Department of Agriculture

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PHILIPPINE RICE RESEARCH INSTITUTE

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DA-PHILRICE R&D HIGHLIGHTS

GENETIC RESOURCES DIVISION

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DIVISION

Genetic Resources Division

Jonathan M. Niones

EXECUTIVE SUMMARY

The Genetic Resources Division (GRD) operates with two core goals: conservation and management of rice germplasm and seed quality assurance in PhilRice seed production and seed stock. These goals/projects significantly contribute to sustainably increasing productivity, cost-effectiveness, and profitability of rice farming; and enhanced value, availability, and utilization of rice for better quality, safety, health, nutrition, and income.

The division houses the PhilRice Genebank that leads the effort on the repository and *ex situ* conservation of rice genetic resources, consisting of traditional cultivars, modern varieties, farmers› selections, elite breeding materials, weedy rice, and wild rice relatives in the Philippines, as well as foreign introductions. Thus, it ensures the collection, conservation, and utilization of high-quality genetic resources seeds to support breeding new rice varieties. Through its seed technology unit, the division also leads the internal field inspection and quality assurance of seed produced at the PhilRice seed production unit.

The PhilRice Germplasm Management System and *Oryza*GEMs online have 6,679 datasets with regulated access levels. The 7,268 are identified accessions, in which 5,667 DOI-assigned accessions were registered in the Global Information System (GLIS) of the International Treaty on Plant Genetic Resources for Food and Agriculture.

In partnership with other research divisions at PhilRice, GRD categorized 2,180 rice accessions as resistant to intermediate in response to blast disease, brown leafhopper, green leafhopper, salinity stress, drought stress, and with good grain quality.

Fourteen traditional rice varieties exhibited the presence of alleles of 5- 8 important traits based on 16 functional trait-based markers. Moreover, 2,382 TRVs were genotyped using 10 SNP markers, with 99.31% of the samples revealing a favorable allele to bacterial leaf blight.

One hundred five inbred varieties from Basic Seed (67 varieties), Foundations Seed (13 varieties), and Register Seed (25 varieties) were inspected in dry and wet seasons with average field purity of 99.0%. Seed quality monitoring of carry-over seed lots of most BS varieties conducted showed 90% to 95% of seeds are vigorous and viable.

PROJECT 1

Conservation and Management of Rice Germplasm

Marilyn C. Ferrer

The PhilRice Genebank provides a safe and economical means to secure Philippine rice diversity long-term and ensure that stakeholders have ready, convenient access to all the diversity they need for direct use and to improve rice in the service of farmers and consumers. The project focuses on the most valuable resources of PhilRice 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 breeding new rice varieties.

Eighty-seven rice germplasm was acquired, consisting of 39 Philippine released varieties, 30 breeding lines, 16 traditional rice varieties, and two foreign introductions. Most of the germplasms received this year are through donations from PhilRice PBBD, JIRCAS, Hungary, and a collection from Ifugao.

Three hundred ten rice accessions were evaluated for field drought stress, of which 103 were drought-resistant, and 207 were sensitive. In addition, Sipur Pua (PRRI000034), Champion (PRRI6556), Dinorado colored 2 (PRRI5779), Batangueño (PRRI6360), Feria (Red) (PRRI6332), Dinorado (PPRI6791), PE-2 (PRRI4127), Red-C4 (PRRI4230), Unknown (PRRI3958) and Matag-ibid (PRRI6531) showed good leaf rolling score (LRS) and phenotypic acceptability (PAcp). Also, 1,581 rice accessions were analyzed for AC (791) and GT (790).

The 826 accessions were characterized and exhibited interesting characteristics such as early maturity, short plant height, high lodging resistance, glabrous leaves, and stay green features, which can be helpful for farmers and breeders. Early maturity (<102DAS)

PROJECT 1

was observed in 7-7 Red, Dainy, Gojar Goria, Magkasar, N 22, and Sathi Bagari. Moreover, Bahil 1 and Lawangin (A) had the shortest culm length (63 cm). Twenty-nine (29) accessions had exhibited very strong lodging resistance, 26 accessions had glabrous leaves, and 112 accessions had stay green feature.

The DNA of 1,300 traditional rice varieties with QR and barcode are available and stored in short-term (-20°) and long-term (-80°) storage at PhilRice Genebank. DNA fingerprints of 810 TRVs were generated using 16 STR markers.

There were 3,271 accessions characterized using the traits based on 16 SSR markers and 10 SNP markers. Fourteen traditional rice varieties have multiple genes for at least five important traits. On the other hand, 99.31% of 2,382 TRVs showed bacterial leaf blight and none to panicle architecture trait.

