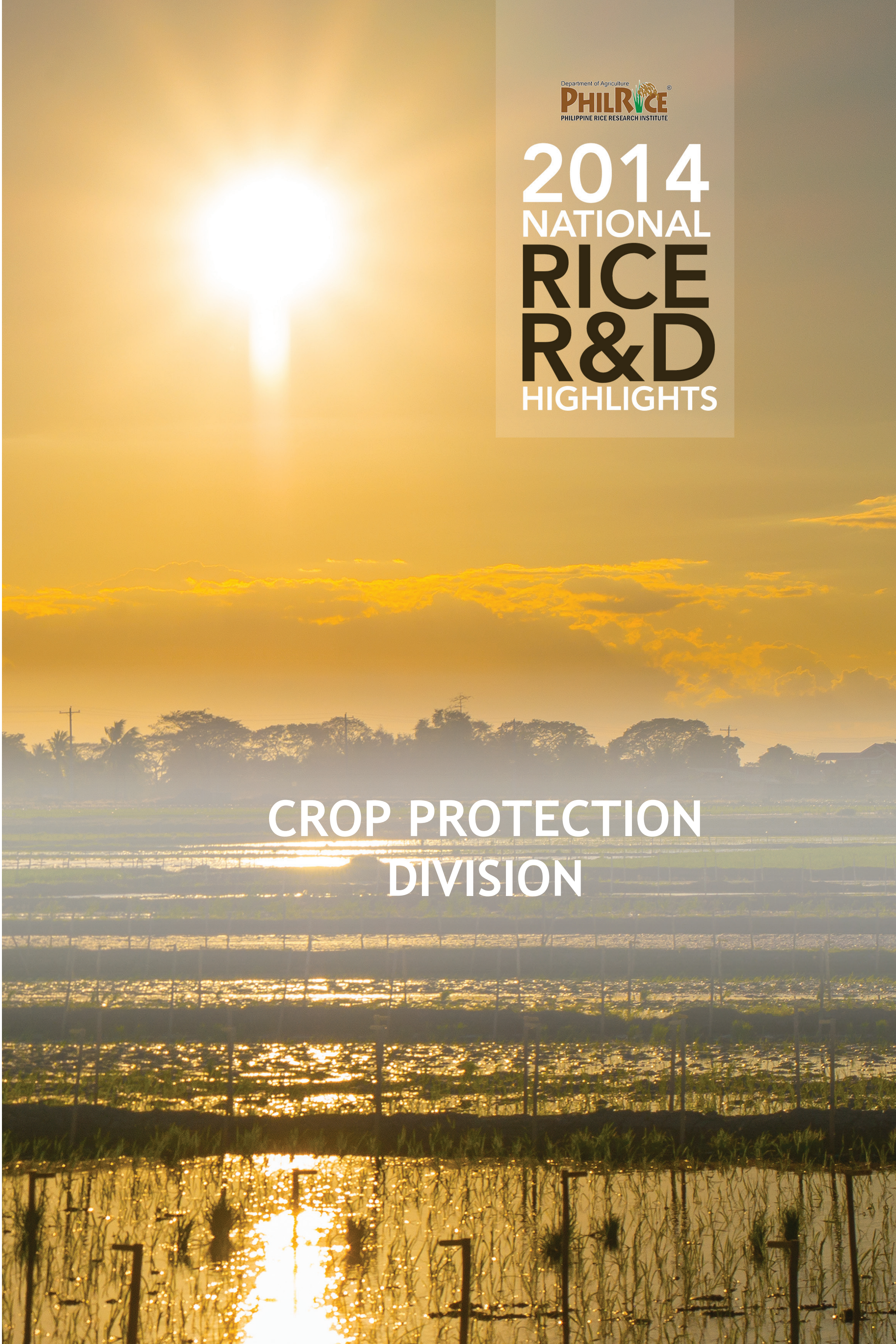

Department of Agriculture
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

2014 NATIONAL RICE R&D HIGHLIGHTS

CROP PROTECTION DIVISION

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CROP PROTECTION DIVISION

Division Head - EC Martin

Executive Summary

Research goal of the Crop Protection Division (CPD) for 2014 focused on the development of technologies to help farmers improve their pest management decision-making towards 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) Ecological Engineering Towards a Sustainable Integrated Pest Management (IPM) Program in Rice and Rice-based Farming System, 2) Screening of Rice Materials for Insect Pest and Diseases Resistance, 3) Biology and Ecology of Pest, 4) Microbial inoculants in Rice farming (Special Projects), 5) Evaluation and optimization of pest management strategies/ techniques.

These five projects will each contribute to the development of sound pest management strategies and pest-resistant varieties. These researches 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 in identified areas.

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.

Blast caused by Magnaporthe grisea [Herbert] Barr., is one of the most important diseases of rice worldwide. Based on the preliminary analysis on the morphological and cultural characteristics of Magnaporthe grisea isolates in the laboratory, there were six (6) different growth patterns initially observed. The observed instability revealed a significant assessment on variations among isolates as partitioned in space.

Sheath blight of rice caused by Rhizoctonia solani Kuhn is one of the most important rice diseases. So far, none of the leading high yielding varieties have acceptable levels of resistance to the pathogen causing the disease and is currently managed through fungicides. Dual culture test revealed that T5Oi and TMDRi overgrew R. solani and covered the entire surface of plated PDA after 7 days of incubation. Both Trichoderma isolates had high antagonistic effects to R. solani at the middle stage of incubation.

Damage of the rice plants due to the rice bug infestation during milking to ripening includes empty grains, shriveled panicle, unfilled grains and discoloration of mature grains, thus, such rice has lower milling quality or is pecky rice of inferior grade. The fungus, Beauveria bassiana (Balsamo) Vuillemin and Metarhizium anisopliae Sorokin are the two common groups of fungi that are use in the control of insects under different orders. These fungi can kill over 70% of the insect in 4 to 5 days in the laboratory. The use of the fungus could help in the management of the insect particularly the rice bug in the field.

Actinomycetes are the most economically and biotechnologically valuable prokaryotes. They are responsible for the production of half of the discovered bioactive secondary metabolites. One of the genera of actinomycete is Streptomyces. 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.

Rice fields surrounded by flowering weeds had higher population of parasitoids and predators than in farmer's fields. The opposite was recorded on the population of herbivores (mostly plant hoppers and leafhoppers). Results indicated the high population of these beneficial organisms and arthropod species richness in the ecological engineering field as compared to farmers' field.

Control measures of a certain pest are usually based on its biology because control measures will work effectively when applied at the vulnerable stage of the pest. The rice grain bug (RGB), a formerly pest of legume (as reported by BPI based on Barrion, AT, 2009 fax communication) and presently infesting on the rice crop near the flood-prone areas of Mainit lake in Caraga. The RGB is a small, fast moving insects and ant-like in appearance. The size of the adults (8-9mm) is more or less equivalent to the size of the rice grain.

In managing rice bugs, Guimba et al. (2006) and Estoy (1995) reported that decaying golden apple snails attract rice bugs in the field effectively. Interestingly, most of the attracted rice bugs were males.

Weedy rice is an emerging pest in irrigated rice ecosystem especially in Iloilo. Field observations and anecdotal accounts by rice farmers indicating that weedy rices are not generally infected by bacterial blight and tungro compared to the cultivated rice (Donayre, personal communication). Continuous evaluation of weedy rices from other provinces are still on going to identify possible resistance against Tungro and BLB.

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. Results showed that CPRE in rice paddies has an average length of 38.36cm and has an average weight of 64.62 grams. Forty-five percent of the populations were females carrying 112 to 500 eggs.

The use of biological means in controlling rodent pests is new in the Philippines. One of the organisms looked upon is the Sarcocystis singaporensis. It is a Southeast Asian endemic, which is a parasite specific to Rattus and Bandicota species only (Jäkel et al. 1999; 2001). The organism has been found virulent to rodents at certain concentrations and different isolates shows specificity to different rodent pest species.

I. Ecological Engineering Towards 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 maximise ecosystem services through exploiting natural regulation mechanisms instead of suppressing them. Agricultural systems are often designed to maximise specific provisioning services at the expense of other services and are characterized by low biodiversity. In addition, ecosystem services such as invasion resistance and pest regulation are further depressed by pesticides. It enhances biodiversity e.g. by providing refugia, food and breeding places for predators, parasitoids and pollinators to keep damage by pest on a minimum level while fostering the delivery of a wide range of ecosystem services.

