

AGRICULTURAL SCIENCES

AGRICULTURAL SCIENCES DIVISION

AS-01

MANAGEMENT PRACTICES OF GROUPEL CAGE CULTURE IN NEGROS OCCIDENTAL

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The study was conducted to evaluate the farming practices of 68 grouper cage growers in the four grouper growing LGUs in Negros Occidental. A research questionnaire was formulated to investigate the farming practices from stocking until harvest and marketing. The purpose of the study was to provide insights about the strengths and weaknesses of grouper cage culture. It further paves the way for an effective management and production intervention in the context of sustainable aquaculture. The data gathered can be used as a baseline reference for the local government units and concerned government agencies to promote long term livelihood opportunities for small scale fish farmers. Results showed that the industry is still dependent on wild caught grouper fry with poor survival rates. Relatively large number of farmers stocked their cages at low stocking density and still used trash fish as food for the fish. Almost all farmers revealed that mortalities do occur in their cages which were attributed to poor environmental conditions and diseases. Also, majority of the farmers had limited technical knowledge on husbandry and health management resulting to low production. This study suggested that practical training courses on grouper culture should be initiated by the academe in collaboration with the LGUs and other government agencies to enhance competencies in managing grouper cage culture.

Keywords: management practices, grouper cage culture, stocking, feeding, sampling, monitoring of water parameters, disease control and prevention, harvesting

AS - 02

**FINANCIAL ANALYSIS AND RISK
ASSESSMENT OF GROUPER CAGE CULTURE SYSTEMS
IN NEGROS OCCIDENTAL**

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The study assessed the financial and risk exposures of grouper cage farming in Negros Occidental. Through survey questionnaires administered to 68 grouper cage growers in the four grouper growing areas in Binalbagan, Himamaylan, Hinigaran, and Sagay, the study appraised the feasibility and viability of grouper cage farming and established a benchmark for cage farmers in making crucial investment decisions in mariculture development. Data on the financial analysis and risk indicators were analyzed using the mean, range, and standard deviation. Data were presented by province and by LGUs. Results of the study showed that a return of investment (ROI) of 29.95% was realized which was far behind the ROI of some aquaculture projects like shrimp hatchery (40%) and grouper culture in ponds (82%). Further, the analysis showed a payback period of 3.88 years which seem not economically feasible as it posed a high risk of payment default when capital is sourced from banks. It was also noted that the length of the cropping cycle is prolonged from normally 8 months to 10.6 months average and had a long recovery period (3 years and 6 months) for the capital invested. Though the project is not financially attractive in some variables, the project was still feasible in most important variables like profit per crop (Php26541.76) and profit margin (29.91%). Among the four LGUs, Binalbagan showed to have the best performance in both financial analysis and risk indicators- indicating that the area is attractive for mariculture project. To promote competition in the buying and selling of groupers so that the best price of groupers could benefit the farmers, government should take steps to invite more businessmen to get involved in the live fish trade by providing incentives in the form of negotiated freight rates, tax discounts and soft loans.

Keywords: financial analysis, risk assessments, mariculture, grouper cage culture, risk exposure indicators

AS - 03

**THE EFFECT OF GREEN MUSSELS (*Perna viridis*)
AS BIOFILTERS IN THE REDUCTION OF
TURBIDITY IN PRAWN POND**

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Green mussels (*Perna viridis*) at average weight of 10 g were tested as biofilters for 45 days inside the prawn nursery ponds at 12,000 pes of mussels /ha. stocking rate. Mussels in cultches were placed in net bags and were hanged along the series of bamboo plots installed in the middle of the pond. Water transparency and other parameters like pH, temperature, salinity, and dissolved oxygen were monitored twice daily at 7:00-7:30 am and 5:00-5:30 pm. Results of the study showed that average transparency readings in the treated ponds (stocked with mussels) were 56 cm for Nursery Pond-2 and 45 cm for Nursery Pond-13 while in the control ponds (without mussels) showed 26 cm for Nursery Pond-1 and 32 cm for Nursery Pond-14. In NP-2, transparency reading greater than 56 cm was observed in 21 consecutive monitoring days. Transparency was only reduced when inorganic fertilizer was applied to hasten plankton growth. It was apparent that planktons grew densely in the control ponds as indicated in the low transparency of greenish to yellowish green color of the water. Average DO reading however, was lower in the treated ponds. The decrease of DO could have been the effect of mussels as additional biomass and competitors of oxygen. Moreover, metabolic wastes from green mussels resulted to additional organic loads which caused the increase of chemical oxygen demand. There were no marked difference on pH, salinity and temperature in all ponds. The study suggested that to efficiently filter water, mussels should be placed in the ponds' reservoir or in the water supply canal instead of placing them inside the nursery or rearing ponds.

Keywords: biofilters, transparency, planktons, biomass, dissolved oxygen

AS - 04

**GOOD AQUACULTURE PRACTICES AT RESOURCES
PRODUCTION TECHNOLOGY, INCORPORATED: BASIS
FOR EXTENSION SERVICES DEVELOPMENT**

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The study was conducted in 2009 to the employees of the Resources Production Technology (REPROTECH), Inc. in Manjuyod, Oriental Negros to find out the company's level of compliance to good aquaculture practices (GAqP) in marine fish cages and fish ponds as preliminaries of accreditation. The questionnaire, a five-point Likert Scale, had been used in similar studies. The areas in the fish cages rated, based on principles and guidelines in Fisheries Administrative Order (FAO) 214 s. 2001 (the Code of Practice for Aquaculture) and on certification guidelines for Best Aquaculture Practices (BAP), were the following: site selection, design and construction; feeds, feeding, and seed health management; seed selection, stocking; harvesting and product handling; farm management; records; traceability; and workers safety and employees' relations. The computed grand mean obtained by the company when assessed in areas for good aquaculture practices in fish cages, based on tabled range values and interpretations, was 4.12 or highly satisfactory. The areas in fish ponds rated, based on the mentioned guidelines, were the following: site selection; pond design and construction; water usage and effluent management; use of drugs, chemicals, toxic pesticides and fertilizers; seed selection; seed health and farm management; records; traceability; mangrove conservation and biodiversity protection; feeds, feeding, and water management; harvesting and product handling; worker's safety and employees' relations. The grand mean obtained by the company when assessed under areas for good aquaculture practices in fishponds was 4.06 or highly satisfactory. When taken together, REPROTECH's performance on good aquaculture practices in fish cages and in fish ponds was highly satisfactory, much better than its moderately satisfactory performance obtained before this study. The recommendation was to develop Sanitation Standard Operating Procedures (SSOP) as another step of the company to conform to Hazard Analysis Critical Control Point (HACCP) to satisfy its quest for accreditation.

Keywords: GAqP, HACCP, REPROTECH, Inc., marine fish cage, aquaculture practices

AS - 05

**LOW-VOLUME, HIGH-DENSITY CULTURE OF MILKFISH
(*Chanos chanos*, Forsskal) IN MARINE NET CAGES AT
NORTH BAIS, BAY, ORIENTAL NEGROS**

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The study was conducted in 2008 at Resources Production Technology (REPROTECH), Incorporated, an integrated aquaculture business in the north Bais Bay (Manjuyod side), Oriental Negros. It aimed to find out the feasibility and viability of milkfish (*Chanos chanos*, Forsskal) cultured in five 180-m³ (6m x 6m x 5m) low-volume high-density (LVHD) marine net cages and to establish a benchmark for cage milkfish farmers using a promising technology that can have significant contribution to socio-economic growth and food security. The results showed that the cultured milkfish attained an average body weight of 376.32 grams after 163 average culture days, a survival rate of 100%, and a 2.4 feed conversion ratio - satisfactory enough to generate a profit in a cropping period. The average production per 180-m³ cage reached 2,480 kg or 13.78 kg/m³. The profit was Php 34.94 per kilogram, indicating an earning even if milkfish price per kilogram dropped by 10%. Milkfish production in high-volume, low-density (HVL D) floating cages was economically viable for small- and medium-enterprise fish farmers and offered an estimated 64.18% return of investment and a 0.4 year payback period. It was recommended that generated technology on milkfish culture in LVHD marine net cages be shared through training and extension programs of Carlos Hilado Memorial State College-Binalbagan.

Keywords: stocking density, mariculture, milkfish culture, marine net cage, LVHD

AS - 06

**SPECIES PREFERENCE OF FISH PEN FARMERS
IN HIMAMAYLAN CITY: AN ENRICHED EXTENSION
PROGRAM OF CARLOS HILADO MEMORIAL STATE
COLLEGE-COLLEGE OF FISHERIES**

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The study surveyed the species preference of fish pen farmers in Himamaylan City, Negros Occidental in 2009 as basis to enrich the extension program of Carlos Hilado Memorial State College-College of Fisheries. The questionnaire gathered selected personal variables of the respondents for profiling, their culture practices, species preference, the factors affecting their species choice, and their fish-farming problems.

The results were as follows: the fish pen farmers were middle-aged, dominantly male and married; majority reached college; their experience in fish pen farming was reasonably long but not very long; with a sizable combined average annual family income above poverty line; all engaged in monoculture with intensive production scale; stocked between 16 to 20 fishes per square meter; used commercial feeds; culturing their stock between 5 to 7 months; sourced their fry from the wild and hatchery; fed their stock to satiation twice daily; commonly practiced partial or selective harvesting; sampled their stock irregularly; most grew milkfish. The influencing factors modifying species preference were environmental parameters like pen location, economics like feed supply and harvest prices, biology of the cultured species, and technical factors like site proximity to markets. The occurring problems but seldom encountered were turbidity, salinity, low dissolved oxygen, and unstable supply of fry. The recommendations: extension program for fish pen farmers in Himamaylan City should focus on providing education and information on modern fish culture methods, perils of overstocking, effects of overfeeding, etc.; and stocking manipulation to avert mass mortality likely to occur during neap tides.

Keywords: species preference, fish pens, extension program, fish farming, surveys

AS - 07

FISHER FOLK ORGANIZATIONS AND RESOURCE REHABILITATION: A UNIFIED THRUST

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The study, using a questionnaire, surveyed the participation and capability of fisher folk organizations to rehabilitate coastal resources in three coastal towns of Fifth Congressional District of Negros Occidental during the second quarter of 2010. Results will serve as bases to formulate a unified thrust for coastal resources rehabilitation. The results of the study showed that the vision, mission, goals, and objectives of the fisher folk organizations were well stated and agreed with the provisions of R. A. 8550; the most notable problems met by the fisher folk were illegal fishing, overfishing, and pollution; the fisher folk's extent of participation in coastal resource rehabilitation was generally moderate; they assessed themselves as highly capable in coastal resource rehabilitation. The conclusions: the fisher folk were not as well-involved in coastal resources rehabilitation as they ought to be; and their capabilities and potentials not fully tapped. Recommendations included involvement of all the members in resource rehabilitation activities including attendance to training and seminars, and the creation of a federation of fisher folk organizations in the Fifth Congressional District for a unified thrust.

Keywords: survey, fisher folk organizations, coastal resources, resources rehabilitation

AS - 08

**THE EFFECT OF DIET SUPPLEMENTATION WITH
Cnidaria Scyphozoa Aurelia SOFT TISSUE ON THE MOLT-
DEATH SYNDROME OF *Scylla Serrata* MUD CRAB**

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Molt-death-disorders crop up during molting of the mud crab, *Scylla serrata*, and the probable cause of such mortality is typically attributed to inappropriate sustenance. The effects of supplementation using dried jellyfish, *Cnidaria Scyphozoa Aurelia* soft tissue on survival and molting success of *Scylla serrata* was investigated. One hundred *S. serrata* with body weights between 100-150 grams, were captured from coastal estuaries in Batan, Aklan, using baited traps and maintained communally at a stocking density of 3 heads/m², in bamboo pens constructed in a mangrove mudflat. One group (50 heads) was fed with trash fish for two weeks, starved for two days, prior to experimental feeding with trash fish complemented with dried *Cnidaria Scyphozoa Aurelia* jellyfish meat: control group was fed with trash fish for two weeks, starved for two days, before returning to trash fish diet without jellyfish supplementation. Feeding rate was computed at 10 percent of average body weight once daily for both groups. The test group was given jellyfish meat supplementation at satiety once daily in the morning. The duration of the research lasted for 60 days since the 2 day fasting phase. Individual weight was obtained by dividing the weight measured by the number of heads in the population. There were no significant differences ($P > 0.05$) in growth, apparent feed conversion ratio (FCR), among the two groups, following the 60 day experimental period. In both the control and supplemented groups, the crabs weighed between 330-350 g after 60 days of rearing. Survival rate after molting, was 85% in the supplemented group and was significantly ($P > 0.05$) higher than 65% observed in the control group. The mean carapace radius was appreciably ($P > 0.05$) higher in the supplemented group (3.2 in) than in the non-supplemented group (3.0 in).

