

2023

PhilRice R&D Highlights



GENETIC RESOURCES DIVISION



Philippine Rice Research Institute
Central Experiment Station
Maligaya, Science City of Muñoz, 3119 Nueva Ecija

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Genetic Resources Division

Jonathan M. Niones

EXECUTIVE SUMMARY

The 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 project goals significantly contribute in (1) increasing productivity, cost-effectiveness, and profitability of rice farming in a sustainable manner; and (2) enhanced 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 in the Philippines. Thus, it ensures 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 that store and maintain the germplasm information, comprising 18,360 collections, with 7,268 identified as accessions can now be accessed online at <https://gems.philrice.gov.ph/gems> or <https://gems.philrice.gov.ph/genelytics> for seeds and data requests with improved security thru SSL encryption.

Acquired 247 rice germplasm, comprising 102 breeding lines, 77 mutants, 46 Philippine traditional rice varieties (TRV), and 22 improved varieties from Masbate, Samar, Benguet, Ifugao, UPLB, Nueva Ecija, Zambales, Negros Occidental, Pampanga, and IRRI.

There were 3,067 TRVs that underwent genotyping using 27 selected trait-based SNP markers for abiotic, biotic, and grain quality traits. The anaerobic germination trait (qAG3) is particularly noteworthy with the highest number of favorable alleles, followed by drought vegetative (DRO) and amylose trait (waxy) genes in terms of favorable allele frequency.

There were 154 inbred varieties from Basic Seeds (94), Foundation Seeds (19), and Registered Seeds (13) inspected with average field purity of 53.90% as planted in an approximate area of more than 700 ha.

Thirty Adlay germplasm profiles on the agro-morphological, grain color, size, shape index, milling recovery, and Instron cooked hardness were generated.

Majority of them were spherical in shape. Ginampay-A (ADL0059-A) and Kili-Kili (ADL006) had the lightest and darkest hull color (based on their L* values). Milling recovery ranged from 23 to 44.70% with Tapol (ADL0058), Glutinous (ADL0021), and Gulian (ADL0015) having the highest values; Kibba-ong (ADL0019) and Nomnom (ADL0016) with the lowest values.

CORE-FUNDED PROJECT 1:

Conservation and Management of Rice Germplasm (GRD 231-000)

Marilyn Ferrer, Teodora Mananghaya, Malvin Duldulao, Jose Mari Nombrore, Mary Ann Rañeses, Gerald Fajardo, Vanessa Mae Martin, Jonalyn Yabes, Juliet Rillon, Gilely Santiago, Amelia Morales, Maria Corazon Cabral, and Jonathan Niones

The PhilRice Genebank offers a safe and economical means to secure 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 focused on the most valuable resources of the Genebank; seeds, DNA, and germplasm data information management. 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.

Our Genebank maintained the national collection of rice genetic resources, comprising 18,360 collections with 7,268 identified as accessions. Notable achievements include thorough morphological characterization of 557 accessions, some of which carried desirable traits such as early maturity, short plant height, dense panicles, and long grain features. There were 574 varieties distributed to various stakeholders for evaluation, direct utilization, breeding, demonstration, DNA fingerprinting, gene discovery, and trait genotyping. Continuous efforts in seed regeneration ensure the replenishment of seed stocks, with 269 entries successfully producing sufficient seeds that were conserved. Presently, the Genebank is replete with 4,531 conserved rice accessions.

DNA conservation efforts involved genotyping of traditional rice varieties (TRVs) using various markers, facilitating varietal improvement and potential exportation. There were 384 TRVs genotyped using 16 STR markers, while 600 were genotyped using 1K RiCA. Additionally, 3,067 TRVs underwent trait-based genotyping using 27 SNP markers, enabling the identification of desirable traits for breeding programs.

The Germplasm Management System (GEMS) serves as the central database for storing germplasm information. In 2023, GEMS was enriched with 317 passport data, 286 grain quality data, 20 characterization data of mutant lines, and 15,247 inventory data of adjusted/relocated germplasm. The online platform for GEMS (<https://gems.philrice.gov.ph/genelytics/>) was enhanced to provide secure access and facilitate seed and data requests.

