AGRICULTURAL SCIENCES

AS-01

ACCEPTABILITY OF CASSAVA (*Manihot esculenta*) SIOPAO

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Cassava is abundant in the Philippines and is only considered as supplemental food. Being abundant in Camotes Island, cassave was used as a dough ingredient of siopao. To find out its acceptability, experiments were set-up using 5 treatments: T0 (control) using all-purpose flour as dough filled with ground pork and other ingredients; T1 using 25% cassava flour mixed with 75% all-purpose flour; T2 using 50% cassava flour mixed with 50% all-purpose flour; T3 using 75% cassava flour mixed with 25% all-purpose flour; and T4 using 100% cassava flour. All the treatments were subjected to organolyptic tests in terms of texture, odor, flavor, palatability, and general acceptability. T4 was rated as having the best taste. As to texture and odor, T0 was rated highest, followed by T2. For palatability, T2 was rated highest followed by T4. For flavor, T4 was rated highest, followed by T2. For general acceptability, T4 was rated highest, followed by T0. ANOVA showed that there were no significant differences on the acceptability of cassava as a dough ingredient of siopao filled with ground pork and other ingredients in terms of flavor, odor, texture, palatability and general acceptability.

Keywords: *Manihot esculenta*, siopao, acceptability, cassava, Camotes Island

AS - 02

IMBAW (*Adontia edentula*) AS A RESOURCE, FOOD AND LIVELIHOOD OF CAMOTES ISLANDS, CENTRAL PHILIPPINES

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Imbaw, known as mangrove clam (*Adontia edentula*) and an abundant resource in the mangrove areas of Camotes Islands, Cebu, was studied with respect to its perceived abundance, food processing, and livelihood of the inhabitants. An interview questionnaire was prepared for the gleaners, vendors, and selected residents of Camotes Islands. Results show that imbaw are usually found in muddy areas with less pneumatophores and usually caught 2 feet below the surface. They are gathered throughout the year during low tide. Phases of the moon have nothing to do with its abundance. Collection relies on visual techniques and direct contact with the bottom. Perceived distance between clams is 3 meters. Imbaw is prepared as tinola, broiled, and salad (kinilaw). Broiled imbaw mixed with a bit of margarine is served during special occasions. Gleaning usually is concentrated in mangrove areas of Teguis, Poro Cebu being the largest mangrove area in Camotes Islands. Marketing is done through middle men with an average of 5 pieces large clams and 15 pieces smaller clams, which require an hour of gleaning. Prices for bigger clams range from Php2.00 to Php3.00 per piece and smaller clams is Php0.50 to Php1.00 each. Results further show that 1/3 of their catch was left for the gleaners' kitchen and 2/3 for the market. Proceeds of clam gleaning are usually for food purposes only. Perceived problems are the many gleaners; areas are severely disturbed and lower catch when smaller clams are gathered due to its scarcity. Reforestation and size limits were the suggested measures to solve scarcity.

Keywords: Imbaw, *Adontia edentula*, resource, food, livelihood

AS - 03

DEVELOPMENT OF A TECHNOLOGY TO INCREASE THE PRODUCTIVITY OF TUGUI (*Dioscorea esculenta*)

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Yams (*Dioscorea*) play a vital role as source of human food in the country especially in times of food scarcity. *D. esculenta*, locally known as tugui, is one of two species which are of economic importance in the Ilocos Region. Tugui thrives well in marginal areas and is considered as cash crops by upland farmers. The lack of a recommended high-yielding and acceptable variety and a production technology however, limits the productivity of farmers to only about 2.6-3.3 t ha^{-1}. In an effort to increase productivity, a series of research projects were conducted to identify promising accessions that could be recommended to farmers and improve the existing cultural management practice. After three years of evaluation both on-station and on-farm, six accessions (Accessions # 9, 3, 2, 1, 4, and 15) were identified, with mean yields ranging from 13.33 t ha^{-1} to 14.54 t ha^{-1}. These accessions are also highly acceptable to consumers. In terms of crop management, the application of two tons organic fertilizer per hectare was found to sustain high yield and maintain the residual fertility of the soil after continuous cropping, thus shifting cultivation is avoided. In addition, the use of bigger setts (40-90 g) was found to significantly increase yield by 138% as compared to the farmers' practice of using small setts. Planting the identified promising accessions, coupled with improved cultural management practices increase the productivity of tugui. With this, the marginal/idle areas can be made productive and be used to support the government's program on food security.

Keywords: yam, marginal, accession, *Dioscorea*, tugui

AS - 04

OPTIMUM CONDITIONS FOR MYCELIAL GROWTH AND FRUITING BODY PRODUCTION OF *Pleurotus pulmonarius* (Fries) Quélet SPANISH STRAIN

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Pleurotus pulmonarius (Fr.), commonly known as Indian Oyster or Phoenix mushroom is an exotic species of mushroom in the Philippines. It usually grows on lignocellulosic substrates such as hardwood, wood products and agricultural wastes such as rice straw, corn cobs, sugar cane bagasse, coffee residues and banana stalks. This species of mushroom is not yet commercially cultivated in the country due to lack of production technology. With the objective of developing practical and innovative production technology, we evaluated the influence of locally available indigenous culture media and physical conditions (pH, aeration, illumination, and temperature) on the mycelial growth and rice straw based substrate formulations for fruiting body production. *P. pulmonarius* cultured in potato sucrose gelatin with pH of 5.5 and incubated in sealed and dark condition at room temperature recorded fastest mycelial growth with a mean of 90 mm after 7 days of incubation. Among the grain spawning materials evaluated, corn grit produced luxuriantly thick mycelia and shortest incubation period with a mean of 6 days. Substrate formulation composed of 9 parts rice straw: 1 part sawdust recorded the shortest incubation period (12.67 days), highest mean weight of the fruiting bodies (86.71 g) and highest biological efficiency (24.77%).

Keywords: *P. pulmonarius*, physical conditions, indigenous culture media, rice straw based substrate

AS - 05

BIOACTIVES AND PROTEINS IN INDIGENOUS EDIBLE MINDANAO FERNS AS AN ALTERNATIVE FOOD SOURCE

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Many Filipinos suffer from cancer, atherosclerosis, and other degenerative diseases which may be due to the high concentration of free radicals from pollutants and to the type of food we eat. Ferns in the Philippines had been used by native people as food, tea and medicine for a long time. We conducted a study to determine the protein content and antioxidant potential of our ferns to demonstrate their health and wellness benefits for possible reintroducing into the Filipino diet. Ten species of indigenous edible ferns from Mindanao were determined using the Bradford assay to have protein content ranging from 0.08 to 4.39 mg/g wet weight and antioxidant activity by the DPPH assay as high as 83% that of ascorbic acid or at 143 to 588 ORAC units/g wet weight. Of these ten fern species, *Marsilea crenata* (upat-upat) gave the highest protein content and antioxidant activity per wet weight with *Cyathea contaminans*, a tree fern, having the lowest protein content/wet weight. Phytochemical profiles were prepared by Thin Layer Chromatography (TLC). The relative component proteins by SDS-PAGE indicated proteins with molecular weights ranging from 19 – 92kDa, each with only one subunit. The profiles among the ten ferns were similar and differences in the band intensities and the integrity of the proteins were maintained. We established a pteridogarden of these ten ferns in the University Fernery with mass production in the Mt. Musuan Botanical and Zoological Gardens. As an output of the study, we prepared fern gourmet where staff and caterers participated in a contest evaluated by a sensory panel. As part of our extension work to educate the public of the health and wellness benefits of ferns in the diet, we held seminars and trainings, and prepared brochures on the propagation of these ferns and recipes for the fern gourmets.

Keywords: pteridogarden, ferns, anti-oxidants, proteins, phytochemicals

AS - 06

SURVEY AND CHARACTERIZATION OF INDIGENOUS FOOD PLANTS IN ILOCOS NORTE, PHILIPPINES

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Indigenous and traditional edible plant species, usually referred to as indigenous food plants (IFPs), are disappearing at an alarming rate, posing serious threats to food security and agricultural production especially in areas that depend on them for food and livelihood. This study was undertaken to document the IFPs of seven upland and remote municipalities of Ilocos Norte province. It generated information on the IFP's identity and taxonomic nomenclature, socio-economic importance, ethnobotany, and geographic location. A total of 46 IFPs representing 28 plant families were identified. Most of them were wild species; the others were landraces or native varieties of cultivated crops. The identified IFPs are important plant genetic resources contributing to food sufficiency, nutrition, and household income supplements in the study sites. Ethnobotanical data indicate that the plants have become an integral part of the people's daily diet. Seven of the IFPs showed specific elevation, temperature and soil moisture requirements which contributed to the uniqueness of a species in one or two sites. Many of them, however, showed adaptability to a wide range of geomorphic and soil conditions. Recognizing the benefits of these IFPs, the upland communities conserve them through *in situ* conservation and conservation though use. Additionally, the Mariano Marcos State University (MMSU) collected available germplasm and maintains them as living plants and seeds. To prevent further genetic erosion and to protect the IFPs from extinction, collaborative efforts and interventions among various stakeholders should be instituted and strengthened.

Keywords: indigenous food plants, biodiversity conservation, plant genetic resources, wild plant species, traditional varieties

AS - 07

NEXT GENERATION MAINTAINER LINES: MULTIPLE BACTERIAL BLIGHT RESISTANCE GENES AND GOOD GRAIN QUALITY

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Marker-assisted breeding of bacterial blight resistant hybrid rice maintainer lines was started at PhilRice in 2003. Although carried out successfully, there were difficulties in using them for cytoplasmic male sterile (CMS) conversion due to residual fertility restoration capacity. Thus, the first generations of improved maintainer lines were not effectively used in developing resistant F_1 hybrids. In this study, we sought to develop a new generation of maintainer lines with two or multiple resistance genes and no residual fertility in converted CMS lines. Maintainer lines assembled at PhilRice were screened by inoculating them with *Xanthomas oryzae* pv. *Oryzae* (*Xoo*) isolates and confirmed what possible genes were present using gene markers. We utilized IRBB62, a pyramided line having *Xa*4, *Xa*7 and *Xa*21 genes, and identified maintainer lines showing broader resistance for bacterial blight resistance gene but poor in morpho-agronomic traits as donor parents. A combination of forward breeding and marker assisted selection (MAS) were used in development and improvement of maintainer lines. After six generations, ten advanced lines were already uniform. Initial pollen sterility evaluation of F_1 progenies, using three cytoplasmic sources, showed different reaction to iodine staining. This implied the occurrence of sterility inducing factor present in the cytoplasm or in the nucleus of both parents. Grain qualities of these advanced lines exhibited acceptable value for percent chalkiness and amylose content. Therefore, with appropriate CMS source and proper selection, the development of new CMS lines in the background of improved maintainer line having resistance gene is possible.

