 way crosses were initiated (Table 17).

Table 15. Polymorphism survey of 8 founder lines using 263 neutral SSR markers.

Crosses	No. of polymorphic SSR markers	Crosses	No. of polymorphic SSR markers
MGC5XMGC6	42	MGC8XMGC10	53
MGC5XMGC8	53	MGC8XMGC13	109
MGC5XMGC9	53	MGC8XMGC14	58
MGC5XMGC10	51	MGC8XMGC15	59
MGC5XMGC13	101	MGC9XMGC10	72
MGC5XMGC14	56	MGC9XMGC13	141
MGC5XMGC15	47	MGC9XMGC14	68
MGC6XMGC8	49	MGC9XMGC15	59
MGC6XMGC9	51	MGC10XMGC13	142
MGC6XMGC10	41	MGC10XMGC14	66
MGC6XMGC13	96	MGC10XMGC15	48
MGC6XMGC14	50	MGC13XMGC14	124
MGC6XMGC15	49	MGC13XMGC15	117
MGC8XMGC9	66	MGC14XMGC15	57

Table 16. Performance of 8 MAGIC founder lines to Rice Blast.

Code	Variety Name	Result
MGC-5	AZUCENA	intermediate
MGC-6	GOBERNO PUTI	susceptible
MGC-8	BUWA	susceptible
MGC-9	MONDAY	susceptible
MGC-10	BINIGNAY	susceptible
MGC-13	PSB RC3	susceptible
MGC-14	TAPOL WHITE	susceptible
MGC-15	KALANGIKING	susceptible

Table 17. List of 4 way crosses generated in 2014 wet season.

Female	Male	Traits
MGC-8/MGC-5 F1-4	MGC-9/MGC-5 F1-10	drought, sheath blight and RTV resistant
MGC-8/MGC-5 F1-3	MGC-15/MGC-8 F1-5	drought, sheath blight resistant
MGC-9/MGC-8 F1 -6	MGC-13/MGC5 F1-4	drought, sheath blight and RTV resistant
MGC-9/MGC-5 F1-6	MGC-8/MGC-5 F1-1	drought, sheath blight and RTV resistant
MGC-9/MGC-6 F1-1	MGC-9/MGC-8 F1-2	drought, sheath blight and RTV resistant
MGC-9/MGC-8 F1-5	MGC-9/MGC-6	drought, sheath blight and RTV resistant
MGC-10/MGC-6 F1-9	MGC-15/MGC-10 F1-7	drought, sheath blight and RTV resistant
MGC-10/MGC-8 F1-27	MGC-13/MGC-6 F1-5	drought, sheath blight and RTV resistant
MGC-13/MGC-6 F1	MGC-15/MGC-13 F1-15	drought, sheath blight and RTV resistant
MGC-13/MGC-6 F1-1	MGC-10/MGC-8 F1-26	drought, sheath blight and RTV resistant
MGC-14/MGC13 F1-4	MGC-15/MGC-5 F1-6	drought, sheath blight and RTV resistant
MGC-14/MGC-8 F1-3	MGC-14/MGC-6 F1-4	drought, sheath blight and RTV resistant
MGC-14/MGC-6 F1-1	MGC-14/MGC-8 F1-1	drought, sheath blight and RTV resistant
MGC-15/MGC-8 F1-1	MGc-15/MGC-5 F1-21	drought, sheath blight and RTV resistant
MGC-15/MGC-13 F1-9	MGC--13/MGC-6 F1-10	drought, sheath blight and RTV resistant
MGC-15/MGC-13 F1-1	MGC-15/MGC-10 F1-10	drought, sheath blight and RTV resistant
MGC-15/MGC-10 F1-12	MGC-15/MGC-13 F1-6	drought, sheath blight and RTV resistant
MGC-15/MGC-10 F1-6	MGC-10/MGC-6 F1-1	drought, sheath blight and RTV resistant

Exploration of Rice Landraces for Cytoplasmic Male Sterility Diversification

IG Pacada, LM Perez, TM Masajo

Wild abortive (WA) type of cytoplasm has been used extensively in identifying and developing new maintainer lines as well as breeding rice F1 hybrids. Thus, most of PhilRice maintainer converted into male sterile has WA cytosterility source. However, single source of male sterile cytoplasm maybe disastrous in case of sudden outbreak of pest and diseases specifically if the susceptibility is associated with a CMS-inducing factor. Furthermore, cytoplasmic influences yield and agronomic characters, hence, diversification of cytoplasmic source play an important role in improving crop productivity. This study is aimed to develop new sterile cytoplasm source using nucleus substitution approach.

Highlights:

- Nine and 16 breeding population was generated using inter-varietal and inter-subspecific crosses, respectively. Inter-varietal crosses consist of reciprocal crosses between primitive indica and modern varieties while inter-subspecific comprises crosses between javanica traditional variety and modern varieties.