CORE-FUNDED PROJECT 2:

Seed Quality Assurance in PhilRice Seed Stock Cum Seed Production Research (GRD-232-000)

Susan Brena, Rhenalyn Duca, and Maria Celeste Salamanca

Internal field inspection of BSP, FSP, and RSP at CES broadly assessed the number of missing hills, weed occurrence, diseased plants, and plant off-types in 4 strips (1m x 25m area per strip) in a hectare. Field inspection was done at the vegetative, reproductive and ripening stages. Also, buffer stock and carry-over seed lots of the inbred seed and hybrid parental seed stocks were tested for genetic purity and seed viability.

There were 154 varieties field-inspected at least twice in 2023 (72 in DS and 82 in WS); 94 (BSP); 37 (FSP); and 23 (FSP). A total of 86 out of 154 varieties BSP (55), FSP (18), and RSP (13) passed the field inspection with no off-types.

There were 125 varieties (80 BS, 27 FS, 18 RS) tested for purity. Impurities observed led to the downgrading of a number of varieties.

Magnitude of seed dormancy was also assessed. Most BS produced in WS 2023 had a weak (0-7 days) to very strong dormancy (21-28 days) period. Proper temperature control is essential for storage to maintain a high germination percentage and prevent premature seed deterioration.

RCEF-FUNDED PROJECT 1:

Internal Seed Quality Control for Rice Competitiveness (RCS-002-003)

Susan Brena, Bill Clifford Guzman, and Bernyl Cel Pacada

The internal seed quality control inspectorate of FSP and RSP at branch station seed production areas with approximately 619.45 ha worked to pinpoint plant off-types, number of missing hills, weed occurrences, and diseased plants. Also, buffer stock and carry-over seed lots of the inbred seed and hybrid parental seed stocks were tested for genetic purity and seed viability.

Eleven branch and satellite stations' seed production sites covering 752.44 hectares were examined during both seasons.

A total of 3,167 bags of BS, RS and CS carry-over seed stocks from DS and WS 2022, and DS 2023, were tested for laboratory seed germination and seedling emergence. Seed samples tested were stored for 3- 8 months. The 2022 seeds were received from the Isabela, Mindoro, CMU, Agusan, Bicol, Los Baños, Samar, and Zamboanga stations.

RCEF-FUNDED PROJECT 2:

Comprehensive Profiling of Released Inbred Rice Varieties for Purity Assessment and Genetic Identification in The Philippines (RCS-003-001)

Jonathan Niones, Roel Suralta, Teodora Mananghaya, Marilyn Ferrer, Jonalyn Yabes, Mary Ann Rañeses, Gerald Fajardo, Vanessa Mae Marilao, Malvin Duldulao, and Jose Mari Nombrene

DNA fingerprinting is a molecular technique that reveals the probable identity of the plant based on the nucleotide sequences of the DNA that are unique to an individual crop. It identifies markers associated with different traits utilized for plant breeding, genetic diversity, varietal identification, and purity assessment. With combined morpho-agronomic characterization and molecular genotyping, we are able to establish the genetic identity of commercially released Philippine varieties, which is a definite priority in order to protect the integrity and reliability of our own rice varieties.

There were 296 released inbred rice varieties profiled using the 7k Infinium SNP

marker technology. The genetic relatedness heatmap showed two distinct sub-populations: one comprised special rice and varieties from cooler ecosystems, while the other included varieties from various ecosystems.

In the trait-based SNP genotyping of 86 released varieties for grain quality and biotic and abiotic stress traits, NSIC Rc 222 showed favorable alleles to Saltol, qHTSF4.1, qDTY12.1, xa5, and in three waxy genes. Rc 414SR and Rc 484SR have favorable alleles to NAL1 genes. Out of the 86 varieties, 53 exhibited four to five favorable alleles across 19 SNP markers, with most showing favorable alleles for qDTY12.1 and three waxy genes. Rc 222, Rc 360, Rc 400, Rc 414 SR, and Rc 484SR carried 6-7 favorable traits.

