Philippine Rice R&D Highlights 2013

CROP PROTECTION DIVISION

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CROP PROTECTION DIVISON

Division Head: GS Arida

Executive Summary

Research goal of the Crop Protection Division (CPD) for 2013 focused on the development of technologies to help farmers improve their pest management decision-making toward rice self-sufficiency. CPD generated information for the development of safe, economical, environment friendly and sustainable pest management technologies.

There are five CPD based projects to address the above goal, namely: 1) development of Decision Guides for Pest Management, 2) Ecological Engineering Toward a Sustainable Integrated Pest Management (IPM) Program in Rice and Rice-based Farming System, 3) Screening of Rice Advanced lines for Resistance to Key Insect Pests and Diseases, 4) Monitoring and Profiling of Major Diseases, and 5) Microbial Inoculants in Rice Farming (Special Projects).

Diversity of organisms in the ecosystem is favorable for a sustainable integrated pest management program. Population of beneficial organisms and arthropod diversity index was generally higher in the rice field of Palayamanan compared to fields away from the area. Palayamanan served as refugium for beneficial organisms either as source of food, resting place or for reproduction. Beneficial organisms like predators were observed even after harvest of the rice crop. These natural enemies were found in rice stubbles and weeds in bunds and field margins. The presence of perennial plants in field margins that persist within or between years can also serve as good shelter for natural enemies during off-season of rice production.

Weedy rice is an emerging pest in irrigated rice ecosystem especially in Iloilo. Rice fields in Aurora province were surveyed for biotypes of weedy rice. All of the biotypes present in Baler, Aurora have horizontal flag leaves, with short to long awns and with red pericarps. Weedy rice observed are generally taller, with less number of panicles, grains per panicle and tillers than cultivated rice.

Blast caused by Magnaporthe grisea [Herbert] Barr., is one of the most important diseases of rice worldwide. Owing to favorable conditions, it has become a major problem in rice growing areas particularly where there is water stress (rainfed) and in cool-elevated areas. Now, it has become a destructive disease in irrigated areas particularly in the lowlands. The blast isolate from irrigated rice in Bohol gave the typical symptom and reaction to all the popular varieties tested. All others did not give any reaction to the blast isolates. Rice varieties NSIC Rc122, 158, 172, 280 and PSB Rc14 showed 100% resistant lesions, NSIC Rc 128, 216, and 212 showed 90%

resistant lesions, NSIC Rc21SR and NSIC Rc274 showed 60% resistant lesions while rice varieties NSIC Rc 214 showed 90% susceptible lesions, NSIC Rc 148, 152, and PSB Rc 82 showed 80% susceptible lesions in reaction to the blast isolate.

Common rice paddy eel (CRPE) was reported to affect rice cropping in Nueva Ecija, Negros, Cagayan and Isabela. Eel bore holes in rice levees resulting water loss due to seepage. Problems of poor water retention further resulted to poor weed and nutrient management. The farmers' practice of controlling CRPE include physical hunting using electro fishing method, covering holes, spraying mollusicide and application of systemic insecticide. Some farmers also claimed that CRPE can be caught using series of hook and baits along rice levees that will be left for overnight.

Host plant resistance is the most economically and environmentally sound pest management strategy. It is compatible with other management strategies like biological control. There was a continued collaboration between our researchers and plant breeders in the screening of rice varieties for resistance to major rice diseases and insect pests. Induced evaluation was conducted for blast in the screen house. Field evaluation for other major rice diseases including bakanae, blast, bacterial leaf streak and tungro was conducted inside CES. Screening for resistance for brown planthopper and green leafhopper (GLH) were conducted in the greenhouse while screening for resistance against stemborer was conducted in the field.

Pest profiling was conducted in 79 location sites in municipalities served by NIA-UPRIIS Districts 1 and 4. Most of the insect pests recorded were rice planthoppers and leafhoppers, rice bug and stemborer. Only the damage due to stemborer was expected to cause significant loss in yield. Among the rice diseases, sheath blight and false smut were recorded as present in the area.

Nipa can grow well even in soils that are physically and chemically unsuitable for plants, such as those found in the mangroves. One possible reason is that there are microorganisms associated with the roots that are capable of converting atmospheric nitrogen to nitrates and ammonium that are usable to the plants. Eight nitrogen-fixing bacteria were isolated from the different parts of nipa palm (roots, bark, leaves, etc.). Nitrogen-free medium was used to isolate the endophytic nitrogen-fixing bacteria. These isolates will be subjected for evaluation on its effectiveness as plant growth promoter using upland rice as the test crop.

Actinomycetes are the most economically and biotechnologically valuable prokaryotes. They are responsible for the production of half of the discovered bioactive secondary metabolites. More than 50 genera have been used in human, veterinary medicine, agriculture, and industry. One of the genera of actinomycete is Streptomyces. Streptomyces, which generally accounts for an abundant percentage of the soil microflora, is particularly effective colonizers of plant root systems and is able to endure unfavorable growth conditions by forming spores. The actinomycete used in this study has been previously tested for its growth promoting activities. This isolate produced both 1-aminocyclopropane-carboxylic acid (ACC) deaminase and indole-3-acetic acid (IAA). Similarly, it can also solubilize phosphate.

Research Plans of CPD for 2014 include studies on emerging pests like grain bug, common rice paddy eel, genetic diversity and cultural characteristics of Magnaporthe grisea, identification of microbial inoculants and evaluation and optimization of pest management strategies/techniques.