- Inter-specific crosses (crosses from improved wild rice and modern variety) will be conducted in the following season.

Complete Genomic DNA Sequencing of Selected Philippine Traditional Varieties for in Silico Gene Discovery
XGI Caguiat, MVG Embate, VG Dalusong, RP Mallari, LM Perez

Genomic DNA sequencing is a biotechnology tool for discovering genes coding for traits including resistance to pests and diseases, tolerance to abiotic stresses, grain quality. With the revolution of molecular tools and fast-paced evolution of DNA analysis technology, it becomes a common measure for gene discovery in plants especially rice.

Philippine traditional rice varieties currently stored in PhilRice Genebank have immense genetic diversity and potential novel genes for rice genetic improvement. With the advent of intellectual property rights and ownership of rice particularly germplasm under development there is a need to discover local sources of genes or traits for breeding and genetic improvement of rice varieties for resistance to pests and disease, abiotic stress resistance, and good grain quality. This study will generate genomic sequence information of selected Philippine traditional varieties and identification of potential novel genes using in silico gene discovery. Molecular analysis and phenotyping of rice germplasm helps in identification of novel genes. Trainings and memorandum of agreement with collaborators will be useful in handling data analysis. The discovery of genes and potential source of germplasm in local and indigenous traditional rice varieties will mean opportunity for commercialization of rice science advancement in the Philippines.

Highlights:

- Three Philippine traditional varieties were selected based on information of morpho-agronomic traits and evaluation for resistance or tolerance to biotic and abiotic stresses.

- Whole genome sequencing of the varieties was obtained from the Genomic Institute of Asia (GINA) in a fastq format (Tables 18 and 19).

- Initiated collaborative endeavors with the Core Facility for Bioinformatics of the Philippine Genome Center for the intensive bioinformatics analysis and handling of whole genome sequence data of rice.

Table 18. Germplasm information of selected three (3) Philippine traditional rice varieties from PhilRice Genebank.

ACCESSION No.	COLLECTION No.	CULTIVAR NAME	DONOR NAME	PROVINCE	TOWN/CITY	IMPORTANT TRAITS	GRAIN LENGTH (mm)	GRAIN WIDTH (mm)
PRRI001014	1367	BINATO	Michael A. Barbero	Abra	Pob., San Juan	Drought resistant	8.34	3.06
PRRI004381	5218	ARABON		Leyte		Drought resistant	9.18	3.35
	12808	MALAY 2	Imeldalyn G. Pacada	South Cotabato		Blast resistant	9.97	3.03

Table 19. Initial results of whole genome sequence of three (3) Philippine traditional rice varieties obtained from GINA.

ACCESSION No.	COLLECTION No.	CULTIVAR NAME	Total GB	Total Reads	Read Length (bp)		Average Depth of Coverage (X)	Mean Raw Accuracy (%)
					Median	Mode		
PRRI001014	1367	BINATO	12.9	69,558,462	207	231	33.4	98.2
PRRI004381	5218	ARABON	13.4	85,175,314	168	224	33.6	97.6
	12808	MALAY 2	12.8	82,634, 494	168	219	32.3	97.4

Investigating the Bound form of 2-acetyl-1-pyrroline (2-AP) in Philippine Aromatic Rices in the PhilRice Genebank

APP Tuaño, TE Mananghaya, MVG Embate, RMF Cabanting, VG Dalusong, LM Perez, BO Juliano

Aromatic rice with superior eating quality commands higher price in the market and has been increasingly demanded for by niche markets abroad. The popular Thai Jasmine rice “Khao Dawk Mali 105” and Pakistan “Basmati” rice both have been recognized worldwide for their distinct aroma, appearance and eating quality and continue to be highly priced in the international market. The Philippines has released a few aromatic varieties (e.g NSIC Rc128, Rc148 and Rc218SR) but has not yet popularized its own version of aromatic cultivars with high export potential.

2-Acetyl-1-pyrroline (2-AP) has been identified as the most potent compound causing the popcorn-like aroma of cooked rice. Significantly higher amounts of 2-AP were found in aromatic rice varieties. The gene for fragrance in rice has been identified and associated with high 2-AP levels. Molecular markers have been developed to aid the selection for the fragrance (fgr) gene in aromatic rice breeding and efforts to combine various alleles of the fgr gene (expressing different or equal levels of 2-AP) have been made to come up with a “super-aromatic” rice. In 2005, the presence of bound and free forms of 2-AP on a nearly 1:1 ratio has been reported by Japanese rice scientists and showed that the free form of 2-AP volatilizes easily on storage while the bound form has been suspected to have higher retention. The bound form of 2-AP is of greater interest to breeders and consumers as this will give a lingering and persistent aroma and flavor to cooked rice. This study intended to identify and characterize Philippine aromatic traditional varieties with high amounts of bound 2-AP and novel alleles of the fragrance gene. Once a genotype with high amount of bound 2-AP has been identified and characterized, genetic improvement and studies on the effects of environment, cultural and post-harvest management may follow.