Keywords: Molt-death-syndrome, *Scylla serrata*

AS - 09

**MICROWAVE-ASSISTED EXTRACTION OF
CARRAGEENAN FROM RED SEAWEED
(*Kappaphycus Spp.*)**

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This study compared the efficiency of the conventional heating procedure and the relatively rapid microwave-assisted technique in extracting carrageenan from red seaweeds. Different combinations of microwave power level and exposure time were employed in the microwave-assisted extractions (ME): ME₁ (80 watts, 1 min); ME₂ (80 watts, 2 min); ME₃ (80 watts, 3 min); ME₄ (240 watts, 1 min); ME₅ (240 watts, 2 min) and ME₆ (240 watts, 3 min).

Microwave-assisted extraction yielded carrageenan extracts ranging from 31.35 to 43.14 %. Conventional heating method produced only 26.72% extract.

All the carrageenan extracts were dried into chips and were subjected to physical and quality tests. Physical analyses of the carrageenan in terms of color, odor, texture and solubility were done. Meanwhile, the quality of the carrageenan was evaluated in terms of gel formation, viscosity, gel strength, type of carrageenan produced and microbial test.

The carrageenan chips were odorless, yellow to brown and had a coarse texture. Solubility test showed that carrageenan samples were soluble in water, milk solution and salt solution at temperature above 80°C. All samples showed formation of gels. Both the conventional heating and microwave-assisted extraction produced good quality of carrageenan gel in terms of viscosity and gel strength. The carrageenan is safe for human consumption based on methylene blue test.

Based from the results, carrageenan can be extracted with high percentage yield, high viscosity and gel strength by exposure of *Kappaphycus* species to microwave extraction at 240 watts for one (1) minute.

Keywords: carrageenan, microwave-assisted, extraction, seaweed, gel

AS - 10

BALANCING NUTRIENT REQUIREMENTS AND MANURE ODOR MANAGEMENT IN GROWING COBB BROILERS

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The responses of broilers to low crude protein diet with synthetic amino acid supplementation were investigated. A feeding program was designed for five hundred experimental single comb Cobb broilers, using a low protein feedstuff but supplemented with amino acids: isoleucine, leucine, glycine, histidine, methionine, cysteine, tyrosine, lysine, phenylalanine, threonine, and tryptophan. A control group was fed with a three phase feeding program (starter 1-15 days; grower 16-28 days; and finisher at 29-40 days). The objective of the study was to determine the effect of a low protein diet on broilers which were supplemented with dietary amino acids. The parameters compared were: average daily weight gain, food conversion ratio (FCR), thigh base weight, and serum proteins. The same averages of 5g/dL total serum protein, an index of visceral protein status, were obtained for both the control and experimental groups. Average weight gain per day of birds fed with the test diets and those fed with commercial formulations, were 4.7g/d and 4.6 g/d, respectively. Feed conversion ratio, FCR, were 2.1 kg feed/kg meat and 1.8 kg/kg meat from the experimental and control groups respectively. Average thigh ash weight of the experimental feeding group (16 ± 0.04 g) was heavier than in the commercial diet group (12 ± 0.04 g). Manure nitrogen emission was estimated weekly, on air filters, through a colorimetric comparison using bromphenol blue indicator. This study was able to demonstrate that poultry management employing very low crude protein diets supplemented with amino acids can significantly reduce manure nitrogen emissions, without compromising Cobb broiler health and economic productivity.

Keywords: amino acid supplementation, protein, Cobb broiler

AS - 11

USE OF THE AQUATIC WEED *Pistia stratiotes* FOR EARTHWORM AND VERMICOMPOST PRODUCTION

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The aquatic weed *Pistia stratiotes* is a major plant pest in lakes and ponds in the Philippines. No economical use for the harvested weed is available. The study was conducted to determine the usefulness of the plant for the production of earthworm biomass and vermicompost through vermiculture.

Plastic-lined outdoor beds were used for the vermicomposting of fresh *P. stratiotes* collected from infested ponds with the "African night crawler" (*Eudrilus eugeniae*). Earthworm breeders were stocked in the beds and cultured for 30 days. A comparative analysis of the compost (without earthworms) and vermicompost (with earthworms) was done. The compost and vermicompost were also tested in a pot experiment using upland **kangkong** (*Ipomea reptans*) as the test plant.

The results showed that there was a mean increase of 173% in the production of *E. eugeniae* in the beds. Mean vermicompost recovery was 46%. The percentages of the N, P, K, Ca and Mg were higher in the compost than those in the vermicompost as a result of their incorporation into the earthworm biomass. The plants fertilized with vermicompost had better survival and more uniform growth compared to the plants fertilized with compost possibly because of better nutrient availability.

Considering the results and the value of the earthworm biomass and vermicompost produced, it is concluded that the use of the aquatic weed for vermiculture is efficient and economical.

Keywords: aquatic weed, *Pistia stratiotes*, earthworm, vermicompost, vermiculture

AS - 12

**YELLOW CORN (*Zea mays* L.) INBRED
SCREENING FOR SALINE SOIL TOLERANCE**

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Development of salt tolerant crops is the most practical way of ensuring the sustainability of crop production in agricultural areas located along coastal regions. In these areas, corn remains as one of the popular crops although it is very susceptible to salt injury. To address this problem, a project was undertaken to develop yellow corn hybrids that would be tolerant to saline soils. Thus, a series of greenhouse and field trials were conducted to identify the yellow corn inbreds that could be used as parents for developing corn hybrids with salinity tolerance. Thirty yellow corn inbreds were evaluated during the screening using sand-culture and nutrient-culture techniques where the nutrient solutions used had different degree of salinity. Treatment combinations were laid out in randomized complete block design with salinity level as the main plot and inbred as the subplot. Results of greenhouse screening showed APS 9B-B-37-2-2-B, Tupi Yellow (D) 63-1-1-1-B, APS 17B-B-33-2-2-B, Tupi Yellow (D) 86-2-1-1-B and APS 19B-B-55-1-2-B were the inbreds that produced the highest shoot and root biomass among the inbreds under the salinity level of 10 dS m⁻¹. Normally, corn plant would be injured permanently and even die if exposed to salinity level of 4 dS m⁻¹. Further screening under field condition resulted in the selection of six inbreds, namely, APS 15B-B-37-1-1-B, APS 15B-B-70-2-1-B, APS 15B-B-70-2-2-B, Tupi Yellow (D) 63-1-1-1-B, Tupi Yellow (D) 86-2-1-1-B and APS 19B-B-55-1-2-B. The latter two inbreds also exhibited good growth under nutrient solution culture. All these selected inbreds will be used as parents in the diallel crosses that will eventually result in new yellow corn hybrids with better salinity tolerance for growing in salt-affected areas.

Keywords: corn inbreds, breeding, salinity tolerance, screening

AS - 13

INDIGENOUS KNOWLEDGE SYSTEMS AS STIMULUS TO A BETTER SOIL HEALTH AND BIONETWORK

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There have been increasing concerns worldwide on the adverse effects of highly intensive farming activities on the quality and safety of food, the environment, and their contribution to global warming. To address these issues, there must be a concerted effort among various stakeholders to promote the adoption of environment-friendly farming technologies. A project was conducted to document the indigenous practices and existing technologies in selected rice-based farming areas in Southern Luzon Philippines. Practices/strategies and technologies that focus on the improvement of soil health and the conservation of the remaining farm resources are importantly realized. Indigenous practices can be referred as unique practices belonging to a specific community or local group and that the people in a given community have developed over time, and still continue to develop. These practices are based on experience, often tested over years of use, adapted to local culture and environment and as their basis for natural resource management. The worsening ecological conditions of rice and vegetable farms in the project sites and the technological constraints affecting the soil quality were documented. This study showed that there are existing technologies which originated from traditional practices but were modified through time, or changes were made to fit the ecological conditions. Several farmers have been documented to employ innovative practices and approaches to control pests and diseases.

Food security and nutritional adequacy are important indicators of a stable and sustainable farming household and must be the major feature in any attempt to evaluate success in the future. The intensification of production must not be undertaken through ecologically destructive approaches, in which the indigenous knowledge systems may apply. Food security and nutritional adequacy are important indicators of a stable and sustainable farming household and must be the major feature in any attempt to evaluate success.

Keywords: soil health, ecosystem health, indigenous knowledge, sustainable farming system, farming practices

AS - 14

EFFECT OF HUMAN GEOGRAPHY ON SOIL AND ECOSYSTEM HEALTH

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In the Philippines the increasing demand for food, fiber, and energy vis-à-vis the declining hectareage of arable lands has been pressuring the agricultural sector to be more productive and meet the demand of the increasing population. The objective of this paper is to present an assessment of the contribution of human geography on soil and ecosystem health in selected sites in Laguna and Quezon, Philippines. The agricultural issues deliberated are focused on 'soil quality' and the impacts on the surrounding environment. The methodology employed in the study included resource assessment, physical observations, and surveys consisting of open- and close-ended questions including land use and cover changes and their relations to human population. The questionnaire was administered to each of the municipality under study and information obtained from the surveys were complemented through interviews with local officials in the relevant departments.

Research findings showed that the quantities of land available for agriculture are declining in all study sites. The deterioration of agricultural water quality in the country has rapidly proceeded with the vast increase in population accompanied by development and change in land use. Environment contaminants, particularly in soil and water, affect the well-being of the environment. This was brought about by the careless dumping of waste materials, excessive use of chemical fertilizers and pesticides, and increased agricultural activities to meet people's demand in terms of quantity and quality improvement of agricultural produce and food diversification. Since there is a growing demand for organic foods, driven primarily by consumers' perceptions of the quality and safety of these foods, it is important that governments, industry, and consumers carefully examine issues related to organic food quality and safety and ensure necessary interventions to protect the consumers.

Keywords: soil health, ecosystem health, soil quality, water quality, organic foods

AS - 15

**PROPORTION OF PHOSPHORUS, POTASSIUM, ZINC AND
MOLYBDENUM IN RELATION TO CORN
(*Zea mays L.*) GROWTH ON LIMESTONE-DERIVED SOILS**

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Limestone-derived soils or calcareous soils contain high amounts of CaCO_3 that effervesce when treated with 0.1 N HCl and which inherently possess several nutritional problems. Such unique chemical condition makes it one of the problem soils that generally have very low productivity. But the need to produce more food because of the increase in population coupled with the reduction of arable land per person makes it necessary to utilize these soils more effectively and efficiently.

This study was conducted to evaluate the physical and chemical attributes related to nutritional problems of corn on a CaCO_3 -derived soil and quantify the specific limitations and possible corrections.

A field experiment on the effect of fertilization, quantities and balances of phosphorus, potassium, zinc and molybdenum on the yield of corn on a limestone-derived soil from El Salvador, Misamis Oriental was conducted.

The pH of the surface and subsoil of the Bolinao clay were strongly acidic and moderately acidic, respectively, while the C horizon was alkaline. Free CaCO_3 was low in Bolinao clay especially at the solum which refers to the A (top soil) and B (subsoil) horizons (or zone of soil development) and does not include the C horizon. The surface soils were low in P and organic matter.

On a very weak calcareous Bolinao clay, corn responded only to P fertilization up to 120 kg P_2O_5 /ha. There were no significant yield increments attributed to K, Zn and Mo applications indicating that 0.8 meq K/100g and 10.9 ppm Zn were sufficient. The corresponding proportion of K on the exchange site was 1.6 % which produces Ca/K ratio of 20.5. High grain yields were associated with 0.29 % P and 2.0 % K in the earleaf. The corresponding nutrient proportions were 6.7 to 7.5 for K/Ca and 5 for K/Mg. Contrary to some results, Zn concentration in the earleaf, stover and grains increased as more P was applied.

Keywords: Corn, limestone, calcareous soils, problem soil, fertilization

AS - 16

**DEVELOPING LOW INORGANIC FERTILIZER
RECOMMENDATION FOR BANANA CVS. SABA
AND LAKATAN IN QUEZON PROVINCE**

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Banana is the most economically important fruit crop in the Philippines and the only locally grown fruit available year-round. Banana is grown in adverse environments in the country from the lowlands, flat and sloping uplands to the marginal hilly lands. Most banana plantations are found in Mindanao, well fed with inorganic fertilizers. This study was conducted to develop a low inorganic fertilizer recommendation for banana for low income farmers in Quezon Province. Three-month old tissue cultured banana cvs. Saba and Lakatan seedlings, half of which were pre- inoculated with biofertilizers (BF) Mykovam and BioN in the nursery during pricking, were outplanted in three farmers' farms in General Nakar and Infanta, Quezon Province. The experimental design was RCBD with four blocks. Planted seedlings were applied with either 100% Recommended Inorganic Fertilizer (RF = 250N:30P2O5:350K2O kg/ha) or 25% RF. Results show that, in all farms, the onset of fruiting and harvesting was earlier (556-570 days) in the 100%RF treated plants but not significant as compared with 25%RF+BF (588-663 days). Likewise, the number and weight of hands per bunch and the number of fingers per hand were generally higher in 100%RF than the 25%RF+BF but not significant from each other. However, the number of bunch harvested in the 100%RF was two to three times more than in 25%RF+BF. Total weight of hands per bunch in 100%RF ranged from 7.19-10.11 kg while in the 25%RF ranged from 5.28-5.87 kg. Results showed the feasibility of substituting more than half of the inorganic fertilizer recommendation with BF and maintaining the same performance as that of 100% RF.