I. Development of Decision Guides for Pest Management

Project Leader: GS Arida

The project aims to develop decision guides for the management of major insect pests and conserving natural enemies particularly on: planthoppers, natural enemies such as spiders and coccinelids, weedy rice, rice blast and common rice paddy eel.

Survival of natural enemies during rice off-season

GS Rillon and AJ Gabriel

This study aims to provide system that will support natural enemy populations with resources such as food for adults, alternative prey, shelter, and providing habitat between seasons. Furthermore, this process may be manipulated to maximize survival and encourage early season activity of natural enemies to increase their effectiveness.

Highlights:

- Many species of natural enemies were present in rice field commonly composed of spiders, wasps, coccinellids and other natural enemies (Figure 1).

- After rice harvest, natural enemies moved to rice stubble then to other habitats like vegetation in bunds and field margins (Figure 2). These habitats of natural enemies are important as source of foods.

- The natural enemies were also found in high numbers in non-rice areas (Figure 3). Hence, it is necessary that we should manage this vegetation to conserve natural enemies.

- During land preparation, partial cutting of weeds is recommended to leave enough vegetation as refuge for natural enemies so as not to displace them. The timely cutting of weeds in the bunds and nearby vegetation can move many natural enemies into the newly established rice fields so that they will be present in the early season of rice production and before pest population build-up (Figure 4a).

- Do not cut and burn or spray herbicide in bunds as this will eliminate the habitat of natural enemies in the field during non-rice period (Figure 4b).

- Maintain perennial plants in nearby field margins to serve as good shelter, and provide pollen and nectar for natural enemies during off-season rice production.

- Furthermore, consider planting crops that can support natural enemy populations and can be harvested in due time to generate profit although the availability of soil moisture during fallow period is critical to support its growth (Figure 4c).

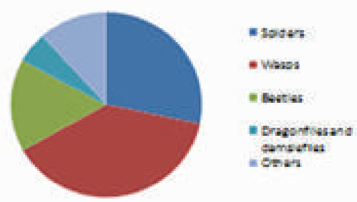

Figure 1. Composition of major natural enemies in rice

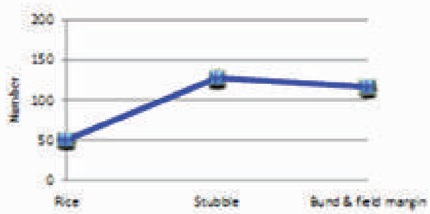

Figure 2. Movement of natural enemies in the field

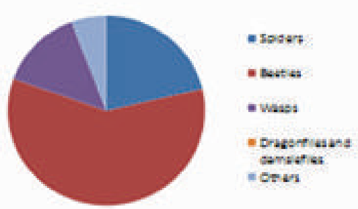

Figure 3. Natural enemies in bunds and field margins

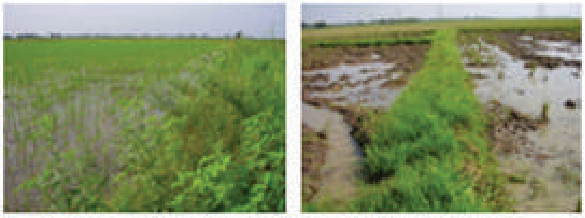

Figure 4a. Leave enough vegetation for natural enemies

Figure. 4b. Avoid burning or spraying herbicide in bunds

Figure 4c. Plant other crops during fallow period

Survey and characterization of weedy rice biotypes in Central and Southern Luzon

EC Martin

This study focused on determining the distribution and extent of weedy rice infestation in Central and Southern Luzon as well as to determine the morphological and other agronomic characteristics of the different weedy rice biotypes present in those areas through survey.

Seeds collected from Baler, Aurora during 2012 WS were grown in screenhouse during 2013 DS. The plants were maintained and data on agronomic characteristics were gathered.

Highlights:

- All of the biotypes present in Baler, Aurora have horizontal flag leaves, with short to long awns and with red pericarps.

- Weedy rice observed is generally taller, with less number of panicles, grains per panicle and tillers than cultivated rice.

- Weedy rice present in Baler, Aurora has longer panicle length and width of grain than cultivated rice.

- Weedy rice has also lighter weight of 1000 grains and shorter length of grains.

Table 1. Morphologic characteristics of weedy rice collected in Baler, Aurora as compared with cultivated rice.

	Characteristics	Weedy rice	Cultivated rice
1	Plant height (cm)	117.84	83.49
2	Number of panicles/hill	7.52	10.58
3	Number of tillers/hill	7.73	10.90
4	Panicle length (cm)	22.29	22.12
5	Number of grains/panicle	97.19	97.40
6	Length of grain (mm)	8.38	9.40
7	Width of grain (mm)	2.64	2.57
8	Weight of 1000 grain (g)	21.79	22.56
9	Awn length (mm)	14.40	0.00
10	Color of grain	light yellow, yellow, rusty brown	yellow

Integrated weedy rice management in direct seeded rice in Iloilo
EC Martin

The adoption of direct seeding culture makes weedy rice infestation one of the most serious and costly problems of rice growers in Iloilo Province. This was due to the fact that the majority of farmers do not know the importance of thorough land preparation and use of clean seeds and with the rapid increase in the number of fields infested with weedy rice, and the infestation becoming more severe compared to ten years ago, this weed is a serious threat in rice fields. This activity focused on increasing efficiency of rice production by testing and adapting a promising integrated weedy rice management (IWRM) method in farmers' field in Iloilo province.