EXTRA CORE PROJECT 1:

Genetic Improvement of Rice Breeding Materials and Technology in The Philippines (RTF- 052-074)

Jonathan Niones, Teodora Mananghaya, Jennifer Niones, Juliet Rillon, Mitsuhiro Obara (Japan), and Kazuhiro Sasaki (Japan)

Nutrient deficiency is a common soil problem, and nitrogen is the major limiting factor in rice production. Hence, it is desirable to genetically improve the uptake and use efficiency of nitrogen to fuel rice production. Improved root system eases the uptake of broad solutes and water. A few genes associated with roots and nitrogen uptake have been identified and used in rice breeding programs. Efficient QTL/gene(s) for root elongation and nitrogen uptake have been introduced into NSIC Rc 160 and Rc 240 cultivars.

Three near-isogenic lines (NILs) - NSC160NILqRL6.1, NSC160NILEHD, NSC160PYL (qRL6.1+EHD) - and control variety NSIC Rc160 were established at PhilRice CES and Negros under four fertilizer treatments: zero, half (50%), normal (100%), and 150% recommended NPK rate, 120-60-60 for dry season.

The NILs (NSIC Rc160NILqRL6.1 (PR53682-qRL6.1-1-B-B-B) and NSIC Rc160NIL EHD together with NSIC Rc160 genetic materials showed significant variations in nitrogen uptake, in response to high and low-fertility soil conditions, in CES and Negros. Three NILs (NSIC Rc160NILqRL6.1, NSIC Rc160NIL EHD, and NSIC Rc160NIL qRL6.1+EHD) were established in the low-soil fertility environment.

Genetic Improvement of 'Adlay' (Coix lacryma-jobi) in the Philippines: Genetic Profile of Existing Adlay Germplasm, Phase 2 (2RTF- 052-074)

Jonathan Niones, Roel Suralta, Teodora Mananghaya, Mary Ann Rañeses, Marilyn Ferrer, Jonalyn Yabes, Jose Mari Nombroere, Jennifer Niones, Marissa Romero, Henry Mamucod, Graciela Caro, Teresa Yvonne Santiago, and Ezra Spencer Delim

Adlay is a promising alternative and complementary to rice and corn in the Philippines. It is replete with nutrients, dietary fiber, protein and minerals. Adlay grain composition as known has a low glycemic index—making it heart-healthy and completely safe for those watching their blood sugar. Initiatives on the conservation, genetic profiling, and diversity assessment activities prior to improvement of 'Adlay' are being sustained in PhilRice.

Eighty Adlay germplasm were collected with standard passport data, assigned unique collection numbers and stored at the PhilRice Genebank. Majority of the remaining 28 Adlay collections from Phase I were light brown in color, circular in shape, had hard grains, dark intensity of brown coloration, and intermediate endosperm types based on the UPOV descriptors. Tapol (ADL0077) variety showed the longest and widest grains.

One output table on the color ($L^*a^*b^*$ values), size, shape index, milling recovery, and Instron cooked hardness of 30 ex-situ adlay germplasm was generated, majority of which were spherical in shape. Ginampay-A (ADL0059-A) and Kili-Kili (ADL006) had the lightest and darkest hull color (based on their L^* values). Milling recovery ranged from 23 to 44.70% with Tapol (ADL0058), Glutinous (ADL0021), and Gulian (ADL0015) having the highest values; Kibba-ong (ADL0019) and Nomnom (ADL0016) with the lowest.

There were 56 mutant breeding lines selected from the indigenous Adlay (Kibuwa and Nomnom) parental varieties. The average plant height observed in the Kibuwa mutants was 225.20 cm which was higher than the Nomnom mutants at 157.60 cm. Majority of their phenotypic traits except for plant height were comparable with the wild type. The Tapol and Kinampay mutant lines and the 56 selections from Kibuwa and Nomnom mutants are currently planted at the Adlay experimental site of DA-PhilRice for selection.