Highlights:

- The optimized Bradbury marker in the Molecular Genetics Laboratory, PhilRice Central Experiment Station and the potassium hydroxide (KOH) method for aroma phenotyping were adopted to analyze the export quality traditional rice varieties (TRVs) of the Department of Agriculture (DA).

- Twenty-two samples had the fgr allele while seven samples were non-fgr. Among the fragrant samples by Bradbury marker, only four samples were non-aromatic and the rest were aromatic using the KOH method. Only one sample was non-fgr by Bradbury marker but was aromatic by KOH method and based on farmers' remarks (Table 20). On the other hand, only 27 of the 53 accessions from the PhilRice gene bank tagged as scented rices were aromatic using the KOH method.

- Aromatic rices (released varieties as Mabango 1 to 5: NSIC Rc128, Rc148, Rc218, Rc342, Rc344, and Mestizo 1) from 2014DS crop were subjected to preliminary storage treatments and will be analyzed for total and bound 2-AP determination. Molecular analysis of these samples showed that only Rc148, Rc218 and Rc342 had the fgr allele.

Table 20. Genotyping and phenotyping of fragrance in selected DA's export quality traditional rice varieties.

Variety Name	Collection No.	Fragrance Genotyping	KOH Method	Farmers' Remarks
Asucena	Coll. No. 12812	fgr	non aromatic	
Kinamuros	Coll. No. 12846	fgr	non aromatic	
Mimis B	Coll. No. 12703	fgr	aromatic	
Galo A	Coll. No. 12746	fgr		
Galo B	Coll. No. 12745	fgr	aromatic	
Galo B	Coll. No. 12746	fgr	aromatic	
Galo C	Coll. No. 12744	fgr	aromatic	
Galo C	Coll. No. 12745	fgr		
Binernal Red P1B	Coll. No. 12677	fgr	aromatic	
Binernal Red P2B	Coll. No. 12677	fgr		
Binernal Red P2C	Coll. No. 12677	fgr		
Binernal Red P3B	Coll. No. 12677	fgr		
Binernal White	Coll. No. 12679	fgr	aromatic	
Malido	Coll. No. 12655	fgr	aromatic	aromatic
Malido Red	Coll. No. 12849	fgr	aromatic	aromatic
Binerhen	Coll. No. 12838	fgr	aromatic	aromatic
Dumudao		fgr	non aromatic	non aromatic
Brillante P2	Coll. No. 12678	fgr	aromatic	
Guyod	Coll. No. 12803	fgr	aromatic	
RV8 (from Don Bosco)	Coll. No. 12837	fgr	non aromatic	
Speaker	Coll. No. 12796	fgr	aromatic	
Kabundulan	Coll. No. 12848	fgr	aromatic	
Dinorado	Coll. No. 12801	non-fgr	aromatic	
Galo A	Coll. No. 12744	non-fgr	aromatic	
Galo B	Coll. No. 12744	non-fgr	aromatic	
Awot	Coll. No. 12802	non-fgr	aromatic	
Awot	Coll. No. 12800	non-fgr	aromatic	
Inipot-Ibon	Coll. No. 12841	non-fgr	aromatic	aromatic
Maria Gakit	Coll. No. 12795	non-fgr		

Fragrance genotyping by Bradbury marker: fgr – presence of fgr allele, non-fgr - absence of fgr allele.

Ethnoguided Survey and Collection of Philippine Medicinal Traditional Rice Varieties

RMF Cabanting, LM Perez

The need to discover and conserve natural sources of medicine and other high value products is becoming increasingly important. Ethoguided approaches involving ethnobotany and ethnomedicine have been reported as significant tools for elucidating the roles of plants in basic health care system of many societies. In the Philippines, rice has always been a strong pivot in the culture and traditions of Filipinos and agriculture based research. However, the ethnomedicinal attributes of rice especially those of traditional varieties remain scarce and underexplored. To date, no baseline catalogue describing the rice varieties used for ethnomedical treatment exits. This study aims to collect and conserve traditional rice varieties and gather information from local communities concerning their use of rice in folk medicine. Ethnoguided survey was held using semi-structured interviews with knowledgeable locals as our key informants.

Highlights:

- The study was undertaken in four provinces namely: Zamboanga del Norte, Zamboanga del Sur, North Cotabato, and Palawan. Interviews were carried out from September 17 to October 2, 2014 in six municipalities with the aid of local agriculture technicians and Upland Rice Technologists.

- Data was gathered from 12 key informants composed of three females and nine males using a semi-structured questionnaire. Information collected includes interviewee's personal information, topics related to the medicinal use of specific varieties such as therapeutic properties, remedy preparation and dosage, etymology and planting practices.