Keywords: tissue-cultured banana, biofertilizers, Mykovam, Bio-N

AS - 17

**CRITICAL SOIL MOISTURE REQUIREMENT OF BANANA
CV. LAKATAN (*Musa acuminata* Colla.)**

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Most of the recommendations for banana production are based on the studies of banana cv. Cavendish. Studies for local banana cvs are necessary. A pot experiment in screen house was conducted to determine the critical soil moisture requirement of Lakatan banana at different growth stages. Three-month old tissue-cultured Lakatan banana seedlings were planted in half drums with 70-kg Lipa clay loam surface soil sample. The experiment was laid out in Randomized Complete Block Design (RCBD) with four soil moisture treatments (20, 25, 30, and 35% moisture by weight). Soil moisture treatments were maintained throughout the growing period of banana. Soil moisture was monitored semi-weekly and water was added to maintain the required water moisture level treatments. Agronomic parameters were collected monthly covering the different growth stages of the banana starting one month after transplanting. Plant biomass samples were partitioned and nutrient contents of each partition were analyzed. Nutrient content of the soil was analyzed monthly. Banana with 30 and 35% soil moisture levels were significantly taller, have broader leaf area, and larger pseudostem diameter compared with those with lower moisture levels. Plants with less than 30% soil moisture content tend to develop more roots due to water stress. Nutrient contents of the partitioned plant biomass with lower moisture contents (20 and 25%), showed high total nitrogen and phosphorus in the plant corm and stem while at higher moisture contents (30 and 35%) the nutrients were evenly distributed. Total phosphorus showed no distinct differences within the treatments. The 30% moisture level appeared to be optimum for the growth of banana. At 25% soil moisture content, the plants showed signs of water stress and a drastic reduction in growth rate and eventual death of the plants at 20% moisture content. This means that Lakatan banana growers need to maintain soil moisture near or at field capacity.

Keywords: banana, lakatan, soil moisture requirement, pot experiment

AS - 18

ENHANCING COCONUT GROWTH AND SURVIVAL IN THE FIELD WITH BIOFERTILIZER AND BIO-ORGANIC MATERIAL APPLICATION

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Coconut-based products serve as one of the top ten dollar earners of the country. However, land conversion and aging coconut plantations threaten to deplete coco-based products' supply. Transplanting new coconut seedlings was encouraged by the Federation of Free Farmers (FFF) in its 17 anchor farms in support of the Coconut Farm Development Program (CFDP). The members of the coconut farmer cooperatives were trained on the use of biofertilizer products namely Mykovam and BioGroe and bio-organic soil amendments to decrease dependence on chemical-based inputs. Three anchor farms became researcher- managed demonstration sites, while the rest of the anchor farms became farmer-managed demonstration trials.

Results of inoculation trials, after one year and six months in the field in Quezon and Zamboanga showed that very slow growth rate was observed, with an average of only 20 cm and only one additional frond per plant, per quarter. In the Quezon site, leaf nutrient analysis showed that although nitrogen (N) content was similar for all treatments, potassium (K) content was significantly highest in Mykovam (M) and BioGroe (B) singly inoculated plants. Phosphorus (P) content was significantly highest in combined MB treated seedlings at 2,660.97 ppm, 41% increase over the control. In the Bohol and Zamboanga sites, extreme summer condition affected plant growth by decreasing total number of actively photosynthesizing leaves that led to shorter plant height. However, leaf N and P content was highest in Mykovam+ RRC (Recommended Rate of Chemical Fertilizers) treated plants followed by ½ RRC treatment. This is equivalent to a 26% increase in N and 10% increase in P content compared to the control plants, while K content was highest in Mykovam +1/2 RRC. These results imply that biofertilizer inoculation can assist coconut seedlings extract nutrients better and survive in the harsh field conditions.

Keywords: coconut, mykovam, biofertilizers, biogroe, fff

AS - 19

**THE EFFECTS OF VERMICOMPOSTS, MYCORRHIZA,
AND INORGANIC CHEMICAL FERTILIZERS ON GROWTH
PARAMETERS OF CORN (*Zea mays*)**

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Corn is second to rice in terms of hectareage production due to its use as food and as animal feed. Continuous research on alternatives to chemical fertilizers is of utmost importance. Two greenhouse trials were established to determine the potential of using vermicompost and Mykovam for corn production along with three levels of chemical fertilizers. In the second trial, five different inoculation methods of Mykovam and vermicompost were evaluated.

Results showed that height growth and dry matter production of corn plants were comparable in the three chemical fertilizer treatments (0, $\frac{1}{2}$ RRC as 60-30-30 and full RRC as 120-60-60 kg NPK/ha). Soil amendment treatments such as Mykovam (M) alone, vermicompost (V) alone or combined Mykovam and vermicompost (M+V) significantly promoted shoot dry matter weight by 9%, 28% and 22%, respectively over the control. In terms of height increment, $\frac{1}{2}$ RRC + M gave the biggest height increment at 93.97 cm or a 15% increase over the uninoculated and unfertilized control (0 fertilizer). Best shoot dry matter production was observed in the following treatments: $\frac{1}{2}$ RRC + M, $\frac{1}{2}$ RRC with M+V and full RRC with V or M+V. Heaviest cob yield was in full RRC + Mykovam, followed by full RRC and M + V. This indicated that Mykovam and vermicompost can potentially improve vegetative growth and enhance corn yield and are effective soil amendments to chemical fertilizers for better corn growth and dry matter production. Benefit cost ratio analysis showed that the best treatment was in RRC +Mykovam+ Vermicompost treatment.

In the second corn trial, the combination of Mykovam and vermicompost in liquid form was found to be the best preparation in terms of shoot and cob dry weight. The banding method of applying Mykovam was also comparable with the application of Mykovam in tablet form. Further studies should be done to explore more efficient inoculation methods for corn.

Keywords: corn, mykovam, vermicompost, chemical fertilizers

AS - 20

TAPPING OF PILI (*CANARIUM OVATUM* ENGL.) FOR SUSTAINED RESIN YIELD

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This study is a combination of R&D and techno-transfer activities on the improved tapping of pili (*Canarium ovatum* Engl.) in the Bicol Region.

The effect of tapping length, ethylene concentration and rainfall on resin yield was determined by tapping 36 pili trees growing in Barangay Calomagon, Bulan, Sorsogon. The study used three tapping lengths (15 cm, 20 cm and 30 cm) at the same width (2 cm) and same depth (enough not to reach the cambium) and four levels of ethylene application using the brand name "ethrel" at 0%; 0.5%; 1.5%; and 2.5% concentrations. Retapping after the weekly resin harvest was done immediately above the previous cut. Each treatment was replicated thrice.

Increasing tapping length increased resin yield with 30 cm giving the highest yield. Ethrel concentration likewise affected resin yield which was highest at 2.5%, while monthly rainfall did not.

The development of *Canarium* resin tapping as an alternative source of livelihood option for farmers and pili growers will rely on the following identified strengths: a) supply of resin is expected to be plenty as evidenced by the tremendous number of *Canarium* trees growing in the area and resin yield collected in this study following FPRDI tapping techniques and b) concerned farmers and pili growers have been trained on proper methods of *Canarium* resin tapping.

Further, resin yield of trees with ethrel application increase by 37.5%, thus additional revenue income for farmers and resin tappers.

The farmers' active participation in the seminar/training was evident following the correct tapping procedures. The technology's adaptability may indicate a bright and sustainable *Canarium* resin production in the entire province of Sorsogon.

Keywords: *Canarium* trees, pili, Manila clemi, resin tapping, Bicol, Sorsogon, tapping length, ethylene concentration, rainfall

AS - 21

**FINALLY, FROM WEED TO CROP? *Cassia tora* L.
(MANI-MANI): ECOTYPIC DIVERSITY AND
UTILIZATION IN BUKIDNON**

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Cassia tora L. is locally known as mani-mani, a common weed in the Philippines that usually grows in pasturelands and farmlands with other weeds. Mani-mani is a phenotypical variable in 12 municipalities of Bukidnon. Analysis of variance showed highly significant differences among ecotypes for plant height, number of primary branches per plant, number of mature pods per plant, number of seeds per pod, and weight of 100 seeds. Shannon-Weaver's Diversity Index showed high diversity ($H' > 0.75$) for 10 of the 13 traits evaluated including percent crude protein. Protein concentration of seeds from Libona (20.40%) and Malitbog (19.50%) were comparable with most mungbean varieties (usually from 20% to 22%). In 5 municipalities, uses of mani-mani were documented in this study: relief for stomachache, menstrual pain and muscle pain, component vegetable for viands, and component for swine feed. It is therefore possible to select for an acceptable ecotype or to breed for improved lines with available genetic diversity to increase its economic adaptability as a new crop in the country.

Keywords: *Cassia tora*, mani-mani, genetic diversity, Bukidnon, weedy legume, ecotypic diversity

AS - 22

**PHENOTYPIC VARIATION IN MORPHOLOGICAL TRAITS,
FRUIT, SEED AND OIL OF JATROPHA (*Jatropha curcas*)
FROM THREE PROVENANCES**

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Jatropha (*Jatropha curcas* L.) is a promising crop for large-scale production of biodiesel. In recent years, it has become a focus of research and development investments in many relevant government agencies and private companies in the Philippines. Heightened attention to *jatropha* was driven by the belief that it can be made to yield the desired quantity of product in marginal lands; and growing it in marginal lands would prevent the food and fuel competition. Widely distributed across the country, identification of provenances that will give higher seed yield and oil content is deemed necessary before large plantations are established.

Eight trees from each of the three provenances planted in Mt. Makiling in Los Baños, Laguna were selected from among the experimental plants to examine tree-to-tree variation. The provenances were Bacolod, South Cotabato, and Talisay.

Variability was large in all morphological traits, the highest being in length of unbranched stem (CV = 46.51%) and number of first order branches (CV = 33.72%). Seed yield was positively and significantly correlated with basal diameter, length of unbranched stem, and crown diameter.

Variability was small in fruit and seed traits. Crown diameter appeared to be a predictor ($P < 0.05$) of three seed size parameters, namely: length, breadth and thickness. Among the seed traits, seed length was significantly correlated ($r = 0.498$) with oil content. The oil content in kernel ranged from 41.40% to 59.26%.

Keywords: *Jatropha curcas* L., provenances, oil content

AS - 23

**HERITABILITY OF AND RELATIONSHIP
AMONG SELECTED SEED TRAITS OF THREE
PROVENANCES OF *Jatropha curcas* L.**

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Due to its high oil yield per hectare and its ability to grow in a wide range of environment, *Jatropha* is on top of the promising potential crops as biofuel feedstock. However, *Jatropha*'s full potential is yet to be realized due to lack of systematic improvement/breeding programs aimed at increased oil yield.

Improvement programs require knowledge on variability and genetic parameters. Thus, this study intended to determine the extent of variation and relationship between seed traits.

Data on seed traits for the three provenances, namely, South Cotabato, Bacolod and Talisay, were obtained from Vallesteros (2009). Analysis of variance showed no considerable difference between provenances in seed length and breadth at $P < 0.05$. Seeds from South Cotabato were found to be significantly thicker than the other two provenances.

Heritability estimates obtained for all the seed traits were high (>80%). High genotypic coefficients of variations (GCV) indicate that traits are less amenable to changes due to environmental flux. Seed thickness had the highest heritability and GCV (721.3%). In general, variation among the provenances in terms of the seed characters studied is low, which indicates narrow genetic resource of *Jatropha* in the country. Unproductive breeding is expected unless introduction of material from other sources, especially from the center of origin of the plant, is done.

Keywords: Heritability, *Jatropha curcas*, provenances

AS - 24

**VARIATION IN PHYSIOLOGY AND WATER USE
EFFICIENCY AMONG *Musa balbisiana* GENOTYPES
IN RESPONSE TO DROUGHT**

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Musa balbisiana genotypes are reported to have traits that confer field drought tolerance. However, the natural variation in these traits is relatively unknown, and therefore cannot be exploited in breeding programs. This paper reports on the variation of the effects of drought on the growth and physiology of twenty-nine wild and edible *M. balbisiana* genotypes from the Philippine and Southeast Asian germplasm collection.

Two batches of tissue-culture derived seedlings were potted out and established in the greenhouse from March to May 2010. Drought was imposed after three months. Pots were weighed at soil field capacity and periodically during progressive drought. Stomatal conductance determination showed that stomatal openings closed on the third and sixth day after water was withheld in April and May 2010, respectively. The stomatal conductance was significantly affected by the interaction between genotype and stress condition.

Water use efficiency (WUE) differed significantly among genotypes during drought, which ranged from 8.9 to 19 g dry matter kg⁻¹ water used. Genotypic differences in relative water content (RWC) were observed in April 2010 trial, but not in May 2010 when temperatures were much higher. RWC ranged from 80-96% even when leaves were already wilted. Genotypic variation in plant and root growth and accumulation of dry matter were also observed.

