Department of Agriculture

PHILRICE®

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DA-PHILRICE R&D HIGHLIGHTS

CROP PROTECTION DIVISION

Content

DIVISION

Crop Protection Division

Genaro S. Rillon

EXECUTIVE SUMMARY

The Crop Protection Division (CPD) aims to prevent yield loss so that abundant rice harvest will be achieved. Specifically, CPD aims to generate, develop and promote sustainable pest management strategies that will help farmers improve their pest management decision-making. Pest management strategies should be ecosystem-based that promote ecological diversity, environment-friendly, safe, economical, sustainable and compatible with other management options. Hence CPD contributes to the achievement of the strategic outcomes of PhilRice such as: 1. Increased productivity, cost effectiveness, and profitability of rice farming in a sustainable manner; 2. Enhanced value, availability, and utilization of rice, diversified rice-based farming products for better quality, safety, health, nutrition, and income; and 3. Advanced rice science and technology as continuing sources of growth.

During the year, the division implemented three core-funded projects. The first project is on the evaluation of rice materials for insect pest and disease resistance. The role of screening is very important in identifying rice lines that will show resistance to major diseases and insect pests and this compliments rice varietal development to produce better varieties. The efforts so far have been successful over the years in maintaining disease and insect pest resistance in released varieties. The second project generally aims to characterize the resistance of PhilRice breeding lines under development and other rice germplasm as potential source of resistance genes against two distinct major rice diseases, the rice blast and the bacterial leaf blight. The third project implemented interrelated five component activities to: 1. Monitor the population of rice bug through developed and improved trap; 2. Determine the dynamics of major diseases of irrigated-lowland rice as influenced by the application of Trichoderma harzianum; 3. Determine the ecology and cultural management of selected major weeds of rice; 4. Identify and mitigate the spread of the multiple-herbicide resistant weeds; and 5. Determine the ecology of golden apple snail, ricefield rat, and rice paddy eel as influenced by cultural management techniques.

EXECUTIVE SUMMARY

The division have also implemented five externally funded projects namely: 1. Development of a diagnostic platform for forecasting the effectiveness of resistance genes against rice blast. The goal of this project is to have a Magnaporthe oryzae Avr gene-based (Mo-Avr) diagnosis platform for real-time pathogen field surveillance and monitoring of effective blast resistance genes in rice blast hotspot areas and main rice growing areas; 2. Mechanisms of rice insect pest and disease resistance in traditional rice varieties and development of genetic stocks with novel sources of resistance genes: Component B. Characterizing the mechanism of resistance to rice blast and bacterial leaf blight in traditional rice varieties. The ultimate aim of this project is to develop genetic stocks with introgressed novel resistance genes characterized from TRVs. These resistance genes would be readily available as genetic resources for rice breeding program; 3. Monitoring the Occurrence, Host Plant Specificity, and Management of the Fall Armyworm (Spodoptera frugiperda) in- and around-Rice Ecosystems in the Philippines. This project generally aims to contribute in developing a location-specific sustainable integrated pest management strategies/decision guide in managing the FAW in rice; 4. Pest Risk Identification and Management Project. The objective of this project is to develop of localized surveillance, early warning and forecasting systems for pest outbreaks and epidemics; and 5. Establishment of Prevention Network for Migratory Pests in Asia Region. With the current problem on RPH, this project seeks to contribute in the establishment of a multilateral strategy for the timely prevention of rice planthoppers in the Asia Region.

PROJECT 1

Evaluation of Rice Lines for Disease & Insect Pests Resistance

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Rice diseases and insect pests are considered major barriers to achieving the goal of increased rice production since they can cause significant seed yield and quality reduction resulting in reduced farmer' income. Conversely, reducing insect pests and disease losses is one way to increase yield. Therefore, screening is essential in identifying resistant rice lines to major diseases and insect pests that could be used for breeding or recommended for evaluation by the National Cooperative Testing.