- Seventeen (17) traditional rice varieties that possess ethnomedicinal attributes have been documented, 16 of which are now conserved at the PhilRice Genebank.

- The varieties are used to cure ailments including measles, pimples, fever, common cold, cough, beriberi, and fatigue. Some are used as preventive measure for relapse (ie. recurrence of ailments) and to prevent ailments caused by kulam or bulong. Administrations of remedies are oral and external (topically). The most frequently used part of the plant was the grains which are cooked either as regular rice or as porridge. Some preparations also use roots and leaves. Single varieties may be used for different ailments using different preparations. Most of the oral remedies were taken in once or three times a day as a full dose and with varying amounts depending on the age of the patient and severity of the ailment. Actual remedy preparation, aside from oral information, and crop stand will be documented in 2015DS.

Discovery of Crack (Fissure) Resistance in Parental Genetic Stocks Towards Stable High Head Rice Recovery

APP Tuaño, TE Mananghaya, RMF Cabanting, VG Dalusong, LM Perez and BO Juliano

One of the many important traits of rice quality is milling recovery. Milled rice yield is of economic significance to retailers, millers and farmers since milled rice with higher percentage of head rice (whole kernels) have been sold at higher price in the market than milled rice with more broken grains. Factors affecting milling recovery include grain chalkiness, grain dimensions, grain maturity, grain moisture content during harvest, weather conditions during grain filling and during harvesting, post-harvest operations and handling, drying practices and milling equipment. One of the main causes of low head rice yield is grain cracking or fissuring brought by pre- and post-harvest stresses. It has been reported to have the ability to resist pre- and post-harvest fissuring and has been found to be due to the low permeability of its hull protecting the rice grain from exposure to external moisture.

The PhilRice breeding program maintains the crossing block which serves as the source of breeding parentals and donors of valuable traits. Identification and characterization of materials with crack resistance trait and stable high head rice yield among breeding parentals with other important traits will help rice breeders improve the milling quality of current elite lines. Validated selection methods are also important to aid breeders in their selection. Further biochemical and physiological studies may also be undertaken once crack resistant cultivars have been characterized leading to the improvement of head rice recovery of Philippine rice through breeding.

Highlights:

- Crossing block samples (n = 419) from 2013WS crop were analyzed. Twenty-six samples were selected as crack resistant with stressed head rice yield (HRY) >50% using the brown rice humidification method while 13 were crack susceptible with stressed HRY <25% and unstressed HRY >35%. Unstressed HRY of crack resistant rices ranged from 34-67%; stressed rough rice HRY: 39-57%; stressed brown rice HRY: 48-63%. Crack susceptible samples had stressed HRY of 7-23% using rough rice soaking and stressed HRY of 6-24% using brown rice humidification.

- Crossing block 2014DS samples (n = 225) were likewise analyzed and 13 varieties were crack resistant by the stressed brown rice humidification method. Twenty-three common samples in both seasons were selected based on 2013DS preliminary screening. Top three crack resistant varieties were recommended for further genetic investigations under a related study in the Crops Biotechnology Center.
- The identified crack resistant samples varied in AC, ASV and Instron hardness. AC ranged from 3-26%; ASV ranged from 3.8-7.0; Instron hardness ranged from 1.0-4.2%.
- Further screening in terms of eating quality indicators will be considered prior to selecting final pool of crack resistant samples for pre-breeding and genetic studies. Grain morphology and instrumental grain hardness analysis is ongoing.

IV. Optimization of Germplasm Conservation Procedures

Project Leader: IG Pacada

Characterization and evaluation of germplasm is linked to utilization. Low utilization of conserved germplasm is due to lack of documentation and inadequate description of collections. Developing a sytem that can provide quick information what is stored at genebank will facilitate genebank curator and researcher in germplasm management and enhanced gene pool utilization, respectively.

Development of reference collection of digital database and germplasm query software

IG Pacada, MC Ferrer, MD Duldualo, and LM Perez

Traditionally, reference collection or seed file (duplicate of what is conserved at genebank), locates in an organize box file. However, conserving, documenting, evaluating and securing long-term maintenance of reference collection is not simple. The development of virtual seed file provide back up and long term preservation. In addition, this can be coupled with software with the capability of digitizing available seed file and storing its grain type information. This study aimed to develop germplasm query software for quick retrieval information of seed file, digitizing all available seed file, and generate grain type information using software features.

Highlights:

- Developed graphical user interface (GUI) for scanning, grain type information, and search function (Figure 16).

- Developed auto cropping default (with fix size) from scanner source (Figure 17).

