

ABSTRACTS OF PAPERS

Presented at the Scientific Sessions of the Philippine Association of Entomologists, Inc. held during the 51th Anniversary and Annual Scientific Conference of the Pest Management Council of the Philippines, Inc., 2-5 July, 2019, Coron Westown Resort, Coron, Palawan.

Acronyms in authors addresses: BCRU – Biological Control Research Unit, Center for Natural Science and Environmental Research; BSU – Benguet State University, La Trinidad, Benguet; CAFS – College of Agriculture and Food Science; CAS – College of Arts and Sciences; CBSUA – Central Bicol State University of Agriculture, Pili, Camarines Sur; CLSU – Central Luzon State University, Science City of Muñoz, Nueva Ecija; CS – College of Science; CSU – Cagayan State University, Tuguegarao, Cagayan; DA – Department of Agriculture; DLSU – De La Salle University; EBD – Environmental Biology Division; IB – Institute of Biology; IBS – Institute of Biological Sciences; ICCEM – Institute for Climate Change and Environmental Management; IPB – Institute of Plant Breeding; IWEP – Institute of Weed Science, Entomology and Plant Pathology; MMSU – Mariano Marcos State University; MNH – Museum of Natural History; NCPC – National Crop Protection Center; NIMBB – National Institute of Molecular Biology and Biotechnology; PCA-ARC – Philippine Coconut Authority Albay Research Center; PhilRice – Philippine Rice Research Institute; RPCP – Regional Crop Protection Center; RFO – Regional Field Office; RITM – Research Institute for Tropical Medicine; UPD – University of the Philippines Diliman, Diliman, Quezon City; UPLB – University of the Philippines Los Baños, College (Los Baños), Laguna; UPM – University of the Philippines Manila; VSU – Visayas State University, Visca, Baybay, Leyte; WVSU – West Visayas State University.

ORAL PAPERS

1. NATURAL INTROGRESSION OF Bt GENES FROM Bt CORN TO TRADITIONAL MAIZE: THE CASE OF SILANGAN VARIETY FROM SAN CARLOS, PANGASINAN, PHILIPPINES

Merdelyn T. Caasi-Lit, Bryan A. Novio, Artemio M. Salazar, Jefferson P. Paril, Raphael P. Cuizon, John Paul A. Macasaet, Bernard B. Panabang, Aldrin M. Alvarez & Angelyn D. Marmeto. Entomology Laboratory, IPB, CAFS, UPLB. mcclit@up.edu.ph

The Asian corn borer (ACB), *Ostrinia furnacalis* (Guenee), became effectively managed when Bt corn was introduced in 2003 in the Philippines. However, ACB remains a serious problem for open pollinated varieties (OPV). The search for alternative and safe control measures continues especially for the latter. The Corn Germplasm Utilization through Advanced Research and Development (CGUARD) program of the Department of Agriculture initiated the collection of our traditional maize varieties from all over the country as sources of traits for tolerance or resistance to biotic and abiotic stresses. Field performance and status of these genetic resources were initially assessed for ACB resistance vis-à-vis the last 15 years of Bt corn planting. The screening efforts partly aims to determine the presence of Bt genes (Cry1Ab) in the collection. Field visits were done in several towns of San Carlos, Pangasinan, to interview the original Silangan corn farmers. This traditional corn has been planted since the 1930's by their parents and they continue to grow the said variety despite the availability of Bt corn in the surrounding field. This study discussed the case of Silangan variety from Pangasinan which has been naturally introgressed with Bt Cry1Ab genes. This traditional maize has good agronomic/consumer qualities and observed tolerance to drought.

Key words: Asian corn borer, Bt corn, CGUARD, Cry1ab, natural introgression, *Ostrinia furnacalis*, Pangasinan, Silangan maize, traditional corn

2. ASSESSMENT OF NON-TARGET CONTACT TOXICITY OF DINOTEFURAN AND THIAMETHOXAM ON ADULT *Comperiella calauanica* Barrion et al. (HYMENOPTERA: ENCYRTIDAE)

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Neonicotinoids are known for very high neurotoxicity to insects and relative safety to mammals, including humans. However, being broad-spectrum and reportedly highly toxic to bees, these insecticides have been implicated in decline of populations of beneficial insects, particularly honey bees. Their toxicity to non-target species, especially *Comperiella calauanica* Barrion et al., the highly specific and very efficient parasitoid of coconut scale insects,

Aspidiotus rigidus Reyne, should be assessed. Contact toxicity of two locally utilized neonicotinoids, dinotefuran and thiamethoxam, on adult female *C. calauanica* was determined using leaf disk and whole leaf uptake assays. Concentrations including upper and lower limits of recommended dosages for field use of these neonicotinoids were applied as treatments, with water as negative control. Both dinotefuran and thiamethoxam were highly toxic to adult *C. calauanica*, even at the lowest recommended dosage. Complete mortality was observed within 2-3 hours from exposure in the leaf disk assay, and within four hours for dinotefuran, and between 4-5 hours for thiamethoxam in the whole leaf uptake assay. Twitching and other responses associated with impaired nervous function were observed in *C. calauanica* exposed to either neonicotinoid, suggesting neurotoxic effects. These findings strongly point to the incompatibility between *C. calauanica* and the use of neonicotinoids to control *A. rigidus*. Safer alternatives must be studied should chemical control be deemed necessary.

Key words: *Comperiella calauanica*, dinotefuran, integrated pest management, neonicotinoids, thiamethoxam

3. COMPARATIVE PERFORMANCE OF ENTOMOPATHOGENS AGAINST THE RICE BUG *Leptocorisa oratoria* (Fabricius), IN EASTERN VISAYAS. I. LABORATORY EFFICACY

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Two entomopathogens were tested as possible alternative strategies to insecticides against rice bug, *Leptocorisa oratoria* (Fabricius). Three days after application, rice bugs treated with *Metarhizium anisopliae* (Metsch.) Sorok. SPW isolate and *Beauveria bassiana* (Bals.) Vuill. showed 75.83% and 55% infection, respectively, under laboratory conditions using 1x10⁸ spore count. Increasing the spore concentration from 1x10⁶ to 1x10⁸ directly increased the effectiveness of both entomopathogens in the pot experiment. However, their effectiveness is affected by heavy rains (615-788.6 mm) when applied in the field. Only *B. bassiana* showed highest infection of 44.26% in all treatments. *M. anisopliae* SPW was found to only infect other rice pests. However, in the 2nd trial, *M. anisopliae* SPW showed 29.83% infection, and *B. bassiana*, 12.1%. Infection occurrence can last up to harvesting. *M. anisopliae* SPW isolate is currently being mass-produced in a cost-effective medium at the Pest Management Laboratory, AES, Abuyog, Leyte

Key words: *Beauveria bassiana*, *Leptocorisa oratoria*, *Metarhizium anisopliae*, rice bug

4. COLLECTION, CHARACTERIZATION AND IDENTIFICATION OF PARASITIDS AND PREDATORS OF MAJOR INSECT PESTS OF ARABICA COFFEE

Gemma Das-Ilen, Bonie S. Ligat, Bernard S. Tad-awan, Andres A. Basalong, Nora Hill G. Evasco, Danjones M. Catchero, Oliver D. Balanban & Mohammed L. Abdelkawi. BSU.

The major insect pests of arabica coffee were coffee berry borer (CBB), scale insects, aphids, mealybugs, snout beetle, and stem borer. The scale insects, aphids, mealybugs, snout beetle, and stem borer infest Arabica coffee from seedling stage until maturity while CBB infests berries. Potential biological control agents associated with these major insect pests were also collected. Potential predators feeding on aphids, scale insects, and mealybugs were lady beetles (Coleoptera: Coccinellidae), namely: black lady beetle [*Chilocorus nigritus* (Fabricius)], orange lady beetle [*C. circumdatus* (Gyllenhal)], 16-spotted lady beetle [*Tytthaspis sedecimpunctata* (L.)], yellow spotless lady beetle [*Illeis koebelei* Timberlake]; ant beetle (Coleoptera: Anthicidae): *Anthicus* sp.; brown lacewings (Neuroptera: Hemerobiidae): *Hemerobius* spp.; green lacewings (Neuroptera: Chrysopidae): *Chrysoperla rufilabris* sp. The Assassin bug (Hemiptera: Reduviidae) *Zelus* sp. feeds on adult CBB. Potential parasitoids that emerged from scale insects were small wasps (Hymenoptera: Eulophidae): (*Hemiptarsenus* sp.); Encyrtidae (*Anagyrus* sp., *Copidosoma* sp., *Chrysocharis* sp., and *Microterys* sp.). No parasitoids emerged from aphids, mealybugs, snout beetles, stem borer, and CBB.

Key words: Arabica coffee pests, biological control, parasitoids, predators.

5. BIOLOGICAL CONTROL OF COFFEE BERRY BORER [*Hypothenemus hampei* (Ferrari)] AND GREEN SCALE INSECT (*Coccus viridis* Green) INFESTING ORGANICALLY GROWN ARABICA COFFEE IN BENGUET

Gemma Das-Ilen, Bonie S. Ligat, Sr., Wilbert A. Dacus & Kevin Joe P. Eladjoe. BSU.

Coffee berry borer, *Hypothenemus hampei* (Ferrari), infestation ranged from 28-90% on arabica coffee plantations in the different municipalities of Benguet while green scale, *Coccus viridis* Green, had no injury arabica leaves and stems. The lady beetle, *Chilocorus circumdatus*

Gyllenhal (Coleoptera: Coccinellidae) was identified as a natural enemy of *C. viridis*. The lady beetles were present in six municipalities of Benguet province, namely: La Trinidad, Kapangan, Kibungan, Mankayan, Atok, and Buguias. Lady beetle eggs are white, laid in clusters (6-25 eggs), and banana-shaped. Larvae have four instars which are alligator-like. Pupae are capsule-like, orange in the center, and are surrounded by hair-like structures. Adults are convex, white upon emerging, but turns predominantly orange after a few minutes. First instar larvae consumed an average of nine green scale insects per day occupying a length of approximately 1.19 mm on the shoots of coffee plants and the second instar consumed an average of seven green scale insects per day occupying a length of approximately 1.98 mm. The third instar larvae consumed an average of five scale insects per day occupying a length of approximately 2.38 mm. The fourth instar and adult predator consumed an average of seven and six of scale insects per day, respectively, occupying a length of approximately 2.78mm on the shoots of coffee plants. The natural enemy of coffee berry borer was *Beauveria bassiana* (Bals.) Vuill., an entomopathogenic fungi.

Key words: biological control, coffee berry borer, green scale insect, lady beetle, organic coffee.

6. SURFACE CHARACTERIZATION AND WETTING PROPERTIES OF COCONUT SCALE INSECTS, *Aspidiotus destructor* Signoret AND *Aspidiotus rigidus* Reyne (HEMIPTERA: DIASPIDIDAE) FROM THE PHILIPPINES

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Biological surfaces are important in the interaction of organisms with their environment. Such surfaces are composed of micro-hierarchical structures that are products of evolution and functional for the organism to thrive. Biomimetics revolves around the idea that evolution produces the most resilient design fitted for a specific environment. Thus, technology could be inspired from nature itself. Coconut scale insects (CSI) such as *Aspidiotus destructor* Signoret and *A. rigidus* Reyne are major pests of coconut in the Philippines. These species are interesting because their wax scale cover protects the organism from water loss and wetting, and enables it to attach to the substrate using secretions. The hierarchical micro- and nano-structures and wetting properties of the scale covers of CSIs were described and compared. Scanning electron microscopy revealed that *A. destructor* and *A. rigidus* could be differentiated using the micro-structures on their scale covers. The scale cover of *A. destructor* has overlapping wax layers while that of *A. rigidus* has a uniformly layered structure. Wettability test by way of contact angle measurement showed the CSI scale cover's hydrophobicity (>90° contact angle), which may be attributed to its surface topology, wherein the wax protrusions inhibit the water from spreading fluidly. These findings on the scale cover of the two *Aspidiotus* spp. may have implications on morphological characterization for taxonomic studies, as well as future applications for biomimetic design of hydrophobic materials.

Key words: *Aspidiotus destructor*, *Aspidiotus rigidus*, biomimetics, contact angle, surface characterization.

7. DNA BARCODE FOR THE LANZONES SCALE, *Unaspis mabilis* Lit & Barbecho (HEMIPTERA: DIASPIDIDAE)

Vanessa Kate I. Alvarez¹, Barbara L. Caoili¹, Ireneo L. Lit Jr.^{2,3,4}, Cristian C. Lucañas^{3,4}, Kristine O. Abenis², & Romnick A. Latina². ¹IWEP, CAFS; ²EBD, IBS, CAS, UPLB; ³Cave Ecology Laboratory, IBS, UPLB; ⁴Entomology Section, MNH, UPLB.

The mitochondrial cytochrome c oxidase subunit 1 (COI) nucleotide sequences of *Unaspis mabilis* Lit & Barbecho (Hemiptera: Diaspididae), infesting lanzones leaves are provided for the first time. The total genomic DNA of each mussel scale insect was extracted from individuals infesting lanzones leaves from selected sites in Los Baños, Laguna. A COI gene amplicon with approximately 700 bp was obtained using the primer pair PcoF1 and LepR1. Nucleotide sequence alignment showed no variation among the COI sequences from all the samples, indicating a single haplotype. BLASTn search yielded no significant hit nor match with any of the available sequences for *Unaspis* species. The closest hit was *Aulacaspis tubercularis* Newstead (GenBank Accession No. HM474091) with only 87.4% nucleotide similarity. DNA barcode generated from this study (GenBank Acc. Nos. MN114099, MN14101, and MN114102), could be used to verify the species identity of other lanzones scale accessions, and monitor the distribution and spread of *U. mabilis* which would greatly influence possible pest management options.

Key words: cytochrome c oxidase subunit 1 (COI), Diaspididae, DNA barcode, Hemiptera, Lanzones scale, *Unaspis mabilis*

8. REVISION OF THE ANT GENUS *Tetheamyрма* Bolton, 1991 (FORMICIDAE: MYRMICINAE: CREMATOGASTRINI)

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The crematogastrine ant genus *Tetheamyрма* Bolton, 1991 is revised, with the description of a new species, *Tetheamyрма bidentata* General & Buenavente, 2018. The worker and queen castes are described.

Key words: ant, Crematogastrini, *Tetheamyрма*, *Tetheamyрма bidentata*

9. MORPHOMETRIC ANALYSIS OF WING ELEMENTS OF THE GENUS *Cleora* (LEPIDOPTERA: GEOMETRIDAE) IN MTS. GUITING-GUITING AND MAKILING, PHILIPPINES

Allyssa Mae O. Huet, Ireneo L. Lit, Jr., Aimee Lynn A. Barrion-Dupo & Emmanuel Ryan C. de Chavez. IBS, CAS, UPLB.