Highlights:

- On farm trials were conducted in farmers' fields in Dingle Nuevo, Iloilo.

- Yield data are still being processed at WESVIARC, Iloilo

Resistance of popular rice varieties to *Magnaporthe grisea [Herbert] Barr.*, the rice blast fungus from different rice growing areas in the Philippines

FA Dela Peña and MCE Pascual

Blast caused by Magnaporthe grisea [Herbert] Barr., is one of the most important diseases of rice worldwide (Long et al., 2001; Pan et al., 1998). Owing to favorable conditions, it has become a major problem in rice growing areas particularly where there is water stress (rainfed) and in cool-elevated areas. Now, it has become a destructive disease in irrigated areas particularly in the lowlands.

To control the disease, many rice cultivars with blast resistance have been developed. However, resistance can be broken down within several years after release due to increase in new blast races virulent to the resistance (Mew et al., 2001). Typically, a variety released as blast-resistant shows signs of susceptibility after only very few seasons of cultivation in blast-prone environments (Zeigler and Correa, 2000).

Highlights:

- 401 blast samples collected in different rice-growing areas in the Philippines in 2004-2012 (Fig. 5) with 1,676 monoconidial isolates were maintained at -20°C for long-term storage.

- 24 blast isolates were used to inoculate 22 popular rice varieties and the susceptible check, IR50. The blast isolates used were those from the irrigated areas in the Visayas (Bohol and Leyte Provinces) and the newly isolated blast fungus from NSIC Rc216 collected in an irrigated rice area in Nueva Ecija.

- Of the 24 blast isolates tested, only 13 were completely evaluated due to some limitations in the blast room. Sometimes the environmental condition was not favorable for disease development resulting in not prominent manifestation of lesions or no lesions at all. In other times, the plants die due to too much heat in the blast room. Generally, the plants were etiolated due perhaps to the not optimized light condition. Susceptibility was observed in some varieties though not the very typical symptoms.

- The blast isolate from irrigated rice in Bohol gave the typical symptom and reaction to all the popular varieties tested. All others did not give any reaction to the blast isolates. Rice varieties NSIC Rc122, 158, 172, 280 and PSB Rc14 showed 100% resistant lesions, NSIC Rc 128, 216, and 212 showed 90% resistant lesions, NSIC Rc21SR and NSIC Rc274 showed

60% resistant lesions while rice varieties NSIC Rc 214 showed 90% susceptible lesions, NSIC Rc 148, 152, and PSB Rc 82 showed 80% susceptible lesions in reaction to the blast isolate.

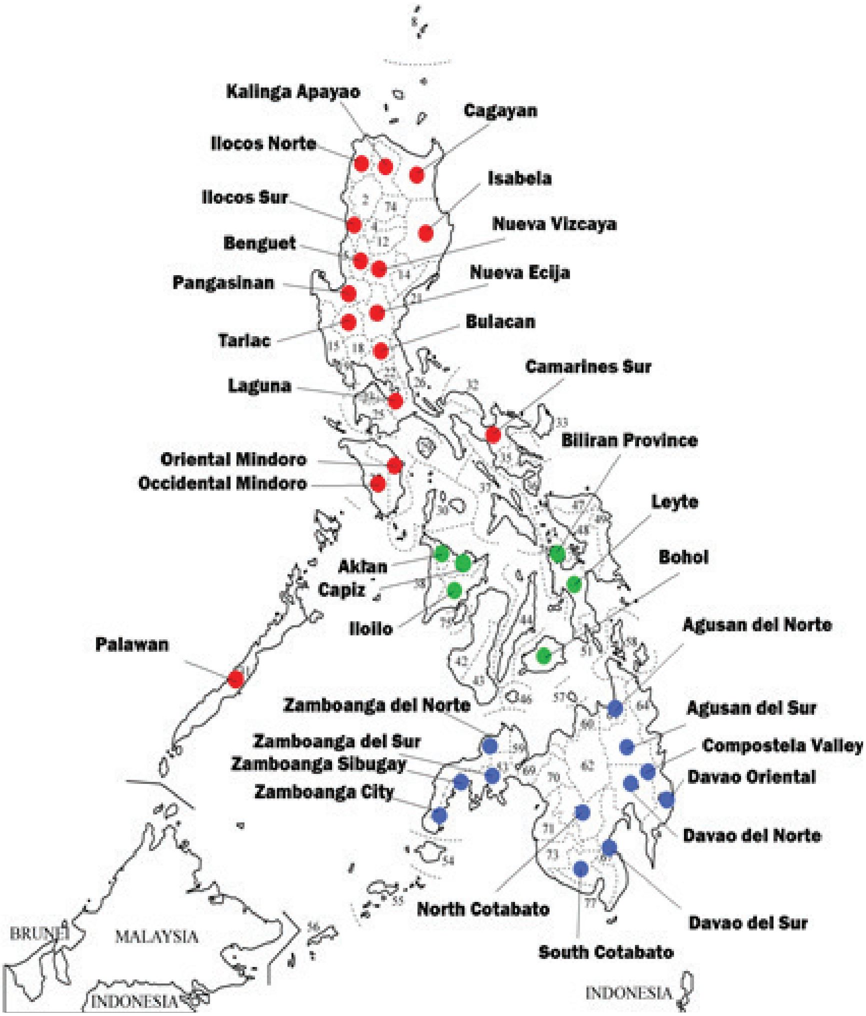

Figure 5. Rice growing areas in the Philippines where Magnaporthe grisea was collected (2004-2012)