In 2021, 3,658 entries composed of 777 inbred lines, 517 hybrid parent lines, and 2364 germplasm accessions were evaluated for resistance to major rice diseases and insect pests in PhilRice CES. In addition, the 517 hybrid parent lines were assessed in PhilRice Isabela against major rice diseases and stemborer damage while in PhilRice Negros for resistance to tungro under the modified field evaluation method. Disease resistance evaluation was done by examining the dominant lesion type and leaf area infected for blast resistance, the lesion length for bacterial leaf blight (BLB), relative lesion height for sheath blight (ShB), and percent infection for rice tungro disease. For stem borer, brown planthopper (BPH) and green leafhopper (GLH) resistance evaluation, damage assessment and percent damage for deadheart (DH) and whitehead (WH) were also assessed.

Results showed that in PhilRice CES, 1,395 (66.32%) rice entries had resistant reactions to blast while 151 (6.92%) entries had intermediate reactions to the disease. None of the entries showed resistant reactions against sheath blight, and 61 (2.97%) had intermediate reactions to the disease. For BPH, 5 (0.29%) entries showed resistant reactions while 245 (18.18%) entries had intermediate reactions. For GLH, 1 (0.05%) entry had a resistant reaction while 3 (0.23%) entries had intermediate reactions, and the rest were susceptible. Resistance to deadheart damage was noted in 199 (11.65%) entries for stemborer damage assessment. Intermediate reactions were observed in 52 (3.04%) entries, while five were susceptible. Resistant reactions to stemborer (WH) damage were recorded in 164 (9.60%) entries.

PROJECT 1

Intermediate reactions were noted in 365 (21.37%) rice entries, and 78 entries were found susceptible to whitehead.In PhilRice Isabela, 182 (35.20%) hybrid parent lines showed resistant reactions to blast, while 201 (38.38%) entries had intermediate reactions to the disease. For BLB evaluation, 174 (33.65%) hybrid parent lines showed resistant reactions and 260 (50.29%) entries with intermediate reactions to the disease. For ShB, resistant reactions were noted in 103 (19.9%) hybrid parent lines, and 299 (57.83%) hybrids had intermediate reactions to the disease. Low pest pressure for SB (DH) damage was noted. However, SB (WH) damage was observed during the wet season. Two hundred seven hybrid lines showed resistant reactions to whitehead damage; intermediate reactions were noted in 43 hybrid lines.

In PhilRice Negros, under the modified field method of evaluation, 3 (0.58%) hybrid lines showed resistance to tungro while 60 (11.61%00) hybrid lines had intermediate reactions. In contrast, the rest of the hybrids were susceptible to the disease.

Using a micro-chamber under screenhouse conditions was an effective screening method for sheath blight evaluation. Under field conditions, inoculated at 45 DAT and 21-day old seedlings under screenhouse conditions using the micro-chamber method conducted for two seasons had comparable results.

PROJECT 2

Characterization of PhilRice Elite Germplasm for Functional Disease Resistance Genes

Jennifer T. Niones , Eleanor S. Avellanoza, and Anna Marie Irang

Host resistance is considered the most effective, economical, and environmentally friendly way of rice disease management. PhilRice had long acknowledged this by making disease resistance one of the traits mainly considered in its varietal improvement program. Using diverse disease resistance genes with different host protection mechanisms and effectiveness in a broad range of pathogen races promotes stable and durable disease resistance.

To attain this, in-depth characterization of disease resistance among PhilRice breeding parentals, elite rice genotypes, and other germplasm as potential sources of novel disease resistance genes is needed to ensure the variation of resistance genes (R genes) in our breeding program.

This project aimed to better characterize the resistance of PhilRice breeding lines under development and other rice germplasm as a potential source of resistance genes against two distinct major rice diseases, the rice blast (*Pyricularia oryzae*) and the bacterial leaf blight (*Xanthomonas oryzae pv. oryzae*). In addition, elucidated the genetic variation of rice blast and bacterial blight resistance among PhilRice elite germplasm.

Using the differential system to characterize disease resistance, we evaluated the resistance reaction of 70 parentals or donor lines against differential rice blast and bacterial blight isolates. In addition, we estimated the R-genes harboring in these rice genotypes. These donor lines are part of the core collection used in our rice hybridization program as parentals or donor sources. These lines were also genotyped, using R-gene specific DNA markers, for the presence of bacterial blight (*Xa* gene) and rice blast major resistance genes (*Pi* gene).