Cleora Curtis is a common genus of Geometridae in lowland forests. Its species delineation relies on careful examination of genitalia. This study used morphometric analysis of wing pattern elements in an attempt to distinguish *Cleora* species collected from Mts. Guiting-guiting and Makiling. There are four new records from Mt. Guiting-guiting, namely: *C. injectaria*, *C. propulsaria*, *C. pupillata luzonensis*, and *C. onycha onycha*. *C. o. onycha* is also a new record for the Philippines. In Mt. Makiling, there are six species, namely: *C. batillata*, *C. contiguata bigladiata*, *C. determinata*, *C. decisaria*, *C. inoffensa*, and *C. lacteata*. Linear measurements of meristic elements of the *Cleora* wings as well as geometric analysis were done. In the linear character analysis of forewing and hindwing, species are not distinguished. In contrast, shape analysis of forewing successfully discriminated the species as indicated by the significant Mahalanobis distance. However, for the hindwing, the species clumped together indicating that the shapes are closely similar. Overall, results of the linear and geometric analysis of these wing elements were subjected to principal component analysis (PCA). PCA showed overlaps between species. Meanwhile, canonical variance analysis (CVA) revealed that although clustering was observed on wing shape, there were only minimal differences. Therefore, among the characters analyzed, only geometric morphometrics of the forewing, particularly the shape, can be used as a tool to differentiate *Cleora* species.

Key words: *Cleora*, geometric morphometrics, Geometridae, Mt. Guiting-guiting, Mt. Makiling, wing patterns

10. TAXONOMY AND NEST STRUCTURE OF HOVER WASPS (HYMENOPTERA: VESPIDAE: STENOGASTRINAE) IN MT. MAKILING, PHILIPPINES

Jasmine Renette D. Jimenez, Ireneo L. Lit, Jr., & Kristine O. Abenis. EBD, IBS, CAS, UPLB.

Five species of hover wasps (Hymenoptera: Vespidae: Stenogastrinae) are included in the faunal list for Mount Makiling, Laguna, Philippines. They are *Eustenogaster luzonensis* (Rohwer), *Liostenogaster varipicta* (Rohwer), *Parischnogaster depressigaster* (Rohwer), *P. nigricans* (Cameron), and *P. timida* (Williams). *E. luzonensis* was not recovered or collected during this study. On the other hand, *P. nigricans*, known to occur in Luzon but was not included in previous works, is now confirmed to be present in the mountain, particularly in the lower and middle slopes. The nests of the four species collected were also studied, photographed, and described. Each nest exhibits differences in architecture, which may also be reflective of other characteristics such as morphology. The mandibles of the wasps were dissected and photographed, and their length, width, and height were measured. Additional variations in characters were added in each description. The nests can be differentiated from one species to another, with those of *P. nigricans* being the most flexible. Hence, nest structure may also be identified according the wasp species that constructed them. *L. varipicta* which uses mud, has longer and thinner mandibles compared to vegetable material users like *Parischnogaster* spp.

Key words: hover wasps, Mt. Makiling, nest architecture, Stenogastrinae

11. NEW COLEOPTERAN PEST RECORD ON MANGO IN ILOCOS NORTE

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& Lyle M. Alforja. NCPC, CAFS, UPLB.

Four samples of a coleopteran pest on mango from Ilocos Norte, Philippines, were forwarded by Chief Marivic Begonia of the RCPC 1, San Fernando, La Union Center on February 13, 2019 to the UPLB NCPC - Quick Response Team. The pest, identified as *Deporaus* sp. (Mango leaf-cutting beetle) (Coleoptera: Rhynchitidae), is a new record. The characteristic damage of the mango leaf-cutting weevil as observed in the field on March 28, 2019 are cut young leaves. Infestation is characterized by “window panes” (scraping adaxial leaf epidermis) on young leaves by adult weevils. It attacks new flushes of leaves, turning the affected leaves brown, curly, and crumpled. A similar pest on mango was recorded in nearby countries such as India, Thailand, Malaysia, Bangladesh, and China. Reports on the genus *Deporaus* in the Philippines do not include its historical infestation on mango. A collaborative research, development, and capacity-building will be conducted shortly with the concerned farmers, LGUs, RCPC 1 and the project staff.

Key words: *Deporaus* sp., mango leaf-cutting weevil, new pest record, Rhynchitidae

12. TEMPORAL PATTERNS OF THE PIT-BUILDING ACTIVITY OF ANTLION LARVAE (*Myrmeleon angustipennis* Banks)

Timothy P. Parakikay, Ireneo L. Lit, Jr., & Aimee Lynn B. Dupo. EBD, IBS, CAS, UPLB.

Antlion larvae are known to be a “sit-and-wait” type of predator. They construct conical pits in sandy soil that serve as traps. Thus, it has become a model organism commonly used for behavioral ecology studies. We determined whether antlion larvae are nocturnal or not, by observing the relationship between the number of pits created and the time of the day. The experiment followed a factorial repeated measure design, with times set up in the morning, noon, and evening. Time had a significant influence on the activity of antlion larvae, i.e., they were more active at night, and, therefore, antlion larvae can be considered nocturnal.

Key words: antlion larvae, *Myrmeleon angustipennis*, Myrmeleontidae, Neuroptera, pit-building, temporal activity.

13. PESTS OF PHILIPPINE STINGLESS BEES

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Many pests attack hives of *Tetragonula biroi* (Friese) but these can be managed. A 10-year monitoring project was conducted by the team of the UPLB Bee Program from 2010 to the present in selected meliponaries in the Philippines to identify the different pests of *T. biroi*. The species of pests we have identified were: (1) hive syrphid fly, *Ceriana* sp.; (2) hive phorid fly; (3) small hive beetle, *Aethina tumida*; (4) a beetle under the Family Nitidulidae; (5) and another under Histeridae; (6) soldier fly, *Hermetia* sp.; and (7) some species of pollen mites. Majority of these pests are destructive found inside the nest or hive feeding on honey and/or pollen. Managed colonies of *T. biroi* can be protected from these pests by maintaining strong colonies, by performing proper beekeeping practices, and through quarantine.

Key words: Coleoptera, Diptera, hive pests, stingless bee, *Tetragonula biroi*,

14. EFFECTS OF WEEDING PROCESSES ON THE POPULATION OF CORN PESTS

Timothy P. Parakikay¹, Ireneo L. Lit, Jr.¹, Merdelyn T. Caasi-Lit², Aimee Lynn A. Barrion-Dupo¹, Kristine O. Abenis¹, Bernard B. Panabang² and Ruby Ana P. Laude². ¹EBD, IBS, CAS, UPLB; ²Entomology Laboratory, IPB, CAFS, UPLB.

Corn or maize is the second most important crop in the Philippines. Two main factors that reduce corn crop yield are insect pests and weeds. Weeds also include what are generally considered as alternate hosts of insect pests. Along this line, knowledge of weeds as alternate hosts of pests is also important in integrated pest management. We aimed to determine the effects of weeding practices on the population of pests and other arthropods associated with corn. A susceptible traditional open-pollinated white corn variety, IPB Var 6, was used, with two treatments, namely: (1) regulated weeding, or weeding during the early vegetative and at 30-40 days after planting, and (2) unweeded plots, each with three replications. Insects and other arthropods were visually counted (non-destructive sampling) on selected plants at the inner rows. There were more major pests among weeded plots. Arthropods observed were predominantly pest species, and among the major pests, the Asian corn borer, *Ostrinia furnacalis* (Guenée), was the most recorded species. T-test showed no significant difference between the treatments (p-value= 0.93), probably because the available area cannot accommodate an experimental design that considers interplot migration of insects.

Key words: corn, *Ostrinia furnacalis*, pest population, weeding practices, *Zea mays*.

15. EFFECTS OF COFFEE GROUNDS MIXED IN SOIL ON SOIL ARTHROPOD DIVERSITY AND GROWTH OF PECHAY (*Brassica rapa* L.)

Fatima Grace S. Tambaoan & Ireneo L. Lit, Jr. EBD, IBS, CAS, UPLB.

Consumption of brewed coffee is increasing, generating more wastes from coffee grounds (used ground coffee). Establishments and groups have encouraged the use of coffee grounds as soil additives or amendments for home gardens, or for use in growing vegetables, to prevent coffee grounds from going to landfills. As part of on-going studies on effects of soil amendments on the abundance and diversity of soil arthropods, we performed preliminary potted experiments and monitored the initial and final arthropod composition and abundance in the two treatments – soil only and soil mixed with fresh coffee grounds. Numerically, more arthropods, especially collembolans and mites were observed in soil only, than in soil mixed with coffee grounds. Diversity was also higher without coffee grounds. Pechay plants used as indicators were stunted in potted soil with coffee grounds. However, statistically, the two treatments did not differ significantly in terms of soil arthropod diversity. It is believed that caffeine residues possibly caused poor growth of pechay in the potted soil. Coffee grounds should be composted first before using them as soil additives or amendments. The use of fresh coffee grounds as soil amendment should be avoided, especially when growing plants from seed. Further studies using garden plots instead of pots as well as comparison with conventional gardening practices are recommended.

Key words: *Brassica rapa*, coffee grounds, soil additives-amendments, soil arthropod diversity.

16. FIRST RECORD OF *Verticillium epiphytum* Hansf. AND *Fusarium* cf. *incarnatum-equiseti* SPECIES COMPLEX AS ENTOMOPATHOGENS OF *Aspidiotus* spp. (HEMIPTERA: DIASPIDIDAE)

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The pathogenicity of putative entomopathogenic fungi collected from collected coconut scale insects (*Aspidiotus* spp.) cadavers were investigated in this study. The identities of these isolates were confirmed through nucleotide sequencing. ITS-primers were used for general identification of the isolates and those that were identified as *Lecanicillium* and *Fusarium* species were selected for further species identification using other markers. For the *Lecanicillium* species, large subunit (LSU) and small subunit (SSU) rRNA primers were used and through this the identity of the isolates were confirmed to be *Verticillium epiphytum* Hansf. instead. On the other hand, using TEF-1 primers, it was found that the *Fusarium* species belong to any one of the following three species complexes: *F. incarnatum-equiseti* complex, *F. concolor* complex, and *F. fujikuroi* complex. Greenhouse bioassay studies were conducted using the identified isolates against the *Aspidiotus* spp. in vivo, and high average mortality rates were observed. This proves that the *Fusarium* sp. and *V. epiphytum* isolates are pathogenic against *A. destructor* and *A. rigidus*. Furthermore, this is the first record of its pathogenicity to both *Aspidiotus* spp.

Key words: *Aspidiotus* spp. *Fusarium* sp., scale insect entomopathogens, *Verticillium epiphytum*

17. PRELIMINARY FINDINGS OF MOLECULAR VARIATION IN BROWN PLANTHOPPER, *Nilaparvata lugens* (Stål), AMONG POPULATIONS FROM ISABELA AND LAGUNA

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Brown planthopper (BPH), *Nilaparvata lugens* (Stål), is the most destructive rice pest in Asia. It causes severe damage to rice, resulting to great losses to farmers. Since its first record of infestation in the Philippines in 1954, BPH still persists causing resurgence or outbreaks in different provinces that imply more complex approaches to manage its population. Using 850-bp cytochrome oxidase I (COI) sequences, three BPH haplotypes were reported in the Philippines, with one dominating just like in other Asian countries. A preliminary analysis of molecular variation among and within BPH populations from Roxas City, Isabela and Calauan, Laguna was conducted. After having the genomic DNA isolation and gene amplification optimized, amplicons were sent for sequencing. Molecular variations were

analyzed using the aligned partial nucleotide sequences coding for the COI of BPH. Two haplotypes from 581-bp partial sequences were recognized. Through BLASTn, the dominant haplotype showed 100% nucleotide identity while the other showed 99.83% with *N. lugens* MK032794.1. Polymorphism was found at the 370th nucleotide position showing transversion of A ↔ T.

Key words: brown planthopper, cytochrome oxidase I, mitochondrial DNA, *Nilaparvata lugens*,

18. FIRST REPORT OF THE LANZONES SCALE, *Unaspis mabilis* Lit & Barbecho (HEMIPTERA: DIASPIDIDAE), AS A PEST OF CACAO

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The lanzones scale, *Unaspis mabilis* Lit & Barbecho (Hemiptera: Diaspididae), has been known since 2008 to infest lanzones leaves exclusively. It has demonstrated aggressive spread throughout almost all lanzones plantations from North Cotabato and Davao in Mindanao to various provinces in Luzon and, more recently, in Mindoro and Panay Islands. In 2017, mussel scales collected from cacao trees in Caticlan, Aklan, showed field characteristics that were quite similar to lanzones scales. Examination of slide-mounted specimens showed that they were indeed conspecific with those infesting lanzones. DNA extracted from the cacao-infesting scale insects matched the DNA barcode generated from a complementary study (GenBank Acc. Nos. MN114099, MN14101, and MN114102), and hence, supported the species identity based on morphological characters. The need for pest management R & D for *U. mabilis* is emphasized considering that cacao is a high value crop.

Key words: cacao, cytochrome c oxidase subunit 1, Diaspididae, DNA barcode, Hemiptera, Lanzones scale, *Theobroma cacao*, *Unaspis mabilis*.

19. EFFECTS OF WEEDING PRACTICES ON THE SOIL AND LITTER ARTHROPOD DIVERSITY IN CORN (*Zea mays* L.)

Fatima Grace S. Tambaonan¹, Ireneo L. Lit, Jr.¹, Merdelyn T. Caasi-Lit², Aimee Lynn A. Barrion-Dupo¹, Kristine O. Abenis¹, Bernard B. Panabang², & Ruby Ana P. Laude². ¹EBD, IBS, CAS, UPLB; ²Entomology Laboratory, IPB, CAFS, UPLB.

The diversity of soil and litter arthropods in plots of field corn (*Zea mays* L.) was determined at different crop phenological stages (seed/seedling, vegetative, and reproductive) under two weeding treatments, namely: (1) regulated weeding, i.e., weeding during the early vegetative and at 30-40 days after planting; and (2) no weeding, each with three replications. A susceptible traditional open-pollinated white corn variety, IPB Var 6, was planted. Soil and litter samples were gathered before planting and every other week thereafter, and were run through Berlese-Tullgren funnels for at least 48 hours to extract the arthropods. Arthropods were sorted, preserved, processed, and identified. Individuals per morphospecies were counted and diversity indices computed. Insects and other arthropods belong to 14 insect orders/arthropod classes, most notably mites and collembolans. Treatments did not differ significantly until the pollen shed/reproductive stage. Removal of weeds decreased soil arthropod populations. There was higher soil arthropod diversity in unweeded (control) plots. Regulated weeding probably promoted plant diversity in the experimental plots and, in turn, encouraged soil arthropod diversity. Previous studies abroad have suggested that in supporting soil food webs, weed rhizospheres may be more important than crop rhizospheres since crops tend to maximize their aboveground net primary productivity. Hence, weeds are significant in protecting soil biodiversity, especially in conventionally tilled agroecosystems. Conserving soil biodiversity is part of the pursuit for sustainable and environmentally sound agricultural practices.

Key words: corn, soil and litter arthropod diversity, weeding practices, *Zea mays*.

20. HOUSEHOLD ANTS (HYMENOPTERA: FORMICIDAE) OF TANGUB, MISAMIS OCCIDENTAL

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Tangub is the smallest city in northern Mindanao where majority of the population are farmers and like in other urban areas, ants are common pests in households. Protein (canned

plain tuna flakes) and concentrated sugar solution baits were used to determine appropriate baiting methods for ant pest control. Collected ants were preserved in 95% ethanol, examined in the laboratory, and identified at least up to genus level. Six genera were identified, namely: *Monomorium*, *Paratrechina*, *Pheidole*, *Solenopsis*, *Tapinoma*, and *Tetramorium*. The average numbers of species and of individuals attracted were not significantly different between the two baits. The most abundant species was *Solenopsis geminata* (Fabricius), which was apparently more attracted to the tuna baits. The other species baited from various households were *Monomorium pharaonis* (L.), *Paratrechina longicornis* (Latreille), *Pheidole* sp., and *Tapinoma melanocephalum* (Fabricius). *Tetramorium* sp. was only encountered once. Based on Simpson's Index of Diversity, sugar baits attracted more species.