Management of Common Rice Paddy Eel (CRPE) (Monopterus albus) under Philippine rice ecosystem

EC Martin and LV Marquez

Common rice paddy eel (CRPE) was reported to affect rice cropping in Nueva Ecija, Negros, Cagayan and Isabela. Eel bore holes in rice levees resulting in water loss due to seepage. Problems of poor water retention further resulted to poor weed and nutrient management. Moreover, draining also became a problem during ripening stage because water l entered in the same holes when neighboring farmers irrigated their field. Farmers practice of controlling CRPE include physical hunting using electro fishing method, covering holes, spraying mollusicide and application of systemic insecticide. Some farmers also claimed that CRPE can be caught using series of hook and baits along rice levees that are left r overnight.

This study focused on determining the effectiveness of combined physical, botanical and chemical control methods against CRPE, assess the extent of damage of t CRPE to rice, characterize rice field infested with CRPE, and compare species of eel in different study sites and describe its biology.

Highlights:

- Thru farmers interview, CRPE was identified to be present in 5 towns of Nueva Ecija, 3 towns in Bataan, 2 towns in Isabela, 2 towns in Nueva Viscaya, 1 town in Ifugao, 1 town in Cagayan, 1 town in Pampanga and 1 town in Pangasinan. CRPE weight sampling was done in Maragol, Munoz, Nueva Ecija. Ninety (90) samples were caught thru electro fishing. Minimum wt is 2.6 g and maximum wt is 169.10 g.

- Six focus group discussion was done in Negros, Brgy. Pogonsino, Solano, Nueva Viscaya, Brgy. Victoria, San Mateo, Isabela and Brgy. Amulong, Iguig, Cagayan.

- All farmers agreed that CRPE does not feed on rice, however; their perception was divided into beliefs that CRPE was beneficial and a pest in rice production. All farm workers believed that CRPE was beneficial as it gives additional food and income for their family. On the other hand, land owners believed that CRPE is a pest due to its tunneling activity in rice field leeves and due to the more destructive effect of eel-hunting on their fields.

- According to the farmers, CRPE was observed in the field in 2005 and the sudden increase of population was in 2010. They observed that CRPE was active at night, lives in swallow muddy water/leeves and feeds mainly on golden apple snail, aquatic insects, fingerlings of other fish, and tadpole. They also notice that there were more CRPE during wet season than in dry season.

- In Isabela, CRPE buying business started 2010 at P60/kg. In an interview with Mrs Terisita Daniega of San Jose City who did the business of buying and selling CRPE on September 16, 2013, she said she was able to buy and sell 200kg of CRPE daily during land preparation to early reproductive stage of rice and reached 700kg/day during harvesting to fallow period. CRPE was bought in 18 barangays of Lupao, Nueva Ecija; Science City of Muñoz, Nueva Ecija, San Jose City, Nueva Ecija;, Llanera, Nueva Ecija; and Baler, Aurora. All the CRPE collected daily were packed and sold at night by another middle man who brought them to Manila. She claimed that her profit reached P20,000/month during the height of CRPE population.

- CRPE hunters from Visayas and Luzon told different experiences during the conduct of the interview. CRPE hunters from Negros used electro fishing method in shallow muddy canals and even in drainage canals of sugarcane plantations and were able to sell their catch up to P170/kg. The hunters held their catch in plastic containers while waiting for the buyers to come in their area. The usual buyers stopped buying and the price decreased to only P25/kg in the public market. Hunters from Bulacan used hook and fishing line and their catch was sold in their neighborhood at P70/kg. In Nueva Ecija, Nueva Viscaya, Isabela and Cagayan, the CRPE was hunted at night in rivers/canals and at leeves during day time. They were able to demand a selling price ranging from P90 to P120/kg because there are several buyers that visit their areas.

- Staffs of NIA in Iguig, Cagayan complained that tunnels made by CRPE caused chaos in flowing irrigation water schedule. Farmers tend to keep irrigation water flowing in their field even if it is not yet their schedule. Barangay officials prevented CRPE hunters from entering their barangay because of the damage they make in leeves and because electric fishing is considered illegal.

II. Ecological Engineering toward a Sustainable Integrated Pest Management (IPM) Program in Rice and Rice-based Farming System

Project Leader: GS Arida

Ecological engineering is the development of strategies to maximize ecosystem services through exploiting natural regulation mechanisms instead of suppressing them. This project investigates the impact of Palayamanan, an integrated farming system (crops, livestock and aquaculture), on conservation biological control. It is possible that Palayamanan serves as refuge to beneficial organisms that can provide a sustainable IPM in surrounding areas with large rice monoculture. Sustainable IPM means less input for farmers and reduction in hazards to humans and the environment.