Twenty promising lines developed for irrigated lowland rice ecosystem and 14 released varieties have shown resistant reactions to all 20 differential blast isolates. These 34 donor lines (60%) exhibited broad-spectrum resistance against the 20 standard differential blast isolates. PR 44660-25-1-1-3-1-3-1-B showed broad-spectrum blast resistance against rice blast differential isolates. DNA markers, *Pi9*, *Pii*, *Pia*, and *Pib*, were detected in this donor line. Therefore, this line is a good candidate as a source of broad-spectrum resistance against blast disease.

Twenty-six donor lines (37%) showed resistance to nine to ten bacterial blight pathogenic races. Based on their bacterial blight disease reaction pattern, four donor lines were estimated to harbor the *Xa4* gene, three lines having *xa5*, two with *Xa7*, six with *Xa21*, and one with the *xa13* gene. Using DNA markers, *Xa4* gene were detected in 49 lines (70%), *xa5* in 11 lines (15.7%), *Xa21* gene in four lines (5.7 %), *Xa7* in two lines (2.85) and *xa13* in one line (1.4%). *Xa4* and *xa5* were detected in eight test lines, while *Xa4* and *Xa21* combinations were detected in three lines.

PROJECT 3

Ecology & Non-Chemical Ways of Managing Rice Pests (ECOWAYS)

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Pests can reduce rice's potential and actual yield by 77% and 37.4%, respectively. Despite the threat, however, pests can be managed through cultural, physical, mechanical, biological, or chemical methods. However, the efficacies of these methods require a deep understanding of the biology and ecology of pests to establish knowledge of what, where, and when these pest management methods will be implemented. Chemical control remains the most commonly used method to combat rice pests. Many farmers prefer this method because of its ease of application and immediate results after the application. However, when used alone, this method may cause imbalances in agro-ecological ecosystems and could result in pesticide resistance. Thus, other control methods such as cultural and biological methods complement chemical control and create holistic pest management strategies for rice production.

This project mainly aimed to improve pest management decision-support and develop sustainable pest management strategies in rice by studying the ecology of major rice pests and their management in non-chemical ways. Specifically, it monitored the population of rice bugs through developed and improved traps, determined the dynamics of major diseases of irrigated-lowland rice as influenced by the application of *Trichoderma harzianum*, determined the ecology and cultural management of selected major weeds of rice, identified and mitigated the spread of the multiple-herbicide resistant weeds, and determined the ecology of golden apple snail, ricefield rat, and rice paddy eel as influenced by cultural management techniques.

Invasive apple snail has been reported as an effective attractant to rice bugs. However, despite the discoveries, limited or no study hasyet to be conducted on using invasive apple snail as attractant inside a trap to monitor or lessen the population of rice bugs.A field study was conducted at Mapangpang, Science City of Muñoz, Nueva Ecija and PhilRice CES to monitor the population of rice bugs through a developed and improved trap with invasive apple snail inside. As a result, rice bug catches in all sites of Mapangpang and PhilRice were generally low (1-3 rice bugs/m2).

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On the other hand, trap designs' 2, 3, and 4 trapped more rice bugs than different trap designs. Furthermore, rice bugs were more attracted to invasive apple snails one to two weeks after the traps were installed. Invasive apple snail, used as an attractant, was still effective up to three weeks after putting inside the traps.

A field experiment was conducted in two runs from January to November 2021 to determine the dynamics of major diseases of irrigated-lowland rice (rice blast, sheath blight, bacterial leaf blight, and bacterial leaf streak) as influenced by *Trichoderma harzianum*.

Two *Trichoderma* isolates (T5Oi and TMDRi) were applied: (T1) T5Oi applied before seeding, as root dipping for seedlings before transplanting, and spraying at 15 and 30 DAT; and (T2) TMDRi applied before seeding, as root dipping for seedlings before transplanting, and spraying at 15 and 30 DAT. In addition, fungicide (copper hydroxide) was used at 15 and 30 DAT (T3) and no treatment (T4) was included as a control check. The experiment was arranged in RCBD with four replications. Disease incidence and percent control were gathered ten days after transplanting.

