2022 PhilRice R&D Highlights

Genetic Resources Division

Philippine Rice Research Institute
Central Experiment Station
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DIVISION

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EXECUTIVE SUMMARY

The Genetic Resources Division (GRD) operates with two core goals: (1) conservation and management of rice germplasm, and (2) internal seed quality assurance in PhilRice seed production and seed stocks. These goals/projects significantly contribute to (1) increasing productivity, cost-effectiveness, and profitability of rice farming in a sustainable manner and (2) enhancing value, availability, and utilization of rice for better quality, safety, health, nutrition, and income. GRD houses the PhilRice Genebank that leads efforts on the repository and ex situ conservation of rice genetic resources. Thus, it ensures the conservation and utilization of high-quality genetic resource materials to support the breeding program of new varieties. GRD, through its seed technology unit, also leads the internal field inspection and seed quality assurance of PhilRice seeds

The PhilRice Germplasm Management System Version 2.0 (GEMS 2.0) and OryzaGEMs online version with 11,608 datasets were uploaded to the GEMS database; 6,684 datasets are available at the PhilRice OryzaGEMS intranet portal with regulated level of access. GEMS database can now be accessed online at https://gems.philrice.gov.ph/gems for seeds and data requests with improved security through secure sockets layer (SSL) encryption.

Eighty-one of 2,039 traditional rice varieties (TRVs) were found to have multiple alleles using 20 selected trait-based SNP markers for abiotic, biotic, and grain quality traits.

Heirloom or traditional rice varieties (TRVs) were conserved through the PhilRice Blackbox storage system in partnership with the Ifugao and South Cotabato IP communities.

A total of 185 TRVs germplasm samples acquired from Laguna, Marinduque, Bohol, Samar, Nueva Ecija, Ifugao, Camarines Sur, Leyte, Albay, and Masbate. One hundred forty-five inbred varieties from basic seeds (BS, 92 varieties),

foundation seeds (FS, 30 varieties) and registered seeds (RS, 23 varieties) were inspected in 2022 dry season (DS) and wet season (WS) with average field purity of 97.5%.

Sixty-six varieties from seed quality monitoring of carry-over seed lots from BS (41), FS (13) and RS (12) varieties showed an average of 90.25% of seeds are vigorous and viable. NSIC Rc 358 showed a significant rate of reduction of viability at 69% after 18 months of storage. The new storage facility for BS seed stocks contributed to the significant maintenance of high seed viability.

CORE-FUNDED PROJECT 1:

Conservation and Management of Rice Germplasm

Marilyn C. Ferrer, Jonathan M. Niones, Loida M. Perez, Teodora E. Mananghaya, Malvin D. Duldulao, Jose Mari Z. Nombrere, Mary Ann M. Rañeses, Juliet P. Rillon, Gilely D. Santiago, Amelia V. Morales, Roel R. Suralta, and Maria Corazon J. Cabral

The PhilRice Genebank provides a secure cost-effective means to safeguard Philippine rice diversity for the long term and ensure that stakeholders have ready, convenient access to all the diversity they need for direct use or to improve rice. The project focuses on the most valuable resources of the Genebank: seeds, DNA, and data. This guarantees that potentially beneficial germplasm diversity is collected, conserved, characterized, evaluated, and accessible for direct use and in support of the breeding of new rice varieties.

There were 540 rice germplasm accessions acquired, of which 185 are Philippine TRVs collected from Laguna, Marinduque, Bohol, Samar, Nueva Ecija, Ifugao, Camarines Sur, Leyte, Albay, and Masbate.

A total of 629 seed stocks were regenerated, in which 611 entries produced enough seeds (>500g) contributing to the increase of the total number of available accessions for distribution. We processed 36 seed requests covering 910 entries/seed packets;

Five hundred five rice accessions were agro-morphologically characterized (from vegetative to reproductive stage) using standard rice descriptors in 2022 WS. Some of the TRVs exhibit many interesting characteristics that can be useful for breeders, such as early maturity, short plant height, dense panicles, and long grains. The average maturity of the accessions is 132 DAS; early maturity (102 DAS) was observed in two accessions. Five materials have the shortest

culm length (100 cm); two have dense panicles (<300 filled grains/panicle); four accessions had long panicles (<35cm); four materials have long grains (<11mm);

There were 2,012 traditional rice varieties (TRVs) collected and genomic isolation was conducted using a modified cetyltrimethylammonuim bromide (CTAB) method. The deoxyribonucleic acid (DNA) stocks were conserved and stored at -20°C for medium-term and -80°C for long-term storage.