Keywords: hybrid rice, maintainer line, *Xoo* isolates, bacterial blight, MAS

AS - 08

SUBMERGENCE TOLERANT RICE: MITIGATING THE EFFECT OF CLIMATE CHANGE IN FLASH FLOOD-PRONE AREAS IN THE PHILIPPINES

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Cultivated rice, *Oryza sativa* L., needs water in order to grow and produce the most important staple food for more than half of world's population. When completely underwater for several days particularly at vegetative stage, rice seedlings wilt and die causing significant reduction in yield. This paper describes the genetic improvement of rice *via* transfer of *sub1* locus for submergence tolerance from IR64-Sub1 into high yielding varieties using marker-assisted breeding methods. Six commercial varieties - NSIC Rc160, NSIC Rc128, NSIC Rc154, NSIC Rc158, and PSB Rc82 - were used in conventional hybridization and development of progenies. Using *sub1* markers ART5 and RM8300 in chromosome 9, foreground selection of plants with *sub1* identified improved lines currently at BC2F2 and BC3F1. Recombinant selection using 5 microsatellite markers in the *sub1* region combined with background selection using 27 markers identified 7 improved PSB Rc82, now at BC2F2. Promising submergence tolerant rice cultivar in the background of NSIC Rc160 showed 58% survival compared to IR64-Sub1 and IR42 (control) at 39% and 0%, respectively, under on-farm evaluation in San Antonio, Nueva Ecija. The development of submergence tolerant rice varieties will give farmers an option to alleviate the effect of submergence as a result of climate change particularly in flash flood-prone areas in the country.

Keywords: rice, sub1, submergence tolerance, marker assisted selection, genetic improvement

AS - 09

CONFINED FIELD TEST OF PRO-VITAMIN A ENRICHED 'GOLDEN RICE' EVENT GR2-R INTROGRESSED LINES OF IR64 AND PSB Rc82

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The Golden Rice 2 event "R" (GR2-R) was introduced from the donor Kaybonnet harboring the GR2-R locus into two popular Philippine varieties, IR64 and PSB Rc82. IRRI scientists performed the preliminary work in the Philippines using marker-assisted backcrossing and line selection. Selected progenies and introgression lines were tested under contained and confined conditions at IRRI. In this study conducted by PhilRice, a total of 80 introgression lines derived from these crosses were subjected to confined field testing (CFT) with the approval and under the regulatory supervision of the Bureau of Plant Industry, Department of Agriculture. The CFT involved 38 introgression lines of IR64 at BC3F3, 32 lines of PSB Rc82 at BC3F1, and 10 lines of PSB Rc82 at BC2F3. Evaluation focused on the following parameters: morpho-agronomic and post-harvest characteristics, reaction to pests and diseases, genetic similarity to the recurrent parent based on 373 genome-wide SNP markers, and total carotenoid content after two months of storage at ambient temperature. Among the IR64-GR2R lines, 32 were selected as closely resembling the wild type IR64 based on phenotypic acceptability and morpho-agronomic characteristics. The selected IR64-GR2R lines had the following characteristics: 75 to 126 cm plant height, 80 to 86 heading days, 101 to 106 maturity days, and 5.17 to 11.20 μg/g total carotenoid content, as compared to 7.65 μg/g in Kaybonnet and 0.42 μg/g in IR64. Among the PSB Rc82-GR2R lines, 13 were identified as similar to wild type PSB Rc82, having 92 to 132 cm plant height, 81 to 86 heading days, 104 to 111 maturity days, and 80.5 to 90.5% recurrent parent genome recovery. Based on these results, selected lines will be subjected to generation advance, phenotypic selection and multi-location field evaluation.

Keywords: Golden Rice 2, confined field test, vitamin A deficiency, beta carotene, SNP genotyping

AS - 10

EVALUATION OF GROWTH AND YIELD PERFORMANCE OF TRADITIONAL UPLAND RICES IN LOW ELEVATION UPLAND AGROECOSYSTEM

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In answer to the Philippines' rice self-sufficiency goal, the expansion of production areas for upland rice and propagation of traditional rice varieties for food security are recommended. Traditional upland rice (TUR) is usually cultivated through *kaingin* system in high elevation mountainous areas that pose ecological hazards to the upland agro-ecosystem and forest resources. Considering the wide agro-ecological adaptability and resiliency of this crop, the utilization of less risk-prone areas (*i.e.* lower-elevation and marginal upland) is possible resulting not only in converting less productive soil to become productive but also enhancing the sustainability of the environment. A total of 42 traditional upland rice varieties were planted in low elevation upland areas of Batac, Ilocos Norte during the 2010 and 2011 wet seasons in order to evaluate the agronomic performance and to identify high yielding TUR varieties adaptable to lower elevation upland agro-ecosystem. Six promising entries were found adaptable for low elevation (78-97 meter above sea level) uplands as manifested by their good growth and yield performance. TUR 36, TUR 4 (*Isek*), TUR 28 (*Pamplona*), TUR 42 (*Maluit*), TUR 46 (*Wagwag*) and TUR 47 (*Limon*) consistently produced yields of 3.3 to 4.6 t ha^{-1} . They are tall and low tillering, have medium panicles, are fertile to highly fertile, medium maturing, and weighed approximately 26 to 30 g/1000 grains. These entries also possess highly acceptable sensory qualities, *i.e.* aroma, gloss, smoothness and taste.

Keywords: traditional upland rice, rice self-sufficiency, agronomic evaluation, promising traditional upland varieties, sensory qualities

AS - 11

MORPHO-AGRONOMIC DIVERSITY OF UPLAND RICE LANDRACES AND TRADITIONAL VARIETIES FROM BUKIDNON

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Cortes (2011) collected 140 upland rice landraces and traditional varieties (URLTVs) from 24 barangays in Bukidnon that were culturally valuable to indigenous communities. These were highly diverse for most seed traits. Sixty-six URLTVs with adequate viable seeds were grown on August 2012 at the CMU-Agricultural Experiment Station for morpho-agronomic characterization to determine their potential use in upland rice breeding. The study was a balanced lattice design with two replications. Only 55 URLTVs with adequate plant stand were considered for data collection. Most URLTVs were short-statured, perhaps as a natural adaptation to wind-threatened agro-ecosystem conditions, although based on Shannon-Weaver Diversity Index, plant height at 35 and 90 days after planting (DAP) were highly diverse (H'=0.94 and 0.83, respectively). At 90 DAP, height ranged from 51.60 to 95.80 cm. Other highly diverse traits were: flag leaf length (H'=0.90), number of culm (H'=90), culm length (H'=0.88), days to first heading (H'=0.82), and main heading date (H'=0.92). Qualitative traits often useful as genetic markers have variable diversity: presence/absence of awn (H'=0.22), auricle color (H'=0.36), and leaf blade attitude or angle (H'=0.32) had low diversity; panicle exertion (H'=0.49) had moderate diversity, whereas panicle: attitude (or angle) of branches (H'=0.53) and lemma/palea color (H'=0.83) with 9 colors identified had high diversity. Such phenotypic variations need to be confirmed at the molecular level to fully determine their value in upland rice varietal improvement.

Keywords: rice breeding, *Oryza sativa*, rice, traditional varieties, landraces, Bukidnon

AS - 12

COMPARATIVE CHARACTERIZATION OF IN SITU *Oryza rufipogon* Griff. POPULATIONS IN LAKES APO AND NAPALIT, BUKIDNON

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Wild rices are valuable gene sources for rice breeding. Four of the 25 wild *Oryza* species can be found in the Philippines; one of these is *O. rufipogon* which grows around Lake Apo (~373 meters above sea level, masl), Bukidnon, reported in 1961. It is believed to be one of the progenitors of *O. sativa* and has valuable traits for cold, drought and salinity tolerance, as well as resistance to tungro virus. On February 2012, sightings of *O. rufipogon* in Lake Napalit (~2,824 masl), Bukidnon were confirmed by faculty and student researchers of Central Mindanao University. This study compared the morpho-ecological status of *O. rufipogon* populations around the two lakes. Ten 1 m x 1 m quadrants with *O. rufipogon* clusters were established per lake. Initial findings from November 2012 to January 2013 showed that Lake Apo populations (LAP) have longer leaves (35.10 cm), culms (123.58 cm), and awns (65.19 cm) than those in Lake Napalit (LNP): 20.70 cm leaf, 70.55 cm culm, and 49.37 awn lengths. However, leaf width (0.85 cm LAP, 0.84 cm LNP), panicle length (35.90 cm LAP, 37.49 cm LNP), percent panicle shattering (71.99% LAP, 68.33% LNP), and number of basal primary branches per panicle (7 LAP, 6 LNP) were comparable. Rainfall was higher in Lake Napalit (73.50 mm) than in Lake Apo (26.33 mm). Temperature was relatively cooler in Lake Napalit (23.5^{o}C) than in Lake Apo (25.3^{o}C). Variable characteristics between the two populations will be potentially useful in rice breeding.