Key words: Formicidae, household ants, Hymenoptera, sugar baits, tuna baits, urban pests.

21. PRELIMINARY STUDY OF THE EFFECTS OF MICROPLASTICS ON SOIL ARTHROPOD ECOLOGY

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Microplastics are small pieces of plastics 0.33-5.00 mm long. They range from micro beads used in personal care products and pre-production pellets and powders to fibers from synthetic clothing and fragments degraded from larger plastic products. They have become ubiquitous in our environment today, but most studies on them tend to focus on marine ecosystems, their effects on marine organisms, and how plastic pollution in marine environments eventually lead back to humans. Only a few have studied their presence and distribution in terrestrial ecosystems and their effect on the soil and soil organisms. Our preliminary study gathered 1-liter soil samples from selected areas on the lower slopes of Mount Makiling and in the UPLB Campus. Each soil sample was dissolved in a gallon of tap water and the resulting floating debris after settling were examined and sorted. Microplastics from the rural site (near households) accounted for 96.15% of the total samples found, of which 69.23% were from synthetic textile fibers, 15.38% from beads or styrofoam, and 11.54% assorted plastic fragments. Initial dissections also showed the presence of microplastics in guts of cockroaches, earthworms, beetles, and maggots.

Key words: earthworms, microplastics, plastic pollution, soil arthropods.

22. ECOLOGY OF INSECTS AND OTHER ARTHROPODS OF *Rafflesia consueloae* Galindo et al.

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Studying the ecology of insect and other arthropod visitors of *Rafflesia* is important in understanding their roles on its life history and propagation such as through pollination. This pioneering study documented 19 flowers of the most recently discovered *Rafflesia consueloae* Galindon et al. in five sites in Mt. Balukbok, Nueva Ecija, Philippines using video cameras to determine visitor species diversities, assemblages, behaviors, and interactions with the flower. Visitation of various insects and other arthropods (grouped into morphospecies) were captured through video footage and then assessed using Cowlog 3.0.2 by recording durations of visits, tallying behaviors exhibited from a user-made behavior classification system, and comparing species diversity between specimens collected from field sampling and from videos. Sixteen morphospecies were identified from the videos in interaction with the flower. Of these, only one did not belong to Insecta. An additional nine morphospecies were collected during field sampling, all of which were dipterans, bringing to 25 the potential arthropod assemblage in Mt. Balukbok. Of those interacting with the flower, Diptera sp. 1, Sarcophagidae sp. 1, Calliphoridae sp. 1, and Conopidae sp. 1 were the most abundant. Calliphoridae sp. 1 and Sarcophagidae sp. 1 were observed to exhibit "landing" behaviors most frequently. These carrion flies were also the only morphospecies observed to carry pollen out of the flower. Conopidae sp. 1 was consistently observed to oviposit on the perigone lobes and diaphragm. *R. consueloae* follows a low-level of sapromyophily as its pollination syndrome, while also being capable of brood-site deception.

Key words: conservation biology, Diptera, floral visitors, pollination biology, *Rafflesia consueloae*, sapromyophily.

23. STINGLESS BEES (HYMENOPTERA: APIDAE: MELIPONINI) UNDER THE GENUS

***Tetragonula* Moure IN THE PHILIPPINES**

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The nesting habits, morphological and genetic structures of stingless bees were assessed using the traditional taxonomic characters and BLAST analysis results in 18 populations of *Tetragonula* in the Philippines. Different structures, shapes and color of stingless bee nest entrances were recorded. Dendrograms were drawn using measurement from morphometric characters. Most species build their nests in tree cavities, cemented walls, and rocks with circular shape of entrances. Irregular shapes of nests from Ogbong (Catanduanes), Calapan (Oriental, Mindoro), Alabat and Perez (Quezon) were observed. Most colony entrances are hard and dark in color, facing east with 3-15 guard bees. Light colored entrances were observed in colonies from Cacilles (Hernani, Samar) and Pangi (Gasán, Marinduque). Nesting habits of stingless bees were not species-specific. Only amplicon from 16S rRNA genes were reproducible in 12 colonies analyzed. No hits found in sample specimens from Panim-an, Caramoan, Camarines Sur and Oriental, Mindoro (Calapan and Naujan). However, samples from Tagbilaran, Bohol and Tagum, Davao were confirmed. In Luzon, the identified species were: *Tetragonula iridipennis* (Smith) from Alabat and Perez (Quezon), Gasán (Marinduque), Garchitorena (Camarines Sur), Viga (Catanduanes), Placer (Masbate) and Naujan (Mindoro), and *T. laeviceps* (Smith) from Calapan (Mindoro), and Caramoan (Camarines Sur). In the Visayas, *T. laeviceps* was also found in Hernani (Samar), Marbuena and Nasidman (Iloilo) and *T. sapiens* (Cockerell) in Tagbilaran (Bohol). In Mindanao, *T. sapiens* was also identified from Tagum (Davao). An unidentified species was found in Paniki (Aroroy, Masbate).

Key words: gene structure, morphometrics, nesting habits, stingless bees, *Tetragonula*.

24. USE OF UNMANNED AERIAL VEHICLE (UAV) AND PIX4D-MAPPER IN MONITORING AND MAPPING OF ARMYWORM INFESTED ONION AREAS IN BONGABON, NUEVA ECIJA

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Remote sensing is one of the advanced technologies that can be used in early detection, mapping, and spatial tracking of plant pests and diseases. This technology can give updated data on the geoinformation and plant health status of the areas by conducting image analysis and classification processes using images captured by satellites and Unmanned Aerial Vehicles (UAV). Onion armyworm (OAW), *Spodoptera exigua* (Hübner), is the most destructive insect pest of onion today, as it attacked onion plants in the field in huge numbers and can destroy entire onion fields in one night. It leaves whitish appearance of onion leaves and damaged bulbs which are no longer fit for human consumption. Damage manifestations are very visible in aerial images captured by UAVs. Thus, these imageries were utilized to detect, monitor and mapped the infested onion fields in Bongabon, Nueva Ecija. Orthophotos of UAV-captured imageries were processed using Pix4D- Mapper. Also, the Normalized Difference Vegetation Index (NDVI) and orthomosaics of captured images were produced and analyzed using the same software and ArcGIS to generate geotomological maps showing the point of infestation, actual health status of the area by extracting the infested and the non-infested onion fields. These maps were later turned over to the decision-makers and extension workers to raise the level of awareness on the infestation and use as monitoring tool in OAW prevention and spread as well as in planning for pesticide management and environmental protection.

Key words: Onion armyworm, Pix4D- Mapper, remote sensing, *Spodoptera exigua*, unmanned aerial vehicle (UAV).

25. COMPARATIVE PERFORMANCE OF ENTOMOPATHOGENS AGAINST THE RICE BUG, *Leptocorisa oratoria* (Fabricius), IN EASTERN VISAYAS. II. FIELD EFFICACY AND COST-AND-RETURN ANALYSIS

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Metarhizium anisopliae (Metsch.) Sorok. SPW isolate and *Beauveria bassiana* (Bals.) Vuill. were evaluated under field conditions against the rice bug, *Leptocorisa oratoria* (Fabricius). Cost and return analysis of the production of the two entomopathogens was also conducted. *M. anisopliae* SPW and *B. bassiana* isolates infect both nymphal and adult stages of rice bug. Infected rice bug exhibited whitish mycelial growths in the ventral portion of thorax and on the bases of the legs, 3-7 days after application. Highest observed nymphal infection in the laboratory of *B. bassiana* and *M. anisopliae* were 88.33 and 96.67%, respectively, seven days

after application. On the other hand, under greenhouse conditions, adult rice bugs succumbed to 85% infection by *B. bassiana* but only 57.50% infection by *M. anisopliae* SPW. Using palay as substrate for the two entomopathogens lowered production cost per bag of PhP 18.59 and was more economical than cracked corn, i.e., PhP 21.59 per bag. In the field, use of entomopathogens significantly reduced rice bug population. However, its efficacy was hampered when applied during rainy season. Pesticide application done by farmers incurred 115.16% higher cost compared with the production cost per bag when using *Metarhizium*.

Key words: *Beauveria bassiana*, cost and return analysis, entomopathogenic fungi, *Leptocorisa oratoria*, *Metarhizium anisopliae* SPW isolate

26. PARALLEL GENETIC DIVERGENCE OF THE COCONUT SCALE INSECT *Aspidiotus rigidus* Reyne (HEMIPTERA: DIASPIDIDAE) AND ITS HOST-SPECIFIC PARASITOID *Comperiella calauanica* Barrion et al. (HYMENOPTERA: ENCYRTIDAE) IN THE PHILIPPINES

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The Philippines faced coconut scale insect (CSI), *Aspidiotus rigidus* Reyne, outbreaks in CALABARZON from 2009-2014, and in Basilan and Zamboanga recently. From 2009, infestation only reached manageable status in early 2017 mainly due to the parasitoid *Comperiella calauanica* Barrion et al. This encyrtid was discovered during the outbreak in Calauan, Laguna, with a highly successful 80% parasitization specific to CSI. The introduction of CSI into the Philippines was believed to be either by wind or accidentally through imported infested palms. However, inferring from the source population, the route and mechanism of spread of CSI need further evidence. The history or geographic origin of an invading population can be traced by characterizing genetic variation using molecular markers. Sequences of cytochrome oxidase (COI) gene and the nuclear protein encoding gene - elongation factor 1a (EF-1a) were utilized to investigate the genetic structure and diversity of CSI from localities with documented outbreaks from 2014-2017. Both COI and EF-1a markers and all approaches revealed two distinct genetic groups, separating the Luzon outbreak population from those in Mindanao. Two mitochondrial, and four nuclear haplotypes (one from Luzon, and three from Mindanao) exist. In addition, parallel genetic divergence among *C. calauanica* populations was observed, with two distinct populations from Luzon and Mindanao. These could provide critical information for designing and implementing quarantine strategies, and defining and testing ecological and evolutionary studies to understand the invasion success and decline of outbreak populations.

Key words: *Aspidiotus rigidus*, coconut scale insect, *Comperiella calauanica*, genetic diversity, parallel divergence

27. POPULATION DYNAMICS OF INSECTS ASSOCIATED WITH DRAGON FRUIT (*Hylocereus* sp.)

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Population dynamics include seasonal occurrence, diversity, and estimated damage assessment of major insect pests. Insect monitoring methods were visual count, use of yellow and blue sticky boards, and commercial methyl eugenol sprayed on PET bottles. In particular, insects associated with dragon fruit production indicated predominance of tachinid fly, all three species of ants (*Paratrechina* sp., *Solenopsis* sp., and *Tapinoma* sp.) and aphids during the vegetative stage. Only three species of ants and fruit fly (*Bactrocera* sp.) were observed during the flowering stage, and ants again at the fruiting stage. Insect diversity index on dragon fruit was low attributable to only a few insect species noted and was only for one site in Batac City, Ilocos Norte. Similarly, diversity index was low when superficially taken at the three crop stages. An *in-vivo* experiment showed that the rate of damage of fruit fly on the fruit was 25% and described as having numerous exit holes, very soft to touch and with oozing sap from the holes. The injury caused by the red ants was 30% of the total number of collected fruits described as having numerous white, pin-sized pricks on the skin with few coalescing scab-like lesions.

Key words: damage assessment, diversity index, dragon fruit, *Hylocereus* sp., population

dynamics, seasonal occurrence

28. FIELD PARASITISM OF *Marietta carnesi* (Howard) (HYMENOPTERA: APHELINIDAE) ON *Comperiella calauanica* Barrion et al. (HYMENOPTERA: ENCYRTIDAE) IN ORANI, BATAAN, PHILIPPINES.

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Comperiella calauanica Barrion et al. is a native, highly specific encyrtid endoparasitoid that is effective and efficient against the coconut scale insect, *Aspidiotus rigidus* Reyne. The aphelinid *Marietta carnesi* (Howard) and its hyperparasitism on *C. calauanica* has been reported earlier. So far, *M. carnesi* has been the only confirmed natural enemy of the aforementioned encyrtid in the field. The hyperparasitism of *M. carnesi* on *C. calauanica* is here reported from samples collected in Orani, Bataan. Very low degrees of hyperparasitism were observed, with mean average values of 3.66%, 2.10%, and 1.70% recorded for three sampling periods. Correlation and regression analyses on the number of hyperparasitized scales against the number of parasitized scales seem to show a much lower degree of host density-dependence of hyperparasitism of *M. carnesi* compared to primary parasitism of *C. calauanica* on *A. rigidus*. These findings appear to strongly support the view that the occurrence of *M. carnesi* as hyperparasitoid would not have much implication on the efficacy of *C. calauanica* as biological control agent of *A. rigidus*.

Key words: *Aspidiotus rigidus*, biological control, *Comperiella calauanica*, hyperparasitism, *Marietta carnesi*.

29. LARVAL ECOLOGY OF *Anopheles* MOSQUITOES IN KUDAT, SABAH, MALAYSIA

Wilfredo Aure & Tock Hing Chua. ¹RITM; ²Universiti Malaysia Sabah.

Malaria remains one of the most important mosquito-borne diseases in Malaysia. Knowledge on vector ecology is needed for suitable disease management. Data are still limited on *Anopheles* larval ecology in Kudat, Sabah, Malaysian Borneo, one of the main endemic areas for malaria particularly *Plasmodium knowlesi* Sinton & Mulligan (Pk). The contribution of land use types and physicochemical characteristics of aquatic habitats to conditions favorable for vector larval development and density, was investigated, especially *Anopheles*. A longitudinal survey of mosquito larval habitats was conducted in different land use types to determine species composition, larval abundance, diversity, and habitat types. GLMM predicted mean value of *Anopheles* larvae were highest in rubber tree (1.66, SE 0.40) followed by coconut (0.91, SE 0.40), clearing sites (0.81, SE 0.36), oil palm (0.62, SE 0.42), settlement (0.56, SE 0.41), and least, in forested areas (0.46, SE 0.42). In terms of abundance, *An. balabacensis* Baisas (75.7%) > *An. barbirostris* van der Wulp (1.9%) = *An. lesteri* de Meillon (1.9%) = *An. borneensis* MacArthur (1.9%) > *Aedes albopictus* (Skuse) (17.7%) > *Cx. gelidus* Theobald (0.9 %). Important breeding sites of *An. balabacensis* larvae were artificial containers (21%), puddles (21%), and intermittent streams (58%). Larval densities vary with land use types. Human activities promoted proliferation of breeding habitats for *Anopheles* mosquitoes, particularly *An. balabacensis*. Thus incorporating the aspect of deforestation in health policy and malaria research is recommended for better insights and understanding effects of ecological changes on Pk malaria transmission.

Key words: *Anopheles*, larval ecology, malaria, Malaysia, *Plasmodium knowlesi*, Sabah.