In the first run, incidence and severity of sheath blight were 10.9% and 34.1% in T1 while 10.8% and 31.9% in T2; BLB were 13.6% and 36.4% in T1, 14.7%, and 38.0% in T2. In 2021WS, the incidence and severity of sheath blight were 3.55% and 1.39% in T1, 9.62%, and 3.06% in T2; bacterial leaf streak was 21.69 % and 30.38% in T1, 18.26%, and 30.35% in T2; and bacterial leaf blight were 12.76% and 19.72% in T1, 13.70% and 17.95% in T2. T1 reduced sheath blight incidence by 78%; T2 by 40.36%.

Using a high seeding rate and good water management by flooding are effective techniques against various weeds of wet direct-seeded rice (WDSR). Their efficacies, however, are not known against lowland ecotype *C. rotundus* (CYPRO). Therefore, two separate experiments were conducted in two runs to determine the influence of seeding rate and flooding period on the growth of lowland ecotype CYPRO and growth and yield variables of WDSR under flooded conditions.

The first experiment involved two levels of weed pressure (without and with CYPRO) and four seeding rates of WDSR (60, 120, 180, and 240kg/ha). The second one involved three flooding periods (7, 14, and 21 days after seeding (DAS)) plus full saturated conditions. As a result, shoot biomass of lowland ecotype CYPRO was heaviest at 60kg/ha while lightest at 240kg/ha. But it was not significantly different at 60, 120, and 180kg/ha; and at 180 and 240kg/ha. However, from 60 kg ha-1, it was reduced by 10, 20, and 41% at 120, 180, and 240 kg ha-1, respectively.

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The shoot biomass of the weed had no significant difference during different flooding periods. Nevertheless, it was only heavier by 8% when flooded at 7 DAS compared with 23 and 31% when flooded at 14 and 21 DAS. The grain yield of WDSR was significantly higher when the crop was grown without the lowland ecotype CYPRO. However, grain yield was not significantly different at four seeding rates. It was not also significantly different during different flooding periods. When flooded at 7 DAS, however, grain yield was 66% higher when flooded at 14 DAS (39%) and 21 DAS (40%).

A series of focus group discussions were conducted in Brgy. Poblacion West, Rizal; Brgy. Marawa, Jaen, and Brgy. Sto Cristo, San Antonio, Nueva Ecija. Four elicitation techniques (rich pictures, weed identification and management exercise, credibility ladder of information sources, and historical timeline) were used during the discussion to determine farmers' practices in cultivating rice, the most considered weeds, and their weed management strategies. For example, farmers in Rizal, Nueva Ecija, remove weeds by harrowing them using hand tractors. They also manage and protect their rice plants from weed infestation through hand weeding and spraying of herbicides (Nominee, Pyanchor, and Sofit).

Farmers considered *Echinochloa crusgalli*, *Echinochloa glabrescens*, *Leptochloa chinensis*, *Digitaria ciliaris*, and *Echinochloa colona* as the most common weeds of their planted rice. Farmers in Jaen and San Antonio also consider weeds a major pest. Therefore, they commonly manage by spraying herbicides of different brands and active ingredients (Frontier, Pyanchor, Agroxone, 2.4 D, Pyanchor Ultra, Sofit, Advance, Nominee, Ricestar, 2.4 D, Clincher, and Round up). *Echinochloa colona*, *Ipomoea aquatic*, *Echinochloa glabrescens*, *Echinochloa crusgalli*, *Ischaemun rugosum*, *Leptochloa chinensis*, and *Physalis angulata* were the most considered weeds.