Keywords: *Musa*, banana drought, physiology, water use efficiency, stomatal conductance

AS - 25

DIFFERENTIAL RESPONSE OF OPEN-POLLINATED AND HYBRID TOMATO VARIETIES TO PGPR INOCULATION UNDER FIELD CONDITION

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Enhancement of plant growth through inoculation with plant growth promoting rhizobacteria (PGPR) has been reported for various vegetable and agronomic crops. However, studies on varietal response to PGPR inoculation under field condition were limited. A field trial was conducted at UPLB to determine the response of ten open-pollinated (OP) and hybrid tomato varieties to PGPR inoculation under two levels of fertilization, recommended rate (138-47-60 NPK) and half the recommended rate. The following parameters were assessed at flowering and fruiting stage; plant growth, number of flower clusters and branches, nutrient uptake, dry matter and fruit yield.

Inoculation increased the number of branches formed by Improved Apollo by 33% for both fertilizer rates while Rosanna had a remarkable 40% increase with half-fertilizer rate application. Inoculation also increased the number of flower clusters of Rossana by 60% in the half-fertilizer treatment while 60-150% increases were obtained for inoculated Caraibo, Discovery and Atlas with full fertilization. The increase in root dry weight due to inoculation also increased the root shoot ratio of OP varieties, Northern Red and Improved Apollo. In general, inoculation increased P content of the evaluated varieties from 0.20 to 0.21% P which also resulted to enhanced P uptake. The increase in P content of inoculated tomatoes indicates P solubilising activity of PGPR. With inoculation, the total fruit weight of Rosanna was increased by 27% while Atlas showed 19% increase across fertilizer treatments.

The results showed the different responses of OP and hybrid tomatoes to PGPR inoculation. There were OP and hybrid tomatoes which responded positively to inoculation while there were varieties which did not show significant response. This variation needs to be verified under different field condition because a significant variety-PGPR interaction is crucial in the adoption of PGPR inoculation technology.

Keywords: PGPR, inoculation, tomato, phosphorus, open-pollinated

AS - 26

EFFECTS OF *Jatropha curcas* L. HEDGEROW AND VARIOUS MANAGEMENT PRACTICES ON THE YIELD OF MAIZE AND SOIL PROPERTIES OF AN ALLEY CROPPING SYSTEM

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The study was conducted to evaluate the growth performance of *Jatropha curcas* L. planted as contour hedgerow (spaced 0.5 meter along the contour and 4 meters between contours) and its effects on the various management practices on maize and soil properties of an alley cropping system. This was laid out in split-split plot experimental design replicated three times. Fertilizer treatments comprised the main plot, pruning as the subplot, while mulching treatments served as the sub-subplot.

Findings revealed that average height and diameter growth of *J. curcas* hedgerow were enhanced by higher pruning (75-cm) having 124.89 cm and 5.5 cm, respectively. The low pruning (50-cm) had only an average height of 84.89 cm and diameter of 4.9 cm.

Maize treated with organic biofertilizer had longer ear length (16.05 cm) and higher grain yield (2652 kg ha⁻¹) while those applied with pure inorganic fertilizer had shorter ears and lesser yield. Dry matter and grain yield of maize were enhanced with *J. curcas* mulch pruning with 3793.8 kg ha⁻¹ and 2570.8 kg ha⁻¹, respectively.

Improvement of the soil chemical and physical properties was observed when the contour hedgerows have stabilized. Findings revealed *J. curcas* hedgerow's potential of preventing sheet erosion in sloping farmland having soil accumulation ranging from 23.09 tons ha⁻¹ to 36.51 tons ha⁻¹ while the no hedge plot had a soil loss of 24.32 tons ha⁻¹. Soil accumulation was also observed to be higher when *J. curcas* pruning was applied as mulch with 37.63 ton ha⁻¹ while the plot with no mulching application had only 20.88 tons ha⁻¹.

Financial analysis showed that *J. curcas* hedgerows in an alley cropping system had the capability of providing profit to farmers. Treatments with hedges have higher Benefit Cost Ratio ranging from 2.7 to 3.1 as compared with the no hedge plot with only 2.1.

Keywords: agroforestry, alley cropping, *Jatropha curcas*, maize, hedgerow

AS - 27

HEALTH STATUS OF BANANA IN THE NATIONAL AND REGIONAL GERMPLASM COLLECTIONS

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A large collection of wild, edible, and introduced banana cultivars is being maintained in the national and regional germplasm collections at the Institute of Plant Breeding, UPLB and Bureau of Plant Industry, Bago-Oshiro, Davao City. *Banana bunchy top virus* (BBTV), *Banana bract mosaic virus* (BBrMV), and *Cucumber mosaic virus* (CMV) are the major viruses detected in the germplasm collections. Virus-infected accessions and/or cultivars were replaced with virus-free materials. Efforts to eliminate viruses through *in-vitro* techniques are also being exerted.

In BPI Davao, 10 out of 85 accessions were infected either by BBTV or BBrMV, hence, they were eradicated from the collection. In IPB, BBrMV and CMV were detected from wild *Musa balbisiana* collections. A total of 268 samples from 61 banana cultivars and accessions in *in-vitro* culture were indexed through ELISA. All samples were found to be negative to viruses except one sample from Grand Naine which was BBTV-positive. In the repository glasshouse, an *ex-situ* gene banking strategy, a total of 64 local and introduced banana cultivars were indexed against BBTV, BBrMV, and CMV. Of these, 32 accessions were newly recollected to replace the accessions that were lost either by natural calamities or disease infection. Moradong Puti, was BBTV-positive while one Pondol plant and two Moko plants were CMV-positive. Infected plants were eradicated from the collections.

Keywords: banana germplasm collection, *in-vitro* technique, field genebank, ELISA, virus indexing

AS - 28

**CHANGES ON THE ANTIOXIDANT ACTIVITY
AND TOTAL PHENOLICS CONTENT OF DIFFERENT
LEAFY AND FRUIT VEGETABLES AS AFFECTED BY
STORAGE TIME AND TEMPERATURE**

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Antioxidants are known to provide health benefits such as the prevention of diseases like cancer, cardio and cerebro vascular diseases. Vegetables contain considerable amount of antioxidants. This study shows changes in the levels of antioxidant activity and total phenolic content of malunggay, pechay, chili leaves, sweet potato tops, and kangkong and fruit vegetables okra, tomato, eggplant, ampalaya, sitao as they are affected by storage temperatures and time of storage.

Ten leafy and fruit vegetables were stored under cold and room temperatures and monitored for total phenolics content using the Folin-Ciocalteu method and antioxidative activity using the DPPH method until the end of marketability. Results were statistically analyzed.

The antioxidative activity of leafy vegetables stored both at room temperature and refrigerated temperatures showed that prolonged and cold storage decreased. The total phenolics content of leafy vegetables stored at refrigerated temperature showed varied effects with chili and malunggay decreased, while kangkong, sweet potato tops, and pechay increased. Generally, leafy vegetables stored at room temperature showed increasing trends while fruit vegetables exhibited decreasing total phenolics content except for okra and sitao.

Storage time and temperature affect the antioxidant activity and total phenolic content of leafy and fruit vegetables. The total phenolics content of vegetables at room temperature increased while those at refrigerated temperature decreased. Antioxidative activity behaves otherwise.

Keywords: Phenolics content, antioxidant activity, fruit vegetables, leafy vegetables, cold storage

AS - 29

NUTRITIONAL AND PHYSICAL REQUIREMENTS FOR MYCELIAL GROWTH OF *Agrocybe cylindracea* (DC.: Fr.) Maire

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Agrocybe cylindracea is a widely distributed edible mushroom that usually grows in fallen logs and agricultural wastes. This mushroom has great potential in the nutraceutical and pharmaceutical industries because of its hypoglycemic effects, anti-carcinogenic activity and antioxidant property. Although this mushroom is successfully cultivated in Japan and Taiwan, the production technology under Philippine condition has not yet been developed. The results generated from this study will serve as benchmark information for the development of production technology for growing this mushroom.

The research team evaluated different indigenous materials and physical factors (pH, aeration and illumination) and different grain materials for efficient and luxuriant mycelial growth and proliferation. Among the different indigenous culture media evaluated, sorghum sucrose gulaman registered very thin and widest mycelial diameter with a mean of 82.67 mm after 8 days of incubation while corn grit sucrose gulaman recorded very thin and smallest mycelial diameter with a mean of 40.67 mm. Moreover, coconut water gulaman is the most suitable medium for optimum mycelia growth with a mean mycelia diameter of 64 mm. Results further showed that *A. cylindracea* cultured on coconut water gulaman at pH 6 incubated in sealed and alternating light and dark conditions favored the mycelial growth and proliferation. Meanwhile, among the grains evaluated for mass production of fruiting bags, sorghum seeds recorded the shortest incubation period with a mean of 14 days while rice seeds had the longest incubation period with a mean of 41.33 days.

Keywords: *Agrocybe cylindracea*, biophysiology, indigenous culture media, grain spawn

AS - 30

**THE EFFECTS OF A SMALL-SCALE COMMUNITY
LIVESTOCK PRODUCTION ON THE DIVERSITY
OF THE FOREST FODDER SOURCE IN AN UPLAND
VILLAGE OF BATANGAS, PHILIPPINES**

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Livestock production has been an integral part of several small-scale integrated farming systems. Most of these utilized communal feed sources such as grasslands and forests as important sources of feed especially during the dry season when all other conventional feed sources become scarce. Extraction of the forests to supply feeds for the livestock involves the alteration of this ecosystem, which will eventually result to changes in the forest ecosystem and its capacity to provide ecosystem functions. There have been limited studies on the change in forest diversity as a result of utilizing them as livestock feeds; hence, measuring this change is therefore useful. The effects of livestock tethering on forest diversity was determined on a secondary growth *molave*-type forest, which have been exposed to long-term livestock tethering in the past. Tethering involved cutting of the fodder trees and feeding the foliages to the livestock. Forest diversity and similarity of species were measured and compared in two landscape locations with four and five sampling points on areas that were 'tethered' and 'not tethered' to livestock. Forest diversity index was negatively correlated (-0.50) with tethering but was significant only at 17.0% level. It should be noted however, that it was ten years since livestock tethering was stopped, forest regeneration may have already occurred. In both landscape locations, forest diversity was relatively higher in the 'not tethered' areas than the 'tethered' areas. A low similarity of species was observed between the 'not tethered' areas and a higher similarity between the 'tethered' areas. A higher percentage of the fodder species existed in the 'tethered' sites than the 'not tethered' site. The results suggest that long-term livestock tethering in the forest would reduced forest diversity and tend to leave similar species, more of fodder tree species.

Keywords: forest diversity, livestock production, integrated farming system, tethering

AS - 31

***Lentinus tigrinus*, AN ADDITION TO NEWLY
RECORDED AND SUCCESSFULLY PROPAGATED
WILD STRAIN OF PHILIPPINE EDIBLE MUSHROOM**

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Most of the commercially cultivated mushrooms in the Philippines were imported from other countries and their cultivation technologies were modified to suit the local conditions. Though well accepted by most Filipinos, these imported strains are not always available in the local market and one of the strategies is to use our own mycological resources. In the past, we were successful in the domestication of *Collybia*, *Schizophyllum*, *Ganoderma*, *Coprinus*, *Auricularia* and *Volvariella*. Another wild locally growing mushroom with nutraceutical potential is *Lentinus tigrinus*, which are usually found growing on fallen logs. In our desire to develop a practical production technology for this mushroom, we initiated study on its biophysiology. The secondary mycelial growth and fruiting body performance were elucidated with special reference to the influence of different indigenous culture media, pH, aeration and illumination. The secondary mycelia grew best on coconut water gulaman with a pH of 8 while being incubated in sealed and dark condition. Among the evaluated granular spawn, palay seeds yielded very luxuriant mycelial growth having the shortest incubation period of 5 days. Highest biological efficiency of 15.93% was recorded in a formulation consisting of 8 parts of rice straw + 2 parts of sawdust. *Lentinus tigrinus* has a great potential for cultivation as another newly recorded and propagated Philippine wild edible mushroom.

Keywords: *Lentinus tigrinus*, biophysiology, secondary mycelia, mycelial growth, biological efficiency

AS - 32

**THE SUSCEPTIBILITY OF THE LACEWING BUTTERFLY,
CETHOSIA BIBLIS INSULARIS C & R FELDER
(NYMPHALIDAE: LEPIDOPTERA) TO CRY 1 AB PROTEIN**

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There are very few studies in the Philippines related to the risk assessment of Bt corn to non target organisms. The lacewing butterfly, *Cethosia biblis insularis* C & R Felder is a non target organism and an uncommon butterfly present in riparian areas (land immediately surrounding water source) where Bt corn is planted. It feeds on flowers where Bt corn pollen are deposited during pollen shedding. This study was conducted at NCPC-CPC Plant Quarantine Support Laboratory from January 2009 to May 2010 to find out the effect of Cry 1 Ab protein on the lacewing butterfly.