Effect of habitat manipulation through vegetation diversity surrounding rice field on the population of insect pests, its damage, and beneficial organisms

GS Arida, BS Punzal, LV Marquez and J Settele

The role of ecological engineering as a component in pest management is new in rice and its benefits are given little attention. In fact, research on ecological engineering in rice is very limited. Recently, Gurr et al. (2004) presented a more recent discussion on ecological engineering. He describes ecological engineering as human activity that modifies the environment according to ecological principles. It is a useful conceptual framework for considering the practice of habitat manipulation for arthropod pest management. Its main philosophy is the use of cultural techniques to affect habitat manipulation like planting of flowering plants as source of nectar and pollen of parasitoids and in effect enhance biological control. It considers vegetation diversity to be playing a central role in habitat manipulation. There is wide acceptance of the importance of field margins as reservoirs of the natural enemies and more effective biological controls where crops are bordered by wild vegetation from which natural enemies colonize (Nicholls et. al 2001; Alfieri, 2004). About 65% of arthropods associated in rice ecosystem are predators and parasitoids (Settle et al., 1996).

Highlights:

- Population of the different arthropod functional groups was highest during the booting stage of the rice crop. This was recorded from both samples in ecological engineering (rice fields with several species of flowering weeds planted in the surrounding area) (Fig.6) and farmers' fields (Fig. 7). In addition, population of the different arthropod functional groups was higher during the wet than the dry season.

- The green leafhoppers were the most abundant among the herbivores followed by the brown planthopper and white backed planthoppers.

- Population of parasitoids was higher in the ecological engineering fields compared to farmers' fields. Several species of parasitoids were collected as early as the tillering stage in the ecological engineering field which was attributed to the presence of flowering weeds surrounding the rice fields in the ecological engineering plots. These flowering weeds are source of food like nectar and pollen of the parasitoids and adult predators.

- Population of predators and species richness was higher in the ecological engineering fields compared to farmers' fields. This was also attributed to the presence of flowering plants surrounding the ecological engineering field that serves as source of food, breeding place and for resting. The most common predators collected in the ecological engineering fields consisted of several species of spiders, coccinilids, damselflies, water surface dwelling Microvelids and Mirid bugs. However, very few species were collected in farmers' fields and consisted mostly of coccinilids and spiders.

- Abundance of beneficial organisms and species' diversity in ecological engineering field was evident in all crop stages during sampling.

- Results indicated the high population of these beneficial organisms and arthropod species' richness in the ecological engineering field as compared to farmers' field. Conservation of the rich communities of these beneficial organisms in the rice ecosystem is an important component for an effective and sustainable Integrated Pest Management (IPM) in rice.

Figure 6. Ecological engineering field showing several species of flowering weeds.

Figure 7. Farmer's field without flowering weeds near the area.

III. Screening of Rice Materials for Insect Pests and Diseases

Project Leader: JP Rillon

The role of pest and disease screening is important in identifying and selecting rice lines for breeding purposes, thus, a need for continuous screening of promising lines to determine their reactions to major rice diseases and pests under induced and natural field conditions.

Evaluation of rice lines for resistance to major diseases

JP Rillon and SV Duca

Rice diseases are a major limiting factor in achieving the goal of increasing rice production. Rice diseases are important barrier in reducing grain quality and yield. Among the diseases, tungro, blast and bacterial leaf blight are considered to be the most devastating diseases in most rice growing areas. The changing environment, like having heavy rainfall, can usually increase disease occurrence while hot and humid weather will lead to the occurrence and spread of disease. Rice plants need to be evaluated to determine the presence or outbreak of diseases in the field. The role of disease screening is important in identifying rice lines that will show resistance to the major rice diseases. Rice lines resistant to the major diseases can be used in breeding purposes. There is need for continuous screening for disease resistance from one year to the next due to disease resistance breakdown often with devastating results.

Highlights:

- Two thousand nine hundred twenty-six rice entries representing 25 groups (RF, PR, Monogenic, ZS, CY, LT, VA, DRS, TG, IL1, MAT, Hybrid, Special Purpose, Cold Tolerant, Saline Prone, Upland, Rainfed Lowland Dry Seeded) were screened for their resistance to blast, bacterial leaf blight, sheath blight and tungro under induced evaluation. Other 10 groups (ILH, PYTH, ONH, FR, MET 0, MET 1, ILTPR, Pre NCT, Multiline and Palayamanan) entries were evaluated against prevailing rice diseases during the season.

- For blast evaluation, 2214 rice entries were direct seeded in blast screening nursery surrounded with IR72 and IR50 susceptible check varieties. Three hundred one entries were found resistant to blast, while 322 with intermediate reaction to the disease.

- For tungro evaluation, virus infected GLH were allowed to feed on seedling test plants for 24 hours for virus inoculation. The entries were examined for the presence of symptoms after 2 weeks of inoculation. Line F6-12 (rainfed group) showed resistant reaction to rice tungro virus whereas DSR4955ON, RF34 and RF50 had intermediate reaction to the disease.

- For bacterial leaf blight and sheath blight, plants were transplanted to the field and inoculated at 45-60 DAT. Evaluations were performed for development of bacterial leaf blight and sheath blight. Four hundred fifty-nine entries were identified with intermediate reactions to bacterial leaf blight while 56 entries had intermediate reaction to sheath blight.

Table 2. Promising rice lines to major rice diseases.

PR34185-B-5-1-2-1-1-1-1-2-1-4-2-1 (A)	Hybrid19
PR40073-3B-2 (G)	MAT3
Hangangchal 1 (J) (NEW)	DSR4955ON
IR86384-58-2-1-B	DrS 1034
GSR IR1-12-S2-Y3-Y2 (NEW)	RF24
PR30245-IR64-ID 18-1-4 (NEW)	RF34
F6-12	RF50
RL12PN3434	DSR7
IR85820-92-3-2-3 (tpr)	DSR22
Hybrid16	DSR24

- Under natural field evaluation, 712 rice selections were evaluated for the prevailing rice diseases during the season. Majority of the test entries were found resistant to intermediate to blast, bacterial leaf blight, sheath bight, bacterial leaf streak, bakanae, leaf scald and false smut.