The role of ecological engineering as a component in pest management is new in Asia and its benefits in rice is given little attention. 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 play a central role in habitat manipulation.

Palayamanan, an integrated farming system (crops, livestock and aquaculture), could provide an ideal situation for ecological engineering. Hence, the impact of Palayamanan on conservation biological control should be investigated. 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 around rice fields on the population of insect pests, beneficial organisms and damage
GS Arida

Conservation of beneficial organisms requires sufficient habitat biodiversity at the landscape level. Many of the beneficial organisms like generalist predators have long life cycles and with limited capacities to move long distances, while most insect pest species are winged and have high migratory capacities.

The role of ecological engineering (EE) as a component in pest management is new in rice and its benefits is given little attention. 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 play a central role in habitat manipulation.

Highlights:

- Results in 2014 dry and wet season showed that rice fields surrounded by flowering weeds (Figure 1) had higher population of parasitoids and predators than in non-ecological engineering in farmers' fields (Figure 2). The opposite was recorded on the population of herbivores (mostly plant hoppers and leafhoppers). Generally, population of the different arthropod functional groups and species richness was higher in the field surrounded by flowering weeds as compared to the non-ecological engineering in farmers' fields.

- Planting of flowering plants improve habitat diversity resulting to higher arthropod species richness, higher population of predators and parasitoids in rice fields and in effect with low vulnerability for pest outbreaks.

Figure 1. Ecological engineering field.

Figure 2. Non-ecological engineering field.

II. Screening of Rice Materials for Insect Pest and Diseases Resistance

Project leader: JP Rillon

Developing rice varieties resistant to major insect pests and diseases is the most economically and environmentally sound management approach in breeding program to prolong the varieties performance in the field. One way to increase yield is to reduce losses to insect pests and diseases. The role of screening is important in identifying rice lines that will show resistance to major rice pests. Rice lines resistance to major pests can be used in the development of improved varieties. There will be a need for continuos screening for pest resistance. Promising lines were evaluated for resistance to blast, bacterial leaf blight, sheath blight and tungro. For insect, lines were evaluated for resistance to yellow stemborer, green leafhopper and brown planthopper. Susceptible varieties were used to check the validity of the data on pest resistance.

Evaluation of rice lines for resistance to major diseases

JP Rillon, MSV 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. 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 will be a need for continuous screening for disease resistance from one year to the next due to disease resistance breakdown often with devastating results.

Highlights:

- Four thousand nine hundred ninety four rice entries representing 14 groups under preliminary yield trial(special purpose), preliminary yield trial (regular), Rainfed, direct seeded, double haploid, hybrid parentals, blast lines, special purpose seed increase, IL1, MAT, Hybrid, Special Purpose, Cold Tolerant, Saline Prone, Upland and Rainfed Lowland Dry Seeded were screened for their resistance to blast, bacterial leaf blight, sheath blight and tungro under induce, modified field method of evaluation and against prevailing rice diseases during the season.

- For blast evaluation, 1299 rice entries were direct seeded in blast screening nursery surrounded with IR42 and IR50 susceptible check varieties. Two hundred fifty entries were found resistant to blast, while 189 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. PYT SP4 showed intermediate reaction to the disease.

- For bacterial leaf blight and sheath blight, plants were transplanted into the field and inoculated at 45 to 60 DAT. Evaluations were performed for development of bacterial leaf blight and sheath blight. Three hundred six entries have been identified with intermediate reactions to bacterial leaf blight while 322 entries had intermediate reaction to sheath blight.

- During the dry season, low disease pressure was observed under natural field evaluation. In wet season, the prevailing diseases identified were sheath blight, bacterial leaf blight and leaf sclad.

Table1. Summary table of reactions of promising lines and varieties to major rice diseases. 2014.

Reaction	No. of Accessions			
	Blast	Bacterial Leaf Blight	Sheath Blight	Rice Tungro Virus
Resistant	250	0	0	0
Intermediate	189	306	321	1
Susceptible	860	84.	1140	1083

Centralized screening for resistance to insect pests of rice
GD 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 have 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:

- A total of 500 rice lines were evaluated against stemborer under field condition during DS 2014. The same number of entries was also evaluated against BPH and GLH under screenhouse condition.

- During DS 2014, a low stemborer pressure was observed under field condition during the vegetative stage of the entries. However, evaluation against stemborer at reproductive stage had a valid data with 31.46% WH on susceptible check (TN1).

- Under field condition, result showed that majority of the entries was moderately resistant to stemborer during the reproductive stage. Result under screenhouse condition showed that damage range from intermediate to susceptible reactions for BPH and moderately susceptible to susceptible for GLH.

- During WS 2014, a total of 766 rice lines were evaluated against the test insects; stemborer, BPH and GLH. A valid data was also obtained for stemborer at reproductive stage with 14.83% on susceptible check, TN1.

- Result showed that 33 PYT-R, 46 PYT-SP, 2 RF, 1 DSR and 40 KOPIA were resistant to stemborer at reproductive stage. Under screenhouse condition, majority was moderately susceptible to susceptible to BPH and GLH.

Table 2. Reactions of different entries to major insect pests of rice. PhilRice, CES. 2014 DS.

Entries	STEMBORER					BPH					GLH				
	R	MR	I	MS	S	R	MR	I	MS	S	R	MR	I	MS	S
PYT-R(162)	52	77	21	2	0	0	0	44	46	72	0	0	0	49	113
PYT-SP (143)	46	76	16	3	0	0	0	21	57	14	0	0	0	34	109
RF (114)	37	59	17	1	0	0	0	45	40	29	0	0	3	67	44
DSR(81)	36	34	9	2	0	0	0	34	8	39	0	0	17	38	26

Table 3. Reactions of different entries to major insect pests of rice. PhilRice, CES. 2014 WS.

Entries	STEMBORER					BPH					GLH				
	R	MR	I	MS	S	R	MR	I	MS	S	R	MR	I	MS	S
PYT-R(110)	33	37	14	14	12	0	0	45	34	31	0	0	42	39	29
PYT-SP(150)	46	44	27	26	7	0	0	38	89	23	0	0	48	69	33
RF (110)	2	10	21	41	36	0	0	40	43	27	0	0	40	42	28
DSR(89)	1	7	12	37	32	0	0	31	40	18	0	0	37	30	22
KOPIA (307)	40	84	48	70	65	0	0	3	107	197	0	0	0	55	252

Profile and Role of Secondary Metabolites in Rice Plant Immunity to Rice Leaf Blast, Bacterial Leaf Blight, and Tungro

NC Ramos , CT Estonilo, RGA Ramos, JP Rillion

Plants synthesize a greater array of secondary compounds than animals because they cannot rely on physical mobility to escape their predators. Plants therefore produce chemical defense against such predators. These compounds are secondary metabolites known to be part of the normal growth and development of a plant. However, some researches revealed that these compounds are also produce as part of their response to biotic attacks.

The use of high performance liquid chromatography (HPLC) coupled to diode-array UV-Vis detection, has undoubtedly made things much easier, allowing for quick and efficient characterization of crude extracts. Nuclear magnetic resonance (NMR) was the only technique used with the 1H the most commonly observed nucleus. Apart from 1H and 13C spectra, other techniques exist, often employing complex pulse sequences to obtain specific information, which are very useful in determining structures from spectra.

For this year, the study focused on first, identify and purchase available analytical standards and UPLC column appropriate for the goal of the project. Second, optimize the extraction method by identifying different solvents and concentrations. Third, send the extracts to analytical laboratories with NMR and preparative column as to be used as baseline data. Lastly, optimize the UPLC method.

Highlights:

- Three (3) analytical standards for secondary metabolites namely Sakuranetin, Momilactone and Oryzaline, were identified available from Chemline Scientific Corporation. Atlantis C18 column from Rainphil Inc. was purchased for reversed phase UPLC system.

- Three (3) solvents were used for sample extraction. Methanol, petroleum ether and acetone were prepared in varying concentrations from 80 to100%. Each extracts were quality checked.

- A preparative column was used from the Institute of Chemistry (IC) at University of the Philippines (UP) Diliman, where each extracts were separated into isolates.