Bioassay using the maximum hazard dose (i.e approximately 10x the maximum Cry 1 Ab protein in Bt corn) was done. The estimated amount of Cry 1Ab protein in Bt corn pollen is 0.09 mg/g pollen. Whole leaves of *Adenia zucca*, the host plant of lacewing butterfly were soaked in Cry 1 Ab protein and air dried. Another set of leaves were dipped in 0.1 M carbonated buffer and these served as control group. Ten three day-old larvae were exposed per leaf. Nine trials or 450 treated larvae and 450 non-treated larvae were done. The percentage mortality range for the treated group was 0-10% with a mean of 3.11%. The percentage mortality range for the control group was 0-14% with a mean of 1.56%. The range of weight in grams of the treated group was 0.016-0.053 with a mean of 0.035 while the control group has 0.011-0.045 with a mean of 0.033, respectively. Differences on mean mortality and mean weight of treated control leaves using t-test with computed values of 0.704 and 0.315 were not significant. Hence, the Cry 1 Ab protein was not toxic to the lacewing butterfly.

Keywords: Cry 1Ab protein, Lacewing, Butterfly, Susceptibility, Lepidoptera

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**MARKER-AIDED TRANSFER OF GENES FOR β -
CAROTENE BIOSYNTHESIS INTO POPULAR
PHILIPPINE RICE VARIETIES**

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Golden Rice accumulates β -carotene in the grains and is considered as a sustainable and effective food-based strategy to alleviate vitamin A deficiency. Through DNA marker-assisted recurrent backcrossing, Golden Rice1 (GR1) locus was introgressed into PSB Rc82 and NSIC Rc128 varieties. Selection in the progenies was based on yellow-colored dehulled grains after bleach treatment, presence of GR1-specific PCR amplicons, high recovery of the recurrent parent genome, good agronomic traits and high betacarotene content. Parental recovery was measured using phenotypic data and polymorphic simple sequence repeat (SSR) markers (98 for PSB Rc82 and 103 for NSIC Rc128 progenies). After 2-3 backcrosses and 3-4 selfing generations, nine introgression lines (four from PSB Rc82 and five from NSIC Rc128) were selected. SSR data revealed at least 80% genomic recovery of the recurrent parents. The highest β -carotene concentration in the progenies using samples stored for two months at ambient temperature was 1.80 μg per gram of milled grains compared to 1.62 $\mu\text{g}/\text{g}$ in the GR donor. These results illustrate the feasibility of transferring Golden Rice trait into popular local varieties using this approach. Concomitant with the work on GR1 was the introgression of Golden Rice2 event R (GR2-R, $\sim 36 \mu\text{g}/\text{g}$) into PSB Rc82. With higher betacarotene content, GR2-R will be used in line development, single- and multi-location field tests, biosafety and sensory evaluation, and other tests required for regulatory approval and varietal release. Activities towards combining GR2-R with resistance to tungro and bacterial blight in elite genotypes are underway.

Keywords: Golden Rice, vitamin A deficiency, beta-carotene, marker-assisted introgression, varietal evaluation

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**APPLICATION OF DIHAPLOID BREEDING TECHNOLOGY
IN VARIETY DEVELOPMENT AND QTL MAPPING
IN RICE (*Oryza sativa* L.)**

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Dihaploid technology has become a promising tool in breeding for producing homozygous lines more rapidly than most conventional breeding methods. Doubled haploids (DH) are also excellent materials for genetic studies because of their homozygosity and uniformity. A total of 313 DHs were generated thru another culture from the F1 of PSB Rc10 and Nipponbare. Characterization of these DHs revealed the very high homogeneity and stability at the DNA level using SSR analysis and under field conditions.

Field trials of 237 DHs in 2009 WS resulted in selection and advancement of 54 superior lines in 2010 DS and WS. Ten 10 DHs have been selected as promising lines based on high yield, phenotypic acceptability, tolerance to major pests, and uniformity which are better/comparable to the checks; PSB Rc10, PSB Rc18, and PSB Rc82. In less than 3 years, elite breeding lines were developed while conventionally, it takes 6-7 years for selected inbreds to reach yield trial. Stable and potential donor parentals were also developed and included in the germplasm pool based on resistance to blast (9), early maturity (3), enhanced grain quality (3), and short to medium plant height (10). On the other hand, a mapping population consisting of 219 DHs was used for identifying QTL for grain quality traits using 205 SSR markers. Thirteen QTLs were identified; three for amylose content and five each for gel consistency and gelatinization temperature. QTL mapping for drought tolerant traits such as days to maturity, spikelet fertility, early vigor, and green leaf retention is now ongoing using the same mapping population. Information on mapped QTLs associated with these traits and the SSR markers that have tight linkage to them may be used to speed up the process of breeding new rice varieties with better quality and drought tolerance through molecular marker-assisted selection (MAS).

Keywords: anther culture, QTL, doubled haploids, SSR markers, MAS

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***PWT3 - Rwt3* INTERACTION UBIQUITOUSLY INVOLVED
IN THE INCOMPATIBILITY BETWEEN AN *Avena* ISOLATE
OF *Magnaporthe oryzae* AND CEREALS**

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Pwt3 (pathogenicity to wheat) is a locus conditioning the specificity of *Avena/Triticum* isolates of *Magnaporthe oryzae* on wheat identified among F₁ progeny derived from parent cross between an *Avena* isolate carrying the avirulence allele *PWT3* and a *Triticum* isolate carrying the virulence allele *pwt3*. To confirm the monofactorial segregation of *PWT3*, an F₁ culture was backcrossed with the *Triticum* isolate four times producing near isogenic lines of the *Triticum* isolate carrying *PWT3*. Several hexaploid and tetraploid wheat cultivars including barley inoculated with two parental isolates and a near isogenic line of *Triticum* isolate responded to *PWT3*. Representative cultivars of hexaploid and tetraploid wheat cultivars inoculated with 31 BC₄F₁ cultures were resistant to all *PWT3* carriers and susceptible to all *pwt3* carriers, suggesting that they recognize *PWT3*. Resistance gene *Rwt3* corresponding to *PWT3* was identified in wheat cultivars including a resistance gene in barley which may correspond to *PWT3*. These results suggest that *PWT3* could be ubiquitously involved in the avirulence of the *Avena* isolate on wheat and barley because of the possible ubiquitous distribution of *Rwt3* on these cereals. *PWT3* locus was mapped on chromosome 6 using SSR markers providing a starting point for cloning of this gene.

Keywords: avirulence gene, gene-for-gene interaction, *Magnaporthe oryzae*, resistance gene, wheat blast

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**GENETIC DIVERSITY, POPULATION STRUCTURE
AND DNA FINGERPRINTING OF ABACA (*Musa textilis* Nee)**

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Abaca, an indigenous fiber crop, is a major export commodity of the country. Assessing the genetic diversity of abaca is a prerequisite to a successful breeding program. Using microsatellite markers, the genetic diversity of abaca in Luzon, Visayas and Mindanao was determined to be highly diverse ($H = 0.67$). These variations present in abaca population are needed in widening the genetic background of the species, thereby, providing a wide selection of parents for abaca breeding programs. The genetic structure of abaca population is considered as genetically heterogeneous with 94% variability within population (AMOVA). Principal component analysis revealed sharing of alleles in three populations. Distance matrix analysis clustered abaca genotypes from Luzon, Visayas and Mindanao into three big groups and six small groups. This study also optimized SSR markers with high polymorphism information content (PIC) value (0.48 to 0.79). A combination of SSR markers that can differentiate T genome (*textilis*), B genome (*balbisiana*) and A genome (*acuminata*) of the genus *Musa* was also identified. Using these markers, some of the duplicate accessions of abaca in the gene bank were recognized. Likewise, these SSR markers can distinguish susceptible, tolerant and resistant genotypes to abaca bunchy top disease (AbBTD) which are crucial for marker-assisted breeding for AbBTD resistance trait. These results are useful for abaca varietal identification, germplasm characterization, marker-assisted selection, and for the development of DNA-based diagnostic kit for AbBTD disease.

Keywords: genetic diversity, phylogeny, microsatellites, molecular markers, fiber

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**GENETIC DIVERSITY AND CLUSTERING OF PINEAPPLE
(*Ananas comosus* (L.) Merr.) GENOTYPES USING RANDOM
AMPLIFIED POLYMORPHIC DNA (RAPD)**

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Genetic variation among 14 pineapple genotypes was assessed through molecular characterization using Random Amplified Polymorphic DNA (RAPD). RAPD was utilized to measure the genetic diversity and relationship among the different genotypes. The Doyle and Doyle extraction method was done in the DNA extraction of the 14 pineapple genotypes. Two Operon primers (OPY-15 and OPAV-06) were used in the PCR - based RAPD analysis of the different genotypes. Of the two primers used, OPY-15 (5'AGTCGCCCTT3') yielded consistent DNA polymorphic amplification in repeated trials and generated 11 banding patterns ranging from 0.40 – 3.00bp. Using primer OPAV-06 (5'CCCGAGATCC3'), banding patterns formed were not clearly identified. Cluster analysis was done by similarity matrix within the NTSys program using unweighted pair-group method with arithmetic averages (UPGMA) to determine values of genetic distance. A dendrogram of the 14 genotypes separated the pineapple cultivars and hybrids from the wild relatives. Based on the dendrogram at 0.76 similarity coefficient, the 14 genotypes were divided into four clusters: Cluster 1, *Ananas bracteatus*; Cluster 2, 'Smooth Cayenne', 'MD2', 'Aklan' and 'MG3'; Cluster 3, 'Red Spanish', 'Clone 74', 'NP2' and 'Queen'; and Cluster 4, 92-1 (hybrid), 'DM Gold', 92-2 (hybrid), 'Sweet 16' and Calauan (ornamental-like). At 0.51 coefficient similarity, 3 clusters were generated: Cluster 1, *Ananas bracteatus*; Cluster 2, 'Smooth Cayenne', 'MD2', 'Aklan', 'MG3', 'Red Spanish', 'Clone 74', 'NP2' and 'Queen'; and Cluster 3, 92-1 (hybrid), 'DM Gold', 92-2 (hybrid), 'Sweet 16' and Calauan (ornamental-like). The RAPD of the 14 pineapple genotypes studied could be an ideal tool for detection of variation and relationship among genotypes and hence, can be useful in the assessment of genetic diversity and cluster analysis of pineapple germplasm accessions and varieties.

Keywords: pineapple, genetic diversity, operon primer, cluster analysis, dendrogram, randomly amplified polymorphic DNA (RAPD)

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CHARACTERIZATION OF RESTORER AND MAINTAINER LINES USING MORPHOLOGICAL AND SSR MARKERS

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Genetic diversity is a prerequisite in any breeding program. Genetic diversity can be measured by different approaches such as pedigree analysis, morphological data and use of molecular markers. In this study, we evaluated the diversity of 175 parent lines (39 maintainer and 136 restorer) used in hybrid rice breeding program at PhilRice using 26 qualitative, 12 quantitative traits and 38 microsatellite or simple sequence repeat (SSR) markers. The data was analyzed using Unweighted Pair-group method with arithmetic mean (UPGMA). Morphological analysis revealed two major clusters with similarity coefficient of 3.09. Out of the 38 traits analyzed, eight gave significant contribution for the separation of some individuals and groups of genotypes. The percentage of contribution of each trait to total genetic variation was estimated through principal component analysis (PCA). Analysis based on SSR markers showed two major clusters with similarity coefficient of 0.71. Four maintainer lines represented one group whereas the other group consisted 36 maintainer and 56 restorer lines. Combined analysis also showed two major clusters with similarity coefficient of 0.42. One consisted of only two maintainer lines whereas other comprised 37 maintainer and 55 restorer lines. Overall, the results showed an average degree of variation among the hybrid parent lines indicating that there is a need for new germplasm source to improve the diversity of our hybrid breeding materials. In addition, the study provided important information for hybrid rice breeders on heterotic group identification and enhancement of heterotic F_1 combination.

Keywords: genetic diversity, heterosis, hybrid rice, SSR, UPGMA

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GERMPLASM COLLECTION BY DNA FINGERPRINTING

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The PhilRice Genebank was established in 1985 and holds 11, 259 collections. Most of the collections came from the elevated Cordilleras, from agricultural colleges and development centers as well as opportunistic collecting by PhilRice staff. However, with the limited resources such as finite storage space, low processing and maintenance outlay, there is an urgent need to identify duplicates and unique accessions for maximum resource utilization. The morphological characterization procedure presently employed in the PhilRice genebank is inadequate for this purpose because it represents a narrow portion of the genome and are influenced by the environment. The study aimed to: obtain DNA fingerprints of 427 rice germplasm accessions in the PhilRice Genebank using the multiplex SSR system, and determine the level of DNA polymorphism among the 427 rice accessions.

The dendrograms generated from UPGM and bootstrapping revealed 100% similarity coefficient for Binangkuro accessions from Occidental Mindoro. Binuhangin and Buntalan accessions also from Occidental Mindoro as well emerged to have 100% similarity coefficients. Bolig-bolig accessions from Palawan and Banate accessions from Iloilo both showed 100% similarity coefficients. Such accessions are hence considered as redundants. On the other hand, 22 unique accessions were detected in the germplasm. In conclusion, the allelic diversity revealed by multiplex PCR consisting of 4 SSR markers serves as baseline information of the genetic diversity of the 427 rice gerplasm accessions. Multiplex PCR enhances the efficiency of SSR markers, thus providing a marker system allowing heterozygosity assessment. The multiplex procedure was also found useful in determining redundancy in the germplasm.