30. WHAT'S FOR DINNER? DOCUMENTING INSECT PREY DIVERSITY THROUGH BAT FECAL ANALYSIS

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Insect diversity in front of bat-inhabited caves in Puting Bato, Polillo Island was recorded and compared to the contents of fecal pellets from insectivorous bats inhabiting those caves. UV-light trap was used to sample the insects along a 2-km transect with three plots. Altogether, five insect orders were noticeably abundant – Coleoptera, Hymenoptera, Hemiptera, Lepidoptera, and Diptera (the most abundant). Fecal pellets from 45 individuals belonging to nine species under three families of insectivorous bats were collected. Distribution of Coleoptera, Lepidoptera, Hemiptera, and Hymenoptera showed significant differences across bat species ($p < 0.05$). The diversity of prey consumed reflected the

diversity of insects as food sources for the bats. However, data on prey consumption and prey availability showed no evidence of correlation ($\rho > 0.05$). This suggests that bats could prey on insects which are hard to detect morphologically in fecal samples due to their relative digestibility. Molecular techniques are recommended for more accurate data on insect prey diversity through fecal analysis.

Key words: cave bats, fecal analysis, insect prey diversity, insectivorous bats, Polillo Island.

31. A REVIEW OF DR. ADELINA A. BARRION'S CONTRIBUTIONS TO ASIAN CORN BORER STUDIES

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Archived in old folders at the Entomology Laboratory of the Institute of Plant Breeding, the previous works of the late Dr. Adelina A. Barrion, a distinguished Filipino insect geneticist, were retrieved. These works were cited in relation to the recently funded project entitled "Basic studies on the Asian corn borer, *Ostrinia furnacalis* (Guenee)" funded by Biotechnology Coalition of the Philippines in collaboration with different players of the corn seed industry. The unpublished papers of Dr. Barrion from the 1981 PCARR project entitled "Breeding for Corn Borer Resistance" had been important milestones in basic studies on Asian corn borer (ACB). Several studies conducted by her team on larval morphology, chaetotaxy, head capsule, heterovoltinicity, and life cycle were discussed. Based on the breadth of research work on the ACB that Dr. Barrion and her team had accomplished, there is a need to compile and publish these works in their original form. This paper, therefore, aims to: 1) revisit and review the works of Dr. A.A. Barrion which will significantly contribute to the local references on the ACB; 2) consider these old works for possible publication in a local journal or as a book of collected works; and 3) pay tribute to an outstanding entomologist recognizing her pioneering works on the ACB.

Key words: Adelina A. Barrion, Asian corn borer, basic studies, *Ostrinia furnacalis*, scientific contributions.

32. INVASIVE THRIPS INJURIOUS TO GARLIC (*Allium sativum* L.) IN ILOCOS NORTE, PHILIPPINES

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"Ilocos White" is the most common variety planted for commercial garlic production in the Philippines. Thrips or "kulisipsip" are associated with this variety in the Experimental Area of Mariano Marcos State University, Batac, Ilocos Norte. Accurate identification of thrips infesting garlic is crucial in designing appropriate pest management strategies. Thrips samples were collected at random in about 200-m plot planted to "Ilocos White" in the said area in January-February 2019, at late vegetative stage by shaking and beating plants on white board. Specimens were sorted under a stereomicroscope, cleared, mounted on slides using Canada balsam, and examined under a light microscope. Two species of thrips are infesting garlic plants in the study area, namely: *Thrips tabaci* Lindeman, an invasive terebrantian known as pest of onion and confirmed as vector of viral and bacterial pathogens in other countries, and *Haplothrips gowdeyi* Franklin, an invasive tubuliferan associated with flowers of Poaceae and Asteraceae plants. Females and larvae of *T. tabaci* were found on almost all samples while the population of *H. gowdeyi* was low, probably due to the absence of garlic flowers. There was no male *T. tabaci* in the collection which could mean that the thrips population on garlic maybe parthenogenetic. Based on these findings, detection of viral and bacterial pathogens in *T. tabaci* and garlic tissues, and monitoring of *H. gowdeyi* population on flowering garlic are recommended.

Key words: garlic, *Haplothrips gowdeyi*, Ilocos Norte, *Thrips tabaci*.

33. ASSESSMENT PROTOCOL FOR FIELD BIOEFFICACY EVALUATION OF INSECTICIDES AGAINST ONION ARMYWORM, *Spodoptera exigua* (Hübner) (LEPIDOPTERA: NOCTUIDAE)

Karen P. Ardez, Mario V. Navasero, & Maeden B. Bato. NCPC, CAFS, UPLB.

Field bioefficacy evaluation of some insecticides against onion armyworm (OAW), *Spodoptera exigua* (Hübner), was conducted in Muñoz, Nueva Ecija during the 2017-2018 onion cropping season. Three indicators of level of infestation/degree of damage were used, namely: counting of larvae per instar outside and inside leaves, damage severity rating, and

visual damage rating. Number of OAW larvae found outside of leaves is not a reliable indicator of infestation level because it accounts only for 20% of all larvae counted; the rest are found inside leaves. Destructive sampling to count larvae outside and inside leaves is recommended. However, first instars should be excluded considering its clumped distribution in the field. Severity rating provides better estimates of level of damage but visual damage rating may suffice for purposes of comparison between treatments.

Key words: insecticide evaluation, onion armyworm, sampling protocol, *Spodoptera exigua*.

34. INFLUENCE OF FRUIT PHYSICO-BIOCHEMICAL PROPERTIES OF PHILIPPINE 'CARABAO' MANGO CULTIVARS ON THE OVIPOSITIONAL PREFERENCE AND INSECT DEVELOPMENT OF ORIENTAL FRUIT FLY, *Bactrocera dorsalis* (Hendel)

Maria Luz J. Sison, Cris Q. Cortaga, Ana Kristine S. Barcos, Niño R. Laurel, Raquel D. Javier, & John Marty C. Mateo. IPB, CAFS, UPLB.

The Philippines is regarded as a major world exporter of 'Carabao' mango. This mango variety is also reputed internationally as among the world's sweetest. However, the export potential of this variety cannot be maximized due to insect pests such as the Oriental fruit fly, *Bactrocera dorsalis* (Hendel), which are most often difficult to control. To address this concern, the Institute of Plant Breeding-UPLB, with support from DOST-PCAARRD, continuously identifies and evaluates putative fruit fly-resistant mango accessions. In this study, five least and five most preferred 'Carabao' mango accessions were correlated with different fruit physico-biochemical characteristics, to understand their influence on the ovipositional preference and development of *B. dorsalis*, and to elucidate possible physico-biochemical bases of resistance/susceptibility of mango fruits. Pearson correlation analysis (at $\alpha=5\%$) of least and most preferred accessions showed that ovipositional preference was positively correlated to adult emergence ($r=0.840$), flesh % protein ($r=0.662$), peel % protein ($r=0.760$), flesh total flavonoids ($r=0.953$) and peel total flavonoids ($r=0.694$) while peel firmness ($r=-0.594$), flesh % fat ($r=-0.756$), peel % fat ($r=-0.644$) and pH ($r=-0.591$) showed a negative correlation. For adult emergence, there was a positive correlation with ovipositional preference ($r=0.840$), peel % protein ($r=0.587$), flesh % ash ($r=0.593$) and flesh total flavonoids ($r=0.786$) while peel % moisture ($r=-0.561$), flesh % fat ($r=-0.553$) and peel % relative scavenging activity ($r=-0.813$) showed a negative correlation. The results can help in selecting and improving Philippine 'Carabao' mango with resistance to *B. dorsalis*.

Key words: adult emergence, *Bactrocera dorsalis*, 'Carabao' mango, host plant resistance, Oriental fruit fly, ovipositional preference, physico-biochemical properties.

35. NON-HOST STATUS OF PHILIPPINE 'HASS' AVOCADOS (*Persea americana* Mill.) TO FRUIT FLIES *Bactrocera dorsalis* (Hendel) AND *B. occipitalis* (Bezzi) (DIPTERA: TEPHRITIDAE)

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The host status of 'Hass' avocados (*Persea americana* Mill.) to two fruit fly species *Bactrocera dorsalis* (Hendel) and *B. occipitalis* (Bezzi) was studied in Dole Philippines orchards from 2009 to the present. The procedure and this report adapts the ISPM 37 protocol as of April 2016. The two fruit fly species are found in the avocado orchards. Of the 79,404 commercially mature fruits harvested hard green and collected from the field and from the packing house, zero fruit was found with any fruit fly infestation. Different field caging tests under semi-natural field conditions were carried out in Tupi, South Cotabato; Calinan, Davao City; and Malaybalay, Bukidnon orchards. The 560 fruit attached to trees and introduced with gravid fruit flies were not infested with either species, while the host fruit (*Carica papaya* L.) exhibited 80-100% infestation. We conclude the non-host status of 'Hass' avocados to fruit flies, *B. dorsalis* and *B. occipitalis* in the Philippines.

Key words: *Bactrocera dorsalis*, *Bactrocera occipitalis*, *Carica papaya*, fruit flies, 'Hass' avocados, *Persea americana*, non-host status.

36. SMARTER PEST IDENTIFICATION TECHNOLOGY (SPIdTech): A DIGITAL PLATFORM TO IDENTIFY, MANAGE, REPORT, AND MONITOR INSECT PEST AND CROP DISEASE OCCURRENCE

Angelo C. Guiam, Melvin D. Ebuenga, Wilson N. de Panis & Kristine E. Gamba. NCPC, CAFS, UPLB.

Crop pest and disease occurrences, aggravated by climate change, greatly affect global food

production. To address this issue, a system named SPIdTech (Smarter Pest Identification Technology) was developed to educate and help farmers and other agricultural workers in identifying, managing, and reporting major pests and diseases of rice, corn, coffee, cacao, banana, coconut, sugarcane, soybean, and tomato in the Philippines. It provides two major features: Pest and Disease Identification that uses machine learning technology to identify pests and diseases through mobile phone cameras; and Pest and Disease Library that acts as a virtual encyclopedia containing data on identification signs, life stages, management practices, and other pertinent information about a pest or disease. Data such as GPS location to map and tag the data, top three identification results to monitor the occurrence of pest and disease in the area, and image data to record and verify the results were collected from the users for faster and remote monitoring. An offline version was also developed to extend the capacity of the application to areas with minimal internet connectivity. More than being a system for monitoring, SPIdTech is an educational platform that will raise familiarization with common pests and diseases in the Philippines.

Key words: pest identification using artificial intelligence, SPIdTech

37. A RECONSIDERATION OF THE BIOGEOGRAPHY OF THE LUZON-ENDEMIC GENUS *Psithyristria* (HEMIPTERA: CICADIDAE): PARALLELISM TO MAMMALIAN DISTRIBUTION PATTERNS IN LUZON, PHILIPPINES

Ireneo L. Lit, Jr. EBD, IBS, CAS, & Entomology Section, MNH, UPLB.

The genus *Psithyristria* is so far as known endemic to Luzon Island and is composed of relatively small cicadas occurring generally at 1,000 m asl. A previous study focusing on the systematics and evolution of the group pointed mainly to the adaptation of the group to high elevations as the major factor to explain its distribution in the mountains of Luzon. Recent studies showed the complex geological origins of Luzon island as well as patterns of mammalian diversity in Luzon that follow biogeographical sky islands. The phylogeny of *Psithyristria* was reviewed and the inferred possible affinities of more recently described species were incorporated into the cladograms. The distributions of all known *Psithyristria* species were mapped. In turn, the redrawn cladograms were diagrammed onto the distribution maps. The results show parallels of sky island distribution patterns seen among Luzon mammals as well as possible adaptive radiation after the initial colonization by the ancestor of *Psithyristriini*.

Key words: cicada, endemics, island biogeography, *Psithyristria*, sky islands.

PAE FALL ARMYWORM AWARENESS FORUM

38. FALL ARMYWORM, *Spodoptera frugiperda* (J.E. Smith) (LEPIDOPTERA: NOCTUIDAE): BIOGEOGRAPHICAL ORIGIN, DISTRIBUTION AND SPREAD

Ireneo L. Lit, Jr. EBD, IBS, CAS, & Entomology Section, MNH, UPLB.

The Fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith), had not been reported to occur in the Philippines based on pest records for the last 100 years or so. Recently, however, it is being monitored as it threatens to invade the Philippines, having been reported quite recently in Taiwan and in other neighboring Asian countries, most notably Indonesia (Sumatra) and Thailand. FAW is known to have originated from and is widely distributed in the Americas, but in 2016, it arrived and invaded Africa, and from there, it spread quickly in 2018 to India, and in 2019 to Sri Lanka and other Asian countries. The patterns of spread and colonization are similar to the trends observed for the *Erythrina* gall wasp, *Quadrastichus erythrinae* Kim which reached the Philippines around 2005 and killed coral trees up to 2012. Other invasive species that apparently show the same routes are the coconut leaf beetle, *Brontispa longissima* Gestro, and possibly also, the spread of the rigid coconut scale, *Aspidiotus rigidus* Reyne from Indonesia and the Philippines to Vietnam. Extreme weather events attributed to the current climate change as well as inevitable consequences of global trade and international travel are among the suspected contributory factors in these current aggressive spread of invasive species like the FAW.

Key words: biogeography, biological invasions, fall armyworm, *Spodoptera frugiperda*.

39. THE INVASIVE FALL ARMYWORM, *Spodoptera frugiperda* (J.E. Smith) (LEPIDOPTERA: NOCTUIDAE): DISTINGUISHING CHARACTERISTICS

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The fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith), is a pest known to subsist and inflict damage to economically important grasses like corn and rice. This lepidopteran has been recorded to have moved from its South American origin to Africa in 2016. From Africa, FAW has made its way to Asia; larvae attacking inside the whorls and destroying developing corn tassel. Hence, it is important for farmers to properly identify this pest before initiating pest control measures. At present, there are five species of *Spodoptera* that are known to occur in the Philippines: 1) beet or onion armyworm, *S. exigua* (Hübner); 2) African armyworm, *S. exempta* (Walker); 3) common cutworm, *S. litura* (Fabricius); 4) lily caterpillar, *S. picta* (Guérin-Ménéville); and 5) lawn armyworm, *S. mauritia* (Boisduval). FAW larvae can be distinguished from the rest of *Spodoptera* recorded in the country through the distinct upside-down Y pattern in the frontal aspect of the larval head. In addition, four large dots arranged as a square mark the dorsal side of the last larval body segment. Meanwhile, the dots on the other larval body segments are arranged in a trapezoid.

Key words: armyworms, corn, fall armyworm, rice, *Spodoptera*

40. LEPIDOPTERAN PESTS OF CORN IN THE PHILIPPINES VIS-À-VIS THE IMMINENT INVASION BY THE FALL ARMYWORM, *Spodoptera frugiperda* (J.E. Smith) (LEPIDOPTERA: NOCTUIDAE): QUICK REVIEW AND NATURE OF DAMAGE

Merdelyn T. Caasi-Lit. Entomology Laboratory, Crop Improvement Division, IPB, CAFS, UPLB.

A quick review of the field characteristics of lepidopteran pests of field corn already known to occur in the Philippines as well as their nature of damage is provided. This aims to provide field technicians, research entomologists, and other workers a working familiarity, especially of species closely related to the fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith). Diagnostic notes and photographs of the following are provided: the Asian corn borer, *Ostrinia furnacalis* (Guenée) (Crambidae) and the species of Noctuidae, namely: the corn earworm *Helicoverpa armigera* (Hübner); true armyworm, *Mythimna separata* (Walker); common cutworm, *S. litura* (Fabricius); and the corn semi-looper, *Chrysodeixis eriosoma* (Doubleday). Aside from the morphological characteristics enumerated for the larvae of these species, their damage to field corn is nowhere similar to what is known in other countries for FAW. Characteristic larval features and damages to corn that differentiate each of these lepidopterous species are discussed.