Eight hundred ten TRVs were genotyped using 16 short tandem repeat (STR) markers, and 210 TRVs were genotyped using 7K Infinium single nucleotide polymorphism (SNP) genotyping. Molecular characterization using simple sequence repeats (SSR) and functional markers showed that 14 TRVs harbored five to six favorable alleles.

Exactly 2,039 TRVs were analyzed for trait-based genotyping using 20 selected SNP markers for biotic, abiotic, and grain quality QTL/gene alleles, and 81 TRVs were found to possess multiple traits.

The GEMS database was updated with 324 passport data entries (from collection nos. 17658 to 17981); 443 characterization entries; disease data entries (blast 768, sheath blight and bacterial leaf blight 354, tungro-induced 775); insect pest data (green leafhopper and brown planthopper 828); 725 roots elongation characterization entries, 310 drought data, 470 salinity evaluation entries, 1,035 grain quality entries, and 11,851 inventory entries of adjusted/relocated germplasm at medium-term storage.

Online access to OryzaGEMS was made available with 6,684 datasets highlighting these key features and functionalities: (i) simple and advanced search features, (ii) user registration for access level privilege sets (admin, level 1–public, level 2-researcher, level 3-breeder), (iii) approval of germplasm seeds and data request, and (iv) automated user feedback form generation; facilitated also the changes on the domain of Online GEMS to improve security thru SSL encryption including back-end database (https://gems.philrice.gov.ph/gems).

The Black Box System preserves the heirloom rice varieties or TRVs of Indigenous Peoples. The system agreement was signed by DA-PhilRice, farmers, and local government unit representatives on October 4, 2022 in Nueva Ecija. TRVs from communities in Ifugao (Hungduan and Hingyon) and Lake Sebu, South Cotabato (T'boli and Ubo tribes) were deposited in Black box storage at PhilRice Genebank through collaborative efforts involving the indigenous communities, LGU, DA-Bureau of Agricultural Research, Food and Agriculture Organization, and PhilRice.

GRD hosted a webinar on "LI-BIRD's Approach to Supporting Community Seed Banks" presented by Mr. Pitambar Shrestha of the Local Initiatives for Biodiversity, Research, and Development (LI-BIRD) in Pokhara, Nepal.

CORE-FUNDED PROJECT 2:

Seed Quality Assurance in PhilRice Seed Stock cum Seed Production Research

Susan R. Brena

The internal field inspection of breeder seed (BS), foundation seed (FS), and registered seeds (RS) at CES seed production areas: number of missing hills, weed occurrence, diseased plants, and off-type plants. Buffer stocks and carry-over seed lots of inbred and hybrid parental seed stocks were tested for genetic purity and seed viability, as follows:

One hundred forty-five varieties (67 in DS and 78 in WS) were inspected four times in the field in 2022: 92 (BS); 30 (FS); and 23 (RS). Ninety-three of the 145 varieties i.e. BS (68), FS (14), and RS (11)—passed the field inspection without off-types.

The internal seed quality unit conducted varietal purity tests for 113 varieties: BS (71); FS (23); and RS (19), of which 50 varieties—BS (29), FS (9), and RS (12)—passed.

The dormancy test of 41 BS varieties produced in 2022 DS was conducted after threshing and at weekly intervals after drying. Of them were 36 highly dormant (2-45%), five varieties were moderately dormant (56-72%);

The germination percentage (GP) of BS produced in the 2021 and 2022 DS was monitored and tested after 12 months of storage in a cold room (18°C), the majority of which had high GP (>95%); except NSIC Rc 25 (84%); Rc 358 (80%); Rc 584 (58%); and Rc 506 (71%).

Internal Seed Quality Control for Rice Competitiveness

Susan R. Brena and Rhenalyn F. Duca

The internal field inspection of foundation seed (FS) and registered seed (RS) at branch station seed production areas was monitored in 2022. There were 778.48ha (270.43ha in DS; 508.05ha in WS) inspected for plant off-types, number of missing hills, weed occurrence, and diseased plants. High levels of plant off-types were observed at Central Mindanao University and PhilRice Midsayap. Buffer stocks and carry-over seed lots of inbred and hybrid parental stocks were tested for genetic purity and seed viability.