Keywords: wild rice, Bukidnon, rice breeding, *Oryza rufipogon*, plant genetic resources, Lake Apo, Lake Napalit

AS - 13

YIELD POTENTIAL AND NITROGEN USE EFFICIENCY OF IRRIGATED LOWLAND RICE VARIETIES THROUGH LEAF COLOR CHART (LCC)-BASED NITROGEN MANAGEMENT WITH VARYING N-P-K RATIOS

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Nitrogen (N) is usually limiting in irrigated rice production due mainly to leaching and volatilization. Therefore, increasing N use efficiency is needed to improve grain yield and reduce N losses and groundwater contamination. The leaf color chart (LCC) is an inexpensive (P50/unit) and practical tool used to assess the "real time" plant need for N. The LCC can be used to attain the grain yield potential (maximum yield under optimum crop management) and agronomic N use efficiency (ANUE or kg grain/kg N applied) and to lower cost of N fertilizer. However, phosphorus (P) and potassium (K) are also important in the attainment of yield potential. Inbreds PSB Rc82 and NSIC Rc160, and hybrid Mestiso 20 were tested in 2012 dry season. Fertilizer treatments were: a) control with no fertilizer; b) nutrient omission plots: (b1) N omission plot (-N,+P,+K), (b2) P omission plot (+N,-P,+K), (b3) K omission plot (+N,+P,-K); c) LCC-based N management with 4:2:1 NPK ratio, where 35 kg N/ha was applied when LCC reading was below 4; d) LCC-based N with 4:1:2 NPK ratio, where 35 kg N/ha was applied when LCC reading was below 4; and e) growth stage-based N management, where N was applied in three splits: 35 kg N/ha each at mid-tillering, panicle initiation and flowering stages. All P and K fertilizers were applied basal at 14 days after transplanting. Mestiso 20 had significantly higher yields (6.6-10.4 t/ha) than yields of PSB Rc82 and NSIC Rc160 (5.2-9.5 and 5.0-8.9 t/ha), higher harvest index than PSB Rc82 and NSIC Rc160, and higher ANUE of 31.9-53.9 kg grain/kg N applied than inbred varieties. With LCC, varying the N, P and K ratio did not affect yield and ANUE since P and K were optimum under Maligaya clay soil condition based on nutrient omission plot technique.

Keywords: agronomic nitrogen use efficiency, hybrid rice variety, inbred rice variety, leaf color chart, yield potential

AS - 14

DISEASE RESISTANCE AND YIELD ASSESSMENTS OF PEANUT (*Arachishypogaea* L.) INOCULATED WITH *Sclerotium rolfsii* Sacc. AT DIFFERENT GROWTH STAGES

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Sclerotium rolfsii Sacc.is an economically important pathogen causing damping-off, seed borne rot, pod rot, and stem and root rot diseases in peanut. A study using split plot arrangement in Randomized Complete Block Design replicated three (3) times was conducted to determine the yield potential of three promising peanut varieties (PSB Pn 1, PSB Pn 6, and CV Pn 90320) as influenced by growth stage inoculation and varietal resistance to *Sclerotium rolfsii*. Inoculation of *S. rolfsii* served as the factor under the Main Plot, Variety represented the Subplot factor, and Growth Stage for the Sub-subplot. The inoculation of *S. rolfsii* had a highly significant effect on the severity of stem rot infection while variety factor had a significant effect on the percent pre- and post-emergence damping-off infection in variety CV Pn 90320 at 20.766% and 18.192%, respectively. There was also a highly significant effect of growth stage on the percent pre- and post-emergence damping-off infections.On the three-factor interaction, the Seedling Stage was the most susceptible stage of peanut to pre-emergence damping-off while Full Pod Stage was the most susceptible to post-emergence damping-off, stem rot, and pod infections.The highest yield of 1,447.7 kg/ha was recorded from variety PSB Pn 1 inoculated with *S. rolfsii* at full pod stage.The three-factor interaction effectwas found to have no significant difference on yield. However, the same interaction caused a significant effect on the percent pod infection of the three peanut varieties.

Keywords: *Sclerotium rolfsii*, inoculation, peanut, varietal resistance, yield

AS - 15

SCREENING EGGPLANT GERMPLASM FOR DROUGHT TOLERANCE UNDER GREENHOUSE CONDITION

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Drought stress can adversely affect the plant morphology, physiological processes and potential fruit yield of hardy vegetable crops like eggplant (*Solanum melongena* L.). The threat of climate change has made it imperative to develop new eggplant varieties for drought-prone environments. One hundred eggplant genotypes consisting of commercial varieties and different species from the national eggplant germplasm collection were screened for drought tolerance under greenhouse conditions. Greenhouse experiments were conducted in batches with two commercial varieties (Dumaguete Long Purple and Mistisa) as controls. Three-week old seedlings were transplanted to 16 liter-plastic pails containing 10 kilograms soil. Drought was imposed on 6 week-old seedlings by discontinuing irrigation for drought treatment and regular watering for the well-watered treatment. The top 20% and the lowest performing entries for each batch were included in a verification trial in order to identify possible parental materials. The performance of 27 selected genotypes together with the check varieties was reassessed under drought condition in the greenhouse. These genotypes differed significantly in terms of measured morphological and physiological traits. Wide variation in stomatal conductance, an indication of stomatal opening under stress, was observed with values ranging from 64.02 – 294.49 mmol/m^2s. The relative leaf water content (RWC) of the entries also differed significantly with RWC values of 43 to about 100% under drought. On the other hand, the root shoot (RS) ratio values showed entries with high dry matter allocation to the roots. Moreover, root dry weight values ranged from 0.12 to 1.72 g $plant^{-1}$. The significant variation among eggplant genotypes under drought condition indicated opportunities for the development of drought tolerant eggplant varieties.

Keywords: eggplant, drought, germplasm, breeding, root morphology

AS - 16

DETECTION OF CAPRINE ARTHRITIS ENCEPHALITIS (CAE) VIRUS IN BLOOD SAMPLES BY LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) ASSAY

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Caprine arthritis encephalitis (CAE) virus, of the subfamily Lentivirus of the Retroviridae causes persistent disease which is characterized by polyarthritis and mastitis in adult goats and progressive paresis (leukoencephalomyelitis) in kids. This is transmitted mainly through ingestion of virus-infected colostrum and by direct contact. A loop-mediated isothermal amplification (LAMP) assay was developed for the detection of caprine arthritis encephalitis (CAE) virus using blood samples. Species-specific primers amplifying the *gag* gene of the proviral region were used to detect CAE virus. The LAMP reaction result was obtained 60 minutes after incubation at a constant temperature of 63^{o}C in a heating block. Resulting amplicons of the assay were visualized by addition of SYBR green dye after the reaction and by agarose gel electrophoresis. The sensitivity of LAMP assay was evaluated by comparing its result with nested-PCR. Based on the experiments, the result of the assay indicates a rapid and sensitive test for the detection of CAE virus.

Keywords: loop-mediated isothermal amplification (LAMP), caprine arthritis encephalitis (CAE) virus, proviral region, nested-PCR

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DEVELOPMENT OF LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) PROTOCOL FOR RAPID DETECTION OF WHITE SPOT SYNDROME VIRUS (WSSV) IN SELECTED SITES OF THE PHILIPPINES

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Shrimp disease outbreaks in the Philippines have remained uncontrollable because disease diagnostics is inaccessible to most shrimp farmers. A new technology known as loop-mediated isothermal amplification (LAMP) is a practical alternative for rapid detection of viral and bacterial pathogens. This assay is performed under isothermal condition using four sets of primers that target six distinct regions in the DNA template. In this study, loop mediated isothermal amplification protocol for detection of WSSV was developed which we hope to bring to the farmer's level. Asymptomatic *Litopenaeus vannamei* samples were collected from selected sites (Iloilo, Batangas, Bulacan, Laoag, and Leyte) were tested for WSSV infection using LAMP. Results showed that samples from Iloilo, Batangas, Bulacan, and Leyte were positive for WSSV infection, while shrimps collected from Laoag were found to be WSSV-free. LAMP assay was performed along with the conventional PCR method for further confirmation and detection. Temperature range of 55p C - 68p C for WSSV detection and incubation period of 45 minutes to 1 hour were shown to be viable conditions for the LAMP assay. The detection of WSSV using LAMP was found to be 10 times more sensitive than PCR. These results suggest that LAMP protocol can serve as a good alternative for the conventional PCR due to its higher sensitivity, speed, and practicality because it does not need an expensive thermal cycler. This can make pathogen detection accessible to small scale shrimp industries in the country.

Keywords: LAMP, WSSV, PCR, *Litopenaeus vannamei*, shrimp

AS - 18

GENOTYPING AND MOLECULAR CHARACTERIZATION OF NRAMP1/-2 GENES AS LOCATION OF MARKERS FOR RESISTANCE AND/OR SUSCEPTIBILITY TO *Mycobacterium bovis* IN SWAMP AND RIVERINE WATER BUFFALOES

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Natural resistance-associated macrophage proteins (*NRAMP*) is associated with disease resistance across animal species. It plays a critical role in innate immunity and adaptive immunity. This study investigated the contribution of *NRAMP1* and *NRAMP2* to the resistance or susceptibility of water buffalo to *Mycobacterium bovis* infection. Water buffaloes were TB tested by single intradermal tuberculin test (SITT) using Bovine antigen. Animals which reacted to SITT were subjected to comparative intradermal tuberculin test (CITT). NRAMP genes were then further examined by PCR and single strand conformational polymorphism (SSCP) assay. The isolated genes were also cloned and sequence to confirm the nucleotide polymorphisms. Nucleotides were assessed by sequence alignment. The SSCP result showed that among the reactor and non-reactor animals to intradermal tuberculin test, four conformational patterns were observed in *NRAMP1* while two conformational patterns in *NRAMP2*. SSCP showed that the frequency of occurrence of four-band pattern were mostly from the reactor animals (66.41%). Sequence alignment clearly established the nucleotide polymorphisms between the conformational patterns. This study suggests that these polymorphisms are potential markers for resistance or susceptibility to Mycobacterium infection. The findings regarding the allelic patterns comparing the reactor and non-reactor water buffaloes will be very useful in future breeding plan for the selection of TB resistant animals.