- All isolates were submitted to Analytical Laboratory Services at IC, UP Diliman for NMR analyses.

III. Microbial Inoculants in Rice Farming

Project Leader: JVA Cruz

Recently, bacterial volatiles have been reported to promote growth and to induce systemic resistance in Arabidopsis. Strain AOK-30 of Streptomyces padanus volatiles are associated with this induced drought tolerance. Based on these earlier reports, tissue-cultured seedlings may recognize and respond to AOK-30 as an external stimulus. Thus, if drought tolerance of tissue-cultured seedlings is enhanced by actinomycetes, perhaps the seedlings can be acclimatized under a relatively lower humidity, enabling the seedlings to grow and escape diseases (Hasegawa, 2004).
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).

In recent years, it was recognized that activities in the plant root system and their associated physical and biological environment determine the productivity and quality of crops. The roots are populated by microorganisms which directly or indirectly affect plant growth. Biological processes associated with these microorganisms around the roots can be manipulated, thus, offering opportunity for optimizing crop productivity (Paterno, 2004).

Endophytic Nitrogen-Fixing Bacteria in Nipa Palm (Nypa fruticans)
JVA Cruz, MKM Cadiente, TH Xuan, ET Rasco, ES Paterno

The nipa (Nypa fruticans) environment has limited nutrients along with soil salinity, but the palm is sustainably and highly productive. Its productivity is supported by indefinite mechanisms for its fertility maintenance, in which symbiotic microbes are involved.

Highlights:

- In this study, fifty-one isolates from nipa palm were screened for multiple plant growth-promoting traits. Forty-three isolates produced indole acetic acid (IAA), six were able to produce siderophore as shown by orange halo around the colonies, and twenty-seven showed ACC deaminase activity in vitro.

- Thirty-seven of the 51 isolates dissolved precipitated tricalcium phosphate as shown by clearing zones around isolates grown in Pikovskaya's medium.

- Thirty-six isolates were nitrogen-fixing bacteria, while eighteen isolates hydrolyzed starch.

- Five isolates were selected from among 51 isolates evaluated for further study. Selection was based on their growth promoting activities such as their IAA and phosphatase production. Growth rate was also considered as basis of selection. The selected isolates were subjected to morphological, biochemical analysis and 16S rDNA analysis to establish isolate identity. The probable identities of the selected isolates are as follows: NBol1, Enterobacter aerogenes; NBol2, Raoultella planticola; NQb2, Pectobacterium cypripedii; NAyr1, Serratia marcescens; NAol2, Pantoea agglomerans.

- In the growth room, the selected bacteria increased total biomass dry weight of upland rice by 25 % to 50% at 14 days after sowing (DAS) and by 40% at 21 DAS. Bacteria colonized the roots of upland rice with population densities ranging from 2.1×10^7 to 2.4×10^7 CFU g^{-1} rhizosphere soil.

Assessment of Actinomycetes for Enhancing the Growth and Yield of Upland Rice

JVA Cruz, CS Mabayag, MKM Cadiente and ES Paterno

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 significant increase in grain yield by this isolate under screen house experiment and its ability to colonize the rhizosphere under growth room condition demonstrate the potential of this actinomycete as microbial inoculant for upland rice. Hence, this study was proposed.

Highlights:

Part I: Survival of actinomycete in a soil-based carrier

- The initial population of 3.2×10^6 cfu/g increased to 6.2×10^6 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 6.7×10^7 cfu/g 8 days after inoculation followed by a gradual increase with a final population of 9.5×10^7 cfu/g at 109 days after inoculation which is 2,868 percent of the initial population.

Part II: Survival of actinomycete in a CRH-based carrier

- This study determined the survival of an actinomycete in a CRH-based carrier. Its cell population was counted periodically up to 250 days of incubation using the spread plate method.

- The initial population of 2.2×10^4 cfu/g increased to 2.9×10^7 cfu/g (135, 160%) 5 days after inoculation (DAI). However, number of cells decreased to 1.5×10^7 cfu/g 170 DAI, gradually increasing to a final population of 1.8×10^7 cfu/g at 250 DAI; 8.17×10^7 percent of the initial population remained viable in the CRH-based carrier.

- Actinomycete population increased by 135,160 percent at only five days after inoculation. The significant increase in actinomycete population demonstrates its potential as microbial inoculant for crops. However, field assessment is also recommended to determine the effect of biotic and abiotic stresses in the performance of promising actinomycete.

IV. Biology and ecology of pests

Project Leader: GF Estoy

Agriculture, especially monoculture has affected the natural biodiversity through the simplification of habitats and ecosystems. As a result, the loss of floristic and structured diversity leads to the reduction of faunal heterogeneity and pest incidence. Philippines has a vast area for upland, rainfed, saline- and submergence-prone environments for rice production. However, some of these areas are often affected by biotic and abiotic stresses which resulted in the low rice production.

Control measures of a certain pest are usually based on its biology because control measures will work effectively when applied at the vulnerable stage of the pest. Thus, there is need to know its basic biology and some aspects of its ecology so that it can be properly manage. The affected rice farmers should be given management options and awareness campaign should be done on rice farmers on the unaffected rice areas.

Biology, Ecology and Management of the Rice Grain Bug (Hemiptera: Lygaeidae) – A New Emerging Pest of Rice

GF Estoy and BM Tabudlong

Control measures of a certain pest are usually based on its biology because control measures will work effectively when applied at the vulnerable stage of the pest. The rice grain bug (RGB), a formerly pest of legume (as reported by BPI based on Barrion, AT, 2009 fax communication) and presently infesting on the rice crop near the flood-prone areas of Mainit lake in Caraga, Mindanao has no basic biological studies. Thus, there is need to know its basic biology and some aspects of its ecology so that it can be properly manage. The affected rice farmers should be given management options and awareness campaign should be done on rice farmers on the unaffected rice areas.

Highlights:

- The RGB is a small, fast moving insects egg, nymph and adult). RGB nymphs undergo 5 instars before they become an adult. The duration of the total developmental stages range from 23.0 to 32.5 days.

- The RGB has a piercing-sucking mouthpart that is used to penetrate the seed coat to get at the nutritious contents within.

- The first pair of legs have an enlarged segment, the femur, which is distinctive and may assist in providing leverage for drilling into hard seeds.

- The insect undergoes 3 developmental stages namely: egg, nymph and adult. Egg size was 1.18±1.13mm. The RGB nymphs undergo 4-5 instars before they become an adult stage. Newly emerged adult are light green to orange between the abdomen and in the thoracic region and later sclerotized after a few minutes and fully developed adult turned light brown to black in color.

- The duration (days) of the developmental stages of P. pallicornis on showed that egg incubation ranged from 6-9, n=150 days. There were 3-9(n=100), 3-10(n=54), 3-11(n=34), 4-11(n=22) and 5-7(n=15) days of the 1st instar, 2nd instar, 3rd instar, 4th instar and 5th instar incubation, respectively. The size of the adults (8-9mm) is more or less equivalent to the size of the rice grain. Female RGB laid their eggs singly which is whitish or transparent in color and then turned reddish to brown upon hatching. The eggs are inserted in a thin layer of the moist tissue paper and in the soil. It could also laid at the base of the rice plant. Preliminary observation on the longevity of the adult lasted more than two months in the laboratory.

- Weed species namely: Echinochloa crusgali, E. glabrescens, Cyperus iria and C. difformis were evaluated as host range of the RGB under screenhouse condition. Results showed that RGB completed its developmental stages from nymph to adult indicating that the four weed species are alternate hosts of RGB in the field. The total nymphal period before they became adult was 25.4, 23.0, 28.1 and 27.1 days on E. crusgali, E. glabrescens, C. iria and C. difforrmis, respectively. The Vigna sesquipedales (check) has a total nymphal period of 32 days.

- The light traps were set-up daily at 6PM to 6AM and light trap catches were collected on the following day. Results showed that very few adult RGB caught in the light trap based on the population density regardless of the location of the light trap in the field indicating that RGB is not attracted to light.

- Nine (9) botanical extracts namely: neem leaf, wild sage, lagundi leaf, marigold leaf, ginger rhizome, chilli pepper fruits, tobacco leaf, lemon grass, sugar apple and insecticide (check) were evaluated against RGB through filter paper and soaking method. Among the botanical extracts tested, filter paper method showed that tobacco leaf extract was very effective on RGB adult showing 100% mortality after 5 minutes post treatment while insecticide caused the same mortality after 1 hour. On the other hand, RGB mortality showed 90%, 85% and 75% after soaking in chilli pepper extract, neem leaf extract, lagundi leaf extract and lemon grass, respectively.