Keywords: DNA Fingerprinting, germplasm, polymorphisms

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ANTIOXIDANT CAPACITY, PHENOLIC CONTENT AND SENSORY PROFILE OF PEANUT SKIN INFUSIONS

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The popularity of functional beverages led to the search for alternative sources of raw materials that provide both great taste and functionality to consumers. Peanut skins, a thin papery skin that encases the peanut seed, are a rich source of phenolic compounds and their utilization in beverage was exploited. The objective of this study was to determine the total phenolics (TP), antioxidant capacity (AOC), phenolic content and descriptive sensory profile of peanut skin infusions and evaluate the relation between these properties.

Raw peanuts were blanched at 100°C, 10 to 20 min, and skins were collected. Hot water infusions were prepared and AOCs were measured using TP and Trolox equivalent antioxidant (TEAC) and oxygen radical absorbance capacity (ORAC) assays. Reversed-phase HPLC was used to determine phenolic acids, stilbenes and flavonoids. Trained panels evaluated the sensory profile of peanut skin infusions.

Principal component (PC) analysis showed that the cumulative percent of variability accounted for by the first three PCs is 87.9%. PC1, accounting for 44.2% of the variance, appears to be associated with TP, TEAC, ORAC, the compound resveratrol and the descriptive attributes 'woody', 'bitter' and 'astringent'. PC2 explained 31.0% with large loadings relating to the attribute 'clarity', and the compounds protocatechuic and caffeic acids, and quercetin. PC3 (12.8%) appears to be associated with the compounds catechin, epicatechin and p-coumaric acid. Distribution of skin infusions for the first two PCs reveals two sample groupings. These findings suggest that peanut skin type may significantly alter AOC properties, phenolic composition and sensory properties. Beverage products with peanut skins, as an alternative health beverage, may deliver beneficial effects to human health.

Keywords: peanut skin, infusions, phenolics, antioxidant capacity, descriptive test

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ABOVEGROUND BIOMASS ESTIMATION OF TIMBER RESOURCES IN PERMANENT FIELD LABORATORY AREA (PFLA 2) IN MT. MAKILING FOREST RESERVE, PHILIPPINES

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The potential role of tropical forests to sequester atmospheric carbon is considered to be the most practical and effective way to reduce the release of CO₂ in the atmosphere. The study focused on the estimation of the aboveground biomass of timber resources in PFLA 2 located at Mt. Makiling Forest Reserve which is characterized by moderate to steep topography. The elevation of the reference point is 261.371 meters above sea level and the vegetation is dominated by balobo, kaong, rattan, and shrubs. In the study, biomass estimate in PFLA 2 in the year 2008 was 402.62 tons per hectare, 351.88 tons/ha in 2006 and 217.44 tons/ha in 2004. The established database through Arc View 3.2a displays the map of PFLA 2 and the locations of the trees as well as the biomass per tree species. Points (individual tree) and polygons (grids) on the map can be associated with its various descriptions in the database.

This study aimed to: (1) to estimate the biomass of timber resources; (2) to determine the biomass changes in the area, and; (3) to develop a GIS-assisted biomass database for PFLA 2. The data were collected from one hectare plot of PFLA 2 using grids of 10m x 10m where the diameter at breast height (eⁿ 5 cm) of trees was measured. Secondary data in 2004 and 2006 were obtained from the Office of the Coordinators for Research Extensions and Linkages (OCREL). Biomass was estimated using the formula: $Y = \exp \{-2.134 + 2.530 * \ln (D)\}$. The data were analyzed, stored and manipulated through Arc View GIS software. A database of trees in the PFLA 2 was produced.

The estimation of biomass or biomass density is necessary tool to explain the flow of carbon (energy) in the ecosystem.

Keywords: arc view, biomass, CO₂, climate change, GIS

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**DYNAMICS OF ENDOMYCORRHIZAS AND ASSOCIATED
FOREST WILDLINGS IN THREE PERMANENT FIELD
LABORATORY AREAS IN MT. MAKILING,
LOS BANOS, LAGUNA, PHILIPPINES**

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This study assessed the dynamics of endomycorrhizal fungi and estimated fine root biomass of forest wildlings through soil coring within 2x2 m regeneration plots in three permanent field laboratory areas of Mt. Makiling to determine the possible correlation among endomycorrhizal fungal diversity, percentage root colonization, fine root biomass, and diversity of forest wildlings. Four genera (*Acaulospora*, *Gigaspora*, *Glomus*, and *Scutellospora*) and 14 species of isolated spores of endomycorrhizal fungi were characterized. *Glomus* species was dominant comprising 90% of the total density of endomycorrhizal spores. The diversity of endomycorrhizal fungi in three PFLAs was relatively low to moderate, most probably due to good condition of the areas. Also, endomycorrhizal fungi were possibly more specific to soil type than to host type, thus, comprehensive studies of soil properties such as soil pH, texture, nutrients, organic matter, moisture and soil organisms should be made. Roots of forest wildlings collected from three PFLAs exhibited specialized structures such as arbuscules and vesicles, and non-septated hyphal strands suggesting endomycorrhizal associations. Fine root biomass obtained from three permanent plots was comparatively low for a tropical rainforest. Although, the turn out could be attributed to certain procedural lapses. Therefore, in the estimation of fine root biomass procedures should be permutated and magnified to increase fine root recovery. A total of 46 species of forest wildlings were recorded in three PFLAs. The diversity of endomycorrhizal fungi was not significantly correlated to the diversity of forest wildlings. Overall, further studies should be undertaken to determine and establish the relationship of endomycorrhizal fungi and forest wildlings to fully understand their dynamics.

Keywords: dynamics, endomycorrhizas, endomycorrhizal fungi, forest wildlings, fine roots

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DETECTION OF EPISOMAL *Banana streak badnavirus* (BSV) IN PHILIPPINE *Musa* GERMPLASM COLLECTION BY IMMUNOCAPTURE-POLYMERASE CHAIN REACTION (IC-PCR)

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Banana streak badnavirus (BSV), one of the five described viruses infecting banana (*Musa* sp), is currently being considered a serious threat and major constraint to *Musa* genetic improvement and germplasm movement. The virus occurs as non-infectious endogenous, wherein viral sequence is incorporated naturally on *Musa* genome, or infectious episomal, which can originate through activation from the endogenous sequences triggered by abiotic stress like tissue culture and drought condition. Accurate detection method must be developed/adapted and used to index the existing germplasm for the presence of episomal BSV. Virus detection was done using Immunocapture-Polymerase Chain Reaction (IC-PCR), which specifically detects episomal virus. Using purified BSV antibody and BSV F1/R1 primers, IC-PCR showed that 18 out of the 22 cultivars tested (82%) gave an amplification product of 220bp indicating the presence of episomal virus. Only 4 cultivars (18%) were negative to BSV. It was noted that all the leaf samples collected from the germplasm came from plants with no typical symptoms of virus infection. Based on the results of IC-PCR, it is very important to use an accurate and effective detection method to determine the presence of episomal BSV in the germplasm collection as part of tight integrated management measures.

Keywords: *Banana streak badnavirus*, Immunocapture-PCR, *Musa* germplasm, endogenous, episomal

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COMPARATIVE STUDY ON POPULATION DYNAMICS OF MAJOR INSECT PESTS AND THEIR NATURAL ENEMIES IN INBRED AND HYBRID RICE IN DIGOS, DAVAO

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The average population of major insect pests and their natural enemies in inbred and hybrid rice was compared during wet season in Digos, Davao del Sur, Philippines. Field survey and monitoring was conducted on 50 selected farmers' field at weekly interval throughout the cropping season. Samples were collected using sweeping method and were transported to laboratory for proper taxonomic identification. Data on average population were subjected to t-Test. White stemborer (*Scirpophaga innotata* Walker, green leafhopper (*Nephotettix* spp.) and brown planthopper (*Nilaparvata lugens* Stal.) were recorded as the dominant insect pests. Results showed that average population of leafhopper and planthopper both in hybrid and inbred rice was highest at 35-42 days after transplanting (DAT). Significant difference between leafhopper population in hybrid and inbred rice was recorded at 5% level. Highest stemborer eggmass count was recorded 35 and 63 DAT for inbred and hybrid, respectively. Adult stemborer incidence was highest at 70-77 DAT. Total average population of predators (*Coccinellidae*, *Miridae*, *Tetragnathidae*, and *Linyphiidae*) and parasitoids (*Ichneumonidae* and *Pipunculidae*) was 57 percent higher in inbred than in hybrid. It was noted that the abundance of these natural enemies is dependent on the availability of their host at a given crop growth stage. This study confirmed that insect pests are important component in the population dynamics of natural enemies.

Keywords: Davao del Sur, hybrid rice, inbred rice, insect pest, natural enemies

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A MULTIPLEX PCR DESIGN FOR THE DETECTION OF THE ABACA BUNCHY TOP VIRUS (ABTV) IN LEAF SAMPLES

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The abaca bunchy top virus or ABTV is one of the most devastating pathogens that infect abaca today. A key element in preventing its spread is early detection and disease indexing of planting materials. To this end, a design for a multiplex PCR able to detect the presence of ABTV DNA has been developed. Four primer pairs were used: Three primer pairs target ABTV genes, namely the coat protein, movement protein, and replication initiation protein (Rep) genes. In addition, a fourth primer pair targets a region in the chloroplast NADH dehydrogenase subunit (*ndhB*) gene, which is conserved in diverse plant taxa. Amplification of the *ndhB* gene serves as an internal positive control. In the detection of plant viruses, the PCR template is often the total DNA extracted from plant samples. Hence, the amplification of an internal positive control would determine if PCR conditions are favorable to amplification of DNA and to an extent, if the quality of the DNA template is acceptable. Each primer pair used for multiplex PCR yields an amplicon of a unique size to ensure unambiguity. An ideal result for the said multiplex PCR design would be the amplification of the *ndhB* intron in all samples (healthy and infected) and at the same time, the amplification of ABTV only in infected samples. The multiplex PCR design outlined above have been tested on 30 leaf samples taken from Bicol and Leyte. Results of the test have so far corroborated with parallel assays using ELISA (enzyme-linked immunoassay).

Keywords: abaca bunchy top virus, ABTV, multiplex PCR, virus detection, coat protein gene, movement protein gene, replication initiation protein, *ndhB* gene

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PCR-BASED IDENTIFICATION OF POTYVIRUSES IN INFECTED ABACA PLANTS USING CODEHOP PRIMERS

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The abaca fiber industry is one of the most lucrative businesses in the country since the Philippines supplies 84% of the total demand in the international market and earns US \$ 80 M annually. However, in recent years, the abaca industry suffers from severe infestations caused by different plant viruses. Most viral diseases are identified based on symptomatology alone. Most viruses belonging to the same family often show the same symptoms particularly the potyviruses. Infected leaf samples showing symptoms typical of bract mosaic infection were collected from Bicol and Davao were used in the study. A new approach was developed in the identification of potyviruses. CODEHOP or consensus degenerate hybrid oligonucleotide primer was designed based on the consensus sequence targeting the C-terminal half of the coat protein, which has the most conserved sequences in a potyviral genome. The CODEHOP forward was paired with a published degenerate N1 primer to specifically amplify the C-terminal half of whichever potyvirus present in the sample. The Bicol isolate produced a 700 bp amplicon while the Davao isolate produced an 800 bp amplicon. Both amplicons were cloned into PCR 2.1 cloning vector (Invitrogen) for sequencing. Sequences were analyzed using internet based programs, Blast and Multalin. Blast sequences revealed that Bicol isolate showed 98% identity with banana bract mosaic virus while Davao isolate showed 98% identity with sugarcane mosaic virus, recently identified as abaca mosaic virus. These results proved that even though both isolates were morphologically identified as bract mosaic, based on CODEHOP PCR, the two isolates, Bicol and Davao, were infected with two different viruses, banana bract mosaic virus and abaca mosaic virus respectively.

Keywords: potyvirus, symptomatology, CODEHOP, coat protein, banana bract mosaic virus, and abaca mosaic virus

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MINIMIZING BACTERIAL LEAF BLIGHT AND OTHER DISEASES IN RICE USING ORGANIC PESTICIDE

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The current agricultural system calls for organic-based pesticides to avoid health and environmental hazards. Hence, we evaluated lactic acid labeled Antica against two important diseases of rice, the bacterial blight (BLB) and tungro. On-farm trial in RCBD was conducted using NSIC Rc156 and PSB Rc72H in Nueva Ecija and Isabela, respectively. Treatments were Antica as spray at 5, 10, 15, and 20 ml/L water, Antica as seed coat (SC), copper hydroxide [Cu(OH)₂] at 3.75 g/L water, and untreated control. Cypermethrin, was used in Isabela instead of [Cu(OH)₂]. Seed treatment was also excluded. Application was done at 2-week intervals 5 days after transplanting (DAT) until heading. Diseases, arthropods, and phytotoxicity were assessed 1 week after treatments. Antica at 5 ml/L water reduced BLB incidence by 17.5% and severity by 33% at 42 DAT compared with the untreated control. As disease progressed, Antica-plots remained to have lesser BLB incidence and severity. At 75 DAT, BLB incidence and severity were lowest in plots sprayed with 5 ml Antica/L water with 33.7% reduction in incidence and 25% reduction in severity. Incidence of tungro, although low, was also reduced in Antica-treated plots with as much as 50%. In Isabela, BLB was lower but data showed 17-25% reduction in incidence in Antica sprayed-plots. Bacterial leaf streak, which occurred in higher frequency in Isabela was also reduced by 25-39%. SC-plots were not statistically different from control. Antica also reduced the number of herbivores such as green leafhoppers, brown planthoppers, and white-backed planthoppers without affecting the predators and parasitoids, except for coccinelids whose densities dropped in plots treated with 20 ml Antica. No phytotoxicity were observed in all plots indicating that Antica is safe for use in rice. Antica gave a yield advantage of 7.3 to 13.87 % over the other treatments. In most instances, Antica was effective at the rate of 5 ml/L water.