Keywords: *NRAMP1*, *NRAMP2*, water buffalo, Mycobacterium, disease resistance, disease susceptibility

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VALIDATION OF CATTLE DNA MARKERS FOR GENETIC DEFECT SCREENING IN WATER BUFFALOES

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Genetic defect screening is one of the important techniques contributing to the advancement of livestock industry. It involves a systematic method of determining genetic or inherited aberrations affecting different species of animals. Here, the use of DNA markers established for screening genetic defects in cattle, *i.e*. Bovine leukocyte adhesion deficiency (BLAD), Deficiency of uridine monophosphate synthase (DUMPS), citrullinemia and freemartinism, were applied to water buffaloes accordingly. Evidences on the genomic relatedness of cattle to water buffaloes would guide the use of the more established genetic information of cattle on buffaloes. PCR and restriction fragment length polymorphisms (RFLP) were utilized to identify the inherited heterozygous and recessive allele conditions. DNA sequencing was also performed to verify the PCR products identifying the specific base change. Apparently, the mutation lethal in cattle was found in normal buffaloes for BLAD; thus, the established target gene markers for cattle may not be suitable for water buffaloes. Nevertheless, this study emphasizes the effectiveness of cattle gene markers for DUMPS, citrullinemia, and freemartinism for genetic defect screening applications on water buffaloes. Therefore, this study leads to having a standard molecular method for breeders in screening the animals at risk for the defects and identify carriers to eliminate recessive defect genes in the Philippine livestock.

Keywords: genetic defect screening, Philippine Carabao Center, BLAD, DUMPS, citrullinemia, freemartin

AS - 20

SINGLE NUCLEOTIDE POLYMORPHISMS IN THREE GENES OF THE WATER BUFFALO (*Bubalus bubalis)* ASSOCIATED WITH MILK YIELD AND MILK COMPONENT TRAITS: THEIR IMPLICATION TO THE PHILIPPINE CARABAO CENTER'S DAIRY BUFFALO BREEDING PROGRAM

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Selection of dairy buffalo cows by the Philippine Carabao Center (PCC) involves collecting milk performance data for 2-3 lactations prior to ranking them based on the milk production, a process which requires 6-7 years to identify a good milker. In the case of bulls, milk performance data of daughters are first evaluated, requiring around 8 years to identify animals with high genetic merit. Using available performance records coupled with deoxyribonucleic acid (DNA) markers (i.e., single nucleotide polymorphisms, SNPs) associated with milk traits, identification of good dairy animals can be dramatically shortened to 2- 3 years while increasing the accuracy of selection. Thus this study sought to identify water buffalo SNPs associated with milk yield and milk component traits. DNA samples of buffalo cows with milk performance data were used in the study. Since the buffalo genome has not yet been sequenced, primers used to amplify the coding regions were based on the gene sequence of cattle. Association studies revealed that the combined effect of three SNP markers found in beta-lactoglobulin, protease inhibitor and prolactin receptor genes have favorable association with milk yield, fat yield, protein yield, milk protein, and milk fat percentages. Only young semen donor bulls with high genetic merit that carry the favorable genotypes of the three markers will be used for breeding immediately rather than wait for progeny testing (PT), thereby reducing the number of bulls entering the PT program, resulting in lower investment costs in the long term.

Keywords: water buffalo, milk production, DNA, SNP, breeding program

AS - 21

VACCINE TRIAL OF RECOMBINANT *Schistosoma japonicum* PARAMYOSIN IN WATER BUFFALOES

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The overall aims of this project are to assess the safety and immunogenicity of the *Schistosoma japonicum* vaccine Paramyosin among water buffalos residing in endemic areas. The study was conducted in four villages in Leyte, an area highly endemic for *S. japonica*. One hundred fifteen animals provided baseline stool samples for coprologic examination, with preliminary results using FLOTAC showing a 10% prevalence of schistosomiasis. Forty-nine animals were treated with 25 mg/kg Praziquantel, and 40, 36 and 32 animals were given the first, second, and third dose of the paramyosin vaccine, respectively. The safety trial involved the first 20 animals and included skin testing, vaccination, anaphylaxis monitoring, and hematology and serum chemistry analysis. None of the animals exhibited anaphylaxis, and all hematology and serum chemistry markers were within normal range or were similar to pre-vaccination levels. Immunogenicity assessment showed that the paramyosin vaccine induced robust antibody responses to all animals, as assessed by ELISA. Overall, this project demonstrated that the *S. japonicum* paramyosin vaccine is safe, well-tolerated, and immunogenic among water buffalos residing in endemic areas. Moreover, the outcome of this work shows promise for the development of a schistosoma vaccine for humans.

Keywords: *Schistosoma japonicum*, paramyosin, vaccine, immunogenicity, water buffaloes

AS - 22

DETECTION AND ISOLATION OF *Fusarium* spp. CAUSING DEGNALA DISEASE IN WATER BUFFALOES

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Degnala disease is an endemic, more or less fatal disease of water buffalo. This disease characterized by necrosis, followed by gangrene of body appendages. The animal becomes weak and emaciated, but also becomes crippled, causing enormous economic losses due to decreased productivity and functional capacity in the form of reduced milk production and draught capacity. This disease is believed to be caused by mycotoxicosis resulting from ingestion of contaminated feeds with *Fusarium* spp. which are opportunistic nosocomial pathogen often fatal invasion mycoses. A total of three animals were found suffering from necrotic lesions on feet and between digits. Moreover, gangrenous ulceration of the earlobes and tail rot were observed. This study aimed to identify the causative agent by performing differential diagnosis, such as ELISA and conventional serological tests for viral and bacterial diseases, as well as plate culture for fungal isolation. The result showed negative from various tests. However, a *Fusarium* species was isolated from the rice straw fed to water buffaloes and clearly identified by staining and direct microscopic exam. The *Fusarium* species was recognized based on colony and presence of multiseptated sickle-shaped conidia. This finding confirmed the presence of Degnala disease caused by the mycotoxicosis produced by *Fusarium* spp. It is recommended to avoid feeding mouldy rice straw in buffalo. However, further field and laboratory investigation are needed to understand the mycotoxin involved in producing Degnala disease.

Keywords: Degnala disease, *Fusarium* spp., Water buffalo, mycotoxicosis

AS - 23

PARENTAGE VERIFICATION USING MICROSATELLITE MARKERS IN WATER BUFFALOES (*Bubalus bubalis)*

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Generation of breeding values requires accurate recording of sire, dam and offspring in the pedigree or herd registry. Misidentification of an animal may give undue credit to a wrong bull thereby affecting the breeding value prediction. Verification of pedigree lines is very important, particularly for those who avail of the many breeding technologies in livestock that have been developed and are being widely used today (such as artificial insemination and embryo transfer). The advent of DNA marker technology, in particular analysis using microsatellite (MS) markers, offers several advantages over conventional parentage testing systems. This study sought to identify polymorphic microsatellite markers that can be used for routine parentage verification of Philippine buffaloes. Out of 75 cattle MS markers genotyped by fragment analysis, twenty markers were found to be polymorphic in Philippine Carabao Center's dairy buffalo population. These twenty markers - FBN12, BM1706, CSSM047, INRA006, RM372, RM209, MB101, RM04, BMS1001, MAF65, ILSTS012, BMS555, MAF45, TGLA227, CSSM019, BM8129, BOVILS30, BMS2152, CSSM037 and TGLA73 - had a PIC value greater than 0.5 and heterozygosity values greater than 0.6. Paternity analysis using at least twelve markers with the aid of the Cervus 3.0 software resulted in the identification of the most probable sire (out of several candidate males). Moreover, parent pair analysis with known sexes resulted in the identification of the most likely dam (out of four possible females) and sire (out of four possible males) of an embryo transfer (ET) calf.

Keywords: water buffalo, parentage verification, DNA, MS marker, paternity analysis

AS - 24

CHARACTERISITICS OF ST. CROIX PROGENIES

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Sheep is the least developed among the livestock industry. Smallholder farmers raise it to supplement their family income. The low productivity of sheep can be attributed to poor genetic quality, poor nutrition, and poor management practices. Genetic quality can be improved through breeding using improved breed. St. Croix has been reported as adapted to tropical condition, fertile, and resistant to parasites. It has no horn, long tail and is pure white in color. This study was conducted to evaluate the reproductive performance of the parental stocks using their offspring. Two groups of ewes and two purebred St. Croix rams were used. Flock mating system was practiced. All animals were fed by combined grazing and cut and carry feeding system. F1 lamb had an average birth weight of 2.34 kg, average weight at 8 months of 17.02 kg, sex ratio of 1.48, twinning percentage of 25.5% and percent mortality of 8.75%. The color of the lamb produced varied from pure white, pure brown, 50% white and 50% brown, 90% black and 10% white. Male lamb produced had horns and all the lamb produced had long tails. Physical characteristics of of the male parent dominantly showed in the progenies like color and the size of tail.

Keywords: Lamb, sheep, St. Croix, progeny, F1

AS - 25

EGG PRODUCTION RATES OF THREE CALANOID COPEPOD (CRUSTACEA, COPEPODA) SPECIES FROM A SARDINE FISHERY SITE OFF DIPOLOG CITY, ZAMBOANGA DEL NORTE, PHILIPPINES

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Sardines are important fisheries species in the Philippines. These species are primarily zooplanktivorous in almost all their life stages, but studies on their zooplankton prey are very rare. Many studies point to the fact that prey population dynamics are strongly linked with positive recruitment and reproduction in many of subtropical and temperate sardine species. This study determined egg production rates of three copepod species from a sardine fishery site off Dipolog City. Females of *Cosmocalanus darwini*, *Subeucalanus* sp., and *Paracalanus* sp. were fed singly or a mixture of the microflagellate *Isochrysis* sp. and the chain-forming diatom *Chaetoceros* sp. for 12 hours, and their egg production rates were determined. Compared with copepods in the control (unfed) group that showed mean egg production rates of 0-4 eggs female^{-1} day^{-1}, all three copepod species fed singly with *Isochrysis* sp. showed highest mean rates of 7-12 eggs female^{-1} day^{-1}. Highest egg production rates may be related with high polyunsaturated fatty acid content in *Isochrysis* sp., which is essential for the growth and egg production of these copepod species.

Keywords: copepods, egg production, *Cosmocalanus darwini*, *Paracalanus* sp., *Subeucalanus* sp., *Isochrysis* sp., *Chaetoceros* sp.