Key words: armyworm-cutworm relatives, corn lepidopteran pests, field characteristics, Lepidoptera, nature of damage, Noctuidae

41. BIO-ECOLOGY OF THE FALL ARMYWORM, *Spodoptera frugiperda* (J.E. Smith): AVAILABLE KNOWLEDGE

Marcela M. Navasero. NCPD, CAFS, UPLB.

This paper briefly described each of the developmental stages of a new invasive pest in the country, *Spodoptera frugiperda* (J.E. Smith), along with its haplotypes and host range, based on data available in the literature, for wider information dissemination among fellow researchers. The egg hatches in 2-3 days. Mean development time (in days) of the six larval instars are as follows: first 3.3, second 1.7, third 1.5, fourth 1.5, fifth 2.0, and sixth 3.7, when reared on corn at 25°C. Total larval duration is about 14 days during warm months and 30 days in cooler months. The pupal duration is about 8-9 days during summer, reaching 20-30 days during cooler weather but they cannot withstand long periods of cold weather. The adult stage is nocturnal, active during warm humid evenings. After a preoviposition period of 3-4 days, the female moth normally deposits most of her eggs during the first 4-5 days but may be extended for up to three weeks. Mean duration of adult life is estimated at 10 days. Two haplotypes or strains determined through DNA barcoding have been reported: the corn strain which feeds predominantly on maize, cotton, and sorghum; and the rice strain which feeds on rice and pasture grasses. It has a very wide host range from its area of origin, many of which are also present in our country, which makes it a potential pest of concern to many of our economically important crops.

Key words: bio-ecology, Fall armyworm, *Spodoptera frugiperda*

42. UPDATES FROM RECENTLY CONDUCTED DETECTION SURVEY FOR FALL ARMYWORM, (*Spodoptera frugiperda* J.E. Smith), IN REGION II, PHILIPPINES

Mario V. Navasero & Gil L. Magsino. NCPD, CAFS, UPLB.

Detection of the Fall armyworm (FAW), (*Spodoptera frugiperda* J.E. Smith), in Taiwan was reported on June 10, 2019, and because of its proximity to the Philippines, this prompted the local and national concerned agencies to intensify their detection and surveillance activities. Initial effort was focused in Cagayan Valley, being the largest corn-producing region in the country. The Regional Crop Protection Center II, through the Bureau of Plant Industry, sent to the National Crop Protection Center, UPLB, for identification, seven noctuid larvae with collection date June 7, 2019 from a Bt corn field in Piat, Cagayan. One of the larvae was positively identified as that of FAW. A picture of another larva from the same site conspicuously showing the distinctive features of FAW was also provided. Immediate follow-up detection survey failed to produce additional specimens of FAW. Since Bt corn was found still working against FAW in new territories of invasion, those found in Piat could have been from non-Bt corn refuge. Bt-corn accounts for about 50% of total plantings of corn in the country and Region II has the highest at 90%, which could have slowed down its spread. Detection surveys focusing on non-Bt corn should be done especially in areas with lower percentages of Bt-corn plantings.

Key words: Cagayan Valley, detection surveys, Fall armyworm, *Spodoptera frugiperda*

43. CLASSICAL NON-CHEMICAL CONTROL: SHARING EXPERIENCES WITH THE COMMON CUTWORM, BLACK ARMYWORM, AND ONION ARMYWORM

Mario V. Navasero. NCPC, CAFS, UPLB.

The National Crop Protection Center-UPLB Quick Response Team had encountered in recent years three cases of cutworm and armyworm outbreaks in Luzon Island, Philippines. The outbreak of the common cutworm, *Spodoptera litura* (Fabricius) in Pangasinan was successfully abated with the use of Nucleopolyhedrosis virus (NPV). This case also was instrumental in the development of the village-level mass production of NPV, the first for a biological control agent in the Philippines. For the black armyworm, *S. exempta* (Walker), several parasitoids, predators, and entomopathogens were documented associated with this species during its outbreak in CALABARZON in 2010. However, cessation of the outbreak was attributed to the obligatory migration behavior of adults that forces them to spread and the succeeding generation reverting back to solitary phase. The most recent was the outbreak of the onion armyworm, *S. exigua* (Hübner), in 2016 in onion-growing areas of Regions I and III. SeMNPV and *Metarhizium rileyi* from infected *S. exigua* larvae had been cultured and their high efficacy to *S. exigua* had been established under laboratory conditions. Preliminary field trials for SeMNPV showed promising results.

Key words: armyworm-cutworm IPM, classical non-chemical control, *Metarhizium rileyi*, SeMNPV, *Spodoptera* species

44. PERSPECTIVES ON MANAGEMENT OF FALL ARMYWORM, (*Spodoptera frugiperda* J.E. Smith), IN THE PHILIPPINES

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Corn production in the Philippines is affected by biotic and abiotic factors. Biotic factors include weeds, diseases like stalk rot, insect pests like aphids and lepidopterans viz., Asian corn borer *Ostrinia furnacalis* (Guenee), corn earworm *Helicoverpa armigera* (Hübner), and common cutworm *Spodoptera litura* (Fabricius). In recent months, an invasive polyphagous species, the Fall armyworm (FAW) *Spodoptera frugiperda* (J.E. Smith), attacked corn in parts of Asia. It also feeds on other crops like sorghum, pearl millet, sugarcane, and cotton. Hitherto, it has been reported from 15 other Asian countries. Chemicals belonging to five or more modes of action (MoA) and Bt corn hybrids are being registered or given conditional approval for management of the pest. However, Bt corn in the Philippines is facing several challenges that may limit sustainability which include poor or no refuge compliance, use of single gene-based technologies, delay in shift to pyramided products during the long years of use leading to potential resistance and cross resistance issues. The use of Bt corn against FAW needs “functionally effective pyramided products with two or more genes of different MoAs” deployed in a seed blend (RIB – refuge in a bag) model. One Bt corn hybrid, MON89034, has proven efficacy against FAW globally, likewise demonstrated in Vietnam. Bayer’s corn hybrids DK6919S and DK9955S, and other crop protection products offer dual or different MoAs against FAW offering flexibility and benefit to farmers, following resistance management guidelines fitting into IPM plans.

Key words: Fall armyworm, MON89034, pest management perspectives, pyramided Bt corn

hybrids, *Spodoptera frugiperda*

POSTER PAPERS

1. OCCURRENCE AND IDENTIFICATION OF INSECT PESTS AND DISEASES ON DIFFERENT WHITE POTATO VARIETIES GROWN AT LOW ELEVATION IN VSU, BAYBAY CITY, LEYTE, PHILIPPINES

Ruben M. Gapsin¹, Elizabeth Carpentero¹, Alberto T. Barrion², Cecilia P. Reyes^{2,3} & Divina M. Amalin². ¹VSU; ²DLSU; ³CSU.

Potato (*Solanum tuberosum* L.) locally known as “patatas” is a cold loving plant widely grown at high elevation areas in which temperature favors its growth. Fifteen different varieties/ selections were planted at low elevation in Baybay City, Leyte to determine their adaptability or performance under this condition. The occurrence and identities of insect pests and diseases attacking potato were investigated. Four collecting methods were employed such as beat tray, pitfall, light trap, and vial tapping. Identification was done under the stereomicroscope, referred to published guides and brochures, and confirmed by authority on the insect groups. The following insect pests occurred in the potato field: *Epilachna* larvae and adult, aphids, leaf miner, thrips, pachyrhynchid beetle, green leafhopper, immature Pseudococcidae, mirid bug (*Halticus* nr. *minutus* Reuter), and orthopteran species. White grubs were also collected from plots where damaged tubers were observed. In addition, several natural enemies were also collected and identified, such as spiders under the families Oxyopidae and Thomisidae, and beneficial insects under the families Formicidae (ants) and Scelionidae. The main disease observed was bacterial wilt which caused high mortality of early-stage potato plants. Tuber rot was also observed in tubers with holes in some varieties. The identification of insect pests and diseases attacking potato is necessary in developing IPM program for promising potato varieties across areas in the Philippines.

Key words: bacterial wilt, insect pests, low elevation, natural enemies, *Solanum tuberosum*, tuber rot.

2. INSECT PESTS AND THEIR ASSOCIATED NATURAL ENEMIES ON LOWLAND POTATO GROWN IN BATAC, ILOCOS NORTE

Noralyn B. Legaspi¹, Marissa I. Atis¹, Franklin C. Sagsagat¹, Marilou P. Lucas¹, Cecilia P. Reyes^{2,3}, Alberto T. Barrion³ & Divina M. Amalin³. ¹MMSU; ²CSU; ³DLSU.

Previous researches confirmed that potato can be cultivated in the warm Ilocos lowlands. Hence, the Lowland Potato Production Technology was developed to increase potato production where it proved feasible, profitable, and socially acceptable. The diversity of cropping in the region, however, encourages build-up of insect pests. The abundance of insect pests and their associated natural enemies was documented to assess the sustainability of lowland potato production under a bio-based pest management strategy. Fifteen heat-tolerant potato varieties were planted in Batac, Ilocos Norte in November 2018. To obtain natural pest pressure and biological control occurrence in the test field, no chemical was sprayed throughout the growing period. Monitoring was done through beating and pitfall methods at vegetative and mature crop stages. Insect count, sorting, and identification was done in the laboratory and yielded eight orders of insect pests dominated by thrips. Among potato varieties, Bengueta was the most susceptible to thrips infestation. Six species of natural enemies were identified, including ants and spiders. The performance of potato varieties was also assessed in terms of yield. Of the 15, three performed the best: Gloria (8.89t ha⁻¹), Raniag (8.19t ha⁻¹), and Meva (6.24t ha⁻¹). Successful growing of lowland potato is possible without chemical spraying. This could be used as a springboard in developing a sustainable lowland potato farming system with biological control as one of the measures in its pest management program.

Key words: diversity, insect pests, integrated pest management, natural enemies, potato, sustainable bio-based pest control.

3. PRELIMINARY SURVEY OF INSECT PESTS AND NATURAL ENEMIES IN A POTATO PRODUCTION AREA UNDER HIGH HILLS ZONE

Teresita D. Masangcay¹, Aurora F. Pinon¹, Belinda A. Tad-Awan¹, Janet P. Pablo¹, Divina

M. Amalin², Alberto T. Barrion² & Chelle Charlden C. Carlos¹. ¹BSU; ²BCRU, DLSU.

A preliminary survey and identification of arthropod pests, both harmful and beneficial to potato, was conducted in Kapangan, Benguet (600 m asl). Fifteen potato varieties were planted using generation zero seeds. No synthetic pesticide was applied to encourage arthropod population in the area. Regardless of variety, monitoring at one and two months after planting revealed leaf miner infestation on the leaves as shown by whitish tunnels on the leaf surfaces. The infestation was very evident in the second month with typical deformations and scaly underside of the leaves. Results of the monitoring/collection one month before harvest gathered from pitfall traps and through plant beating revealed nine different harmful insect species. These were aphids, potato hoppers, thrips, mirid bugs, flea beetles, flea hoppers, and leafminers. These insects outnumbered the tuber moths and whiteflies. During harvest, a few cutworm, white grub, and wireworms were observed from the soil. As to natural enemies, three species of spiders, ants, and one wasp were observed. These are: *Atypena formosana* (Oi) (Araneae: Linyphiidae), *Cheirachantium* sp., *Oxyopes javanus* Thorell (Araneae: Oxyopidae), *Solenopsis* sp. (Hymenoptera: Formicidae), and *Platygaster* sp. (Hymenoptera: Platygasteridae).

Key words: arthropods, harmful and beneficial insects, high hills zone, potato production.

4. LARVAL ANTIBIOSIS TO YELLOW STEM BORER, *Scirpophaga incertulas* (Walker), AMONG TRADITIONAL RICE VARIETIES

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The Philippines is home to various kinds of microflora. A large portion of the Philippine microflora includes actinomycetes (Actinomycetales). They are Gram-negative bacteria that are prolific producers of various natural products. However, actinomycetes remain unexplored especially in the search for different insecticidal natural products. Production of natural insecticides in actinomycetes is typically low such that an effective elicitation method is required to increase microbial production of the insecticidal compounds. One hundred fifty-six BIOTECH actinomycete strains were screened for insecticidal activity against neonate larvae of Asian corn borer (ACB), *Ostrinia furnacalis* (Guenée). Seven out of the 156 strains were found to have moderate insecticidal activity against ACB. Addition of rare earth elements (REE) Lanthanum (La) and Scandium (Sc) in culture media enhanced the insecticidal activity of three out of the seven actinomycetes strains by up to two-fold. Despite the less dramatic effect of REE treatment on insecticidal activity, the appearance of potentially novel compounds in REE-treated strains might provide a new mode of action insecticide. Thus, REE proved to be an effective method in eliciting insecticidal compounds from actinomycetes.

Key words: antibiosis, rice, *Scirpophaga incertulas*, traditional varieties, yellow stem borer.

5. ASSOCIATION OF SILICON CONTENT WITH YELLOW STEM BORER, *Scirpophaga incertulas* (Walker), TOLERANCE IN INDICA RICE CULTIVARS

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Yellow stem borers (YSB), *Scirpophaga incertulas* (Walker), are major pests in rice agriculture. Hence, there have been numerous studies on pest management involving them. Improving stem composition is seen as a way to promote YSB tolerance in rice. Silica (SiO₂) is known to contribute to normal growth and development in rice and is also linked to resistance to pathogen and other environmental factors by affecting physical traits of the stem. Here, Silicon content in rice is shown to positively influence YSB tolerance. In 2017 dry season, YSB occurrence was observed in our field planted to exactly 215 indica rice cultivars varying in terms of maturity and other traits. This allowed evaluation of the relationship of rice straw Silicon content with YSB tolerance. YSB incidence was diagnosed by counting whiteheads during the reproductive stage. Incidence reaching 20% meant significant yield loss. In addition, 25 primary tillers each from individual plants per entry were collected during maturity and sent to the University of York for high-throughput rice straw Silicon content analysis. Out of 185 early maturing rice cultivars attacked by YSB, 45 were found to be tolerant. Pearson's correlation showed positive relationship between Silicon content and YSB tolerance, i.e., higher silicon levels can lead to better tolerance. These rice cultivars with higher silicon content can be utilized in breeding programs as sources of tolerance or

resistance to YSB.

Key words: *Oryza sativa*, rice, *Scirpophaga incertulas*, silicon content, yellow stem borer, yellow stem borer tolerance

6. SEASONAL FLUCTUATION OF YELLOW STEM BORER AND OTHER ARTHROPODS AT THE PHILRICE CENTRAL EXPERIMENT STATION

Gilely C. Santiago & Evelyn M. Valdez. Central Luzon State University, University Science High School.