All branch stations sent samples for varietal purity assessment of newly harvested rice seeds of 2022 (DS and WS), the majority of which were pure. A total of 4,794 bags of carry-over seeds of BS, RS, and certified seed (CS) stocks from 2020, 2021, and 2022 DS were re-tested for laboratory seed germination and seedling emergence. Seed samples from the branch stations tested had been stored for 3 to 16 months.

Comprehensive Profiling of Released Inbred Rice Varieties for Purity Assessment and Genetic Identification in the Philippines

Jonathan M. Niones, Roel R. Suralta, Teodora E. Mananghaya, Marilyn C. Ferrer, Jonalyn C. Yabes, Nica May M. Muñez, Malvin D. Duldulao, Jose Mari Z. Nombrere, Mary Ann Rañeses, VMM Marilao, and Dionicko R. Arceo

Plant DNA fingerprinting identifies markers associated with different traits utilized in plant breeding, genetic diversity, varietal identification, and purity assessment. With the combined morpho-agronomic characterization and molecular genotyping, the genetic identity of commercially released local varieties is established to protect the integrity and reliability of our own rice varieties.

Seventy-nine inbreds were profiled using 15 STR markers (58 varieties) and 7K Infinium SNP markers (21 varieties). The similarity coefficient of NSIC Rc 222 and Rc 508 was noted to be high with 81% in agro-morphology and 84% in SNPs markers. Diagnostic markers of 149 cultivars for each STR marker were identified to differentiate varieties from impurities.

In trait-based SNP genotyping, xa5 for bacterial leaf blight (BLB) resistance (86.36%) and for drought trait (65.91%) was the dominant allele detected in inbred varieties. The majority of them showed the slender grain size allele A (favorable-slender) except NSIC Rc 556 (Salinas 32, GSR) which had the G. allele.

Twenty-four newly released varieties were re-characterized and validated, 12 of which had awns ranging from 0.83mm to 19.27mm; and six had long grains with >10mm average.

Genetic Improvement of Rice Breeding Materials and Technology in the Philippines

Jonathan M. Niones, Teodora E. Mananghaya, Roel R. Suralta, Jennifer T. Niones, Juliet P. Rillon (PhilRice CES), and Mitsuhiro Obara (Japan)

Improved root systems affects the uptake of broad solutes as well as water because the root is the sole organ to uptake nutrients and water from surrounding soils. A few genes associated with roots and nitrogen uptake have been identified and used in rice breeding. These were introduced into NSIC Rc 160 and Rc 240 cultivars.

Three near—isogenic lines (NILs) — NSC160NILqRL6.1, NSC160NILEHD, NSC160PYL (qRL6.1+EHD) — and the control variety NSIC Rc 160 were grown at PhilRice CES and PhilRice Negros under four fertilizer treatments including zero, half (50%), normal (100%), and 150% recommended NPK (nitrogen, phosphorus, potassium) rate (120-60-60 for DS).

At CES, yellowish and stunted growth resulted from zero NPK; vigorous plant growth and dark green color resulted from the 1.5 times treatment. The majority of the test entries at PhilRice Negros showed early symptoms of rice tungro virus infection.

Genetic Improvement of Adlay (*Coix lacryma-jobi*) in the Philippines: Genetic Profiling of Existing Adlay Germplasm

Jonathan M. Niones, Roel R. Suralta, Teodora E. Mananghaya, Marilyn C. Ferrer, Jonalyn C. Yabes, Jose Mari Z. Nombrere, Mary Ann Rañeses, Jennifer T. Niones, Marissa V. Romero, Henry F. Mamucod (CES), and Xavier Greg I. Caguiat

Adlay (Job's tears) contains nutrients, dietary fiber, protein, minerals, and low glycemic index—making it heart-healthy and completely safe for those watching their blood sugar. Conservation, genetic profiling and diversity assessment activities prior to improvement of Adlay are being conducted at PhilRice CES.

Twenty-two Adlay germplasm were collected with standard passport data, assigned a unique collection number, and stored at the PhilRice Genebank. Among the collections, Kibuwa (ADL004), Kili-Kili (ADL006), and Tapol (ADL0014) are promising varieties with good eating quality. Majority of the Adlay cultivars are circular in shape, have hard grains, light and dark intensity of brown coloration, and glutinous and intermediate type of endosperm.