Screening for resistance to insect pests of rice
GC Santiago

Breeding is a long-term project and priorities may change over time. A new selection may well need to be tested in a range of environments, affected by different factors and grown under several cultural techniques. In most breeding programs, there are successive stages of testing: seedlings are initially screened and only the most promising lines go on to further testing. Most of the important sources of resistance to major insect pests have been incorporated into lines that have improved plant types. Some lines were considered promising enough to be named varieties while others proved to be good parents in the new crosses. Focusing on a system to facilitate screening for resistance will hasten the development of a new variety and will save on resources.

Highlights:

- Under field condition during DS 2013, a total 436 AON-R, 166 PYT-R and 36 NCT-TR entries were evaluated for resistance to stemborer. Evaluation at reproductive stage for whiteheads showed that out of these AON-R entries, 28 were Resistant (R) , 13 were Moderately Resistant (MR), 11 were Intermediate (I) and 8 were Moderately Susceptible (MS). On PYT-R, out of 166 entries, result showed that 130 were R, 27 were MR, 8 were I and 1 had MS reactions. For the NCT-TR entries, out of 36 entries, 6 had R, 9 had MR, 8 had I, 11 had MS and 2 had S reactions. These results were valid because the susceptible check (TN1) had a damage rating of 12.36%.

- NCT-TR entries with resistant reaction to whiteheads were: #2 PR36720-17-1-2-1, #5 PR37043-B-6-3-1, #16 C9301-B-2-1-2-2, #18 C9222-B-2-2-1-2-1, #28 PR37704-2B-6-1-2-1-2 and #29 ir85820-92-3-2-3.

- Under screenhouse condition, 36 NCT-TR and 166 PYT-R entries were evaluated for resistance to brown planthopper (BPH) and green leafhopper (GLH). Result showed that out of 36 NCT-R entries, 10 were MR, 10 were I and 16 were MS to BPH. Similarly, result on GLH evaluation showed that 4 had MR, 16 had I, 12 had MS and 4 had S reactions. On PYT-R, out 166 entries, 72 were I, 49 were MS and 54 were S to BPH. The same entries were evaluated for resistance to GLH and result showed that 2 had I, 65 had MS and 99 had S reactions to the test insect.

- A total of 1,413 entries from different ecosystems were evaluated for resistance to stemborer during WS 2013. Out of these entries majority were Resistant to stemborer at reproductive stage with a valid data of 14.83% on susceptible check TN1.

- Under the screenhouse condition during WS 2013, out 334 entries evaluated, 130 were Intermediate to BPH and 82 were Intermediate to GLH.

IV. Monitoring and Profiling of Major Diseases
Project Leader: FA dela Peña

Clear understanding of the complex interactions between the pest and beneficial organisms at the macro-scale level and the farmer's farm practices and technologies being adapted are of utmost importance in developing a strategic pest management scheme. This can be done through proper identification of the pest, estimating the population density present in the field and determining if significant yield loss can occur with the given pest population, hence, the knowledge on the profile of pests and natural enemies in a particular area is necessary for an effective pest management program. This study will eventually identify the risk factors in rice production in order to assist farmers in decision-making regarding the best pest management option at certain situation.

Spatial and temporal pest dynamics in rice production systems of Nueva Ecija (UPRIIS 1&4)
FA dela Peña and LV Marquez

Pest population is dynamic over time and space and circumstantial evidence shows that the shift to modern rice cultivation and crop intensification affects the occurrence of insects and incidence of diseases in the rice ecosystem. Change in density and composition of pests can dramatically cause the pest population to fluctuate within the cropping season, within the year or over a period of time and can cause tremendous yield reduction.

Knowledge on the identity, population/incidence, and damage with a given pest population as well as the presence of beneficial organisms in a particular area at a given time are necessary for an effective pest management program.

Highlights:

- 79 location sites distributed in the municipalities of Carranglan, Munoz, Talugtug, Guimba, Cuyapo, Cabanatuan, Sta Rosa, San Leonardo, Penaranda, Gapan, San Isidro and Cabiao were identified in UPRIIS 1&4 and 26 location sites were actually monitored from seedling to reproductive stages.
- Presence of insect pests such as green leafhopper, whitebacked planthopper, zigzag leafhopper and rice bug was observed. Whitehead damage caused by stemborer was also observed.
- Natural enemies present were Cyrtorhinus sp., non-web spiders, coccinelid, Ophionea sp., Tetragnatha sp., and Pardosa.
- For diseases, only sheath blight and false smut were observed to be present

- Occurrence of weed was very minimal and expected not to cause significant damage on main crop.

Monitoring the shift in population of brown planthopper (Nilaparvata lugens) and whitebacked planthopper (Sogatella furcifera) in PhilRice CES
GC Santiago, EM Valdez and CE Constantino

The remarkable increase in rice production was largely dependent on the development of new rice varieties. However, this has caused a new pest problem. Initial observations showed a shift in the number of population of the whitebacked planthoppers (Sogatella furcifera) and the brown planthoppers (Nilaparvata lugens) in fields planted with popular high yielding varieties of rice, hence, this study was conceptualized.