Insect pest management employs several tactics compatible with each other to become effective. Generally, insect pests are widely distributed and oftentimes their populations overlap. Hence, management is difficult and strategies differ from one pest to another and with different insect growth stages. Knowing the right time to apply intervention is necessary for better pest management. One tool to determine population fluctuations of different arthropods is through light trapping as it provides significant clues to the diversity of insects active at night and helps predict how populations fluctuate during a particular period in relation to prevailing weather conditions. Light trap collections showed that adult yellow stem borer (YSB) population peaked in March (dry season) with 232 moths and in September (wet season) with 48. The highest number of brown planthoppers was in March (2,328) and August (4,552). The trend was similar for other hoppers: zigzag (ZLH) and green leafhoppers, and white-backed planthopper. Among pests, ZLH was the highest with 12,692 individuals trapped in September. Other major pests were the rice black bug, leaf folder, and rice bug but their populations were comparatively low. The mirid bug predominated among natural enemies and its population peaked in March with 1,016 and in September with 10,215. Eggmass counts were very low in all crop growth stages. This was due to the low YSB population throughout the study. Weather data was also correlated to the number of arthropods collected.

Key words: arthropods, light trap, seasonal fluctuation, yellow rice stem borer.

7. SOME BOTANICALS AND MICROBIALS AGAINST ONION ARMYWORM, *Spodoptera exigua* (Hübner) (LEPIDOPTERA: NOCTUIDAE) AT STO. DOMINGO, NUEVA ECIJA

Bonifacio F. Cayabyab¹, Michelle S. Guerrero¹, Lyle M. Alforja¹, Alice G. Aquino¹, Emma A. Perez¹, Manuel P. Gaylon¹, R.J. L. Oboza¹, M.J. B. Perfecto¹, & R. Ramos². ¹NCPC, CAFS, UPLB; ²Onion Growers Association of Sto. Domingo, Nueva Ecija.

Onion, *Allium cepa* L., is one of the high value crops in the Philippines. In 2016, the onion industry lost approximately 20M dollars due to infestation of the onion armyworm (OAW), *Spodoptera exigua* (Hübner). Significant production losses resulted from the insect population outbreak at Dolores, Sto. Domingo, Nueva Ecija, exacerbated by excessive use of pesticides, and climate change. The research evaluated the efficacy of botanicals and microbials against OAW through field experiment from December 2018-April 2019. Nine treatments, namely; NPV crude extract, fungi (*Metarhizium anisopliae* (Metsch.) Sorok., AzTron® (bacterial insecticide), botanicals neem and wood vinegar, synthetic insecticide chlorfenaphyr (Kotetsu®), farmer's practice, and the untreated control were replicated four times represented by four farmers' fields with pheromone traps. The control had no pheromone traps and the pest management practice was based on each farmer's decision. All the treated plots displayed significant decrease in larval counts at fourth and fifth applications. Yield of treated plots were statistically higher as compared to the untreated control. The efficacy of botanicals, pheromones and microbials against OAW was affirmed.

Key words: biopesticides, botanicals, microbials, onion, Onion armyworm, pheromones, *Spodoptera exigua*.

8. IDENTIFICATION OF BACTERIAL ENTOMOPATHOGENS OF *Spodoptera exigua* (Hübner) (LEPIDOPTERA: NOCTUIDAE)

Marcela M. Navasero & Mary Joy C. Mendoza. NCPC, CAFS, UPLB.

Spodoptera exigua (Hübner) is a devastating insect pest of onion that causes economic losses in major onion-producing areas in the country. In search for options in managing the insect pest, entomopathogens that could serve as biocontrol agents against the insect pest were identified. Isolation of the potential entomopathogens were obtained from the gut portion of dead *S. exigua* larvae. The isolates were identified through colony morphology in potato dextrose peptone agar growth media and molecular characterization. Out of 12 isolates, there were only four distinct colonies identified based on morphological characteristics. Of these, one distinctly belongs to *Enterobacter cloacae* (Jordan) Hormaeche & Edwards (100%) while the

other three were close to *Cronobacter sakazakii* (Farmer et al.) Iversen et al. (90%), *E. cloacae* (92%), and *Serratia marcescens* Bizio (85%) but were suggestive of novel species based on molecular identification.

Key words: bacterial entomopathogen, biological control, *Enterobacter cloacae*, Onion armyworm, *Spodoptera exigua*.

9. COMPARISON OF STRIP TYPE AND RUBBER SEPTA TRAPS WITH SEX PHEROMONE LURE OF ONION ARMYWORM, *Spodoptera exigua* (Hübner) (LEPIDOPTERA: NOCTUIDAE), IN STO. DOMINGO, NUEVA ECIJA

Byron Amadeus G. Cayabyab, Sarah Jane B. Manaday, Pablito G. Gonzales, & Gideon Aries S. Burgonio. NCPC, CAFS, UPLB.

The strip type and rubber septa carriers for sex pheromone lures were compared during an 80-day trapping study of onion armyworm, *Spodoptera exigua* (Hübner), from January 13-April 13, 2019 in Dolores, Sto. Domingo, Nueva Ecija. Six traps were used for each type of pheromone carrier. The sex pheromone was tethered at the center of a five-gallon container with water and soap. Male moth catches were counted and recorded daily between 0600 and 0800H. Locations were selected based on the damage assessment observed last onion-growing season. The rubber septa had higher daily catches than the strip type. Moreover, the former had a total (cumulative) male catch of 41,165 while the latter had 6,880. The rubber septa containing sex pheromone can be used for detection, population forecasting, and mass trapping of male moths.

Key words: Onion armyworm, rubber septa, sex pheromone, *Spodoptera exigua*, strip lure, trapping.

10. MOLECULAR IDENTIFICATION OF NUCLEOPOLYHEDROVIRUS (NPV) ISOLATED FROM ONION ARMYWORM, *Spodoptera exigua* (Hübner) (LEPIDOPTERA: NOCTUIDAE)

Bonifacio F. Cayabyab, Michelle S. Guerrero, Janice F. Laquinta, Lyle M. Alforja, Alice G. Aquino, Emma A. Perez, & Manuel P. Gaylon. NCPC, CAFS, UPLB.

A nucleopolyhedrovirus (NPV) sample from Onion armyworm (OAW), *Spodoptera exigua* (Hübner) was collected in a spring onion field at Sitio Tanibong, Abar 1st, San Jose City, Nueva Ecija on 25 August, 2017. Filtered and crude NPV extracts were both tested in the field and laboratory. Preliminary laboratory test resulted to 62.5% and 72% mortality for filtered and crude extracts, respectively. Laboratory rearing of OAW ensured continuous supply of infected larvae. Molecular characterization of the NPV using Polh and Lep 9 genes resulted to 99% nucleotide identity with *S. exigua* multiple nucleopolyhedrovirus (SeMNPV). The outcome suggests that this NPV indeed came from OAW and can be used as an important component for the management of this pest. Twelve infected OAW larvae were sequenced with both forward and reverse reactions.

Key words: Lep 9, Nucleopolyhedrovirus (NPV), Onion armyworm, Polh, SeMNPV, *Spodoptera exigua*.

11. DNA BARCODING OF ONION ARMYWORM, *Spodoptera exigua* (Hübner), IN NUEVA ECIJA AND BENGUET

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In early 2016, a pest outbreak was reported in large areas of onion farms in Nueva Ecija, causing damage in 14 municipalities involving 5,330 hectares and 4,089 farmers. The pest was identified as the Onion armyworm (OAW), *Spodoptera exigua* (Hübner). The outbreak was suspected to have resulted from long distance mass migration triggered during the previous El Niño event, although this pest had been recorded already in the Philippines since the late 1970s. Three years hence, OAW still brings severe damage in Nueva Ecija, forcing farmers to intensify spraying synthetic chemical insecticides to secure their harvest. Continuous monitoring and integrated pest management methods were done through collaboration of units in UPLB and CLSU, LGUs, farmer associations, and DA-BAR. To provide quick and accurate identification during monitoring and for future reference, molecular methods were optimized to have DNA barcodes of this pest. Field-collected OAW adults and larvae from Dolores, Sto. Domingo, Nueva Ecija were processed for genomic DNA extraction and PCR amplification of COI gene. Samples were successfully sequenced and results deposited in the

GenBank database as partial COI sequences of OAW Nueva Ecija population. In November, 2018, OAW adults were also collected through pheromone traps in Benguet State University, La Trinidad, Benguet from farms with onion and other highland vegetables. Comparison of partial COI sequences of OAW populations from Benguet and Nueva Ecija through multiple sequence alignment showed no nucleotide polymorphism.

Key words: Benguet, COI, DNA barcoding, Nueva Ecija, Onion armyworm, *Spodoptera exigua*.

12. CENTRALIZED SCREENING FOR RESISTANCE TO MAJOR INSECT PESTS OF RICE

Gilely C. Santiago. PhilRice.

Insect resistance is the totality of heritable qualities that enable a plant to reduce or withstand damage insects inflict on it. Insect resistant varieties are major elements in the integrated control of rice pests. Their use is compatible with other control tactics. The development of pest resistant rices aims to help farmers increase rice production. Evaluation of different lines for resistance against major pests was conducted under field and screenhouse conditions. In the field, rice lines from different ecosystems were planted late to meet the required pest pressure for evaluation against stem borers (SB). In the screenhouse, compartment seed-boxes were used to evaluate the entries against brown planthopper (BPH) and green leafhopper (GLH). NCT manual and Standard Evaluation System (SES) of IRRRI were followed. During 2018 DS, 248 entries were evaluated under field conditions against SB, and under screenhouse conditions against BPH and GLH. A low SB pressure was observed during vegetative and reproductive stages, hence, data were not valid. Most entries were intermediate to BPH and GLH in the screenhouse. In August 2018, 560 entries were planted. These were also evaluated against SB, BPH, and GLH. Insect pressure was very low during the vegetative stage. Evaluation during reproductive stage was not valid due to rice tungro infection on susceptible check TN1. Evaluations in the screenhouse showed that most entries were intermediate to BPH and GLH. The results will help avoid recommending highly susceptible selections as commercial varieties.

Key words: brown planthopper, green leafhopper, screening, stemborer, Standard Evaluation System.

13. EVALUATION OF GOLDEN APPLE SNAILS (*Pomacea* sp.) AND *Lantana camara* L. AS ATTRACTANTS FOR RICE BUG (*Leptocorisa* sp.)

Evelyn M. Valdez & Dindo King M. Donayre. PhilRice.

A field study was conducted at Maria Aurora and Baler, Aurora, and Burgos, Pangasinan (wet season) to determine the efficacies of golden apple snails (GAS) (*Pomacea* sp.) and *Lantana camara* L. as attractants to rice bug (*Leptocorisa* sp.). One kg each of crushed and uncrushed GAS and 100, 300, and 500 g of *L. camara* were arranged in the field using RCBD. Rice bug individuals attracted to each treatment were counted the next day. Rice bugs were attracted to GAS, crushed or not. However, more rice bugs were attracted to the crushed GAS the next day after the installment. No rice bugs were attracted to *L. camara*.

Key words: attractant, Golden apple snail, *Lantana camara*, *Leptocorisa* sp., *Pomacea* sp., Rice bug

14. PRODUCTION OF *Trichogramma* PARASITOIDS (*T. chilonis* Ishii, *T. japonicum* Ashmead AND *T. evanescens* Westwood) USING DIFFERENT ADHESIVES FOR RICE MOTH, *Corcyra cephalonica* (Stainton), EGGS

Rina Jade G. Genandoy, Ma. Mae C. Legan, Eva L. Lam, & Jelly A. Brillon. College of Agriculture and Forestry, West Visayas State University.

Trichogramma species that could parasitize *Corcyra* eggs with different adhesives were determined. This study was laid out in 2 x 4 for split plot design. The different *Trichogramma* species, namely: *T. chilonis* Ishii, *T. japonicum* Ashmead, and *T. evanescens* Westwood composed the main plot and the different adhesives, namely: A1 (Gum arabic), A2 (Elmer's™ glue), A3 (Corn starch), and A4 (ordinary water-based paste), the subplots. Rate of parasitization of *Corcyra* eggs did not differ significantly among *Trichogramma* species, although numerically, the highest number of parasitized eggs was by *T. evanescens*. Regardless of parasitoid species, the adhesives also showed no significant effect on the percentage of parasitized eggs. Nonetheless, the highest number of parasitized eggs was in Elmer's™ glue and the interaction between parasitoid species and adhesives yielded a

significant result in the percentage of parasitized eggs. The data on the percentage of remaining eggs after physical disturbance showed highly significant difference among species and adhesives. The most number of eggs that remained on the strip was *T. evanescens*. Regardless of species, the adhesives showed highly significant influence on the number of eggs that remained after physical disturbance. The most number of eggs that remained glued was in Elmer's™ glue. The interaction between species and adhesives revealed a significant result in the number of eggs that remained glued after physical disturbance.

Key words: adhesives, *Corcyra cephalonica*, *Trichogramma chilonis*, *Trichogramma evanescens*, *Trichogramma japonicum*

15. EFFECT OF HABITAT MANIPULATION ON THE POPULATIONS OF BENEFICIAL ORGANISMS IN HYBRID RICE SEED PRODUCTION

Val Garcia, Richard S. Santiago, Carlos C. Abon, Jr., & Emmanuel V. Sicat. CLSU-PhilSCAT

The role of ecological engineering as a component in pest management is new in rice and its benefits are given little attention. Ecological engineering modifies the environment according to ecological principles. It is a useful conceptual framework for considering the practice of habitat manipulation for arthropod pest management. Habitat manipulation involves altering the cropping system, and is another form of conservation biological control. During the 2019 Dry Season at Philippine-Sino Center for Agricultural Technology (PhilSCAT) farm and experiment areas, the effect of planting flowering weeds near rice field on the population of beneficial organisms in the hybrid rice ecosystem was determined. Sweep net collections showed that rice fields planted with flowering plants had significantly higher population (14%) of beneficial organisms than fields without (6%). Habitat manipulation which includes cultivating flowering plants as source of nectar and pollen, can help sustain Integrated Pest Management in areas with large rice monoculture. It also serves as refuge for beneficial arthropods. Thus, farmers would spend less on rice production and their health would be protected. The environment is also guarded as chemical use in the farms is greatly reduced.

Key words: beneficial organisms, flowers, habitat manipulation, pest management.

16. SEED-TO-SEED RESEARCH-BASED ADVISORY SERVICES TO MANAGE RICE INSECT PESTS AT PHILRICE NEGROS

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Rice areas in the Visayas include 430,378 ha of irrigated and 516,567 ha of rain-fed ecosystems. One of the commitments of PhilRice-Negros is to produce nationally released seeds for the entire Visayas. At present, actual yields obtained at the station are low, usually associated with insect pests and diseases. Seed quality was likewise compromised because of pest damage. In 2017, a 'pest manager' in the station was initiated through the creation of PhilRice Negros Monitoring Team that conducts real-time surveillance and generates real-time management decisions for pests. Seed-to-seed monitoring protocols are developed, tested and fine-tuned. Quantitative data collection in monitoring fields include characterizing insect pest injuries using four quadrats (1x1-m) and 10-hill sampling per field. Arthropods in the field were collected through sweep net to determine pest and defender (P:D) ratio. Insect pests during seed storage were also monitored. Yellow stem borer (YSB), *Scirpophaga incertulas* (Walker), and green leafhopper (GLH), *Nephotettix nigropictus* (Stål), were major pests that significantly resulted to yield loss. The highest YSB incidence was 50% of the hills and three tillers per hill. GLH was considered a major pest because of high tungro infection. Recommendations included proper cultural management practices and maintenance of field sanitation to eliminate alternate hosts. Comparison of damages from the previous and subsequent weeks was used to evaluate the appropriateness of implemented control measures. In DS2019, no significant insect pest damage was observed, which only shows that pests were properly managed.