AS - 26

SPECIES OF MYSIDS (CRUSTACEA, MYSIDACEA) IN SEAGRASS BEDS OF MISAMIS OCCIDENTAL, NORTHERN MINDANAO, PHILIPPINES

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Tropical seagrass beds are important coastal ecosystems as habitat, nursery and spawning grounds for many ecologically and commercially important shellfish and finfish species, but studies and information on the prey of these fishes, the seagrass zooplankton, are scarce. An indicator of a healthy seagrass bed ecosystem - mysidacean shrimps - are very common resident seagrass zooplankton that trophically link small zooplankton and finfish species. This study was conducted to identify and classify the different mysid species collected from seagrass beds of seven municipalities of Misamis Occidental. Eight species were identified, and all species were found to be new records from the study area. All under Family Mysidae, Subfamilies Siriellinae, Gastrosaccinae, and Mysinae were represented respectively by *Siriella gracilis* and *S. sinensis*; *Anchialina grossa, Haplostylus bengalensis*, *Haplostylus* sp., *Iiella ohshimai* and *Pseudanchialina inermis*; and *Mesopodopsis* sp. *Siriella sinensis* was present in all sampling sites. *Haplostylus* sp. and *Mesopodopsis* sp. are possible new species.

Keywords: seagrass ecosystem, zooplankton, Mysidacea, taxonomy, Misamis Occidental

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POPULATION OF JANITOR FISH (*Hypostomus plecostomus*) IN PULANGUI LAKE, BUKIDNON, CENTRAL MINDANAO

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A study on the population of janitor fish (*Hypostomus plecostomus*) in Pulangui Lake, Bukidnon was conducted with the aim to determine the population level of janitor fish and its effect on the fishing gears of the fishermen. Specifically, this study sought to: 1) determine the percentage composition of janitor fish in the gillnet catch; 2) determine the Catch Per Unit Effort (CPUE) for the janitor fish in the lake; and 3) describe the gillnets of fishermen reported damaged by the janitor fish. Two study sites were chosen situated at Dologon and Tubigon, both in Maramag, Bukidnon, with 3 sampling periods in both study sites. There were 46 fishermen respondents: 26 in Station 1 (Dologon) and 20 in Station 2 (Tubigon). The study showed that the janitor fish was a minor component of the total catch (8.23%) and a CPUE of 0.298 (kg/person/gillnet/trip). A total number of 190 janitor fish was collected during the entire study. Most of the janitor fish collected were 21 - 30cm in length. Characteristic damage made by the janitor fish on the gillnets were in the form of jagged cuts on the nylon strand caused by the spiny hard skin and sharp fins of the janitor fish. Based on the findings of this study, the janitor fish being a minor component of the fish catch is a minimal threat at present. However, like other invasive species, this can be a potential ecological and fisheries problem in Pulangui Lake in the future. It is therefore recommended that population control measures of this fish should be given immediate attention by the concerned authorities. Further study is recommended to include other fish landing areas and longer data monitoring to determine further changes in the population of janitor fish in the lake.

Keywords: population, janitor fish, Pulangui Lake, CPUE

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POPULATION STOCK STRUCTURE OF YELLOWFIN (*Thunnus albacares*) TUNA IN WESTERN AND CENTRAL PACIFIC INFERRED FROM MICROSATELLITES ANALYSIS

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Yellowfin tuna is one of the highly migratory larger tuna species. It is shared by the Philippines with neighbor fishing countries which are likewise highly dependent on the tuna industry for their economy. The sustainable management of tunas, particularly of yellowfin, in the Philippines and in the Western and Central Pacific (WCP) is therefore imperative and this requires an established stock identity. In this study, the population structure of yellowfin tuna in the region was analyzed through 243 individuals from Zambales, Puerto Princesa, Samar, General Santos, and Bismarck Sea using nine microsatellite loci. A significant level of genetic differentiation among the populations was observed ($Fst = 0.1644$, $P < 0.05$). The STRUCTURE analysis revealed that Bismarck Sea samples were different from the Philippine samples. Two divergent stocks in the WCP may exist.

Keywords: *Thunnus albacares*, highly migratory, microsatellite, genetics, population structure

AS - 29

SEVEN SPECIES IN ONE: USING MITOCHONDRIAL DNA TO RESOLVE THE GENETIC IDENTITY OF *DULONG*

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Sustainable management of marine resources requires accurate identification of fish species in all their life stages. Such information is essential for managing biodiversity hotspots, such as the Verde Island Passages in the southern tip of Luzon Island. Among the marine species in the area is a group of small fishes collectively known as *Dulong*. Morphological data from previous investigations concluded that this congener is composed of either the family Clupeidae or Engraulidae in their larval stage. To verify these findings, we utilized partial fragments of the 16S rRNA gene. Seven species from the families Clupeidae, Gobidae and Scombridae were identified among the collections. However, no members of Engraulidae were identified among the samples, possibly due to the seasonality of its abundance. Species distribution and genetic data suggest high connectivity among most sampling sites. Interestingly, individuals collected from the outermost fringes of the Verde Island Passages exhibited different species composition. Such pattern might indicate different ecosystems within this region which merits further investigation.

Keywords: *Dulong*, Clupeidae, 16S rRNA, species composition, connectivity

AS - 30

WATER MANAGEMENT IN BRACKISHWATER FISHPOND: THE METHODS AND PRACTICES OF MILKFISH GROWERS IN PADRE BURGOS, QUEZON

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In brackishwater fishpond culture, water management is the most important aspect of fishpond operation. A sufficient supply of good quality water is essential because it affects production, growth, and survival of fish. This study was conducted to assess the methods and practices involved in water management of brackishwater fishpond. The data can also be used as baseline information for the planning and development of mariculture. This study utilized the descriptive type of research and the survey questionnaire as the main tool for gathering the data. Key informant interviews (KII) and focusedgroup discussions (FGD) were conducted in Padre Burgos, Quezon Province. Results of the study showed that the culture system practiced is the extensive system with 65.71%,followed by semi-intensive 28.57%, and 5.71% for intensive system. The species cultured include: milkfish (*Chanoschanos*), shrimp (*Penaeusmonodon*),mudcrab (*Scylla serrata*),and grouper (*Epinepheluscoioides*). Sizes of fishponds vary from 0.4 to 55.0 hectares per individual fishfarmer.The source of water is through tidal fluctuation, brought into the ponds through river or creek. During low tide, 20 to 50% of pond water is released from pond, and when the tide begins to rise, the gate's slabs are removed and new water is allowed to enter until it reaches the desired water depth (50 - 100 cm) or when the water is fully replaced. Sixty percent of fishfarmers change water daily following the tides; 25.7% changed water twice a week and 14.3% changed the water once a week. Frequent change/freshening of pond water help improved water quality, thus improving fish growth. Maintaining optimum environmental conditions for fish growth is crucial to the success of one's venture in brackishwater fish production and proper water management is of utmost importance.

Keywords: water management; brackishwater fishpond; milkfish growers; methods and practices; Padre Burgos, Quezon

AS - 31

PRODUCTION OF *Porphyra* "GAMET" AND ITS IMPACT TO LIVELIHOOD IN COASTAL AREAS

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Porphyra is the most expensive seaweed produced in Ilocos Norte. It is the most sought-after seaweed locally and internationally, which explains its demand. The *Porphyra* production in Ilocos Norte is confined to gathering that local seaweed from the wild. However, *Porphyra* production has failed to progress from its primitive state due to its age-old method of sun-drying to prolong the shelf life of *Porphyra.* This study highlighted the status of *Porphyra* production and its impact on the livelihood of those who are engaged in the industry. Data were gathered from a semi-structured interview of 57 respondents who have been engaged in *Porphyra* production in Ilocos Norte. The demographic and socio-economic profiles of the respondents and their harvesting and sale practices were determined as frequencies and percentages: Pearson's *r* correlation coefficient and chi square determined the relationship between respondent's practices as to the frequency of gathering. The harvesting practices of *Porphyra* gatherers were: 50-69 gatherings per season; frequency of gathering was five times a week with an average volume of three ganta (1,400 g fresh weight) of *Porphyra* harvested per gathering. Improvement of drying technique of *Porphyra* would increase production and consequently, give higher income to gatherers. It is recommended that the local governments of Burgos and Pagudpud, Ilocos Norte should form a cooperative and acquire mechanical dryers for drying *Porphyra*.

Keywords: harvesting practices, mechanical dryer, livelihood, *Porphyra* production, socio-economics, sun-drying

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GROWTH PERFORMANCE OF RED ALGAE *Gracilaria sp.* USING LONG LINE AND NET CAGE METHOD

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A study was conducted in Simbuco, Kolambugan, Lanao del Norte to: 1) determine the growth of *Gracilaria* sp. in terms of weight (g) and total length (cm) using long line method; 2) determine the growth in terms of weight (g) and total length (cm) using net cage method; and 3) determine the survival rate (%) using long line method and cage method after 45 days and monitor the physico-chemical parameters of the water, such as temperature (^oC), pH, and salinity (ppt). Two treatment methods were used: long line method as treatment (T_1) and net cage method as treatment 2 (T_2). These were arranged in a complete randomized design (CRD) with 3 replications each. There were 3 long line and 3 net cages planted with 20 fragments of *Gracilaria* sp. with an initial length of 15 cm per fragment. Results of the study showed that after 25 days, T_1 had a mean weight (g) of 213.62 while T_2 was only 77.69. After 45 days, the total weight (g) and length (cm) of *Gracilaria* sp. increased with a mean of 347.35 (T_1) compared to T_2 of 83.34 only. Analysis of variance showed that T_1 had significantly higher growth than the net cage method ($P<0.01$). In total length (cm), T_1 had a mean length (cm) of 22.22 while T_2 was only 15.89 ($P<0.05$). However, no significant difference was observed in terms of total length after 45 days of culture ($P<0.05$). A significantly higher survival of *Gracilaria* sp. was observed from T_1 of 18.34 (91.70%) than T_2 of 10 (50%) ($P<0.01$) after 45 days of culture. Mean readings of selected physico-chemical parameters of water were: temperature: 23.5 to 24.6^oC; salinity: 25.0 to 26.5 ppt; and pH: 7.5 to 7.8. Thus, the use of long line method gave higher production than the net cage method. It is recommended that further studies be conducted to compare the floating net cage and submerged net cage methods in terms of growth and survival in the same culture period.