- Preliminary evaluation of the six (6) different attractants to RGB in the screehouse showed that RGB adults are attracted to the apple cider attractant.

- Yield loss is directly proportional to RGB population.

- Validated the presence of RGB on reported infested areas in Caraga.

- Conducted awareness campaigns and workshops (Regions XI and XIII).

Carryover Seed Inoculum of Seedborne Pathogens on Popular Released Varieties and Lines for Rainfed Areas and their Potential for Disease Buildup
AT Angeles, FR Sandoval

Some important rice diseases can be traced from seed infection. Among these are sheath blight caused by Rhizoctonia solani Kuhn, blast caused by Pyricularia oryzae, false smut caused by Ustilago sp. , bakanae,caused by Fusarium fujikuroi and others not yet reported. Rice blast is a consistent field problem in rice crop production while sheath blight, false smut and bakanae diseases are becoming a new concern after being observed in the field with the introduction of new varieties. In the case of bakanae pathogen the variety PSB Rc82, its main host, has been widely used by farmers nationwide and is popularly used as parental in breeding new lines because of its high yielding trait. Persistence of seedborne pathogens might theoretically increase the risk of crop contamination and can encourage disease development with enough initial seed inoculum. The control strategy can start with seeds.

Highlights:

- Pure culture of a local strain of G. fujikuroi isolated from CLSU symptomatic rice plants (Basmati-derived special rice CLSU coded CL1) and used as stock culture in the study

- Sister lines of the two PSB Rc82-based lines tested responded differently to the disease e.g. germination viability, persistence and resistance upon induced inoculation of the bakanae organism.

- Indication of germination inhibition of Line 9 (82sub- BC3F2-202-3-9) was shown in significantly lower germination of the line from the control (PSB Rc82) and in comparison to the other lines.

- Disease infection level (3%) of sister lines Lines 4, 5 and 6 of 82sub-BC3F2-202-3 were significantly lower while no significant infection was observed among sister lines of 82sub-209-7.

- Persistence of the disease in two successive generations of 82sub-BC3F2-202-3 was manifested on seven sister lines (1,2,4,5,6,,9,and 10 while the disease did not prosper in Lines 3, 7, 8.

- Susceptibility/resistance of the PSB Rc82-based sister lines was shown in the reaction of the plant lines after infection was induced.

- Lines 4, 5 and 6 of the ten 82sub-BC3F2-202-3 batch had significant less infection compared to the control and remained so upon inoculation although with slightly increased level from the non-inoculated plants.

- Among 82sub-209-7 lines, Lines 3, 6, and 7 were infected but at least maintained lower level of infection upon inoculation.

- One peculiar characteristic of Line 3 was the presence of purple tint on the stem. Eighty four percent (84%) of the total test seedlings of this line manifested this color trait. After inoculation about 17% of the colored seedlings developed diseased symptoms like the uncolored ones. Should the disease becomes a major concern in the future this trait can be tagged as indicator of resistance to the disease although further experimentation and evaluation can be conducted to validate the observation.

Genetic Diversity and Cultural Characteristics of Magnaporthe Grisea in the Philippines

FD Pena, ISabasaje

Blast caused by Magnaporthe grisea [Herbert] Barr (T.T. Herbert) Yaegashi & Udagawa, is one of the most destructive diseases of rice worldwide because of its wide distribution and high incidence under favorable conditions (Ou, 1985; Singh et al., 2000). It has become a major problem in rice growing areas particularly where there is water stress (upland and rainfed) and in cool-elevated areas. It is also becoming a problem in some 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. To address the problem, a more in depth study of the structure and dynamics of the pathogen population is highly valuable for more effective management strategies of the disease.

Highlights:

- A total of 385 rice blast samples collected in 2004-2008 from different rice growing areas (rainfed, upland, cool-elevated and irrigated lowland areas) in the Philippines was used in the study (Figure 3). Additional 50 new samples were collected from the provinces of North Cotabato, South Cotabato, Surigao del Sur and Surigao del Norte .

- Out of the 385 samples, 375 cultures with 2,076 monoconidial isolates were produced. These are replicated and conserved/maintained in the laboratory.

- Of the 50 new samples collected, 30 blast cultures were produced through monoconidial isolation. The remaining 20 samples are stll in process.

- Three hundred (300) pure isolates were revived from the stock cultures exceeding the target of only 100 isolates.

- Optimization of protocols in DNA extraction and genetic analysis using available materials in the laboratory were already established. DNA extraction is ongoing and a total of thirty (30) isolates were already extracted.

- Based on the preliminary analysis on the morphological and cultural characteristics of Magnaporthe grisea isolates in the laboratory, there were six (6) different growth patterns (Figure 4) initially observed. The observed instability revealed a significant assessment on variations among isolates as partitioned in space.

- These growth patterns observed in the laboratory expressed dominance from the different geographical locations where it was collected (Figure 5). Isolates from the irrigated lowland, group D with 34% of the total population gave the highest percent of population among other groups. Those from the rainfed ecosystem, Group B showed the highest population of 33% while from upland sreas, Group F with 21% accounted for the highest percent population.

- Ten (10) molecular primers for M. grisea were identified as shown in Table 4. These will be used to reveal polymorphisms among the individual strains. Eventually, the molecular characterization of the isolates will determine the genetic relationship of the isolates. Molecular markers are direct manifestations of genetic content and can therefore serve as reliable indices of genetic and pathotypic variation. They are not influenced by environmental factors, thus are highly reproducible.

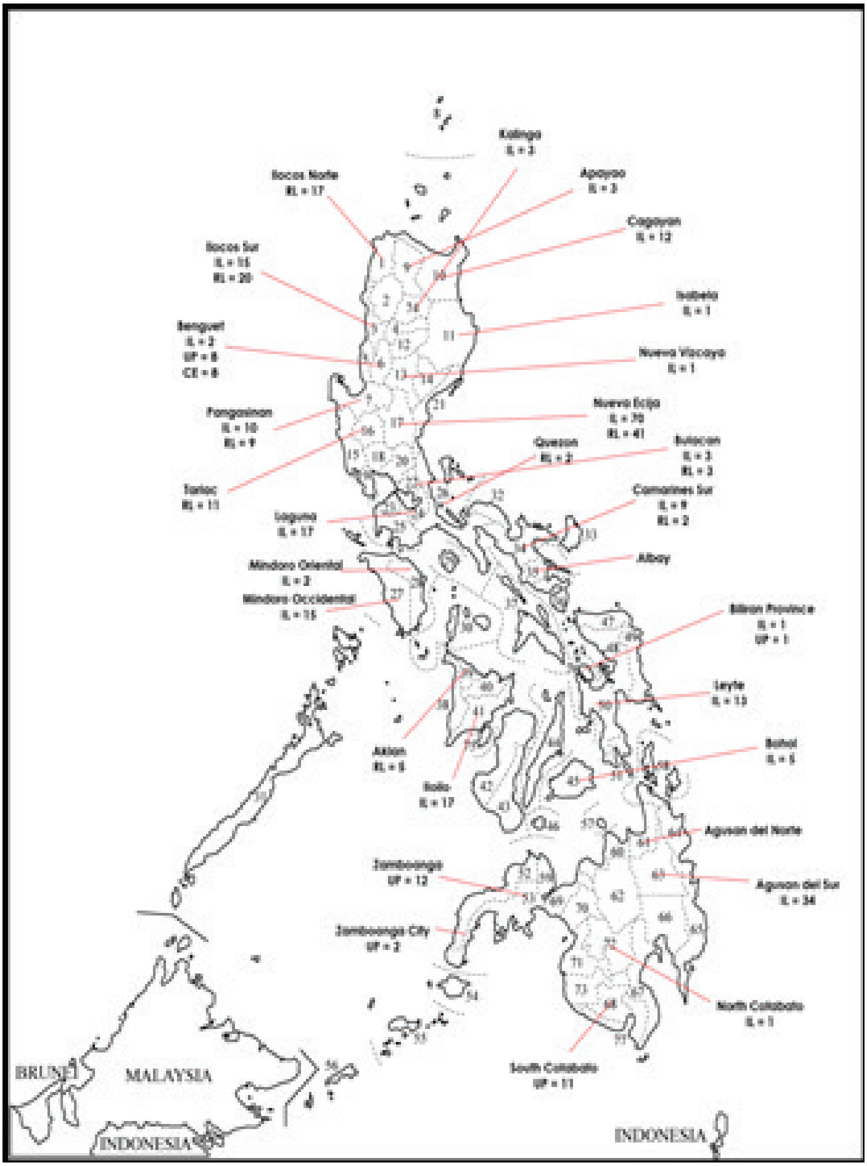

Figure 3. Map of the Philippines showing different geographical locations where rice blast samples were collected with corresponding number of isolates produced.