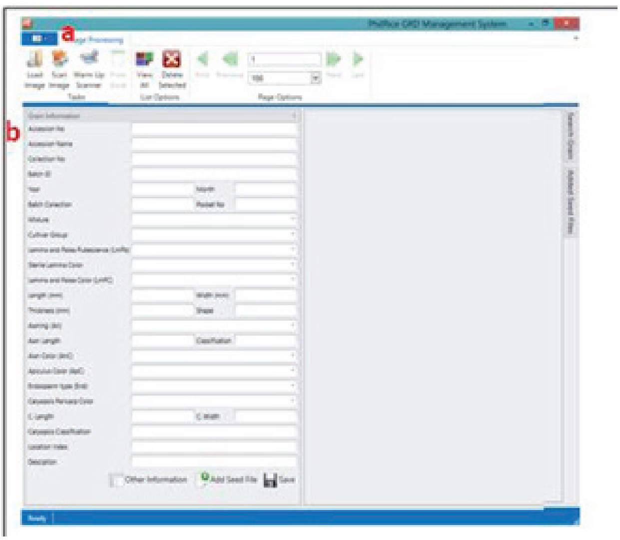

Figure 16. GUI for scanning (a), grain type information (b), and search function (c).

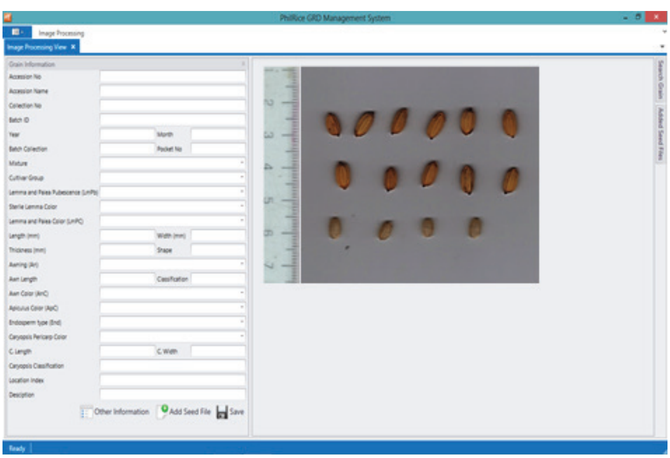

Figure 17. Scanned seed file using the developed auto cropping default.

Classification of Rice Germplasm Into Ecotypes (Japonica / Indica)
MC Ferrer, MIC Calayugan, LM Perez

Exploitation of new germplasm has always played a critical role in rice breeding. The accurate identification of germplasm materials in a genebank is essential for effective germplasm characterization in which without such information breeders has no means of selecting appropriate materials for entry into breeding programs. Systematic ecotype classification leads to a more efficient use of germplasm collection in rice breeding programs. This information can also help breeders to select appropriate parents to improve varieties and broaden the genetic basis of rice, thus the efficiency of germplasm utilization could be greatly improved.

Crossing between japonica and indica have meet several challenges such as high sterility, poor plant type and linkage drag. Identification of indica and japonica rice is important to breeders as these are currently the focus of plant breeders' attention for crossing and development of new plant type. Accurate classification of rice germplasm into the two subspecies can provide essential information for selecting parents in the development of intersubspecific hybrid rice. Among the physiological and morphological characteristics, the grain shape and phenol reaction of grains have been widely used as conventional tools for classifying rice varieties into Japonica and Indica types.

Highlights:

- A total of 5143 accessions were tested using 2% phenol solution, result showed that 3876 accession have positive reaction to phenol solution thus belongs to Indica group, while 1185 were intermediate (Table 21). On the other hand, 82 accessions showed negative reaction to phenol solution thus belong to Japonica group.

- Caryopsis length and caryopsis width of 1711 accessions were gathered. Four round, 56 semi-round, 510 spindle-shaped, 441 half spindle-shaped and 700 are long spindle-shaped were noted.

Table 21. Summary of phenol reaction and ecotype classification

PHENOL REACTION	ECOTYPE	NUMBER OF ACCESSIONS
Positive	Indica	3876
Intermediate	Intermediate	1185
Negative	Japonica	82
TOTAL		5143

V. Conservation of Genetic Resources in the Rice Environment

Project Leader: JT Niones

Recognizing the impact, importance and potential utilization of microbial, invertebrates and plant resources from the rice environment, PhilRice has been studying, evaluating and promoting the use of beneficial microbes ranging from fungi, bacteria and actinomycetes either as potential biological control agent of specific rice pest or as plant growth promoter. Pure isolates of rice pathogens are regularly cultured and utilized in the evaluation of rice plant breeding materials for disease resistance. Moreover, PhilRice has recently renewed its interest in Azolla technology and other N-fixing systems in support to the organic agriculture program.

Along with the increasing collection of these beneficial microbial and non- microbial resources at PhilRice, is the pressing concern to provide a reliable and safe preservation and storage protocol for these genetic resources. Physiological or genetic damage to economically important strains could potentially result in considerable loss of investment in a research and product development program.