Key words: *Nephotettix nigropictus*, *Scirpophaga incertulas*, seed quality, seed-to-seed monitoring.

17. MOSQUITO DIVERSITY AND LAND USE CHANGE

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Mosquitoes are the most relevant vectors of numerous arthropod-borne viruses (arboviruses). The effects of land use change on mosquito communities as well as the incidence of vector-borne pathogens are widely emphasized, but are still poorly understood. The present community of mosquitoes was investigated in identified sites in the Makiling Forest Reserve (MFR) with data on land use change. Based on computed land use change for the period of 1972-2018 of the three selected sites in MFR, the highest change (relative to area) from agriculture to bare and built-up for Barangay Bayog, followed by Barangay Lalakay, and then Barangay Bagong Silang. Meanwhile, 27 different mosquito species were collected, 10 of which were already reported in 1970, while 17 additional species were found. A molecular approach to identify species using COI and ITS2 genes was also done and five out of the seven selected mosquito species agree with the morphological identification that was initially done. Detection of viruses present in the mosquitoes will also be done and these results, overall, will allow better understanding on how landscape characteristics affect the transmission dynamics of different arboviruses.

Key words: arboviruses, land use change, molecular identification, mosquitoes.

18. MOLECULAR DETECTION OF ARBOVIRUSES IN *Culex tritaeniorhynchus* Giles AND *Culex gelidus* Theobald

Jessica Manalaysay & Ma. Anita Mascareñas-Bautista. NIMBB, UPD.

Mosquitoes are one of the most important vectors of human pathogens. They harbor arthropod-borne viruses (arboviruses) which are the causative agents of medically important diseases. Three families of arboviruses, namely: Flaviviridae, Bunyaviridae, and Togaviridae are of public health importance because they cause dengue, zika, Japanese encephalitis (JE), and chikungunya. *Culex tritaeniorhynchus* Giles and *C. gelidus* Theobald have been reported to be among the primary vectors of JE in Asian countries. In the Philippines, there are limited studies about *Culex* and the viruses they transmit in the community. Using Polymerase Chain Reaction, arboviruses were detected from *C. tritaeniorhynchus* and *C. gelidus* from Barangays Lalakay and Bayog in Los Baños, Laguna. Taxonomic identification of *Culex* was also done using molecular methods wherein only *C. gelidus* agreed with the results of morphological identification previously done. The 15 different primer sets for the three arbovirus families detected Flaviviridae and Bunyaviridae in *C. tritaeniorhynchus* and Flaviviridae, Bunyaviridae, and Togaviridae in *C. gelidus*. Subsequent advanced molecular analyses will be done to confirm the presence of arboviruses in these *Culex* samples.

Key words: arboviruses, *Culex gelidus*, *Culex tritaeniorhynchus*, mosquitoes

19. GENETIC ANALYSIS OF *Aedes aegypti* (L.) IN MANILA, PHILIPPINES: DISPERSAL PATTERN, AND GENE EXPRESSION UNDER *Wolbachia* INFECTION

Maria Angenica Regilme¹, Tatsuya Inukai¹, Katherine Viacrusis², Divina M. Amalin², & Kozo Watanabe¹. ¹Ehime University, Japan; ²DLSU.

Anthropogenic land use influences the proliferation patterns of mosquitoes across urban areas. Habitat fragmentation through barriers disrupts gene flow influencing vector competence. The effect of España Boulevard in dispersion patterns of dengue vector was examined from August through September 2017. *A. aegypti* were collected in the north and south sides of the road. DNA and RNA are isolated from individual mosquitoes using Qiagen AllPrep DNA/RNA isolation kit. The effect of the road in the population structure was determined using 12 microsatellite loci for molecular analysis. Double digest restriction-site associated DNA sequencing revealed genome-wide single nucleotide polymorphisms. *Wolbachia* infections were detected by PCR in seven adult mosquitoes. RNA sequencing explained the difference in the gene expression levels of *Wolbachia* infected and non-infected adult mosquitoes. Important genes in *Wolbachia* infected mosquitoes responsible for dengue virus inhibiting properties were analyzed. Control zones along landscapes features in urban areas that can act as barrier or corridor in mosquito dispersal could be determined. If major roads are revealed as barriers, road blocking can be used as an efficient and appropriate spatial unit of studying and controlling the vector.

Key words: *Aedes aegypti*, habitat fragmentation, microsatellite, RNA sequencing, *Wolbachia*.

20. DIVERSITY OF *Anopheles* SPECIES AND DISTRIBUTION OF MOSQUITO-BORNE DISEASE VECTORS IN THE PHILIPPINES

Mary Ann T. Ammugauan, Jason R. Angeles, Richard Paul B. Malijan, & Ferdinand V. Salazar. RITM, DOH.

Mosquito vector surveillance is essential for efficient, environmentally sound, and comprehensive mosquito-borne disease prevention and control. Philippine mosquito diversity and distribution had limited published and documented data. Mosquitoes were collected in 2018 from selected areas, usually those with last known malaria cases. Several provinces continuously monitor vectors to help eradicate mosquito-borne diseases, and submitted samples to the Department of Medical Entomology-Research Institute for Tropical Medicine for validation using carabao-baited traps (CBT) strategically placed in areas that would likely yield anophelines. The CBT attracts the widest range of mosquito species per trap-night compared to other techniques. Among species identified from submitted samples were 19 *Anopheles*, vectors of malaria: *An. flavirostris* (Ludlow), *An. litoralis* King, *An. maculatus* (Theobald); filariasis: *Aedes poicilius* Theobald, *Mansonia uniformis* (Theobald), *Culex quinquefasciatus* Say; dengue/zika/chikungunya: *Ae. aegypti* (L.) and *Ae. albopictus* (Skuse); and Japanese encephalitis: *C. tritaeniorhynchus* Giles, *C. fuscocephala* Theobald, *C. gelidus* Theobald, *C. vishnui* Theobald. Proper identification leads to implementation of cost-effective and efficient control. The presence of mosquito vectors in an area increases the risk of transmission of mosquito-borne diseases and will provide basis for species-specific vector control strategies. These data, however, do not fully give the overall distribution of all mosquitoes in the Philippines especially *Aedes*, since traps targeted only night-biting mosquitoes and only provinces with active mosquito vector surveillance. Further collections using different traps to target all mosquito genera should be done to establish a complete geographic distribution of mosquitoes in the Philippines.

Key words: medical entomology, mosquito distribution, mosquito diversity, mosquito vector surveillance, Philippine mosquitoes.

21. QUICK RESPONSE, SURVEILLANCE, MONITORING AND MANAGEMENT OF NEW AND EMERGING PESTS OF MAJOR CROPS IN THE PHILIPPINES

Bonifacio F. Cayabyab, Gil L. Magsino, Melvin D. Ebuenga, Mario V. Navasero, Marcela M. Navasero, Enrico K. Magalit, Melissa P. Montecalvo, Freddie Webb B. Signabon, Carlos L. Padilla, Randolph N. Candano, & Gideon Aries S. Burgonio. NCPC, CAFS, UPLB.

Requests for technical assistance regarding pest and diseases of crops from government agencies, LGUs, farmer groups/cooperatives, and private entities have increased in the past five years. Pest quick response teams (QRT) had been formed in DA and from NCPC to address these crop protection concerns. A collaborative QRT can be more proactive and respond on time to request for assistance by institutionalizing a Quick Response Program. This DA-BAR-funded project aims to develop monitoring and surveillance protocols and effective management strategies for new and emerging pests of onion, rice, coconut, and other crops in the Philippines. Field surveys and assessments have been conducted in Regions IVB (Romblon), V (Albay and Sorsogon), and IX (Zamboanga del Norte) including Basilan in the ARMM for the coconut scale, *Aspidiotus rigudus* Reyne, infestation. Similar activities were also conducted in Regions VI (Negros Occidental) and 12 (Mlang, North Cotabato) and documented rats and rice grain bugs. Onion armyworms were positively monitored through pheromone traps in La Trinidad, Benguet vegetable farm and on asters at Bayog, Los Baños, Laguna. A new pest record of mango was identified and field investigation together with RCPC I and LGUs was conducted. Notifications on the new pest records and effect of drought on crops were forwarded to concerned stakeholders. Capacity-building on pest surveillance and management including participatory action research will be done shortly together with select RCPCs, LGUs and farmer organizations.

Key words: asters, pest surveillance and monitoring, quick response, rats, rice grain bug.

22. UPDATES ON THE MASS REARING AND PRELIMINARY FIELD RELEASE OF *Comperiella calauanica* Barrion et al. (HYMENOPTERA: ENCYRTIDAE) FOR

CONTROL OF THE COCONUT SCALE, *Aspidiotus rigidus* Reyne (HEMIPTERA: DIASPIDIDAE), IN THE BICOL REGION

Ma. Leonila R. Imperial¹, Lyrma B. Pedrajita¹, Gil G. Manalo¹, Cristeta A. Cueto¹, Billy Joel M. Almarinez², & Divina M. Amalin². ¹PCA-ARC; ²BCRU, DLSU.

The coconut scale insect *Aspidiotus rigidus* Reyne has recently reached Albay and continuously poses threat to the Philippines' coconut industry. Sustainable strategy to lower field population and prevent spread of *A. rigidus* can be done through augmentative release of an endoparasitoid, *Comperiella calauanica* Barrion et al. This encyrtid wasp is a highly specific to *A. rigidus*. In situations that warrant adequate releases of *C. calauanica* for optimal biological control, a readily available source of large number of this parasitoid is crucial. The protocol developed by DLSU-BRCU for laboratory (indoor) and outdoor mass rearing of *C. calauanica* is successfully adapted at PCA-Albay Research Center Biological Control Laboratory. Specific, strict yet feasible conditions were followed to sustain the establishment and maintenance of stock culture of the host, *A. rigidus* as well as the working culture of *C. calauanica*, reared on squash fruit and mangosteen plant in the mass rearing facilities. In the Bicol Region, the first field release of *C. calauanica* took place at PCA-ARC and in one infested farm in Guinobatan, Albay in November 2018. Succeeding releases of mass-reared *C. calauanica* were in nearby areas with observed CSI infestation, either by vial tapping method or exposing *C. calauanica*-parasitized mangosteen plant (sentinel release method) right in the field. Laboratory observation of leaves collected 1-2 months after release indicated high levels of parasitism. Rapid Ground Assessment method developed by PCA was undertaken to monitor parasitoid establishment and assess palm recovery in release sites.

Key words: *Aspidiotus rigidus*, *Comperiella calauanica*, field release, mass rearing, parasitoid monitoring, Rapid Ground Assessment.

23. VERIFICATION OF THE DEVELOPED PEST MANAGEMENT PRODUCTS FOR VEGETABLE PRODUCTION USING DIFFERENT FERTILIZER MANAGEMENT SCHEMES

Alecsis Villarín, Leticia A. Lutap, & Jonathan R. Ramos. MMSU

Increasing concern about risks associated with chemical pesticides made the development of alternative control methods like the use of biopesticides against major pests necessary. Mariano Marcos State University (MMSU) developed promising biopesticide products for common insect pests of vegetables like tomato fruitworm, thrips, and mites in pepper, and *Epilachna* beetles in eggplant. The different products were coded as MMSU Bio-In 3, MMSU Bio-In 6, and MMSU Bio-In 8. Using the formulated biopesticide products, the effectiveness was compared to chemical pesticides in organic, inorganic, and combination (organic and inorganic) farms. Results showed that the effectiveness of the developed MMSU Biopesticide products was comparable with chemical pesticides regardless of fertilizer management scheme. Lower pest incidence was noted. Further, effectiveness of the biopesticide was enhanced when used as an alternate to chemical pesticide as indicated by the higher yield obtained in all the crops evaluated. Cost and return analysis also shows that the developed MMSU Biopesticide were comparable to chemical pesticide especially when used as an alternate to chemical pesticide. The use of biopesticides is promising considering consumer demand for safer and lesser pesticide use or even pesticide-free vegetables.

Key words: fertilizer management, pest management, vegetable production

24. CULTURAL MANAGEMENT PRACTICES AMONG ONION FARMERS IN NUEVA ECIJA

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Onion is a popular vegetable grown for its pungent bulb and flavorful leaves. Central Luzon accounts for the highest volume and hectareage of onion production. Current cultural management practices of onion farmers in Nueva Ecija were studied, based on interview with 180 farmers from nine municipalities. Farmers responded to a combination of semi-structured questionnaires and focused group discussions. Socio-demographic characteristics of onion growers, cropping pattern, irrigations, fertilizer, pest, and other cultural management practices and related activities were documented. All data were analyzed using central tendency theory. Most farmer-respondents were male (91%), married (95%), and had secondary education (53%). On average, 1.4 ha were devoted to onion production and most farmers planted in November-March (68%). Most farmers used Red Pinoy variety (73%),

sowed seeds in November (74%), and applied synthetic fertilizers (66%). All farmers used synthetic pesticides and majority practiced crop rotation (94%). Some (34%) practiced good sanitation and only 1% applied botanical plant extracts to control pests. Nobody planted trap and repellent crops. Most (63%) irrigated onions more than 10x per cropping season with an interval of 3-7 days (69%). Majority (67%) harvested onion 81-90 days after transplanting and relied primarily on synthetic pesticides to control pests. Some practices were not being used maybe because of lack of information and/or poor adoption of technologies. Some of these cultural management practices were used as basis in evaluating and enhancing effectiveness of measures in controlling onion armyworms, *Spodoptera exigua* (Hübner).

Key words: cultural management practices, onion, Onion armyworm, *Spodoptera exigua*.

25. CAPACITY ENHANCEMENT ON INTEGRATED PEST MANAGEMENT FOR PHILSCAT AND SELECTED CLSU STAFF

Val Garcia, Ramil R. Carbonel, Ma. Celia M. Fernando, Carlos C. Abon, Jr., & Emmanuel V. Sicat. CLSU-PhilSCAT.

The training program was designed to guide the participants on pest control using environment-friendly means to improve yield results of Philippine-Sino Center for Agricultural Technology (PhilSCAT) hybrid rice seed production and to capacitate the staff on correct pest identification and application of integrated crop management technologies during crop development. Specifically, it intends to develop the participant's technical competence on Integrated Pest Management and improve their decision-making in managing rice ecosystem to maintain pest populations below damaging levels. Also, the training hopes to achieve a least 40% increase in the participants' level of knowledge, which can be manifested in their Gain-in-Knowledge (Gik). A total of 33 Central Luzon State University (CLSU) Staff (CLSU) from different Centers participated in the training, namely: 46% PhilSCAT, 18% CLSU-Research Office, 15% Ramon Magsaysay Center for Agricultural Environment Studies, 12% University Business Affairs Program (UBAP), and 9% CLSU-Extension Office. Instructional strategies were (30%) participatory lecture-discussions to bring out issues and concerns, and encourage active participation among trainees, and (70%) field practicum and exercises to promote experiential learning and understand the concept or theory being introduced. Evaluating trainee performance, 92% positive increment was recorded based on pre-test and post-test of the participants. Most participants said that they were satisfied with the training course and gave it an overall rating of outstanding and that the training was commendable and they wanted to extend its duration for more hands-on activities.