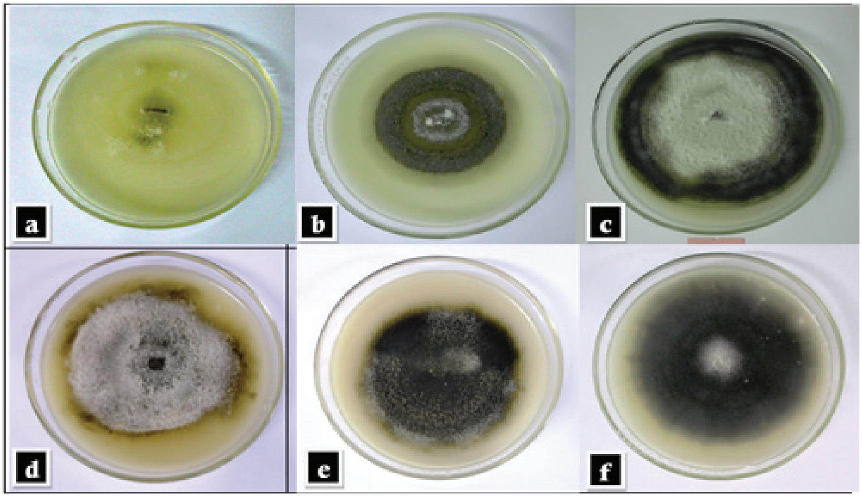

Figure 4. Variability in mycelial growth patterns of Magnaporthe grisea collected from different geographical locations in the Philippines: a) raised mycelial growth and with smooth edge; b) grayish colony color with concentric ring pattern and smooth edge; c) fleecy grayish appearance and with smooth edge; d) raised mycelial growth and irregular colony shape; e) grayish black in color with raised mycelial growth and irregular colony shape; and f) grayish black in color with irregular colony shape.

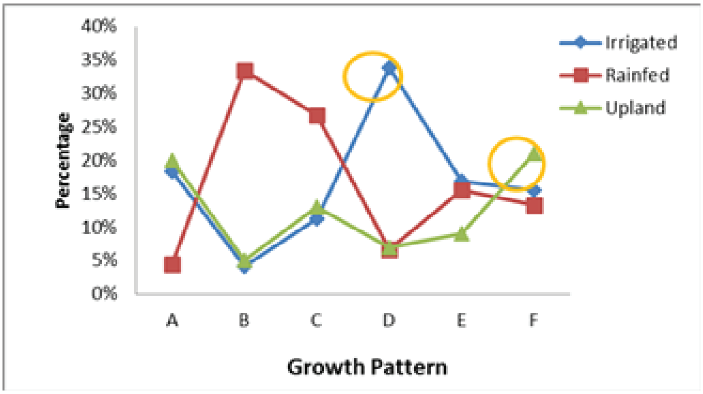

Figure 5. Percentage population of different groups of isolates from different rice growing areas such as irrigated, rainfed and upland areas.

Table 4. List of primer and primer sequences identified for DNA Fingerprinting for the molecular characterization of *Magnaporthe grisea*.

Number	Primer		Sequences
1	C7 1.4	F	TGC CGC CTG CTC TAA GTA AA
		R	TAT CCT TCA CCA ACG ACA CC
2	CUT 1	F	TAT AGC GTT GAC CTT GTG GA
		R	TAA GCA TCT CAG ACC GAA CC
3	E10	F	ACC AGG TGA CGT CGA TAA CC
		R	CTG ACG CCA AAA GCA AGT TA
4	ERG2	F	GCA GGG CTC ATT CTT TTC TA
		R	CCG ACT GGA AGG TTT CTT TA
5	HO 0.85	F	CAT CTA CAA CCC GAG CAA GG
		R	TGT AAA ACA GCC CAT CAA AG
6	H6 1.15	F	TGT ATG ATG CGA GCG GAC TT
		R	TGG ACT GGG TAT TGT TGA GC
7	J16 0.7	F	GTT AGG GCT ACA GGC GGA AG
		R	CTG TGG CGA CGA TCT GTG GT
8	P9 1.0	F	ACC CCA CTC GCT GAC CTT TA
		R	CGG ACG CTT GAT TGC TGT TA
9	PWL2	F	TCC GCC ACT TTT CTC ATT CC
		R	GCC CTC TTC TCG CTG TTC AC
10	Pot2	F	CGG AAG CCC TAA AGC TGT TT
		R	CCC TCA TTC GTC ACA CGT TC

Germination and Dormancy of Weedy Rice and its Competitive Ability
EC Martin, CB Codod

Weedy rice has been in existence for many years in the vast areas of rice culture in Asia where they have been kept under satisfactory control in the transplant flooded culture system. However, these weedy rice and others introduced as contaminants with high yielding varieties are becoming serious problems in countries where direct seeding is replacing the transplant culture for all or more of the rice crops in multi cropping systems. As these trends continue and accelerate, the problem of weedy rice becomes more pervasive and serious.

Highlights:

- During 2014 DS, there was 90% germination of weedy rice seeds under 250C, 96% under 500C, 99% under 750C and 100% germination under 150C. Similarly, the highest percentage germination of 91.25% and 86.50% was recorded on seeds subjected to 75°C during wet season; whereas the lowest germination, 33.75% and 32.75%, was observed on seeds subjected to 25°C. At 15°C WR1 had 66.75 % while WR2 had 55% germination; on the other hand, 84% germination for W1 and 65.75% germination for WR2 was recorded on seeds subjected to 50°C.

- On the seed burial experiment, a gradual decrease on percent germination was observed during the first three months, whereas fluctuating percentage germination was observed on the following months. On the 9th month onwards, no seeds were recovered from the buried net bags, they were rotten.

- The plant height of cultivated rice alone was comparable with cultivated rice + 50 weedy rice seeds at 15, 30, and 45 DAS. At 60 DAS, the plant height of cultivated rice alone was significantly higher at 120, 150 and 200kg/ha as compared to the other treatments inoculated with 50 seeds of weedy rice (table 5).

Table 5. Effect of weedy rice on different seeding rates of cultivated rice. 2014 DS.

SEEDING RATE	15 DAS	30 DAS	45 DAS	60 DAS
80 kg/ha + 50 WR	30.75 AB	60.70 AB	64.55 ABC	66.25 C
120 kg/ha + 50 WR	30.50 AB	55.60 BCD	66.95 A	67.20 C
150 kg/ha + 50 WR	29.60 AB	53.20 CD	64.20 ABC	65.10 C
200 kg/ha + 50 WR	28.60 B	50.70 D	57.65 D	60.20 D
80 kg/ha	28.95 B	63.30 A	65.70 AB	68.50 ABC
120 kg/ha	30.10 AB	61.30 AB	62.55 BC	72.10 A
150 kg/ha	32.20 A	58.50 ABC	61.40 CD	71.50 AB
200 kg/ha	31.15 AB	53.60 CD	57.60 D	64.90 C

Biology and Management of Common Rice Paddy Eel (Monopterus albus) under Philippine Rice Ecosystem

LV Marquez, EC Martin

Common rice paddy eel (Monopterus albus) was reported to affect rice cropping in Nueva Ecija, Negros 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. Moreover, draining also became problem during ripening stage because water will enter in the same holes when neighboring farmers irrigate their field.

Farmers practice of controlling rice paddy eel include physical hunting using electrofishing method, covering holes, spraying mullocicide and application of systemic insecticide. Some farmers also claimed that it could be catch using series of hook and baits along rice levees that will be left for overnight.