Highlights:

- Total of 53,468 GLH, 9,590 ZLH, 2,868 BPH and 1230 WBPH were collected from January to December 2013.

- Percent hoppers collected throughout the year showed that GLH was the highest with 82%, followed by ZLH (12%), BPH (4%) and the least was WBPH (1%).

- The highest collection of hoppers peak on April during DS 2013. Similarly, during WS 2013 the population peaked in September.

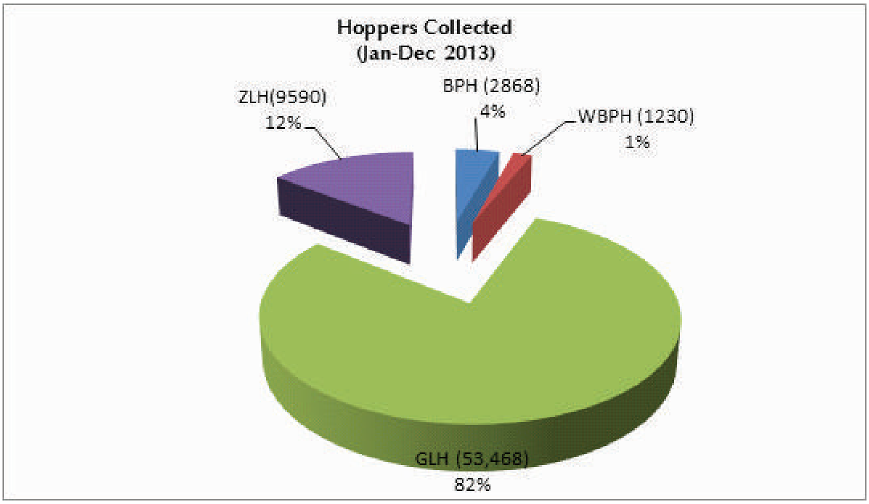

Figure 8. Percent of hoppers collected from January to December 2014. PhilRice CES.

V. Microbial Inoculants in Rice Farming

Project Leader: JA Cruz

The project aims to develop a potential growth promoter for upland rice from endophytic nitrogen-fixing bacteria from nipa palm environment. Plant growth promoting bacteria stimulate the growth of plants through production of metabolites such as siderophore, indoleacetic acid (IAA), and phosphatase (El-Tarabily, 2008). The production of growth promoting substances such as plant hormones is part of the metabolism of various bacteria associated with plants causing modifications in the morphology of roots, influencing nutrient and water absorption, and consequently promoting plant growth (Bashan and Holgium, 1997).

Evaluation of endophytic nitrogen-fixing bacteria isolated from nipa palm (Nypa fruticans) as growth promoter for rice

JA Cruz, MKM Cadiente, HX Truong and ET Rasco Jr.

Rasco (2011) stated that nipa could grow well even in soils that are physically and chemically unsuitable for plants, such as those found in the mangroves. One possible reason is that there are microorganisms associated with the roots that are capable of converting atmospheric nitrogen to nitrates and ammonium that are usable by plants. Tang et. al (2010) found that nipa palm possessed a group of Burkholderia vietnamiensis as its main active nitrogen-fixing endophytic bacterium. Acetylene reduction by the various isolates of B. vietnamiensis produced a 44 to 68 nmol h-1 ethylene production rate.

Hence, it is possible that endophytic nitrogen-fixing bacteria can be isolated from nipa palm that may act probably as plant growth enhancers to other crop such as rice.

Highlights:

- Eight nitrogen-fixing bacteria were isolated from the different parts of nipa palm (roots, bark, leaves, etc.). Nitrogen-free medium was used to isolate the endophytic nitrogen-fixing bacteria.

- Initial morphological test was used to characterize the isolates (Table 3).

- N1, N4, N5, N7, and N8 isolates were found to be gram positive (Figure 10). On the other hand, N2, N3, and N6 isolates were gram negative. In terms of morphology, N1, N4, and N8 isolates were coccoid in shape. N2, N3, N5, and N7 isolates were rod-shaped. N6 has a circular-shaped fragment.

- Morphological observation was not adequate in itself to identify bacteria in the genus and species level; hence, physiological, biochemical, and molecular analysis will be conducted.

- These isolates will be subjected for evaluation on its effectiveness as plant growth promoter using upland rice as the test crop.

Table 3. Source and characteristics of the eight bacteria isolated from nipa palm from Bulacan.

Isolate	Source	Colony Observation	Microscopic characteristics	Gram Staining
N1	Old bark	Yellow, Semi-solid, sticky	Coccoid	+
N2	Old roots	White, sticky	Rod-shaped	-
N3	Old leaves	Off-white, Shiny, sticky	Rod-shaped	-
N4	Old leaves	White, Shiny, sticky	coccoid	+
N5	Old roots	White, Shiny, sticky	Rod-shaped	+
N6	Young bark	White, Shiny, sticky	circular	-
N7	Young roots	Yellow, sticky	Rod-shaped	+
N8	Old leaves	White, Shiny, sticky	coccoid	+