PROJECT 2

Seed Quality Assurance Cum Seed Production Research

Susan R. Brena

In rice seed production, seed quality assurance is employed in the field during the cropping season. The production field undergoes field inspection at different stages of crop growth. The initial inspection was done 20 days after transplanting, where seedlings not aligned within the rows were removed. The next inspection was done at the maximum tillering stage, where various true-to-type plants are distinguishable from off-types. At this period, base color, the intensity of the green color of the leaves, canopy orientation, and leaf margin of plant phenotype are essential features to observe.

In the last inspection, there were fewer problems when off-types are removed on time from vegetative until the reproductive stage. Therefore, field inspection is always coupled by removing off-types at each inspection period. When field inspection is religiously performed by the seed inspector and the inspection reports are appropriately disseminated to field supervisors, harvested rice seeds can be considered high-quality before harvest.

It has been observed that seeds produced in DA-PhilRice in one season are not all distributed in the next season for planting. Many carry-over seed lots are left in warehouses for several months, waiting for distribution to early planters in the succeeding planting season. These seed lots require close monitoring of seed quality while in storage. Thus, germination and vigor tests are needed. Moreover, as the storage period is extended, fungi may increase in number inside the sack. Therefore, a blotter test may be required to determine if seeds in storage need seed treatment. In addition, seed and seed production research is necessary to improve the quality of the seeds produced in PhilRice.

This project ensured that PhilRice produces high-quality seeds for increased rice productivity. Specifically, it provided 97%- 100% field purity before harvest in seed production areas in PhilRice Central Experiment Station, ensured high genetic purity in all varieties planted per seed class, maintained high seed viability and vigor for six months under ambient storage; determined seed production efficiency after harvest in all seed classes planted, assessed the effects of harvest maturity in inbred seed longevity, and established

PROJECT 2

the level of seed dormancy at harvest and duration of after-ripening in selected inbred rice varieties.

The first study under this project focused on the internal field inspection of seed production in the Central Experiment Station. Breeder seed production, foundation seed production, and registered seed production areas were inspected. Number of missing hills, weed occurrence, disease plants, and plant off-types were evaluated. Seed testing of buffer stock and carry-over seed lots of the inbred seed and hybrid parental seed stocks were tested for genetic purity and seed viability

One hundred five (DS: 53 and WS: 52) inbred released varieties composed of Basic Seed (DS: 34 and WS: 33), Foundations Seed (DS: 9 and WS: 4). Register Seed (DS: 10 and WS: 15). The seed production field has an average purity of 99.0% in both seasons. Meanwhile, NSIC Rc 512 and Rc 582 were rejected due to phenotype maturity character differences. In addition, it was noted that NSIC Rc 480 at Baloc RSP showed a high number of off-types such as tall, late maturing, and grains with awn.

A seed viability test was conducted every six months to ensure high seed quality of the carry-over seed lots of inbred and hybrid parental lines in storage. As a result, the seed viability of most of the Breeder Seeds harvested in 2021 DS was maintained at a higher 90% rate except NSIC Rc 358 (88%). However, it was noted that Breeder Seed produced in 2020 WS, showed a rapid decline in seed viability and vigor particularly PSB Rc 82, NSIC Rc 216, Rc 308, Rc 358, and Rc 510. On the other hand, hybrid parental lines stored in PhilRice-Los Baños cold room were tested in November 2021. Parental lines of Mestizo 1, IR58025B (maintainer line), and IR34686R (restorer line) remained high viability. However, these parental lines were produced 4-5 years ago.

Extra-core Project 1

Internal Seed Quality Control for Rice Competitiveness

Susan R. Brena

This project focused on the internal field inspection of foundation seed production and registered seed production at the branch station seed production areas. In 2021, 245.9ha were inspected for the number of missing hills, weed occurrence, disease plants, and plant off-types. On the other hand, seed testing of buffer stock and carry-over seed lots of the inbred and hybrid parental seed stocks were tested for genetic purity and seed viability.

There were 8,833 bags (DS: 4,811 and WS: 4, 022) of old inbred seed stocks re-tested for laboratory seed germination and seedling emergence. In addition, 4,811 eleven bags of Registered Seed (RS) or Certified Seed (CS) carry-over seed stock from 2020 WS and DS were tested. The seed stock tested for seed quality came from PhilRice-Mindoro (417 bags), PhilRice-Samar (432 bags), and PhilRice-Batac (520 bags); PhilRice-Isabela (1042 bags); and PhilRice-CMU (2252 bags).