Highlights:

- Results showed that CPRE in rice paddies has an average length of 38.36cm and has an average weight of 64.62 grams.
- Forty-five percent of the populations were females carrying 112 to 500 eggs.
- CREP stomach contained muds, small pieces of crustacean shells, shells of golden apple snail, insects like long-horned grasshopper and mole cricket, weed seeds and plant parts.
- CREP is omnivores that consumed GAS and insects. Its role as predator in rice ecosystem should be explored more.
- CREP create around 104 tunnels/ha during wet season and 67 tunnels/ha during dry season.

V. Evaluation and optimization of pest management strategies/techniques

Project Leader: DKM Donayre

Pests are one of the major considerations in any rice production. This is because pests can significantly reduce yield and quality of harvests, and income if not properly managed. Indeed, there were several data had been reported already showing the economic impacts of different pest species on rice (Savary et al. 2008; Rola and Pingala 1993; Reissig et al. 1986).

In the Philippines, the use of pesticides to combat different kinds of rice pests still remains top of the most option for many farmers (Donayre et al. 2014; Tanzo and Yusungco 2010; Heong and Escalada 1997). Because of this, outbreaks and resurgence of some major pests came out as a result of continuous use of the same quality and quantity of pesticides in the field. Since pesticides are the main shields of farmers for their crops, continuous production of these chemicals must have been round the clock using the system that requires the use of fossil fuel energy. There are other available pest management strategies and techniques that are also effective against different pest species of rice and at the same time do not require or minimally require the use of fossil fuel energy namely: use of resistant varieties, cultural and biological control methods (PhilRice 2002; PhilRice 2007; PhilRice 2011). Since none of these will work alone, therefore, a holistic approach is still needed to achieve better pest management, and avoid undesirable effects to humans, animals and the environment while at the same time lessen the utilization of fossil fuel.

Development of Delivery System for Enhancing the Efficacy of Selected Biological Control Agent Isolates for the Control of Rice Sheath Blight

MSV Duca, SE Santiago, DKM Donayre, TH Xuan

Sheath blight of rice caused by Rhizoctonia solani Kuhn is one of the most important rice diseases. Yield reduction due to infection by the causal pathogen could reach 6 to 50%. So far, none of the leading high yielding varieties have acceptable levels of resistance to the pathogen causing the disease and is currently managed through fungicides. Through time PhilRice had identified and tested potential biological control agents. However, most of these had not been optimized especially for delivery systems. This study was conducted to a) develop a delivery system that will enhance the efficacy of selected BCA isolates against sheath blight pathogen of rice, and b) optimize delivery system of selected BCA isolates against sheath blight of rice under field conditions.

Highlights:

- Trichoderma 1 (CRSP isolate) and Trichoderma 2 (isolate from rice field) were evaluated in vitro to determine their efficacy as biocontrol agents against Rhizoctonia solani using the dual culture test.

- The two Trichoderma overgrew the R. solani and covered the entire surface of plated PDA after 7 days of incubation. Both Trichoderma showed high antagonistic effects to R. solani at the middle stage of incubation.
- Dual culture test revealed that T5Oi and TMDRi overgrew R. solani and covered the entire surface of plated PDA after 7 days of incubation. Both Trichoderma isolates had high antagonistic effects to R. solani at the middle stage of incubation. On the other hand, R. solani completely overgrew the entire surface of the potato dextrose agar media containing Funguran-OH. This showed that R. solani was not inhibited by the fungicide as compared to the Trichoderma isolates (Table 6 and Figure 6).

- Both Trichoderma isolates inhibited the germination of sclerotia after 15 days of incubation exhibiting mycoparasitism as compared to the untreated sclerotia which was viable as shown by the presence of mycelia growth (Figure 7).

Table 6. Degree of antagonism of the Trichoderma isolates against Rhizoctonia solani.

Antagonist	Trial 1	Trial 2	Trial 3
Trichoderma isolate 1	1	1	1
Trichoderma isolate 1	1	1	1
Chemical control	5	5	5
R. solani alone	5	5	5

1 Trichoderma isolate 1 (CRSP isolate); 2 Trichoderma isolate 2 (isolate from rice); 3 Bell et al. (1982)

scale: 1-Trichoderma completely overgrew the pathogen and covered the entire medium surface, 2-Trichoderma overgrew at least two-thirds of the medium surface, 3-Trichoderma and R. solani each colonized 50% of the medium surface and neither organism appeared to dominate the other; 4-R. solani colonized the Trichoderma at least two-thirds of the medium surface, and 5-R. solani completely overgrew the Trichoderma and occupied the entire medium surface.

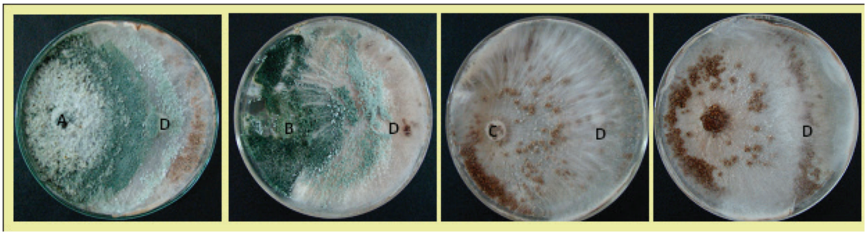

Figure 6. Growth of R. solani as affected by Trichoderma isolate 1 (A), isolate 2 (B) and Funguran-OH (C) as compared to the untreated control alone (D).

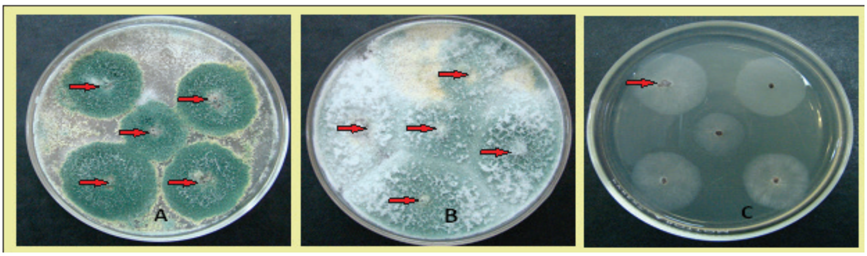

Figure 7. Trichoderma isolates 1 (A) and 2 (B) exhibiting mycoparasitism to R. solani 15 days of incubation as compared to the untreated control (C).

Field Evaluation of Beauveria Bassiana for the Control of Rice Bug
GF Estoy, Jr., BM Tabudlong

The average rice production yield in Caraga is 3.2t/ha, the lowest among the rice growing areas in the country. One of the reasons, rice production is beset with various problems particularly the infestation of insect pests. Among the rice pests, rice bug, Leptocorisa oratorius Fabricius belongs to the family Alydidae is considered the major. Damage of the rice plants due to the rice bug infestation during milking to ripening includes empty grains, shriveled panicle, unfilled grains and discoloration of mature grains, thus, such rice has lower milling quality or is pecky rice of inferior grade. At present, the control of the rice bug population is primarily dependent on the use of pesticides. There is a need to look for other methods of control like the use of entomopathogenic fungi. The use of the fungus could help in the management of the insect particularly the rice bug in the field. However, attempt to evaluate the fungus against the rice bug population under field condition is not yet known, thus, this study.

Highlights:

- Results indicated that the population of the rice bug adult showed a decreasing trend 1 and 2 weeks after fungal application (WAFA) based on the 2 cropping seasons conducted (Table 7). Insecticide (check) application had comparable effect to the rice bug sprayed with the fungus (109-108 conidia/ml). On the other hand, there was an increasing trend of the rice bug nymphs after 1 to 2 WAFA due to the initial population that was already established in the field (Table 8). The development of the fungus on the insect was also affected by the climatic factors such as rainfall causing to wash out the fungal inoculum.

- Yield (t/ha) of PSB Rc82 did not significantly differ ranged from 3.10-3.63 tons regardless of the treatment applied in the 1st cropping season (Table 9). Application of 109 conidia mL-1 fungal suspension showed 3.63 tons which was slightly higher than the other treatments applied. However, plants sprayed with 109 conidia mL-1 suspension significantly higher yield of 4.08 ton ha-1 compared to the untreated control (3.39t/ha) in the 2nd season. Other treatments did not significantly differ ranged from 3.63-3.73t/ha.