Mature seeds of *Leptochloa chinensis* were collected in rice fields of Brgy. Poblacion West, Rizal; Brgy. Marawa, Jaen, and Brgy. Sto Cristo, San Antonio, Nueva Ecija, where focus group discussions were held previously. Seeds were pre-germinated and sown individually in clay pots. Using a hand sprayer (calibrated to deliver at 160L/ha), seedlings were sprayed with bispyribac sodium 12-15 days after seeding using the rates of 250, 500, 1000, and 2000ml/ha. Seedlings treated with water were also included as a control treatment. The experiment was arranged in CRD with 10 replications under screen house conditions. *L. chinensis* from San Antonio had 86, 76, 31, and 10% survival after spraying with bispyribac-sodium at 250, 500, 1000, and

2000ml/ha 21 days after application, respectively. *L. chinensis* from Rizal, on the other hand, had 87, 79, 19, and 5% survival in the same order of rates. At 250 and 500ml/ha, *L. chinensis* showed suspected resistance to bispyribac sodium. Seeds from Jaen did not germinate after sowing.

Four canalet designs were tested as treatments under field conditions, namely (T1) water retention in canalet at 0.5m interval, (T2) water retention in canalet at 1m interval, (T3) water retention in canalet at 1.5m interval, and (T4) water retention in canalet at 2m interval. The canal intervals were constructed inside a 20m2 plot at 3 DAS and rehabilitated at 6 DAS. The average size of each canalet was 3cm wide and 4cm deep. Treatments were replicated three times and laid in RCBD. Irrigation at saturated level was done at 10 DAS and maintained onwards. The efficacy of canalet intervals was determined by counting the number and heights of surviving rice seedlings at 25 DAS. The number of IAS inside each plot was also counted. Results showed that all canalet designs had no significant differences in the number of surviving seedlings as had been influenced by the feeding of IAS. From 151 to 303 seedlings/m2, the number of seedlings that survived was reduced to 3-25 seedlings/m2. No significant difference was also noted in plant height among treatments.

Three flavored baits (corn, melon seeds, and *tinapa* (smoked fish)) were separately mixed with the base ingredients (rice flour, sugar, and vegetable oil) at a ratio of 3:7. Yellow corn, an animal feed obtained from the local agricultural supply, was finely grinded. At the same time, melon seeds and *tinapa* were oven-dried for five hours at 70˚C, then finely grinded afterward. Grinding was done to match the corn, melon seeds, and *tinapa* to the texture of the base ingredients. Bait acceptance of the three rat bait flavors was compared with unflavored rat baits (base ingredients only) at early tillering, reproductive, and harvesting stages at PhilRice-CES farm during the 2021 wet season. Five baiting activities per night were conducted per cropping stage. Approximately 1g molded bait treatments were laid 1m apart in an empty juice tin that can be fixed into a 1-m bamboo stick that served as a bait holder.

Treatments were replicated in three baiting sites. Bait acceptance was rated using a rating scale: 0 – the bait was not moved, 1 – the bait was moved but not tasted, 3 – the bait was eaten but not consumed all, and 5 – the bait was consumed all. All data were subjected to ANOVA while treatments were compared through LSD at a 5%

significance level. Rats consumed all bait treatments at different rates and rice growth stages. Bait consumption was highest in the early tillering stage while lowest in the reproductive stage. No significant difference was observed among treatments at vegetative and reproductive stages. Still, there was a significant difference during the fallow period. *Tinapa*-flavored bait was significantly the most accepted bait (mean rating scale of 2.94), followed by unflavored and corn-flavored baits. Melon-flavored bait was the least accepted.

A trap was designed using a 50cm long PVC pipe (size 100mm), screen wire, and nylon net. Five traps were initially fabricated for the CRPE bait preference test. Five baits were also tested (chicken gut, rat meat, fish guts/cutting, crab shells, and IAS). Crab shell and GAS were crushed. All baits were wrapped using fine mesh cloth and placed inside the trap. The traps were set in a fishpond inside PhilRice-CES farm. Catches were checked, counted, and collected every morning. A bait preference test was done for two weeks. All baits attracted fish. However, baits were attractive to fish only for a minimum of 3 baiting days. No CRPE was attracted and trapped during the baiting period; only small fishes like “bunog” (*Gobius criniger*), “tilapia” (*Oreochronus niloticus*), and “gurami” (*Oshronemus goramy*). The bait preference test showed that crushed IAS meat was the most preferred by fish (8 catches). Following were fish gut/trimmings (4 catches), rat meat (2), chicken guts (2), and crab shells (1). Rat meat attracted fish only after 14 baiting days.