The project aims to: (1) develop conservation and preservation strategies for beneficial microbes, invertebrates and plant resources from the rice environment to ensure their physiological and genomic integrity and quality, for research and development, and public utilization purposes; (2) to establish management system that facilitates record-keeping, utilization, distribution and exchange of these genetic resources.

Conservation and Management of Azolla Species

CLJ Mondejar , GO San Valentin

With PhilRice's renewed interest on Azolla technology and other N-fixing systems in support to the organic agriculture program, there is a pressing need to maintain living azolla reference collections. The reference collection will be the source of Azolla fresh biomass for continuous production of azolla and on basic and applied researches on Azolla.

This study aims to: (1) collect and conserve live plants and spores of Azolla strains found endemic in the Philippines and new accessions and hybrids found producing spores and favorably growing under diverse environmental conditions in the Philippines and (2) to produce biomass of superior Azolla strains for distribution and multiplication at various branch stations. This study is being conducted at PhilRice Los Baños.

Highlights:

- Eleven accessions of Azolla were collected from farmer's field in the provinces of Cagayan, Ifugao, Laguna, Palawan, Albay, Leyte and Misamis Oriental (Figure 18). Under nursery conditions, these accessions were evaluated for their agromorphological differences.

- Eleven accessions from IRRI Azolla Germplasm Collections were requested and conserved at PhilRice Los Baños. IRRI has collected these Philippine indigenous azolla accessions from 1970s to 1980s (Table 22).

- In addition to the 11 Philippine indigenous Azolla species, 53 more Azolla species were requested from IRRI Azolla Germplasm Collection and currently being conserved at PhilRice Los Baños.

- The Azolla accessions were conserved both in vitro and under nursery condition. In vitro conservation technique includes vegetative cultures in nutrient solution and shoot-tip cultures in agar medium (Figure 19). Under nursery condition, azolla accessions were grown in plastic trays filled with flooded rice soil with high P content and with at least 2cm high water level (Figure 20).

Table 22. List of indigenous azolla species/strains requested from IRRI Azolla Germplasm Collections and now conserved at PhilRice Los Baños.

Strains	Date of Collection	Place of Collection
PI 0001	1975	Sto. Domingo, Albay
PI 0004	1977	Ifugao
PI 0024	1980	Floridablance, Pampanga
PI 0034	1980	Majayjay, Laguna
PI 0036	1980	Minanga Norte, Iguig, Cagayan
PI 0063	1983	Tacloban, Leyte
PI 0090	1985	Malatgao, Quezon, Palawan
PI 0091	1985	Kiangan, Ifugao
CA 3003	1982	UPMN, IRRI, Los Baños, Laguna
CA 3019	1988	Mandangwa, Misamis Oriental
PP 7017	1985	Iwahig, Palawan

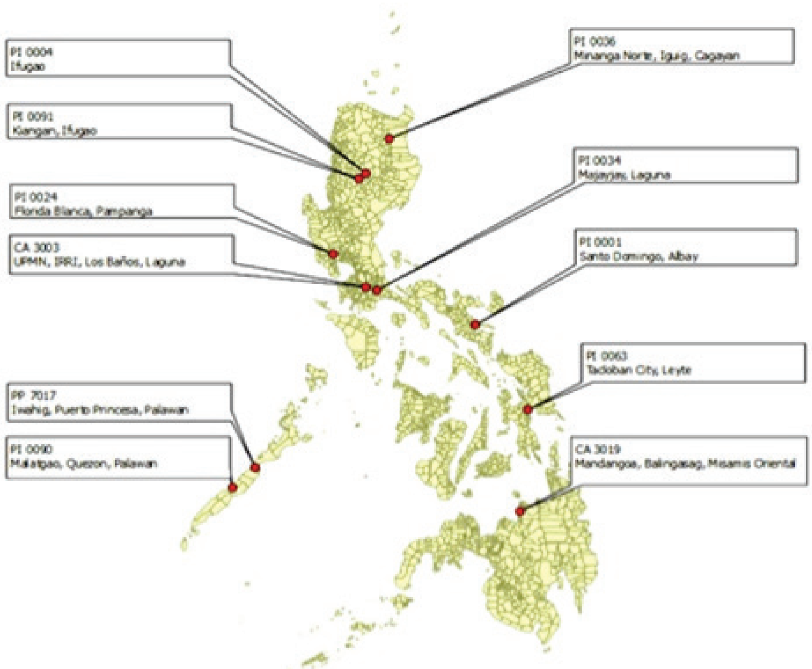

Figure 18. Location map of the place of collection of azolla indigenous in the Philippines

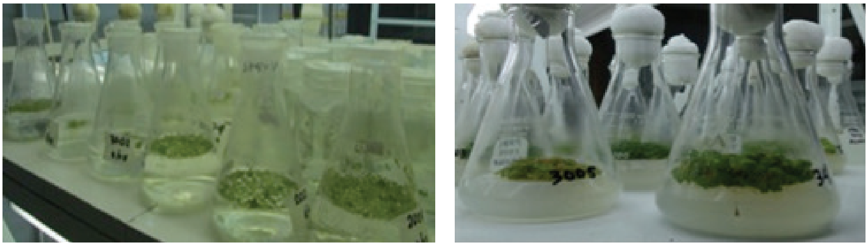

Figure 19. Conservation of azolla in vegetative cultures (left) and in shoot - tip cultures in (right).