- The yield components such as no. of filled grains, % filled spikelet, no. of panicle, damage grains and weight of 1000 grains were not affected by the application of the B. bassiana fungal suspension (Table 10, Table 11). In addition, damage due to rice bug was lower on plants sprayed with 108-109 conidial suspension.

- B. bassiana-infected rice bug showed an increasing trend from 5 to 15 days in the field. The number of infected rice bug observed in the field (25 hills per replication) was dependent on the conidial concentration applied. There were 83.33 mummified rice bug were collected in plants sprayed with higher concentration (Figure 8). However, infection of the rice bug was also observed to the insects sprayed with insecticide and untreated control. This could be attributed to the healthy insect that comes in contact with the infected ones. The characteristic of the rice bug infected with the fungus showed a mycelium growing emerging through host exoskeleton to form dense white covering on the surface. Distinct white fungal growth concentrated along the intersegmental regions of the thorax and joints of the legs.

Table 7. Visual count of rice bug, Leptocorisa oratorius F. adult on PSB Rc82 as affected by the application of B. bassiana fungal suspension[1].

Treatments	Population of rice bug adult/hill				
	Jan-Jun 2014 cropping season		Jul-Dec 2014 cropping season		
	Initial population	1WAFA	Initial population	1WAFA	2WAFA
T1 - Control	2.44	1.64	15.00	15.67	14.33
T2 – 1x10^9 conidia mL^{-1}	2.20	1.08	20.67	15.67	9.67
T3 – 1x10^9 conidia mL^{-1}	2.40	1.28	16.00	13.00	10.00
T4 – 1x10^9 conidia mL^{-1}	2.32	1.40	18.33	16.00	11.67
T5 – insecticide (Bushwak)	2.08	0.88	20.00	18.67	12.33

1/Data based on 25 sample hills per replication. There were 3 replications per treatment.

Table 8. Visual count of the rice bug, Leptocorisa oratorius F. nymph on PSB Rc82 as affected by the application of B. bassiana fungal suspension[1].

Treatments	Population of rice bug nymph/hill				
	Jan-Jun 2014 cropping season		Jul-Dec 2014 cropping season		
	Initial population	1WAFA	Initial population	1WAFA	2WAFA
T1 - Control	0.04	1.32	0.67	3.00	8.67
T2 – 1x10^9 conidia mL^{-1}	0.08	1.08	2.00	5.00	8.00
T3 – 1x10^9 conidia mL^{-1}	0.08	1.12	1.00	5.67	9.00
T4 – 1x10^9 conidia mL^{-1}	0.04	1.56	1.67	3.33	6.62
T5 – insecticide (Bushwak)	0.00	1.80	1.33	3.67	3.67

Table 9. Yield (tons/ha) of PSB RC82 as affected by the application of Beauveria bassiana suspension in the field[1].

Treatments	Yield (tons/ha)	
	1st Cropping (Jan-June 2014)	2nd Cropping (Jul-Dec 2014)
Control (untreated)	3.41 ns	3.39 b
1 x 10^9 conidia mL^{-1} suspension	3.63	4.08 a
1 x 10^8conidia mL^{-1} suspension	3.19	3.73 ab
1 x 10^7 conidia mL^{-1} suspension	3.30	3.64 ab
Insecticide application	3.10	3.73 ab

1/Data based on 2m x 5m crop cut samples.

Table 10. Yield components of PSB RC82 as affected by the application of Beauveria bassiana suspension in the field (January to June 2014 cropping season)[1].

Treatments	No. of filled grains/ panicle	% Filled spikelet/ hill	No. of panicles/ hill	% damage grains	Weight of 1000 grains (grams)
Control (untreated)	43.00 b	50.16ns	12.40ns	12.64 ns	26.07 ns
1 x 10^9 conidia mL^{-1} suspension	71.00 a	59.36	13.20	7.09	26.20
1 x 10^8conidia mL^{-1} suspension	40.00 b	61.37	12.53	9.62	25.73
1 x 10^7 conidia mL^{-1} suspension	31.00 b	60.14	11.40	11.59	25.73
Insecticide application	38.00 b	59.72	12.13	15.12	26.27

[1/]Data based on 5 sample hills per replication.

Table 11. Yield components of PSB RC82 as affected by the application of Beauveria bassiana suspension (July to December 2014 cropping season)[1].

Treatments	No. of filled grains/ panicle	% Filled spikelet/ hill	No. of panicles/ hill	% damage grains	Weight of 1000 grains (grams)
Control (untreated)	64.63 ns	66.38 ns	10.67 ns	7.50 a	26.60 ns
1 x 10^9 conidia mL^{-1} suspension	72.28	74.55	12.0	2.34 b	26.75
1 x 10^8conidia mL^{-1} suspension	61.78	67.56	12.4	2.70 b	26.34
1 x 10^7 conidia mL^{-1} suspension	66.73	66.82	10.8	5.54 a	26.89
Insecticide application	64.24	71.20	12.6	6.74 a	26.64

[1/]Data based on 5 sample hills per replication.

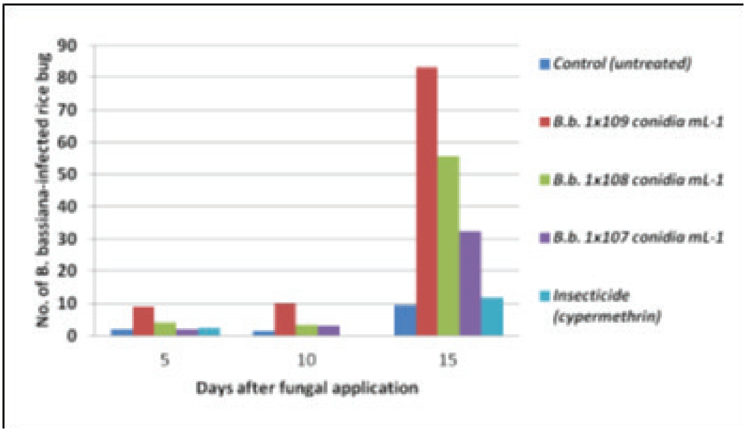

Figure 8. Number of Beauveria bassiana-infected rice bug after application of the fungal suspension in the field[1].

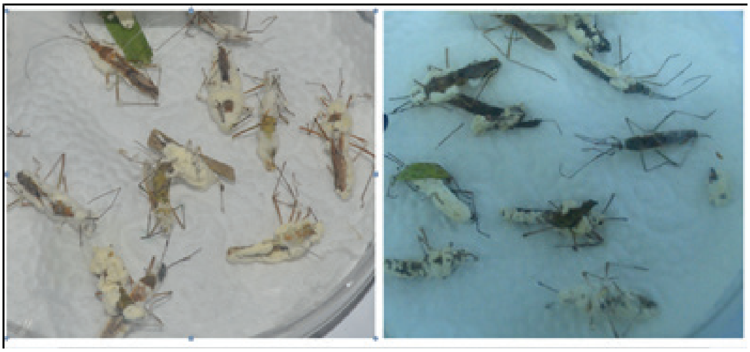

Figure 9. Beauveria bassiana-Infected rice bug in PSB Rc82 as affected by the application of fungal suspension in the field.

Redesigning Tahuri and Sesame Rice Strip Planting to Enhance Arthropod Diversity in Upland

GD Balleras

On-going studies on tahuri- and sesame-rice strip planting focused on rice insect pest and associated natural in Arakan, North Cotabato yielded valuable results. Both, tahuri Vigna umbellata and sesame Sesame indicum favoured an increase in natural enemies' diversity under organic farming systems (Balleras et al., 2013).

Research initiatives on tahuri- and sesame-rice strip farming is now being implemented in identified farmers' field in Arakan North Cotabato.

Although research of this kind may be difficult, costly and time consuming, it should provide information that will be at best increase the chances of success of a habitat manipulation programs and will at the very least provide useful insights into insect pest-natural enemy biology. Results of this study deemed to develop process-base conservation and management models for upland rice farming under specific temporal and spatial scales.

Highlights:

- Both fields were dominated by the predators (Formicids, Oxyopids, Coccinellids, Gryllids, and Lycosids) and parasitoids (Tachinids and Vespids) a prevalent beneficial insects both in sesame and "tahuri".

- Population started to build up at mid-phase and slowed at late-phase of rice cycle.