Extra-core Project 1

Development of a Diagnostice Platform for Forecasting the Efectiveness of Resistence Genes Againts Rice Blast

Jennifer T. Niones, Anna Marie Irang, and Mary Jeanie T. Yanoria

Rice blast caused by *Pyricularia oryzae* remains a primary rice disease incurring significant losses in affected areas. Breeding for resistance is still the most effective, economical, and environmentally sound way to manage rice blast disease. However, this is continuously challenged by the field's diversity and instability of rice blast population. With the understanding of gene-for-gene theory, one way to have an effective and appropriate deployment of resistant cultivars harboring rice blast resistance genes is to have a rice blast AVR gene-based diagnosis platform for real-time pathogen field surveillance and monitoring of effective blast resistance genes in rice blast hotspot areas and main rice growing areas.

Five hundred ninety-eight rice blast isolates collected from rainfed and upland rice areas in the country were subjected to pathotype analysis using differential varieties (DVs), each containing a single resistance (R) gene for blast resistance and genotyping for AVR genes. The blast isolates widely varied in their virulence to DVs carrying resistance R genes. A low frequency of virulent blast isolates was found in DVs for *Pish, Pii, Pi9 (t), Piz, Piz-5, Pita-2,* and *Pi12 (t)* genes; high frequency in DVs for *Pib, Pit, Pia, Pik-s, Piz-t, Pita* and *Pi19*. The presence of 8 AVR genes among these blast isolates was determined by PCR-amplification using AVR-gene-specific DNA markers. The calculated frequency of different AVR genes showed significant variations in the population. *AVR-Pib* and *AVR-Pia* were not detected in any of the isolates.

On the other hand, *AVR-Pi9* was detected in 93% of the blast isolates. The frequency of detection of *AVR-Pib, AVR-Pia, AVR-Pi9, AVRPiz-t,* and *AVR-Pita,* correlated with the resistance frequency of the cognate R genes in the rice blast differential lines. On the other hand, the detection frequency for *AVR-Pii* and *AVR-Pik* did not coincide with the observed resistance frequency of the cognate Pii and Pik alleles. Haplotypes differentiation of *AVR-Pik* alleles and *AVR-Pii* will be confirmed through sequencing.

Extracore Project 1

Eighty-one Philippine released inbred rice varieties for irrigated lowland, rainfed, and upland rice ecosystems were PCR- screened for the presence of major rice blast resistance genes using R gene-specific DNA markers. *Pib, Pia, Pik* allele, and *Pii* genes were the most frequently detected R genes among the evaluated rice varieties.

Most varieties have these R genes, particularly the *Pib* gene. Based on our virulence analysis of blast isolates, most of the isolates were virulent to DV, having *Pib* and *Pia* genes, making them ineffective against the prevailing blast isolates. On the other hand, *Pi9* and *Pish* genes are effective R genes as most blast isolates were resistant to DVs harboring these two R genes. Although of limited numbers, we have identified rice varieties possibly harboring *Pi9.*

Extra-core Project 2

Mechanisms of Rice Insect Pest & Disease Resistance in Traditional Rice Varieties & Development of Genetic Stocks with Novel Sources of Resistance Genes: Component B. Characterizing the Mechanism of Resistance to Rice Blast & Bacterial Leaf Blight in Traditional RiceVarieties

Jennifer T. Niones, Juliet P. Rillon, Jonathan M. Niones, Teodora E. Mananghaya, Rachelle M. Conmigo, and Cayneth Callejo

Traditional rice varieties (TRV) are usually valued for their premium rice grains with excellent eating quality. Most of them also exhibited high resistance to various biotic and abiotic stresses, which made them potential sources of genes useful for rice breeding. At PhilRice, exploring our Genebank collection has identified several TRV accessions with resistance/ tolerance against rice blast and bacterial leaf blight disease. Before using these pest-resistant accessions for rice improvement programs, there is a need for an in-depth understanding and characterization of resistance mechanisms against different pathogenic strains. The spectrum of host resistance against other pathogenic races and the genetics of disease resistance will be determined. Ultimately, it is aimed to develop genetic stocks with introgressed novel resistance genes characterized by TRVs. These resistance genes would be readily available as genetic resources for the rice breeding program.