Figure 20. Soil-and-water medium propagation and conservation of azolla collections.

Conservation and Management of Biocontrol Agents

GF Estoy Jr., BM Tabudlong

Biocontrol agents provide an alternative pest control measures reducing rice pest population below damaging level. During pest outbreaks, there is a great demand for the production of high quality inoculum of these biocontrol agents (BCAs).

Through PhilRice-funded projects, several strains of Metarhizium anisopliae, Beauveria bassiana and Paecilomyces sp. were isolated and proven to be effective in reducing rice insect pests such as white stemborer, rice black bug and rice bug. The study aims to evaluate different conservation techniques for these entomopathogenic fungi. This study is being conducted at PhilRice Agusan.

Highlights:

- Eleven virulent strains of entomopathogenic fungus Beauveria bassiana and nine Metarhizium anisopliae isolates were preserved both in potato dextrose agar covered with mineral oil or as spores in powder form. These biocontrol agents were collected from different insect species (Table 23 and 24).

- Cultures of B. bassiana and M. anisopliae covered with mineral oil were still viable even after 4 years of preservation (Figure 21).

- Viability, virulence and efficacy of newly collected isolates of B. bassiana and M. anisopliae, stored in mineral oil and as powder form, will be evaluated every three months until two years after storage.

Table 23. Newly collected strains of Beauveria bassiana stored in potato dextrose agar slants.

No.	Code Name	Insect Host	Place Collected
1	Bb.#01	Sweet potato weevil	ViSCA, Baybay, Leyte
2	Bb.#02	Coleoptera	ViSCA, Baybay, Leyte
3	Bb.#21	Rice bug	Mahanub, Gigakit, Surigao Del Norte
4	Bb.#22	Rice Bug	Prosperidad, Agusan Del Sur
5	Bb.#27	Rice bug	Trento, Agusan Del Sur
6	Bb.#33	Undetermined larvae	RTRomualdez, Agusan Del Norte
7	Bb.#41	Coccinellid beetle	Alipao, Alegria, Surigao Del Norte
8	Bb.#42	Coccinellid beetle	Gigakit, Surigao Del Norte
9	Bb.#49	Rice bug	RTRomualdez, Agusan Del Norte
10	Bb.#52	Rice bug	RTRomualdez, Agusan Del Norte
11	Bb.#153	Rice bug	Anahaw, Alegria, Surigao Del Norte

Table 24. Newly collected strains of Metarhizium anisopliae stored in potato dextrose agar slants.

No.	Code Name	Insect Host	Place Collected
1	Ma.#01	Sweet potato weevil	Tiaong, Quezon
2	Ma.#3	Rice black bug	Capatungan, Trento, ADS
3	Ma.#5	Rice black bug	Bual , North Cotabato
4	Ma.#6	Rice black bug	Basilisa, RTR, ADN
5	Ma.#15	Rice black bug	Ponyente, Gigakit, SDN
6	Ma.#17	Rice black bug	Kitcharao, ADN
7	Ma.#19	Rice black bug	San Andres, Bunawan, ADS
8	Ma.#20	Rice black bug	San Francisco, ADS
9	Ma.#116	Rice black bug	PhilRice, Basilisa, RTR, ADN

Figure 21. Culture stocks of Metarhizium anisopliae (left) and Beauveria bassiana (right), laid with mineral oil.

Conservation and Management of Microbial Genetic Resources
JT Niones and F Sandoval

The role and impact of microorganisms on agronomically important crops depend on their interaction with their host plant. Negative interaction of microorganisms with their host resulted to diseased plants and significant crop loss while positive host- microorganism interaction can improve crop nutrition and the ability of crops to resist biotic and abiotic stress. With the increasing awareness of the undesirable human and environmental effects of the use of inorganic fertilizers, herbicides and pesticides, PhilRice thorugh its R&D programs had long recognized that beneficial microbes provide an alternative strategy to combat limiting soil nutrient and the destructive effects of weeds and pests on crops.

Maintaining and preserving fungal cultures are not only essential on systematics and biodiversity studies but also in ensuring the quality of microbial agents especially for commercialization and public utilization purposes. Preservation methods of potentially important isolates for agrobiological applications have to be optimized early in the development process of a product so as to avoid potential economic and scientific loss in the event of deterioration of a production strain.