Keywords: growth performance, red algae, *Gracilaria* sp., long line method, net cage method

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ENHANCING THE PRODUCTIVITY OF WHITE CORN THROUGH THE UTILIZATION OF CORN COBS AS POTASSIUM FERTILIZER

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Corn is the second most important cereal crop in the Philippines and the corn industry contributes significantly to the country's economic development. White corn is now being promoted as an alternative staple to rice to supplement the country's food gap. An aspect that can enhance white corn productivity is the effective use of nutrients from agricultural waste, such as corn cobs and naturally occurring indigenous fertilizers. Corn cobs are part of the maize ears that are not utilized for food; these are usually used for cooking fuel or just burned in the field. The mineral nutrients of corn cobs have not been analyzed. In particular, knowledge of the potassium content and the incorporation of corn cobs in the soil as organic fertilizer source (substitute for inorganic source), may mean substantial savings for the corn farmer. This project sought to: 1. compare the cobs from different corn cultivars and their contribution to soil fertility and corn yield in terms of available potassium and other nutrients; 2. to evaluate the effectiveness of corn cobs and ashes when used as K-source for the soil and as foliar spray; and 3. to determine the time required for the potassium to be available for plant uptake in the field. Greenhouse and field experiments were conducted in UPLB, Isabela, and Bukidnon. Preliminary results show that corn cobs are promising materials as potassium source for fertilization of white corn. Ten to fifteen tons cobs per hectare for open pollinated variety, and 20 tons per hectare for hybrids are recommended to provide sufficient K fertilization and rapid growth. Corn fields yielding 6-8 tons grains per hectare can produce 1.5-2 tons cobs/ha at 80% shelling percentage. Ashed corn cobs gave the highest growth and biomass production compared to whole, shredded or finely ground cobs.

Keywords: white corn, corn cobs, potassium fertilization, potassium nutrition, ashed corn cobs

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EVALUATION OF BIO-WASTE MIXTURES AND RATIOS TO IMPROVE ORGANIC FERTILIZER PRODUCTION

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The most eco-friendly option to manage generated biodegradable wastes is to convert these into a valuable resource, one of which is organic fertilizer (OF). However, because of the diversity of these wastes, appropriate mixture combination coupled with the right ratio are necessary considerations in the conversion process because this can facilitate faster decomposition, improve nutrient composition, and offer better recovery rate. Considering these as the criteria, eight mixture combinations and ratios of bio-wastes were evaluated, as follows: OF_1 - 55% plant debris (PD): 35% animal manure (AM): 10% carbonized rice hull (CRH); OF_2 - 35% PD: 55% AM: 10% CRH; OF_3 - 90% fresh plant debris (FPD): 0% AM: 10% CRH; OF_4 - 40% saw dust (SD): 50% AM: 10% CRH; OF_5 - 30% PD: 30% AM: 30% SD: 10% CRH; OF_6 - 40% AM: 50% PD: 10% CRH; OF_7 - 50% AM: 40% PD:10% CRH; and OF_8 – Vermicomposting. Results showed that OF_1, OF_3, and OF_8 are preferred as the best conversion/ production options because these have the highest NPK content (2.15%, 2.00% and 1.95% N, respectively; 3.55%, 3.50% and 1.06% P, respectively; and 1.45%, 2.75% and 2.12% K, respectively); fastest decomposition period (2 to 2.5 months); and highest recovery rate (50 to 70%), except OF_3 which gave only 50%, which is attributed to the composition of the mixture (90% FPD). These also gave better return of investment (ROI) ranging from 37% to 43%. These findings suggest that factors such as different bio-waste materials, mixture combinations, and ratios affect OF production with respect to quality, duration of production, and recovery rate.

Keywords: organic, fertilizer, biodegradable, NPK, decomposition

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ON-FARM PRODUCTION OF VERMICOMPOST AND EARTHWORM BIOMASS (*Eudrilus eugeniae*) FOR NILE TILAPIA (*Oreochromis niloticus*) CULTURE IN FRESHWATER PONDS

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In organic aquaculture, the non-use of chemical fertilizer and fish meal is advocated. Vermicomposting was done using paragrass (*Brachiaria mutica*) and the "African night crawler" (*Eudrilus eugeniae*). The processed grass was stocked in outdoor beds at 100 and 200 kg/m^2 and 1 kg/m^2 of the earthworm. In the first trial, the vermicompost which was obtained after 30 days was applied at 2.5 and 5 t/ha in 200-m^2 freshwater ponds during the 120-day culture of sex-reversed Nile tilapia (*Oreochromis niloticus*) fingerlings stocked at 2/m^2. In the second trial, only application of the vermicompost at 2.5 tons/ha was done in the ponds stocked with the fish at 1/m^2 for 120 days in Treatment I; in Treatment II, the ponds were fertilized with vermicompost at 2.5 t/ha in the first 60 days of culture and feeding of a moist feed consisting of 850 g of fine rice bran and 1 kg of processed earthworm biomass was given to the fish every other day for the last 60 days of culture. The results showed that a production of 41.85 kg of vermicompost and 2.17 kg of earthworm biomass were obtained with 200 kg/m^2 of the processed grass after 30 days of vermicomposting compared to 19.8 kg of vermicompost and 1.05 kg of earthworm biomass with 100 kg/m^2 of the processed grass. In the first trial, the yield of harvestable-sized fish (>50g) was significantly greater ($P<0.05$) in the ponds fertilized with vermicompost at 2.5 t/ha compared to those of the control ponds and ponds fertilized at 5 t/ha. In the second trial, the yield of harvestable-sized fish in the ponds initially fertilized with vermicompost at 2.5 t/ha in the first 60 days and where fish were fed with the moist feed in the last 60 days of culture was 44% more than that of the fish in ponds fertilized only for the whole culture period. The results also indicated that use of vermicompost as organic fertilizer at 2.5 t/ha for 120 days and feeding of the fish with the moist feed in the last 60 days of culture were more cost-effective compared to those of the controls.

Keywords: vermicompost, earthworm, Nile tilapia, freshwater ponds

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SYNERGY EFFECTS OF BIOFERTILIZERS MYKOVAM™ AND BIO-N™ ON GROWTH AND SURVIVAL OF INDIGENOUS TREE SPECIES IN A GRASSLAND IN CAVINTI, LAGUNA

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Indigenous tree species are priority planting materials for the National Greening Program of the Department of Environment and Natural Resources. Areas for reforestation are marginal grasslands where plant growth is stunted and seedling survival is low. BIOTECH's biofertilizers such as Bio-N™ (containing N-fixing bacteria) and Mykovam™ (contains phosphorus and other nutrients absorbing mycorrhizal fungi) can increase seedling growth and survival in such areas. No studies have been done to determine the synergy effects of these biofertilizers on trees. Narra (*Pterocarpus indicus*), salago (*Wikstroemia lanceolata*), kisubeng (*Sapindus saponaria*), and tuai (*Biscofia javanica*) seedlings were either uninoculated or inoculated with Mykovam and outplanted in a grassland in Cavinti, Laguna after four months at BIOTECH, UPLB. Bio-N was added during outplanting. During outplanting, the Mykovam inoculated tuai, salago, kisubeng, narra, and salago exhibited better growth than the control. Mykovam inoculated indigenous tree species were 3 to 26% taller than the control. Four months after outplanting, seedling survival was 100% except the uninoculated salago (5% mortality). Synergy effects of the two biofertilizers were observed on salago and narra. Mykovam+Bio-N increased stem diameter of narra by 53% as compared with Mykovam (32.5%) and BioN (15%). Bio-N+Mykovam promoted the highest number (n=32) of branches in salago followed by those inoculated with Mykovam alone (n=24). BioN promoted the greatest increase in height (17%) of tuai. In kisubeng, Bio-N and Mykovam applied singly gave the greatest increase in stem diameter (20 and 18%, respectively) and the lowest (7%) was in Mykovam+Bio-N treatment. In conclusion, narra and salago inoculated with combined Bio-N™ and Mykovam™ gave the best growth and can be recommended for a successful reforestation in grasslands in Cavinti, Laguna.

Keywords: mycorrhizal fungi, narra, salago, kisubeng, tuai

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UTILIZATION OF WATER HYACINTH DEBRIS AS BULKING MATERIAL FOR COMPOSTING OF MARKET WASTE

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A pilot-scale study was conducted to determine the technical viability of composting technology as an alternative disposal option for large-scale water hyacinth debris. Feedstock materials consisted of chopped, dried water hyacinth (33%), swine manure (10%), and shredded market waste (57%). Dried water hyacinth served as bulking material, swine manure as nitrogen source, and market wastes as wet organic materials. Microbial inoculant was added as a component of the bioreactor composting technology. The composting process was initiated with loading of feedstock materials into the ITDI-developed bioreactor. Partially degraded materials harvested from the reactor were kept in the curing area for further degradation. Based on two pilot-scale runs, the compost produced had the following characteristics: dark brown, humus-like, odorless, pH of 7.9, 37% organic carbon, 14:1 C:N ratio, 12% total NPK, 80% total solids, non phytotoxic, and with acceptable levels of trace elements. These characteristics are indicative of a mature compost product and proved that dried water hyacinth can be an alternative bulking material for composting. Based on the feasibility studies conducted, composting with water hyacinth as dry matter was considered economically viable with an internal rate of return (IRR) of 61.5%. However, the economic viability of composting water hyacinth alone was found even better with an IRR of 85.1% and a lower investment requirement.

Keywords: water hyacinth, composting, in-vessel composting, bioreactor composting, *Eichhornia crassipes*

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ASSESSMENT OF COSTS AND BENEFITS OF A CARBON SEQUESTRATION PROJECT IN MANGROVE PLANTATION

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Payments for environmental services, such as carbon sequestration, propose a win-win solution in climate change mitigation and poverty alleviation. Recognizing the potential economic benefits that can be derived in establishing a carbon sequestration project, a cost and benefit study was done in a mangrove plantation site in northern Bohol, Philippines. Twelve sample plots were established to assess carbon stocks. Three carbon prices were used to determine the net incremental benefits at different ages (15, 20 and 40 years old) of plantations, namely, 10, 15 and 20 USD/ton. Correspondingly, the net present values (NPV) of plantations at different ages and prices were computed. Additionally, the internal rates of return (IRR) were computed for each price of carbon. By estimate, the community will receive negative NPVs if the purpose of the plantation establishment was solely devoted to carbon market at USD 10 per ton and at i = .08. The NPV starts to become positive at USD 15.0/ton at year 20 to 50. At price USD 20, all NPVs are positive. These values indicate that the feasibility of establishing mangrove plantation for carbon market alone is very sensitive to carbon price, *i.e.* at prices below USD 15.0 per ton, the plantation project would not be feasible. Similarly, if the interest rate will increase to 16 percent, the project would become only feasible at price USD 20.0/ton. Consequently, the IRR obtained were 5%, 14% and 50% for prices USD 10, USD 15 and USD 20, respectively. At prevailing market rates of interest at 8.0 percent, the project would not be feasible at USD 10.0 carbon price.