Keywords: Antica, lactic acid, disease, BLB, BLS, tungro, herbivores, rice

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FUSARIUM EAR ROT: MOLECULAR CHARACTERISTICS OF THE PATHOGEN AND HOST RESISTANCE

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The fungi *Fusarium moniliforme* Sheldon and *Fusarium proliferatum* (Matsushima) Niren, the cause of Fusarium ear rot, were reported to produce a series of toxins on corn which include the fumonisins, of which fumonisin B₁ and B₂ have cancer promoting activity. Other mycotoxins produced include moniliformin, fusarin C and fusaric acid. Fumonisin B₁ has been shown to be responsible for most of the toxicological affects observed from ingesting corn infected by toxigenic isolates of these fungi. *F. moniliforme* occurs in all parts of growing corn plant throughout the season.

To appropriately manage Fusarium ear rot in corn, isolates of the causal pathogen must be accurately characterized and identified. Based on morphology, the collected four isolates belong to *Fusarium* sp. To determine the species, they were molecularly characterized by PCR using ITS-rDNA primers and by homology analysis of the nucleotide sequence through BLAST to compare with other reported *Fusarium*-causing ear rot in corn. Results showed that three isolates (from UPLB experiment station, Northern Cotabato and from CMU, Bukidnon) were highly related to *F. moniliforme* from China while one (from South Cotabato) was highly related to *F. graminearum*.

Resistance is still the most economical method to control these pathogens. The identified resistant varieties or inbreds can be used for improvement of corn to ear rots or they can also be directly used by farmers or growers in the case of identified resistant hybrids or populations. Results of resistance evaluation to Fusarium ear rot using ear injection method showed that out of twenty entries evaluated, two inbreds (S3YB 137-1-1-B and TUPI (S3) 15-2-B) were moderately resistant, 14 inbreds and hybrids were moderately susceptible and four were susceptible. None was found highly resistant to the disease. Further evaluation of germplasm is needed to identify highly resistant sources to avoid fumonisin production in corn kernels.

Keywords: Fusarium ear rot, *Fusarium moniliforme*, host resistance, corn

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**EVALUATION OF GAMMA IRRADIATED ABACA
(*Musa textilis* Nee.) FOR RESISTANCE TO ABACA BUNCHY
TOP VIRUS AND BANANA BRACT MOSAIC VIRUS
UNDER SCREENHOUSE CONDITION**

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Abaca (*Musa textilis* Nee.) is the source of natural strong fiber in the Philippines. There has been decreasing production of abaca fibers in the last decade since the available commercial varieties are susceptible to the two major viral diseases, namely bunchy top and bract mosaic. *In vitro* technology coupled with gamma irradiation ($^{60}\text{Cobalt}$) were sought in order to develop varieties with resistance to these two viruses.

To start with the irradiation of two varieties, namely Tinawagan Pula and Tangongon, the optimum dose level or lethal dose or LD_{50} of $^{60}\text{Cobalt}$ was established by taking the rate of shoot proliferation and growth development of shoot cultures (SubCycle 1 to 3). After bulk irradiation using the developed LD_{50} , all plantlets were inoculated with abaca bunchy top virus and banana bract mosaic virus using insect transmission and mechanical transmission, respectively.

Out of the 2,296 plants of variety Tinawagan Pula and 974 plants of variety Tangongon, 43 plants or 1.9% and 9 plants or 0.9%, respectively, were negative to abaca bunchy top virus using Enzyme-linked immunoassay (ELISA). For bract mosaic, from the 2,169 plants of variety Tinawagan Pula, and 1,006 plants of variety Tangongon, 57 plant or 2.6% of variety Tinawagan Pula and 14 plants or 1.4% of variety Tangongon, were negative to banana bract mosaic virus using Polymerase Chain Reaction (PCR). The putatively resistant lines of these two varieties from the screenhouse experiment are being micro-propagated for field evaluation.

Keywords: abaca, abaca bunchy top virus, banana bract mosaic virus, gamma irradiation

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**EFFECT OF *Cymbopogon citratus* (LEMONGRASS)
AND *Pandanus amaryllifolius* (PANDAN) INFUSION ON
RICE-SPOILAGE ORGANISM *Bacillus cereus***

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The Philippines has a rice-based diet wherein people usually get their carbohydrate requirement from rice and its derivatives. *Bacillus cereus* is one of the most common spoilage organism found in rice, wheat, dairy products, etc. There are many ways to cook rice, among them is to add some species of grasses which may improve flavour and aroma. The objective of this study is to find if these aesthetic additions may have antimicrobial benefit. Leaf infusions of the two plants were screened through Kirby-Bauer disk diffusion method for antimicrobial properties. Different concentrations of the leaf infusion were used on vegetative cells (0.2 g/ml, 0.15 g/ml, 0.1 g/ml, 0.5 g/ml, and 0.25 g/ml) and spores (0.8 g/ml, 0.7 g/ml, 0.6 g/ml, 0.5 g/ml, 0.4 g/ml, 0.3 g/ml, and 0.2 g/ml). A close relative, *B. subtilis* was used for control and clindamycin was used as antimicrobial control. The highest inhibition for vegetative *B. cereus* was found at the highest concentration of lemon grass (1.6 mm) and at 0.1 g/ml of pandan (0.6 mm). While for *B. subtilis*, the highest inhibition was found at the same concentration (4.8 mm for lemon grass and 2 mm for pandan). The effect of lemongrass infusion in its inhibition of growth of *B. cereus* is directly proportional to its concentration. While the effect of pandan is increasing at first it decreases at higher concentrations of the infusion. The experiment has demonstrated that lemongrass has more antimicrobial activity than pandan for both *Bacillus* sp. Among the two, *B. subtilis* is more susceptible to antimicrobials. More research is needed to test isolated, purified compounds from infusion of the two plants to be used as rice additive.

Keywords: *Bacillus cereus*, *Cymbopogon citratus*, *Pandanus amaryllifolius*, rice-spoilage

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**LONG-TERM WEED MANAGEMENT, DIVERSITY AND
ABUNDANCE OF BROADLEAF WEEDS IN A BANANA
PLANTATION IN DAVAO CITY, PHILIPPINES**

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Weeds are often considered pests because they reduce crop yield. However, some weeds perform useful ecological functions such as providing a habitat for biocontrol agents, nourishing useful microorganisms in the soil and preventing erosion. Appropriate weed management should therefore aim to maintain a certain level of useful weed population and diversity instead of totally eliminating them. To determine the effects of manual and chemical (paraquat and glyphosate) weed management on the abundance and diversity of broadleaf weed species in a banana plantation, counts, dry weights, seed bank and diversity indices of broadleaf weed species were compared in two identical experiments in 15% and 25% slopes. Bananas were at the fruiting stage and were established 2 to 5 years earlier when the experiment started. Seedling emergence and diversity indices of broadleaf weeds showed an increasing trend in seed banks in both 15% and 25% slope over 3 years. Field counts and biomasses were significantly lower in the chemical plots compared to the manual plots. The sustained dominance of *Ageratum conyzoides* was also observed in the field but chemical treatment was better than manual treatment in reducing its population. Species *Cleome rutidosperma* and *Bidens pilosa*, which were dominant in the first year of sampling, continuously declined. Along with this decline was the increase in *Drymaria cordata* and *Acalypha indica* in the 15% and 25% slopes, respectively. The ecological significance of the shifts in weed composition resulting from manual and chemical weeding is discussed in this study. The chemical treatment was ecologically advantageous compared to manual treatment as it has effectively reduced weed abundance and dominance of noxious weed without concomitantly decreasing weed diversity.

Keywords: *Ageratum conyzoides*, banana plantation, weed diversity, paraquat, glyphosate

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**INSECTICIDE USE IMPACTS OF INTEGRATED
PEST MANAGEMENT (IPM) FARMER FIELD SCHOOLS:
EVIDENCE FROM ONION FARMERS IN THE PHILIPPINES**

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This article empirically examines the impact of Farmer Field Schools (FFS) on insecticide use by onion farmers in the Philippines. FFS is an intensive Integrated Pest Management (IPM) information dissemination method that encourages producers to lower their reliance on chemical insecticides for controlling pests and diseases in their farms. These FFS-IPM trainings have been conducted within vegetable-based production systems in the country since 1994. The data used in the study are from the face-to-face farm level survey in 2009 of 200 onion growers in Nueva Ecija. Using instrumental variable (IV) procedures to control for endogeneity and selection problems in the data, we found that FFS trained onion farmers in the Philippines have significantly lower insecticide expenditures (~PhP5,000) than non-FFS trained control farmers. By not controlling for these econometric biases, the FFS training did not show any effect on insecticide use. The insecticide reducing effect of FFS has important environmental and health implications, and provides evidence about the effectiveness of the FFS training method in disseminating important IPM concepts in the country.

Keywords: Farmer Field Schools; Insecticide Use Impact; Instrumental Variables Technique; Integrated Pest Management (IPM); Onion Production

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**CLIMATE CHANGE MITIGATION IN CROP
PRODUCTION: DEVELOPING YELLOW CORN
(*Zea mays* L.) VARIETIES FOR SALINITY TOLERANCE**

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Problems due to soil salinity are widely spread throughout different agro-ecological zones. Corn (*Zea mays* L.), as one of the major cereal crops in the world, is adversely affected by this stress. Efforts to develop tolerant varieties are underway to limit the ill effect of salinity on corn production. Greenhouse experiments and field trials were conducted to evaluate the potential of 25 yellow corn populations or open pollinated varieties (OPVs) developed by the Institute of Plant Breeding (IPB) for salinity tolerance. Initial screenings were conducted in the greenhouse using the nutrient solution culture with varying degree of salinity. Treatments were replicated three times and were arranged in randomized complete block design with salinity levels serving as main plot and variety as the sub-plot. Results of agronomic parameters like percent survival root and shoot length, root and shoot biomass, chlorophyll content (SPAD value) and leaf area revealed three varieties with good potential for improving their saline tolerance; these were Phil 1-115, IPB Composite 3 and IPB Composite 5. These OPVs were further evaluated by growing them under actual saline soil. IPB Composite 3 and IPB Composite 5 produced the heaviest biomass and grain yield with the IPB Composite 3 being the better of the two. Thus, IPB Composite 3 had been chosen as the best OPV candidate for yellow corn population improvement for salinity tolerance.

Keywords: climate change, salinity tolerance, corn population improvement, nutrient solution culture

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AGRICULTURAL LIMING CONTRIBUTES TO GLOBAL WARMING

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The role of atmospheric CO₂ in global warming is unchallenged. Lime carbonates contribute to atmospheric CO₂ emissions and enhance soil organic carbon (SOC) turnover in limed acid soils. Experimental data on the magnitude of lime-contributed CO₂ are still few although liming is common agricultural practice worldwide. To separate lime-contributed and SOC-originated CO₂-C to CO₂ evolution, we used Ca¹³CO₃ (¹³C 99%) as lime and tracer to an acidic Kuroboku Andisols from Tanashi, Tokyo Prefecture (35°44'N, 139°32'E) and Kunigami Mahji Ultisols of Nakijin, Okinawa Prefecture, Japan (26°38'N, 127°58'E). The lime was applied under two soil water conditions: 70% (FC70) and 30% (FC30) of the field capacity (FC) of the soils incubated at constant temperature (20° C).

After 36 days, ¹³CO₂-C evolution was 74.37 – 79.32% of total CO₂-C emissions from Kuroboku Andisols, and 62.32 – 70.4% in Kunigami Mahji Ultisols. This confirmed significant contribution of carbonates in CO₂ evolution of limed agricultural soils. Liming also increased ¹²CO₂-C evolution from native SOC. Priming effect of lime ranged from 51.97 – 114.95% in Kuroboku Andisols and 10.13 – 35.61% in Kunigami Mahji Ultisols. These are real priming effects since there was no other source of ¹²CO₂-C than SOC. Decrease in soil microbial biomass carbon (SMBC) indicated microbial stress due to liming, and rise in soil pH allowed an increase in microbial populations able to utilize SOC, explaining the extra ¹²CO₂-C evolution in limes soils.