Trichoderma sp. is a soil-borne fungus known to exert biocontrol against a wide range of fungal phytopathogens. At PhilRice, two strains of Trichoderma sp. were isolated and characterized as potential biocontrol agents against fungal diseases of vegetables and rice. In particular, Trichoderma sp. strain 1 is known to control damping-off diseases of onion and solanaceous crops, and anthracnose disease of onion. On the other hand, Trichoderma sp. strain 2 is a potential biocontrol agent against rice sheath blight (Rhizoctonia solani). Streptomyces mutabilis is a soil-inhabiting and root colonizing actinomycete. An isolate of this actinomycete has been characterized by a group of PhilRice researchers as a plant growth promoter through the production of auxin and ACC deaminase.

Highlights:

- Pure cultures of Trichoderma sp. strain 1 and 2 were subjected to three different preservation techniques. Agar blocks fully colonized by the fungus, overlaid with either glycerol or mineral oil, were deep- freeze at -80°C (Figure 22). Filter paper discs completely covered with the fungus were placed in cryovials and then stored in a -80°C freezer. Another preservation technique done is storing the fungal spore-colonized corn grits in an ambient temperature.

- For the preservation of S. mutabilis, agar blocks fully colonized by the actinomycete overlaid with either glycerol or mineral oil, were deep - freeze at -80°C. Sterile soil and carbonized rice hull (CRH) were drenched with spore suspension, placed in 10 ml plastic vials and then stored at either 10°C or ambient temperature (Figure 23).

- Evaluation of different preservation techniques will be done at 6-months, 12- months, 18-months and 24- months after the initial set-up.

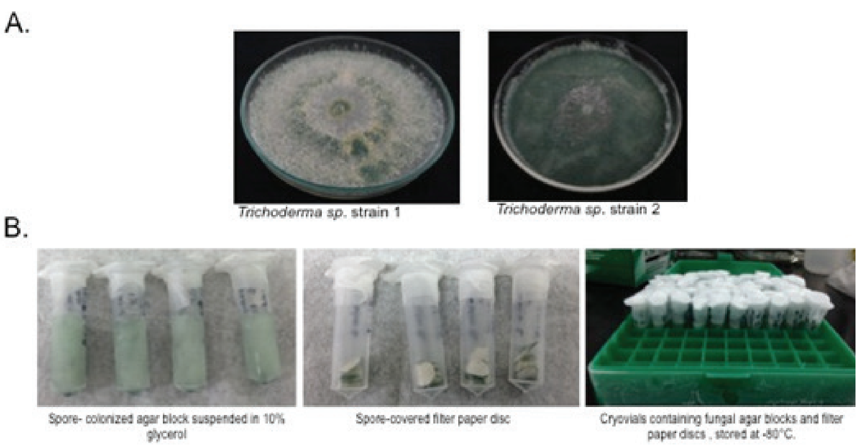

Figure 22. Preservation techniques for Trichoderma sp. a) Colony growth characteristic of a one-week old culture of Trichoderma sp strain 1 and 2. Strain 2 is fast growing compared to strain 1, developed more spores at 1 week after seeding of mycelia- colonized agar block. b). Spore- colonized agar block were suspended in 10% glycerol (left), filter paper discs completely covered with fungal spores (center), and cryovials containing fungal agar blocks and spore-covered filter papers, stored at -80ºC freezer.

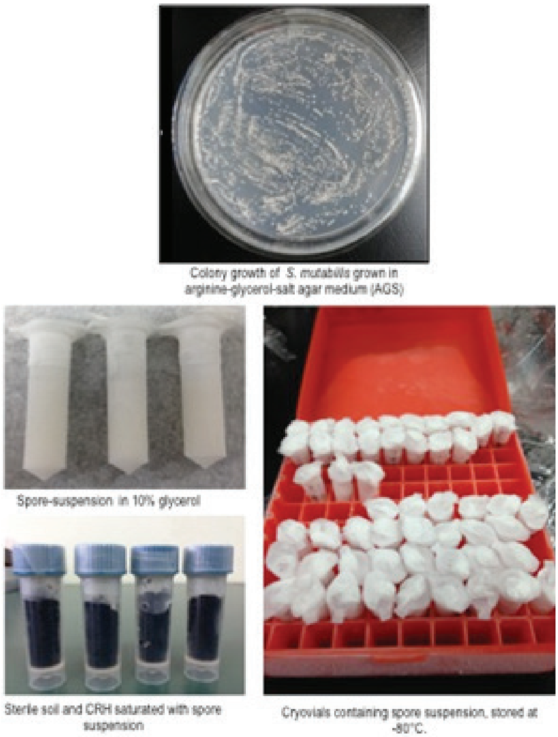

Figure 23. Different conservation techniques for a plant growth promoting strain of Streptomyces mutabilis.

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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