Keywords: carbon stock, conservation, economic value, mangrove plantation, PES

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SEAGRASS CONTRIBUTION TO BLUE CARBON STOCKS IN THE PHILIPPINES

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Like other marine ecosystems, seagrasses play a vital role in enhancing blue carbon stocks. Blue carbon pertains to carbon that is stored and sequestered in mangroves, salt marshes, and seagrass meadows. Seagrasses are ribbon-like subtidal plants that are usually found along intertidal zones, particularly in areas where there is pooling of water during low tide. Globally, they cover 0.1% (18 million ha) and contribute 12% (20 Pg) to the total organic carbon buried in the ocean. To estimate the carbon stocks of a typical seagrass site in the Philippines, standard quadrat sampling was done in Banacon Island, Bohol to collect plant and sediment samples for biomass and carbon density analysis. Banacon Island is the largest man-made mangrove in Asia and is one of the key biodiversity conservation sites in Sulu Sulawesi Seascape. By estimate, seagrass plants contain a carbon stock of about 1.84 tC ha^{-1}. Three seagrass species were identified namely, *Halophila ovalis*, *Cymodocea rotundata* and *Enhalus acoroides*. Among these, *E. acoroides* was the most common. On the other hand, carbon stock in sediment was larger at 57.32 tC ha^{-1}. Contributing much to this value is the thick sediment layer observed that ranged from 56 cm to 100cm. Overall, seagrass meadows of Banacon Island contribute to about 59 tC ha^{-1}, a value that justifies their conservation, in addition to countless ecological services that they also provide to marine organisms and humans. By rough estimate, the Philippine seagrass meadows (27,282 sq km) contain 161 Mt of carbon stock.

Keywords: blue carbon, carbon stock, climate change, forest conservation, seagrass meadow

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TOTAL ECONOMIC VALUATION OF KEY MANGROVE SERVICES IN THE PHILIPPINES: THE CASE OF BOHOL AND PALAWAN

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Total economic value (TEV) was used to estimate the values of different mangrove goods and services in Palawan and Bohol. Contingent valuation method (CVM) and travel cost method (TCM) were done to determine biodiversity and recreational values. Results showed that the highest direct use value per year was estimated at ₱25.521 million for Kamuning site, Palawan compared to ₱21.784 million for Banacon site, Bohol. For both sites, the highest benefit came from shrimp farming with ₱ 8.1 million and ₱ 4.3 million, respectively. Mollusk catch gave higher benefits to Kamuning (₱ 17.65 million per year) than in Banacon (₱ 2.362 million). Benefits from crabs and fish catch were higher in Banacon (₱ 6.6 million and ₱ 3.2 million, respectively) than in Kamuning (₱ 0.604 million and ₱ 0.166 million, respectively). Nipa thatch was the second highest benefit for Kamuning amounting to ₱ 2.4 million. Contingent valuation analysis revealed a willingness to pay (WTP) of ₱ 44/month per individual in both sites. The different factors affecting WTP include education, income and information. Recreation value of mangroves was estimated at ₱ 83,079 in Banacon and ₱ 2,769 in Kamuning. Overall, mangrove forests have multiple benefits to communities. It is important to consider that mangrove management be devolved to local communities for better resource accountability.

Keywords: economic valuation, ecotourism, mangrove, sustainable management, willingness to pay

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MANGROVE COMMUNITY STRUCTURE AS INFLUENCED BY MINING ACTIVITIES IN CLAVER, SURIGAO DEL NORTE

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Surigao del Norte was identified as one of the municipalities with highest mangrove cover in the Philippines. However, the province also has active mining activities as it is blessed with rich mineral resources. The aim of the study was to determine the mangrove structure after decades of mining in the area. Specifically, the objectives were to conduct inventory of mangroves and associated species, biodiversity assessment, vegetation analysis, and regeneration of seedlings and saplings. There were 6 quadrats established with an area of 400 m^2. Within the quadrat, 3 regeneration plots were laid. Biodiversity indices, vegetation analysis and regeneration success were determined. Multivariate analysis was used to generate an ordination of the mangrove community. Bray-Curtis similarity index was constructed and the resulting matrix submitted to single linkage clustering and non-metric multi-dimensional scaling (nMDS). PRIMER 6 and BioDiversity Pro softwares were used in the analyses. The results showed 16 mangroves and 11 associated species observed. Dominance was highest in quadrat 3, Shannon's diversity in quadrat 1 and supported by the rarefaction analysis, evenness in quadrat 4, and species richness in quadrats 1, 2 and 6 with 9 species observed. The species distribution of pooled samples was random (P=0.04). Vegetation analysis revealed 3 species with highest importance values and these were: *Lumnitzera littorea (*68.76%*)*, *Bruguiera sexangula* (44.42%), and *Scyphiphora hydrophyllacea* (40.29%). *Bruguiera gymnorrhiza* gave excellent seedling regeneration. All saplings gave poor regeneration condition. Similarity index revealed quadrats 4 and 5 separated from other groups at 87.7%, followed by quadrats 1 and 2 at 67.6%. The matrix was projected into nMDS overlaid with biodiversity indices showing 0.01 stress value.

Keywords: biodiversity, assessment, multivariate analysis, regeneration, importance values

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BANAHAW DE DOLORES AFTER FIVE YEARS OF RESTRICTED PUBLIC ACCESS: ITS WATER QUALITY AND SOCIO-ECONOMIC STATUS OF THE COMMUNITY

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In 2004, certain areas of Mount Banahaw were declared closed to public access by the Protected Area Management Bureau of the Department of Environment and Natural Resources(PAMB-DENR). This declaration was made to restore the ecosystem integrity from the deterioration caused by unregulated human activities. As a major watershed in Quezon and Laguna, this resource needs restoration activities to ensure that the water sources in the area can regain their intended use before it is re-opened to the public. Water quality assessment was conducted in the three major water sources (Kristalino, SalamingBubog and Suplina Falls) in the closed area from September 2010 to August 2011 using physical and bacteriological parameters. The impact of closure on the socio-economic of Barangay Kinabuhayan, the community nearest to the closed area, was also determined. Results revealed that water from Banahaw de Dolores was generally cold (18.2ºC-21ºC) with near neutral pH (6.37-7.76) and low levels of chemical contaminants (43.1-45.4 ppm total dissolved solids, TDS). Coliform analysis showed that SalamingBubog Falls has overall status of Class AA, while Kristalino Falls and Suplina Falls have Class Astatus based on the water quality criteria set by DENR. This indicates that the water sources have regained their beneficial use as public supply of water after five years of moratorium.Survey showed that 93% of the households in the community are dependent on the mountain for their livelihood. Because farming activities were not affected by the closure, only 12% of the residents (porter/guide and store owners) reported a decrease in income due to the moratorium.Despite the perception among residents that closure did not affect their living condition,data indicated that 60% of themremained below the poverty line based on the 2011 poverty threshold. It is recommended that the local government of Dolores should initiate livelihood programs to empower the community through income diversification.

Keywords: Barangay Kinabuhayan, Mt. Banahaw de Dolores closure, water quality, socio-economic, protected area

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WATERSHED CHARACTERISTICS AND WATER RESOURCE QUALITY

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Understanding the watershed, determining what needs to be restored and protected requires an understanding of its natural features, how it is used and its environmental quality.The study was conducted in the Parang River Basin, Pasuquin, IlocosNorte to determine the watershed characteristics and its water resource quality, specifically the following:area length of the main stream, slope of the main stream, perimeter of the watershed, length of the streams, stream density, stream orders, length of perennial streams, drainage area and density, stream frequency, basin relief, and the ruggedness number.Interviews were also conducted among the residents of the area. Each age group was represented and was randomly selected from the population.Research results revealed that the Parang River Basin has been used for irrigation, drainage, and recreation for several centuries, despite having a high level of salinity (2000.0 milligram per liter electrical conductivity (EC) or ppm), compared to the threshold level of less than 1000.0 ppm EC. It must be noted that the basin is 7.0 km from the coastline; however, the tip is atPapatawen Falls of the same barangay. Papatawen Falls is very saline, 4000.0 ppm EC and the drainage area is the Parang River. The river basin has a 150 ha service area.Existing deep and shallow tube wells used by farmers had an alarming salinity level at an average of 1500.0 ppm EC. Watershed characteristics measured are within the normal values.Comprehensive research studies on surface water management strategies are recommended to determine possible mitigation strategies.

Keywords: river basin, watershed, water quality, Ilocos Norte, water resource

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WATERSHED VULNERABILITY ASSESSMENTS OF MAKILING-BANAHAW GEOTHERMAL AREA, PHILIPPINES

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CHEVRON Geothermal Philippines Holding Inc. (CGPHI) is operating within watershed areas that are supporting multiple uses other than geothermal power generation. This is the first study that undertake an assessment of environmental conservation areas and practices that would enable CGPHI management to plan and implement specific interventions and provide key information on environmental conservation areas and practices within the ecological influence areas using remote sensing/GIS and rapid watershed appraisals. The study revealed that Mak-Ban area straddles seven sub-watershed areas that drain from Mt. Makiling and Mt. Bulalo towards the southern shores of Laguna Lake. Greater proportion of the ecological influence areas are covered with vegetation canopies ranging from low to high density. The vegetation cover and land use in the area includes intact natural forests (mossy forest, lowland dipterocarp forest), secondary forests, coconut plantations, fruit orchards, banana plantations, as well as grassland areas. The study also revealed that it is considered critical areas because of elevation and slope are the upper slopes of Mt. Makiling, Mt. Bulalo and Mt. Olila. Relatives to CGPHI facilities, all slopes of Mt. Bulalo poses threat, with the greatest towards the western slopes because of more facilities that would be affected. Vegetation cover can help mitigate the risks inherent in steep areas and good things about the steep areas around CGPHI is that they are currently under vegetation cover, except for Mt. Bulalo, whose summit areas are degraded as well as its southern slopes.