Few varieties sent for varietal purity assessment were considered RS. Among the samples received from PhilRice-Negros in 2021 DS, only NSIC Rc 222 passed as RS. One variety, PSB Rc 82, was rejected, and five varieties were considered CS. Of the four varieties from PhilRice-Mindoro, two were left, one was CS, and the other was RS. Rejected samples were NSIC Rc 260 from PhilRice-CMU; NSIC Rc 402 from PhilRice-Los Baños; , and NSIC Rc 216 and Rc 222 from PhilRice-Batac. Rejected varieties after the varietal purity test from 2021 WS samples were NSIC Rc 218 (LB); NSIC Rc 216 and Rc 160 (Batac); and NSIC Rc 216 and Rc 402 (Isabela). Downgrading was commonly observed in all stations.

Extra-core Project 2

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, Rachelle M. Conmigo, Nicca May M. Muñez, Dionicko R. Arceo, Malvin D. Duldulao, and Jose Mari Z. Nombrere

DNA fingerprinting enables the identification of organisms at the molecular level. Plant DNA fingerprinting is mainly used to identify markers associated with different traits utilized for plant breeding, genetic diversity, varietal identification, and purity assessment. With the combination of morpho-agronomic characterization and molecular genotyping, we can establish the genetic identity of commercially released Philippine varieties, which is a definite priority to protect the integrity and reliability of our own rice varieties.

DNA samples of 189 released varieties for reference were conserved in short- and long-term storage and 59 released rice cultivars were profiled using 16 STR markers and 7k Infinium SNP technology.

Two major clusters were identified at a 0.26 similarity coefficient. PSB Rc 62 and PSB Rc 3 were closely related to NSIC Rc 138, NSIC Rc 216, NSIC Rc 416, and NSIC Rc 426. The banding pattern of released cultivars for each STR marker was completed. A core satellite was identified to differentiate between and among released cultivars.

Externally-funded Project 1

Genetic Improvement of Rice Breeding Material & Technology in the Philippines

Jonathan M. Niones, Teodora E. Mananghaya, Roel R. Suralta, Jennifer T. Niones, Juliet P. Rillon, M Obara (Japan), Y Fukuta

Nutrient deficiency is a common problem in the world's soil. It is important for stable rice production to uptake effectively and efficiently the supplied fertilizer. Nitrogen, among the nutrients, is a major limiting factor for rice production. Hence, it is also required to genetically improve nitrogen uptake and use efficiency to increase rice production. Improving the root system affects the uptake of broad solutes and water because the root is the sole organ to uptake nutrients and water from surrounding soils. However, few genes associated with roots and nitrogen uptake have been identified and used in rice breeding programs. The identified efficient QTL/gene(s) for the root elongation and nitrogen has been introduced into NSIC Rc 160 and Rc 300 cultivars.

Six progeny lines derived from the NIL*qRL6.1*/ NSIC Rc160//* NR160 cross had an average yield of 4.20t/ha. One line (NILqRL6.1-[NSIC Rc160]-6) had an average yield of 4.42t/ha with a 3.5% (+0.14t/ha) yield advantage of the recipient parent NR160 (4.28t/ha).

For the NSIC Rc 240 genetic background, six progeny lines of NIL*qRL6.1*/ NSIC Rc240// NR240 cross showed an average yield of 3.75t/ha =. One breeding line (NILqRL6.1-[NSIC Rc240]-4) showed a comparable yield with recipient parent NR240 (4.02t/ha).

The progenies with NR160 genetic background were four days (NIL*qRL6.1*/ NSIC Rc160). Eight days (PYL (qRL6.1 with EHD) / NSIC Rc160) matures earlier than of NSIC Rc160 parent (122.7 days after sowing, DAS) in PhilRice-Negros. While the NR240 genetic background was 2.4 days earlier than that of NSIC Rc 240 (118.3 DAS) counterpart in PhilRice-Negros.

Externally-funded Project 2

Staggered Planting of TGMS Lines in Male Fertile Environment Sites for Increased Seed Yield and Quality

Susan R. Brena, May O. Palanog, and Alvin D. Palanog

Maximizing the seed yield of parental seed production can help attain the country's hybrid seed requirement. However, it is empirical that yield-limiting factors should be addressed to optimize parental seed production. The timing of planting that coincides with favorable climatic conditions, particularly temperature and appropriate nutrient management, are crucial factors to consider in optimizing seed production yield in a male fertile environment.

Initial results showed that grain yield was very low across eight planting dates (December 2020 to July 201) and PK treatments. The low grain yield can be attributed to the high temperature during the rice plant's critical stages, which resulted in low spikelet fertility.

A significant variation in grain yield response under various planting dates, treatments, and planting dates x treatment interaction. The result indicates that the timing of planting and P & K applications can address the prevalent low seed yield problem in the TGMS site. However, other soil properties and multiple-nutrient management should be verified further to investigate the underlying cause of the low yield problem.