Keywords: agricultural liming; soil organic carbon; priming effect; lime carbonate; soil microbial biomass carbon

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EFFECT OF CATTLE FARMING ON POTENTIAL GROUNDWATER RESOURCES IN MASBATE, PHILIPPINES

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Masbate Island receives an annual rainfall of 2,624.51 mm. However, 50% of its rocks have no obtainable groundwater and are infested with bacteria and amoeba. The island's area is 46% pasturelands and difficult areas are found in places where large pasturelands are located. This study is aimed at understanding how cattle-raising industry in the island affects groundwater supply in terms of magnitude of recharge and water quality; and at identifying options for cattle-raising management that would help ensure sustainable groundwater supply. Policy review, stakeholders' analysis, interviews and tests on bulk density, amount of surface runoff and runoff-bacteriology test were conducted. The social, economic, institutional and technical aspects that affect the practices of cattle farmers were measured in terms of its effect on the magnitude and quality of potential groundwater resources. The findings of the study showed that practices of the farmers are affected by: their motive to generate income; their socio-economic status; and the incompetence and insufficiencies of policies. These were manifested by their practices on overgrazing, which resulted to compaction of soil in some of the grazing areas; unwillingness to adopt the use of improved grass, and unreligious reforestation of protected areas under FLGMA (Forest Land under Grazing Management Agreement). Forty-two percent of samples were found to have compacted soils. In their practices, the type of grass for grazing influenced the runoff behavior. Cogon grass showed strong influence in the behavior of runoff in which rainfall greater than 30 mm resulted to more than 8 mm-depth runoff. Total and fecal coliform in the runoff is greater than 8.0 MPN per 100 ml.

Keywords: Masbate, pastureland, runoff, cattle raising, cogon grass

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CLIMATE CHANGE MITIGATION THROUGH CONSERVATION OF ANGAT WATERSHED RESERVATION IN LUZON, PHILIPPINES

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The impacts of climate change are becoming more severe. For the past decades, the Philippines have witnessed strong typhoons, prolonged rains and intense drought that caused significant damages to agriculture, infrastructures, human settlements and health. As proposed by the Intergovernmental Panel on Climate Change (IPCC), mitigation strategies such as reforestation and protection of the remaining forest cover can help lessen the impacts of climate change. Forested watersheds such as the Angat Watershed Reservation Dam in Luzon have huge capacity to store and sequester atmospheric carbon. Among the greenhouse gases, carbon dioxide is the most important contributor to global warming. Using the biomass sampling technique developed by ICRAF-ASB and Winrock Foundation, the study estimated the carbon stocks of Angat watershed. On the average, old growth forest has the largest carbon density with 404 ton ha⁻¹. This was followed by second growth forest (387.5 ton ha⁻¹ C), tree plantations of *Swietenia macrophylla* (357 ton ha⁻¹ C) and *Gmelina arborea* (240.7 ton ha⁻¹ C), submarginal forest (151.9 ton ha⁻¹ C), and lastly grassland (65.7 ton ha⁻¹ C). Total carbon stock of the watershed was estimated to around 22 gigaton C, an amount that is significant to help compensate the country's carbon emission level. Overall, the study emphasized the need to protect Angat watershed in order to sustain its twin role of climate change mitigation and sustainable water and energy generation.

Keywords: carbon stock, climate change, dam, watershed

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RISK ASSESSMENT OF SALTWATER INTRUSION

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A study was conducted to investigate the current status of saltwater intrusion in the northern coastal aquifers of Ilocos Norte. Specifically, the study aims to determine the following: the degree of possible salt water intrusion; to identify the possible causes of risks associated with salt water intrusion and to come up with mitigation measures suitable in the locality.

The study area was characterized based on its geophysical and hydrological factors. The cropping pattern practiced is predominantly rice-garlic-vegetables. Groundwater resources are being used both for domestic and agricultural purposes.

Groundwater samples were collected from the farmers 21 existing shallow tubewells (STW) in three coastal barangays of Pasuquin, Ilocos Norte. Collection of samples were done using a portable sampling pump wherein the STWs were purged for 10 minutes prior to collection to pump out possible impurities. Groundwater samples collected were placed in 1 liter nalgene bottles, properly labeled and kept in an ice chest. The samples were immediately submitted to the Regional Testing Center of DOST-I, San Fernando, La Union for chloride and calcium analyses.

Results of analyses showed alarming results especially on chlorides content of groundwater samples. Average chloride content of seven STWs per barangay reached 650.0 mg/liter which is above the recommended limit of 250.0 mg/liter (Ayers, 1976) for irrigation water and 5.0 mg/liter for domestic purposes.

Therefore, the chloride content of groundwater samples analyzed posed an alarming threat to the coastal aquifer under study. There is a possible encroachment of saltwater intrusion to the STWs in farmers' field. A recommendation to undertake a mitigation technique to reduce saltwater intrusion using freshwater technology both in a hypothetical and actual coastal aquifer system is deemed necessary. This would serve as source of management strategies to solve if not to halt the saltwater intrusion landwards, thus protecting the coastal aquifer systems.

Keywords: saltwater intrusion, coastal aquifer system, chloride

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CARBON SINK POTENTIAL OF THE PHILIPPINE MANGROVE FOREST

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The importance of mangrove for both human and coastal organisms has been well-documented in many literatures. Among which is the capacity to trap atmospheric carbon into its biomass and help mitigate the impacts of climate change such as tidal surge, erosion and salt water intrusion. Notwithstanding its smaller share in the global forest cover, it is one of the most productive and biodiverse ecosystems. On the average, mangrove contains as much as half of the old growth forest biomass, and represents 12 genera of plants. The Philippine mangrove forest currently accounts to 247,362 ha, and is gradually increasing because of the coastal rehabilitation programs being implemented by the government, NGOs and communities. Mangrove trees are very common in almost all coastal areas of the country. All regions, except the Cordillera Autonomous Region (CAR) harbor mangrove forest. Among the regions, MIMAROPA (Region 4B) has the largest share with 57,567 ha, followed by ARMM in Mindanao with 45,786 ha, and Region 8 (Samar and Leyte) with 38,781 ha. To estimate the potential of Philippine mangrove for carbon storage, carbon density estimates observed by the Environmental Forestry Programme of the University of the Philippines Los Baños were used. On the average, the country's mangrove could be storing as much as 28.56 to 35.05 megaton carbon (Mt C). Among the provinces, Palawan (53,678 ha) and Sulu (24,305 ha) have the largest carbon stocks with 6 to 7 Mt and 3 to 3.5 Mt, respectively. Indeed, Philippine mangrove has huge potential for carbon storage hence proper forest management is vital to sustain its ecological roles.

Keywords: Philippine mangroves, carbon sink, climate change, conservation

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INCREASING RICE PRODUCTIVITY IN FLASH FLOOD-PRONE AREAS VULNERABLE TO EFFECTS OF CLIMATE CHANGE

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Flash floods of up to 2 weeks can occur at any crop growth stage, sometimes more than once, resulting in severe yield losses in rice. Despite the risk, farmers continue to grow susceptible modern varieties, local landraces with low yield, or leave the field idle and wait for another season. Six mega-varieties introgressed with *SUB1* gene and other lines possessing the *SUB1* gene were disseminated in Southeast Asia; their adoption was facilitated. On-station adaptive yield trials, subjected to normal and flooded conditions, and on-farm researcher and farmer-managed participatory varietal selection (PVS) followed by preference analysis and sensory evaluation were implemented. Following complete flooding for 8 to 13 days, varieties with *SUB1* had 1- 3 t ha⁻¹ yield advantage over normal varieties. Results from PVS showed Swarna-Sub1 (5.2 t ha⁻¹ yield) was most preferred in North Vietnam, while IR64-Sub1 (3.7 t ha⁻¹ yield) was most preferred in Central Vietnam. TDK1-Sub1, developed from the popular variety TDK1, and PSB Rc68 are top choices in Laos and Northeast Thailand. IR64 was the second most popular variety after Ciherang; thus, acceptance of IR64-Sub1 is faster in Indonesia. In the Philippines, IR49830-7-1-2-3 and BR11-Sub1 yielded 4.2 and 3.8 t ha⁻¹, respectively, and were most preferred. Varietal registration and accreditation of IR64-Sub1 (Submarino1) for the Philippines and IR70213-9-CPA-12-UBN-2-1-3-1 (INPARA-3), IR64-Sub1 (INPARA-4) and Swarna-Sub1 (INPARA-5) for Indonesia was made possible, thus commercialization and support from national governments was achieved. Initial success was attained through active partnership among farmers, local officials, extension workers, scientists, and other stakeholders. These Sub1 varieties provide considerable security for farmers in flash flood-prone areas.

Keywords: participatory varietal selection, *SUB1* gene, flash flood-prone areas, submergence tolerant rice

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**VAST-Agro: A COMMUNITY-BASED VULNERABILITY AND
ADAPTIVE CAPACITY ASSESSMENT METHODOLOGY
FOR VARIOUS AGROECOSYSTEM**

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Vulnerability and adaptive capacity assessment is a necessary step prior to planning, implementation and prioritization of responses to changing climate. Often results of global and regional assessments are not appropriate for the local level thus requires a local-level assessment for a more focused and realistic adaptation measures, particularly for the agriculture sector, which is not highlighted in any of the available hazard assessment procedures. This paper aims to present a structured approach to vulnerability assessment specific for the Philippine agricultural systems at the local level. Available hazard assessment procedures were reviewed and examined in terms of their purpose, framework, methods, agriculture-related data and applicability to agriculture areas facing climate change. Based on the concept that vulnerability to climate change is the interaction of exposure to climate change-related hazards and their potential impacts as determined by sensitivity and adaptive capacity, a stepwise procedure was designed for understanding the local situation, describing the climate-related hazards, describing vulnerabilities, capacities and local adaptation measures. Climate-related and agriculture indicators were identified to describe exposure of the production systems and the farming communities to hazards, sensitivity of the system and the communities to the said hazards like high risks areas, vulnerable farming systems and groups, preparedness and adaptive capacity of the farming communities including physical, economic and technological adaptation capacities. As a community-led vulnerability assessment, an instrument was devised requiring data collection techniques involving community participation as well as integration of science, technical and local knowledge. A test of the methodology in the upland areas provided outputs including maps of vulnerable communities and agricultural production areas and a vulnerability index that showed areas requiring immediate attention and specific adaptation measures needed.

Keywords: climate change, vulnerability, adaptive capacity, agroecosystem, agricultural system

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UNDERSTANDING THE PATTERNS, DRIVERS AND IMPACTS OF LAND USE CHANGE IN STA. ROSA SUB-WATERSHED

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Sta. Rosa sub-watershed had undergone an abrupt shift in economic-base from agricultural to an industrial economy. In understanding the patterns, drivers and impacts of land-use changes Sta. Rosa subwatershed. Participatory Rural Appraisal (PRA) activities including Focus Group Discussion, Time Line, Community Land-use Mapping, Causal Mapping and SWOT analysis were conducted in upstream, midstream and lakeshore sites.

The upstream community had undergone land use conversion from forested areas in the 1920s, to deforestation in the 1940s, planting of rice in the 1950s, coffee planting in the 1970s, and start of pineapple planting in the 1980s. The main drivers of land use changes are population migration, food security and income generation. Currently, the main problems focus on agriculture and farming. In order to address this problem, the community proposed crop diversification and use of organic fertilizers such as compost.

The midstream and lakeshore communities had undergone a tremendous degree of land conversion from an agricultural-based to an industrial-residential economy. Industrialization and increase in population are the driving factors for the land use change.

Solid wastes from households and liquid wastes from factories are the major problems in both mid-stream and lakeshore communities. Proper solid waste management and strict implementation of policies on solid waste management by the LGU is strongly recommended.

Keywords: PRA, Sta. Rosa subwatershed, land use change, industrialization, waste management

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ASEPTIC CULTIVATION OF *Coprinus comatus* IN PULP AND PAPER WASTE

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Coprinus comatus is a wild edible mushroom that normally grows in cellulosic substrates. It is considered as a weed mushroom that competes with *Volvariella volvaceae*. In this study, we developed production technology for aseptic cultivation of this mushroom using paper sludge and corn grit. Two strains of *C. comatus* were rescued from decomposing pile of rice straw and cultured in different combinations of pulp and paper waste and corn grit.

Mycelial growth of *C. comatus* strain 1 was more vigorous than strain 2. *C. comatus* strain 1 grown in 7 parts paper waste + 3 parts corn grit had the shortest incubation period with a mean of 6 days while those cultured in 5 parts paper waste + 5 parts of corn grit produced the heaviest fruiting bodies with a mean of 9.87g and the most number of fruiting bodies with a mean of 23. Moreover, 2 parts paper waste + 8 parts corn grit produced the longest fruiting bodies with a mean of 83.49 mm. In contrast, *C. comatus* strain 2 grown in 8 parts paper waste + 2 parts corn grit had the shortest incubation period with a mean of 9 days, heaviest fruiting bodies (8.58g) and the most number of fruiting bodies (64.33). Finally, those that are grown in 7 parts paper waste + 3 parts corn grit produced the longest fruiting bodies with a mean of 40.77 mm.

Keywords: *Coprinus comatus*, aseptic cultivation, pulp and paper waste, production technology, cellulosic