Keywords: CGPHI, ecological influence areas, environmental conservation practices, forest-based cropping systems, watershed vulnerability

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GROWTH PERFORMANCE OF BATINO (*Alstonia macrophylla* L.) INOCULATED WITH DIFFERENT MYCORRHIZAL FUNGI UNDER NURSERY AND FIELD CONDITIONS

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The Caliraya-Lumot-Cavinti watershed area needs immediate reforestation in order to sustain the water required for the hydroelectric power. The soil has a pH of 3.5-5.5, and is deficient in nutrients, in particular nitrogen and phosphorus. Thus, the growth of plants is stunted. Arbuscular mycorrhizal (AM) fungi play an important role in promoting growth and seedling survival in this type of soil condition. Batino (*Alstonia macrophylla* L.) is a fast growing indigenous tree species with good wood for a variety of wood products. However, it is not known which AM fungi are most suited for batino. One month-old batino seedlings were inoculated with ten AM (unidentified species under the genera *Glomus*, *Acaulospora* and *Enthrophospora*) fungi including Mykovam™. The growth of this reforestation species was monitored for four months at BIOTECH's nursery, UPLB and then outplanted in a grassland in the Caliraya-Lumot-Cavinti watershed area following RCBD. Under nursery conditions, the growth of seedlings mycorrhizal with eight out of ten AM fungi studied was better than the control. Under field conditions, the top four AM fungi that promoted higher height increment were: Surigao (2.16x), G19 (2.12x), Mykovam™ (2.05x) and G49 (2.01x), compared to the control (12cm). The KFRI fungus gave lower (-7%) height and stem diameter increment than the control. Surigao increased stem diameter increment by 4.07x, G19 by 4.25x, Mykovam by 4.52x, and G49 by 3.92x, over the control (3.54cm). Mykovam gave the highest leaf and root P concentrations and the lowest was the control. In conclusion, AM fungi coded as Surigao, G19, G49 and Mykovam™ can be used to inoculate batino seedlings for reforestation in grasslands in the Caliraya-Lumot-Cavinti watershed area.

Keywords: *Glomus*, *Acaulospora*, *Enthrophospora*, biofertilizer, Mykovam™

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GROWTH RESPONSES OF KAWAYAN TINIK *(Bambusa blumeana)* SEEDLINGS USING DIFFERENT LEVELS OF BAMBOO BIOCHAR AND ORGANIC FERTILIZER

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The ever increasing demand for bamboo, particularly for kawayan tinik or *Bambusa blumeana*, along with the very limited number and poor quality of bamboo poles available to supply the bamboo industry has made it imperative to enhance bamboo productivity through the use of high quality bamboo planting materials to produce good quality poles for the bamboo industry. The production of quality planting materials is affected by various factors which influence the growth and development of the seedlings. The use of organic fertilizers and soil enhancers are necessary to improve growth and survival of bamboo seedlings. This study aims to: (1) determine the effect of bamboo biochar in the growth of kawayan tinik seedlings; (2) determine the effect of bamboo biochar to the soil as conditioner; and (3) determine and recommend the best level of mixture of bamboo biochar and organic fertilizer. The experiment was laid out in randomized complete block design (RCBD) with four replicate and four treatments. Bamboo biochar has been found to have an influence in the growth and survival of the bamboo seedlings. Seedling grown in pots with a combination of ¾ bamboo biochar and ¼ organic fertilizer had the highest growth measurements and survival counts compared to the other treatments. The same treatment had also a significant impact in terms of the soil's chemical properties, specifically on the increase of macronutrients (NPK) and organic matter content. The best potting mixture combination for the rapid increase in growth and survival of bamboo seedlings was the combined effect of ¾ bamboo biochar and ¼ organic fertilizer for the production of high quality bamboo planting materials.

Keywords: bamboo, biochar, soil conditioner, chemical properties, organic fertilizer

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INFLUENCE OF WATERING REGIMES TO THE ROOTING PERFORMANCE OF BANABA (*Lagerstroemia speciosa* Linn.)

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Banaba tree is used to beautify parks due to its attractive flowers and medicinal value. A study was conducted to evaluate its rooting performance under various watering regimes. It was carried-out in a randomized complete block design with four replications. Treatments include daily watering (T1), watering every 3 days (T2), watering every seven days (T3), and watering once the plants show signs of wilting (T4). Two-month old seedlings with average height of 8 cm were potted in 5" x 7" polyethylene bags using loamy soil. Initial data were taken from the seedlings prior to the establishment of the study. Findings revealed that water stressed treatment (T4) had the highest length gain of the primary root at 3.225 cm. On the other hand, T1 had the lowest at 0.663 cm. Regarding percent survival, no significant difference was shown among treatments but T1 was highest at 90 % while water stressed treatments (T3 and T4) were lowest at 80 %. In terms of the number of lateral roots, treatments under water stress (T3 and T4) had slightly higher production with 4.24 and 4.07, respectively, while, the daily watering (T1) had only 4.06. On shoot-root ratio, significant differences were observed among treatments with the water stressed (T4) having the greatest at 1.308. Root-shoot ratio of T1 was 0.968 while T3 and T4 had 0.915 and 0.865, respectively. Findings imply that water-stressed plants concentrated more of its growth development on the root system rather than on the above ground parts. Root-shoot ratio is usually correlated with seedling quality. For forest trees, potential seedlings for planting must have a root-shoot ratio between 0.5 to 1.

Keywords: *Lagerstroemia speciosa*, water stress, watering regimes, rooting performance, root-shoot ratio

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WOOD ANATOMY OF NATURALLY GROWN PHILIPPINE TEAK (*Tectona philippinensis* Benth. & Hook. *f.*)

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Filipino scientist and educators intend to utilize fully the country's endemic forest tree species like Philippine teak (*Tectona philippinensis* Benth. & Hook. *f.*) of the family Verbenaceae. The species is predominantly found in dry and exposed ridges of Lobo, Batangas. The wood of Philippine teak is classified as comparatively heavy and durable and can be a substitute for molave (*Vitex parviflora* Juss.). The residents of Batangas utilize them for posts and general construction often substituting it for molave. Its potential as first class timber has not yet been investigated. Studies of the basic wood anatomical and morphological characteristics will lead ultimately to the optimum utilization of the species. Macroscopic observations and other physical attributes showed that the wood of Philippine teak is light yellow, grain is slightly wavy and texture is fine, glossy, hard, and heavy. Fiber mensuration indicates that Philippine teak is medium-sized and thin-walled. Rays are observed to be of two kinds: uniseriate and multiseriate and are classified as extremely low. Philippine teak wood can be differentiated from teak (*Tectona grandis* L. *f.*) with the former having smaller pores and thinner rays. The most common anatomical features of the two *Tectonas* are the presence of whitish deposits and tyloses. Being heavy and hard wood species with relative density at 0.710 is an indicator that Philippine teak has strong potential for structural timber. This study addresses a gap in technical information that will lead to harness the potential of the Philippine teak, lead to establishment of plantations to maximize the full utilization of Philippine teak, not only in raw form, but also in engineered and other finished products.

Keywords: *Tectona*, Philippine teak, Lobo, Batangas, wood anatomy

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PHENOLOGY AS TOOL IN PREDICTING PEST INCIDENCE OF ILOCOS WHITE GARLIC IN ILOCOS NORTE

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The study on the phenology and pest incidence at different phenophases of Ilocos white garlic was conducted to determine the appropriate time of applying pest management strategies based on the phenological events of this crop. Purple blotch (*Alternaria porii*) and Cercospora leaf spot (*Cercospora duddiae*) began to have a slight damage as early as the development of the 10^{th} leaf (later part of bolting stage) and 11^{th} leaf (early part of pre-harvest stage), respectively when there was an occurrence of rainfall or when relative humidity was $\geq$88%. These diseases spread rapidly reaching a very high level of damage when the relative humidity was consistently higher than 90% but did not progress rapidly when the relative humidity was below 85%. Likewise, these diseases occurred with slight damage during the development of the 15^{th} leaf (later part of pre-harvest stage) when the relative humidity was consistently below 85%. There was no occurrence of these diseases during the vegetative and early bolting stages of the plants even if there was high relative humidity (>90%) and occurrence of rainfall. Mite damage (called tangle top) appeared as early as the development of the 4^{th} leaf (vegetative stage) when there was a change (low to high) in air temperature of about 1^{o}C or more.

Keywords: phenology, pest management, garlic, diseases, phenophases

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ENVIRONMENTAL FATE OF LAMBDA CYHALOTHRIN IN LOWLAND RICE AREA

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The use of insecticides in lowland rice farming is considered as a major contributor to contamination of the environment. It is therefore of utmost importance to determine the environmental fate of insecticides for the formulation of effective water management practices in order to minimize its adverse effect on the environment and to the community. Paddy plots with dimensions of 12m x 12m were setup for this experiment and were sprayed with lambda-cyhalothrin insecticide. Water samples were collected on day 1, 2, 3, 5, 9, and 14 after the insecticide application. Samples were brought to the National Pesticide Analytical Laboratory for analysis. The results reveal that there is a non-linear trend in the decrease of lambda-cyhalothrin insecticide concentration in the paddy water. One day after the application, the insecticide concentration in the paddy water was reduced by 35.52% from the initial concentration. Two and three days after the insecticide application, the concentration was reduced by 97.75% and 98.42%, respectively. On the fifth day, there was no more insecticide residue found in the paddy water. Hence, in order to prevent or minimize insecticide contamination of bodies of water near the paddy field areas, lowland rice farmers should ensure that the paddy water is properly contained and should not be drained from the field up to five days after the application of insecticide.

Keywords: environmental fate, irrigated rice area, insecticide concentration, lambda-cyhalothrin, water management practices