- Both flowering crops have different ecological function, the generalist predator – Formicids tended to be uniformly distributed across all sesame - rice strips while parasitoids - Tachinids in "tahuri"- rice strips designs.

- The beneficial insects did not have the same food stuffs needs that many other predators and parasitoids have.

- Abundance and spatial distribution of predators and parasitoids is dependent on the plant species and the extent of flowering crop designs. Sesame - rice single strip (60.92%) and "tahuri" - rice triple strip design (32.16%) provided a net population of beneficial insects over pestiferous insects

- Sesame and "tahuri" could serve as the continual source of pollen, nectar and a rich and abundant supply of neutral insects for the various predators and parasitoids.

Exploring the Efficacy of Azolla and Duckweed in Diverting the Appetency of Golden Apple Snails Away from Newly Established Rice Seedlings
DKM Donayre

Golden apple snail (Pomacea canaliculata Lamarck), locally known as kuhol in the Philippines, is also one of the most important pests to consider especially for newly transplanted and direct-seeded rice. In the absence of rice seedlings, GAS can divert its food diet to other plants such as algae, azolla, duckweed, water hyacinth and other succulent plants (PhilRice, 2008). They can also feed on any decomposing organic matter. In controlling GAS, the use of molluscicides still remains top of the most commonly used by farmers in the country.

Azolla, as had been mentioned, have been already known as alternative source of food of GAS in the absence of rice. On the other hand, applying and growing azolla (together with rice) as strategy in diverting the appetency of GAS away from newly direct-seeded rice has never been explored. Hence, this study is proposed.

Highlights:

- Azolla effectively diverted the appetency of golden apple snails away from newly transplanted rice at water depth of 1, 2, and 3cm, and population density of 30, 60 and 90 snails/m^2.

- Applying azolla in wet direct-seeded rice did not effectively divert the appetency of golden apple snails.

- High percentage of missing seedlings (40 to 100%) was observed in wet-seeded rice with or without azolla application

- Data in this experiment were not presented due to publication and patent reasons.

Weedy Rice: A Potential Source of Resistance to Bacterial Blight and Tungro Diseases
ECMartin, CB Codod, MSV Duca

Since the weedy rice was recognized as an upcoming threat to rice production, research studies regarding these harmful weeds were generally focused on survey to determine the occurrence and extent of their distribution and on their control However, no research undertaking is being done on the beneficial role weedy rice may provide to rice production. One of these may be their possible source of resistance to rice major diseases. This view may have been collaborated by field observations and anecdotal accounts by rice farmers indicating that weedy rices are not generally infected by bacterial blight and tungro compared to the cultivated rice (Donayre, personal communication). Hence, this study is being proposed to determine whether weedy rice may serve as sources for resistance to certain rice diseases, notably bacterial blight and tungro.

Highlights:

- Completed two inoculation trials on three weedy rice biotypes and determined percentage of infection by visual score. Of the three tested weedy rice biotypes, one recorded significantly shorter bacterial blight lesions and two showed tolerance type of resistance to tungro infection.

- Higher incidence of BLB was observed in Ilo-ilo3 at 30 DAS and Ilo-ilo2 at 45 DAS (Figure10). All weedy rice entries had intermediate reaction to BLB including the check variety at 30 DAS. At 45 DAS, only the Ilo-ilo1 had intermediate reaction to BLB and the rest were susceptible to the disease.

- Continuous evaluations of weedy rices from other provinces are still on going to identify possible resistance against Tungro and BLB.

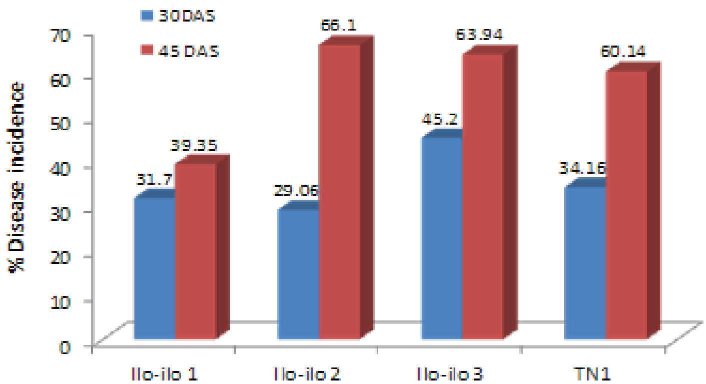

Figure 10. Bacterial leaf blight incidence (%) of 3 weedy rice entries 14 days after inoculation in 30 DAS and 45 DAS

Collection, Identification and Utilization of Native Strains of Sarcocystis Singaporensis, A Biocontrol Agent Against Rodent Pest in the Philippines
UG Duque

Rodent pest has been a problem in food production ever since agriculture started. They are considered as pests due the following reasons; (1) they consume and damage human foods in field and in stores. (2) Through their gnawing and burrowing habit, they destroy many articles and structures. By gnawing through electrical cables, they can cause fires and structural damages. (3) They are responsible for transmitting diseases dangerous to man (www.fao.org, accessed on August 13, 2013).

The use of biological means in controlling rodent pests is new in the Philippines. One of the organisms looked upon is the Sarcocystis singaporensis. It is a Southeast Asian endemic, which is a parasite specific to Rattus and Bandicota species only (Jäkel et al. 1999; 2001). The organism has been found virulent to rodents at certain concentrations and different isolates shows specificity to different rodent pest species. It was initially tested in the Philippines; however, the strains used were isolated from Thailand and Boneo (Duque, et al., unpublished). It is therefore important to identify native strains that can be used under Philippine conditions.

Highlights:

- Collected 6 fecal samples of Reticulated pythons at selected islands in the Philippines.

- 1 sample showed the presence of S. singaporensis detected by microscopy (Figure 11) and 3 samples showed its presence through DNA profiling (Figure 12).

- Mass production using live reticulated pythons (Python reticulatus) and albino rats (Rattus norvegicus) is on-going prior to virulence evaluation against rice field rats (Rattus tanezumi).

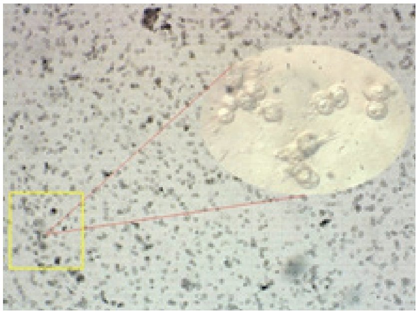

Figure 11. Photo microscope image (100x) of S. singaporensis from fecal sample of P. reticulatus. A drop of suspension from this sample is enough to kill a rat. Inserted image was viewed at 1000x.

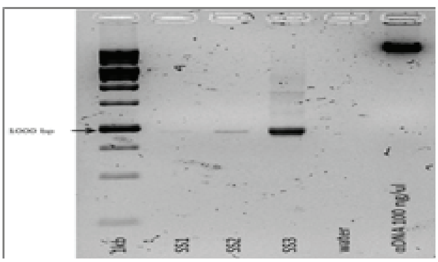

Figure 12. Presence of three S. singaporensis from different fecal samples of P. reticulatus collected in the Philippines as detected by DNA profiling. We used water as negative check and alphaDNA as positive check.

Biochemical Compounds in Decaying Golden Apple Snails and their Potentials in the Development of Synthetic Lure for Rice Bug Management
DKM Donayre

In the Philippines, explorations regarding pheromones for pest management have been very limited. Most studies that were reported usually involved direct application in the field (Punzal et al. 2013; Manuel et al. 2011; Arida et al. 2008; Marquez et al. 2004; Navasero et al. 2004; Arida et al. 2002) but very few had been engaged in studying the pheromone involved per se (de Jesus 2008). Meanwhile in managing rice bugs, Guimba et al. (2006) and Estoy (1995) reported that decaying golden apple snails attract rice bugs in the field effectively. Interestingly, most of the attracted rice bugs were males. The reasons why males were more attracted in decaying golden apple snails, however, still remained unknown. Although Leal et al. (1996) reported that male rice bugs were strongly attracted to 2-(E)-octenyl acetate and octanol semiochemicals, the biochemical compounds involved in decaying golden apple snails causing strong attraction to male rice bugs has never been yet explored. Hence, this study has been proposed.

Highlight:

- Method of identifying the biochemical compounds using gas chromatography-mass spectrometry was under optimization.

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

List of Tables

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