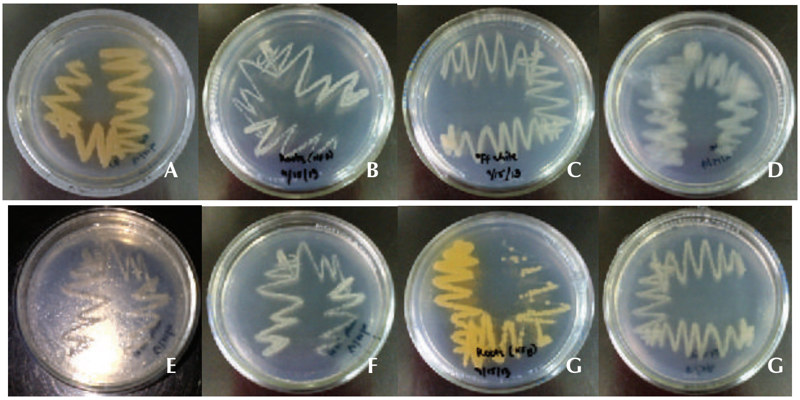

Figure 9. Colonies of bacterial isolates grown in nitrogen-free agar medium: A. N1; B. N2; C. N3; D. N4; E. N5; F. N6; G. N7; and H. N8.

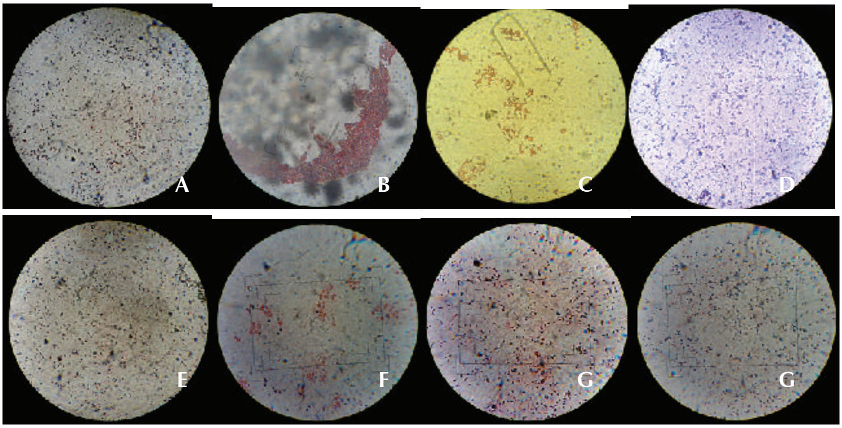

Figure 10. Gram stain view of the eight isolates: A. N1; B. N2; C. N3; D. N4; E. N5; F. N6; G. N7; and H. N8 (Magnification: 100x).

Assessment of actinomycetes for enhancing the growth and yield of upland rice

JA Cruz, MKM Cadiente, and ES Paterno

Actinomycetes are the most economically and biotechnologically valuable prokaryotes. They are responsible for the production of half of the discovered bioactive secondary metabolites. More than 50 genera have been used in human, veterinary medicine, agriculture, and industry. One of the genera of actinomycete is Streptomyces. Streptomyces, generally accounting for an abundant percentage of the soil microflora, is particularly effective colonizers of plant root systems and is able to endure unfavorable growth conditions by forming spores (Alexander, 1977).

The general objective of this activity is to determine the survival of actinomycetes in the soil-based carrier.

Highlights:

- The actinomycete used in this study has been previously tested for its growth promoting activities. This isolate produced both 1-aminocyclopropane-carboxylic acid (ACC) deaminase and indole-3-acetic acid (IAA). Similarly, it can also solubilize phosphate.

- The colonies were counted after about 2-3 days of incubation. The acceptable values for counting colony-forming unit (CFU) range from 30-300 colonies. In counting for the (CFU), formula used was:

CFU=(no.of colonies ×dilution factor)/(oven dry weight)

The CFU was transformed to logarithmic value and was plotted in a graph.

- Figure 11 shows the population of actinomycete in the soil-based carrier. The initial population of 3.2 x 106 cfu/g increased to 6.2 x 106 cfu/g 4 days after inoculation. Bacterial population increased by 94% at 4 days after inoculation. However, number of cells in the soil-based carrier decreased to 6.7 x 107 cfu/g 8 days after inoculation followed by a gradual increase with a final population of 9.5 x 107 cfu/g at 109 days after inoculation; 2,868 percent of the initial population remained viable in the soil-based carrier.

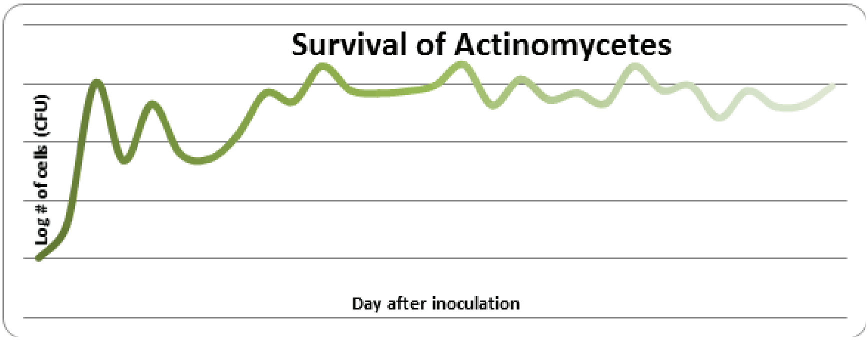

Figure 11. Growth of actinomycete from day 0 to day 109 after inoculation.

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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We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologoies so farmers can produce enough rice for all Filipinos.

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 57 agencies and 70 seed centers strategically located nationwide.

To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-suffiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environment Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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