Key words: capacity-enhancement, decision-making, hybrid rice seed production, Integrated Pest Management.

26. SURVEILLANCE AND MONITORING OF THE ONION ARMYWORM, *Spodoptera exigua* (Hübner), IN GENERAL NATIVIDAD, NUEVA ECIJA

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Onion is one of the high-value crops in the Philippines and very profitable to grow. However, it is very susceptible to onion armyworm (OAW), *Spodoptera exigua* (Hübner), infestations that could entail big yield and huge income losses to farmers. Surveillance, early stress detection and monitoring of the pests using remote sensing are looked into as one way to provide information so interventions can be implemented before a crop becomes permanently impaired. Surveillance and monitoring of onion areas in the municipality of Gen. Natividad were conducted using remote sensing technology, whereby the satellite imageries (Sentinel) of the onion areas collected at weekly basis were delineated, digitized, and processed using Google Earth and ArcGIS. OAW infestation was first detected on January 9, 2019 in Barangay Picaleon and the LGU was immediately informed together with the turnover of the map generated so that interventions can be implemented the soonest possible time. A week after, however, the pest spread to the neighboring Barangay Balarang and gradually worsened as the weeks passed by and as the increasing heat of the summer months drew near. The final map generated on March 26, 2019 showed the total affected area of 150.17 ha of which 7.37 had more than 50% damage. Using remote sensing technology, pest infestation was detected early and monitored and used as an early warning tool for the LGU so that interventions could be done before the pest becomes unmanageable.

Key words: onion, Onion armyworm, remote sensing, *Spodoptera exigua*.

27. UTILIZATION OF SEX PHEROMONE IN THE MONITORING AND MANAGEMENT OF COMMON CUTWORM, *Spodoptera litura* (Fabricius), IN ONION FARMS IN NUEVA ECIJA AND PANGASINAN

Pablito G. Gonzales, Melvin D. Ebuenga, Gideon Aries S. Burgonio, Sarah Jane B. Manaday, & Byron Amadeus G. Cayabyab. NCPC, CAFS, UPLB.

Onion growers in Pangasinan and Nueva Ecija experienced the heavy damage of onion armyworms (OAW), *Spodoptera exigua* (Hübner), for the last three years (2016-2018). However, during the November, 2018-March, 2019 cropping season, a high population of the common cutworm (CCW), *Spodoptera litura* (Fabricius), was monitored in farmers' fields in both provinces. Farmers thought that the infestation was due to OAW considering that they have almost similar damage patterns especially during high larval counts on the leaves. Sex pheromone for CCW was immediately procured from China for its utilization during this cropping period. Monitoring data were presented and possible management strategies were recommended to the onion farmers through LGUs, RCPC, farmers' cooperatives, and individual farmers for their immediate action.

Key words: common cutworm, damage, infestation, onion, pheromone, *Spodoptera litura*.

28. FEEDING BEHAVIOR AND PREDATORY POTENTIAL OF *Feltiella acarisuga* (Vallot) AGAINST *Tetranychus urticae* Koch

Kennilyn May Balbin¹ & Flor A. Ceballo². ¹CLSU, ²IWEP, CAFS, UPLB.

Tetranychus urticae Koch is a major pest of greenhouse crops and a vector of bacterial crown rot caused by *Erwinia mallotivora* Goto. A predatory gall midge, *Feltiella acarisuga* (Vallot), was observed preying on *T. urticae*. This study determined the feeding behavior and predatory potential of *F. acarisuga* against *T. urticae*. Papaya leaf discs with previously counted *T. urticae* eggs were placed in a Petri dish lined with moistened filter paper. A second-instar *F. acarisuga* larva was placed in the Petri dish containing the *T. urticae* eggs. Another set of experiments was conducted but using 10 *T. urticae* adults. After 24 h, the number of eggs or adults were counted and recorded. Data on predation for all the stages of *T. urticae* was remarkable with second instar *F. acarisuga* larvae that can consume an average of 60.3 eggs and 6.1 adults in 24 h under laboratory conditions. Also, a second instar *F. acarisuga* larva can consume 40% of its prey within 24 h in the laboratory. In addition, a consistent behavior of "tasting" its prey was observed.

Key words: biological control, feeding behavior, *Feltiella acarisuga*, predatory potential, *Tetranychus urticae*.

29. INSECT PESTS AND NATURAL ENEMIES OF PROCESSING TOMATO IN ILOCOS NORTE AND SUR

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Insect pests and natural enemies of processing tomato were characterized from 2018-2019 to develop insect pest management technologies for crop production in Ilocos Norte and Sur. Processing tomato in Ilocos Region is commonly cultivated after rice as added income source. Harvested tomatoes will then be processed at Northern Foods Corporation, Batac, Ilocos Norte, the only operational plant in the Philippines. Secondary data were used to identify municipalities, barangays, and farmers producing tomatoes. Fields were randomly selected and surveyed. Sampling was done every two weeks from two weeks after transplanting until end of cropping season. In each site, five spots were randomly selected, and five random plants were observed in each spot. The pest and beneficial insects were visually counted and recorded. Comparing the data from the 2018 field survey, there was an increased incidence of major pests. Leafminer (*Liriomyza sativae* Blanchard) incidence increased in 3-13 barangays in all growth stages of tomato. Tomato fruitworm *Helicoverpa armigera* (Hübner) and whitefly *Bemisia tabaci* (Gennadius) incidence also increased in six barangays from fruiting to maturity. Common cutworm *Spodoptera litura* (Fabricius), on the other hand, had increased as early as vegetative stage in eight barangays. Other insect pests present were hoppers, black winged aphids, 28-spotted lady beetles *Epilachna vigintioctopunctata philippinensis* (Dieke), mealybugs, and dipterans were also observed. Meanwhile, together

with the predatory bugs (*Cyrtopeltis tenuis* Reuter), coccinellid beetles, parasitoids, and different species of spiders have been recorded.

Key words: common cutworm, field surveillance, leafminer, natural enemies, processing tomato, tomato fruitworm, whitefly.

30. REVIEW OF THE STICK INSECT GENUS *Mithrenes* Stål (PHASMATODEA: LONCHODIDAE) IN THE PHILIPPINES

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The reproductive characteristics and eggs of species under the Philippine endemic genus *Mithrenes* Stål were carefully examined. New material and type specimens of *M. asperulus* Stål revealed the presence of the preopercular organ which is absent in the other three described species. Other characters such as those of the male cerci and egg morphology suggest that a separate genus must be established for *M. mindorensis* Hennemann & Conle, *M. panayensis* Hennemann & Conle, and *M. whiteheadi* (Kirby). Two other species, including one from Sibuyan Island, have also been discovered and will be described under the new genus to be proposed.

Key words: biodiversity, Lonchodidae, phasmid, *Mithrenes*.

31. COMPARISON OF DNA METABARCODING AND MORPHOLOGICAL IDENTIFICATION FOR STREAM MACROINVERTEBRATE BIODIVERSITY ASSESSMENT AND MONITORING

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Conventional morphology-based identification is commonly used for routine assessment of freshwater ecosystems. However, cost and time efficient techniques like high-throughput sequencing (HTS) based approaches may resolve constraints in morphology-based surveys. Stream macroinvertebrate species diversity and community composition were characterized via metabarcoding and morphological analysis from samples from Shigenobu River Basin, Ehime Prefecture, Japan. Diversity metrics were compared and the ability of both approaches to evaluate the relationship between macroinvertebrate community and environmental variables was assessed. Altogether, 45 taxa (three families, six subfamilies, 31 genera, and five species) were morphologically identified from 8,276 individuals from 10 sites. Metabarcoding detected 44 species, with 35 collapsed into 11 groups matching the morphologically identified taxa. Logged depth (number of HTS reads) and abundance of morphological taxa, were significantly positively correlated, implying that quantitative data could be used for subsequent analyses. Considerably high rate of relative abundance of morphologically identified samples was detected. Recovery of samples by incidence or presence/absence was considerably low, with a high rate of false-negative detection specifically for scarcely represented species. Given the low taxonomic resolution of morphological assignment, metabarcoding does not reflect most species naturally occurring in our site, which could further be proven with refined morphological assessment of samples. However, abundance-based detection was efficient with 92% of the individuals correctly demonstrated. DNA metabarcoding provides practical and cost-effective approach especially for rapid biological monitoring of freshwater macroinvertebrate communities, but detecting scarce samples should be improved to increase sensitivity of detecting most, if not all, species.

Key words: abundance, biomonitoring, community composition, DNA metabarcoding; high-throughput sequencing read, macroinvertebrates.

32. METAGENOMICS OF *Plutella xylostella* (L.): INSIGHT INTO THE ROLE OF BACTERIA IN INCREASED METABOLISM OF INSECTICIDES

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The Diamondback moth (DBM), *Plutella xylostella* (L.), is considered the most destructive pest of brassicaceous crops (e.g. cabbage, pechay). It is also notorious for developing resistance against different classes of insecticides, including those derived from *Bacillus thuringiensis*

Berliner. Besides endogenous gene expression of an organism, previous studies have shown that the microbial ecology of an organism can contribute to the host's biological function and overall well-being (e.g. aphids and *Buchnera aphidicola* Munson et al., *Riftia pachyptila* Jones and Proteobacteria). Additionally, it has been determined that the predominant microbiota in the gut of DBM are Proteobacteria, implying roles in digestion and nutrient absorption. In line with this, the main objective of our study is to determine the difference in microbial populations of DBM between resistant and susceptible strains upon insecticide exposure. However, determining the microbial ecology at a baseline level is of vital importance because this will serve as a basis for analysis of the developed strains. Thus, the microbial ecology of two Philippine-populations of laboratory-reared DBM, specifically, whole fourth instars of the 1st and 4th generations from Mankayan, and the different larval stages of a 2nd generation population from Buguias, will be analyzed through metagenomics.

Key words: Diamondback moth, insecticide metabolism, metagenomics, *Plutella xylostella*.

33. GREEN SYNTHESIZED COPPER NANOPARTICLES USING CHILI FRUITS (*Capsicum annuum* L.) AND NEEM (*Azadirachta indica* A. Juss.) LEAF EXTRACTS AND THEIR INSECTICIDAL EFFECTS AGAINST *Bemisia tabaci* (Gennadius) B BIOTYPE (HEMIPTERA: ALEYRODIDAE)

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Green extraction of chili (*Capsicum annuum* L.) fruits and neem (*Azadirachta indica* A. Juss.) leaves was conducted using hot continuous reflux method with coconut water as solvent. The aim was to produce nano-formulated organic insecticide against *Bemisia tabaci* (Gennadius). Such nano-technologically prepared extracts (NPE) were successfully produced through optimization of pH, temperature, and concentration levels confirmed through UV-Vis spectrophotometer with absorption peaks at 1.786 at 400 nm for chili and 451 nm for neem. Furthermore, Fourier-transform infrared spectroscopy suggests that Cu nanoparticles were surrounded by different organic molecules like alcohols and phenols, ketones, aldehydes, and carboxylic acid. Hence, the use of organic solvents, such as coconut water was effective in extracting chemical groups that bear the active ingredients of neem (azadirachtin) through test for terpenoids and chili (capsaicinoids) through test for alkaloids for phytochemical analyses. Except for coconut water, the crude extracts and the NPEs demonstrated high comparable repellent effect with dimethoate against *B. tabaci* B Biotype adults. The NPEs, viz., Neem NPE and Chili NPE resulted to 100% mortality 24h after treatment application comparable to dimethoate. LD₅₀ of chili NPE and neem NPE was at 2.73% and 4.30%, respectively, at 50% concentration (v:v, extract:water) observed 12h after treatment application.

Key words: *Bemisia tabaci*, chili fruits, mortality, nanoparticles, neem leaves.

34. MOLECULAR VARIATION AMONG POPULATIONS OF TWO RED SPIDER MITES, *Tetranychus cinnabarinus* (Boisduval) AND *T. kanzawai* Kishida

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Red spider mites (RSM) are considered as one of the major and widely distributed arthropod pests of cassava. These arthropods cause the sporadic drying out of the leaf that starts from the middle part spreading through the leaf blades sparing only the leaf veins. They usually attack mature leaves, but during very high infestations when leaves dry out easily, young leaves and shoots can also be attacked leading to stunted growth or even death of young plants. Gabriel's 1997 list included two morphologically-identified species of red spider mites infesting cassava in the Philippines, namely: *Tetranychus cinnabarinus* (Boisduval) and *T. kanzawai* Kishida. To aid in immediate and accurate species identification of these minute arthropods from collected samples in five provinces, DNA barcoding was conducted. Genomic DNA of each specimen were isolated and gene amplification of cytochrome oxidase I (COI), commonly used genetic marker for arthropods, was done through polymerase chain reaction (PCR). BLASTn alignments resulted to two putatively identified red spider mite species from five provinces. Molecular characterizations of interspecific and intraspecific sample sequences with 879 bp were analyzed. Two polymorphic nucleotides at 665th and 668th positions (transition of T ↔ C) were very distinct among the species while various polymorphisms were found among local populations (provinces) of each species. DNA barcodes were already deposited in the GenBank, which can be accessed by the public as

soon as results are published.

Key words: cytochrome oxidase I, red spider mites, *Tetranychus cinnabarinus*, *Tetranychus kanzawai*.

35. SELECTION FOR IMIDACLOPRID RESISTANCE AND MODE OF INHERITANCE IN THE BROWN PLANTHOPPER, *Nilaparvata lugens* (Stål) (HEMIPTERA: DELPHACIDAE)

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The resistance ratio of 50% lethal dose (LD50) values for the two resistance-selected strains, i.e., resistant strains originating from Vietnam (VT-Res) and the Philippines (PH-Res), to their control strains were ~8- and 157-fold, respectively. Reciprocal cross experiments between VT-Res and the susceptible strain (S-strain), and between PH-Res and the S-strain showed that the degree of dominance was 0.81 and 0.82, and 0.95 and 0.96, respectively. Analysis of the F2 populations and backcrosses to the parental strains indicated that resistance is a major-gene trait following Mendelian inheritance. The strength of the resistance was suppressed by pre-treatment with piperonyl butoxide, an inhibitor of cytochrome P450-mono oxygenases.

Key words: brown planthopper, cross resistance, imidacloprid, insecticide resistance management, laboratory selection, *Nilaparvata lugens*.

36. Cry1Ab-RESISTANCE DETECTION IN THE ASIAN CORN BORER, *Ostrinia furnacalis* (Guenée), USING DIAGNOSTIC DOSE ASSAY AND F2 SCREEN

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A two-step detection method using artificial diet overlay bioassay with diagnostic dose of Cry1Ab protein followed by F2 screen of progenies from sib-mated male and female adults that survived the treatment from diagnostic dose assays was utilized for attempting to isolate major non-recessive resistance alleles from the Asian corn borer, *Ostrinia furnacalis* (Guenée) populations. The number of parental pair-mated male and female adults collected from three sites in Cauayan, Isabela ranged from 123-202 pairs. The total number of families surviving into the F2 generation ranged from 3-9. There were no surviving larval progenies from each F2 family line treated with Bt corn leaf discs. No major non-recessive resistance allele is present in the insect samples collected from the three sites in Isabela.

Key words: Bt corn, diagnostic dose, family line, non-recessive resistance alleles, *Ostrinia furnacalis*.