Dinorado, a traditional Philippine variety, is one of the TRVs identified as having a broad spectrum resistance against rice blast disease. To further analyze the blast resistance in Dinorado, a recombinant inbred lines (RILs) mapping population derived from Dinorado and CO39 (a blast susceptible variety) was generated and developed. QTL analysis mapping of rice blast in Dinorado background RILs have detected several putative QTLs located in chromosome 1, 8,9,10, and 12 regions. , RILs exhibiting rice blast resistance in multiple rice blast hotspots were selected and advanced to the next generation.From our selections, , BC1F6 seeds of 10 Dinorado RILs and 10 Kalinayan RILs are maintained as candidate donor lines for durable blast resistance breeding.

Extra-core Project 3

Monitoring the Occurence, Host Plant Specifity, & Management of the Fall Armyworm (*SPODOPTERA FRUGIPERDA*) In- and Around-Rice Ecosystems in the Philippines

Evelyn M. Valdez, Genaro S. Rillon, Dindo King M. Donayre, Edwin C. Martin, Eduardo Jimmy P. Quilang, Kennedy B. Dela Cruz, and Ravindra C. Joshi

The fall armyworm (FAW), Spodoptera frugiperda (J. E. Smith) (Lepidoptera: Noctuidae), a transboundary invasive pest in many countries, is threatening the food, nutrition, and income security of millions of farming households. Native to the tropical regions of North and South America, this invasive insect pest was first detected in Africa in early 2016 in the rainforest zones of Central and Western Africa.

Since then, FAW has been reported in almost all sub-Saharan African countries and is currently observed to invade South and Southeast Asia countries. The fall armyworm (FAW) is an invasive pest of corn in the Philippines. The first record of its damage to corn was reported in the Philippines on June 20, 2019, in Piat, Cagayan. It has now spread to all regions. DNA barcoding studies revealed the existence of two strains, the Corn strain (C-strain) and the Rice strain (R-strain). It is overly evident that both strains damage to corn. However, little is known about FAW damage and host preference for rice.

Rice, a key food security crop for the Philippines and Asia, is among the key host of the FAW. Thus, adequate early preparedness and mitigation measures must be in place to counter any level of incursions of the FAW on this crop by understanding the spatial and temporal population dynamics, including the risk factors in the Philippines.

This project aimed to contribute in developing a location-specific sustainable integrated pest management strategies/decision guide in managing the FAW in rice. Specifically, it monitored the presence of FAW in and around rice ecosystems; identified areas where it was observed and understand the spatial and temporal FAW population

Extra-core Project 3

dynamics; assessed the level of infestation and damage of FAW on rice and other flora in rice and non-rice habitats; determined the diversity of naturally-occurring beneficial organisms in rice- and non-rice habitats, and the role of natural regulating mechanisms; identified the alternate host plants records of FAW in rice- and non-rice habitats, and conduct host-plant specificity tests; capacitated local researchers and extensionist in using various CABI Knowledge tools for better FAW risk analysis and management, and packaged a location-specific sustainable integrated FAW pest management strategies/decision guide.

Regular FAW monitoring and vegetation analysis were conducted in selected rice-corn growing areas in the provinces of Pangasinan (Region 1), Pampanga, and Tarlac (Region 3) during the 2021 dry and wet seasons. To date, no FAW or damage in rice was recorded at these sites. However, on May 17, 2021, FAW was reported by the Department of Agriculture Regional Field Office 2 (DA-RFO 2) and Regional Crop Protection Center 2 (DA-RCPC 2) to infest the rice seedbeds in Gonzaga, Cagayan, and other municipalities in the region. It is the first record of its damage to rice in the Philippines. For the vegetation analysis, 57 weed species were sampled to determine whether they are host plants of the FAW in all sampling locations. The most common weed species in all sampling sites was the Trianthema portulacastrum. To date, none of the stages of the FAW were found in the weeds. In addition, a three-day online training was conducted in collaboration with the Centre for Agriculture and Biosciences International (CABI) to build the capacity of the researchers and extension workers to identify and control FAW. The monitoring and capacity-building activities will be continued to gather sufficient data to develop location-specific ecologically-based FAW decision guides specific to rice.

Extra-core Project 4

Pest Risk Identification & Management Project

Eduardo Jimmy P. Quilang, Edwin C. Martin, Leonardo V. Marquez, Arlen A. Dela Cruz, Jomar F. Rabajante, Mary Grace V. Lanuza, Femia R. Sandoval, and Dariel Litorco

The project was under the Rice Program of the Research and Development, Extension Agenda, and Programs of the Department of Agriculture Bureau of Agricultural Research (DA-BAR) from 2017 to 2022. It developed and improved current methods for extracting rice crop parameters including indicators for crop health and management practices using remotely sensed data; analyzed risk factors for pest and disease outbreaks; formulated efficient management strategies and tactics to reduce crop losses; improved the capacity of project partners on remote sensing, and pest and disease risk mapping and analysis, and developed a sustainability plan for the continued operation of PRIME.

The PRIME PhilRice team focused on tungro disease model development, research, and model development for brown planthopper (BPH), capacity building, and support to pest surveillance and sustainability plan. In 2021, models were validated at the Central Experiment Station for BPH and select hotspots in Nueva Ecija, Isabela, and Laguna for tungro.

Capacity-building activities for limited e-learning using the PRIME e-learning platform were created as PRIME's alternative to face-to-face training during the Covid-19 pandemic. PRIME offered two courses through the National Retooling on Crop Health to its regional partners from the Department of Agriculture. PRIME 101 had 89 graduates, while PRIME 102 had 45. PhilRice PRIME team contributed two modules to PRIME 102 and overall leadership of the e-learning initiative of the project.

In support of other work packages, PhilRice provided technical support and released the bulletin on BPH and tungro in March and April to address the increasing pest population reported within the Department of Agriculture. Supporting video clips and infographics were also released to project partners

PRIME PhilRice also spearheaded the rice pest management harmonization workshop to develop a sustainability plan for PRIME's operationalization under the Bureau of Plant Industry.

Externally-funded Project 1

Establishment of Prevention Network for Migratory Pest in Asia Region

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One of the recent severe constraints to rice production in Asian countries is rice planthoppers (RPHs). Unfortunately, RPH also transmits viruses devastating to rice plants. For example, rice grassy stunt virus (RGSV) and rice ragged stunt virus (RRSV) are persistently transmitted by brown planthopper (BPH). In addition, recent studies showed that white-backed planthopper (WBPH) could also transmit a new virus, Southern rice black-streaked dwarf virus (SRBSDV or RBSDV-2), which is currently problematic in China and Vietnam. In addition, BPH outbreaks and associated disease epidemics were reported in Bangladesh, Cambodia, China, India, Indonesia, Japan, Korea, Laos, Malaysia, Thailand, and Vietnam.

With the current problem of RPH, this project sought to establish a multilateral strategy for the timely prevention of RPH in the Asia Region. Specifically, this constructed a cooperative network between countries and developed efficient joint response strategies to manage the migration of RPH, shared information on the occurrence of migratory insects and technology development in 12 participating Asian countries, and established collaborative response strategies due to the alternation of cultivation and the increase of agricultural products trade which can bring more possibilities of insects inflow and spreading in the region.

Results of monitoring of planthoppers during the year showed low populations in two sites located in PhilRice CES and Mabini, Sto. Domingo, Nueva Ecija. Due to the low populations of RPH, there was minimal hopperburn damage in the field. In nearby provinces like Bulacan, Tarlac, and Pampanga, farmers reported up to 40% hopperburn damage in February and March. As a result, affected fields were applied with excessive insecticides at the early cropping stage. The reported varieties affected were NSIC Rc160, Rc480, Rc402, Rc216, Rc152, SL20, Long Ping 937, and NK5017.