TRANSACTIONS of the NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY Philippines

ABSTRACTS of PAPERS Presented during the 27th NAST Annual Scientific Meeting

Philippine Agriculture 2020: A Strategy for Poverty Alleviation, Food Security, Global Competitiveness, Sustainability, Justice and Peace

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27th ASM: 13-14 July 2005; The Manila Hotel

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TABLE OF CONTENTS

POSTER SESSIONS

Agricultural Sciences

Enhancing Nodulation and Biological N ₂ -Fixation of	
Soybean by Coinoculation of Plant Growth-Promoting	
Rhizobacteria and Bradyrhizobia	
Constancio A. Asis Jr., Vladimir K. Chebotar	
and Shoichiro.1kao	3
Eggplant Farming After Rice: Screening Pest-Resistant Eggplant for	
a More Productive. Profitable and Sustainable Farming in the Philippines	
Merdelyn T. Caasi-Lit	+
Production of Improved Planting Stocks of Ipil	
(Intsia hijuga Colebr.) Using Stem Cuttings	
Yolina T. Castañeto, Minda F. Edmiston,	
. lxel 11. Arriola and Elmer 7. Castañeto	5
Pestex: Philippine Countrywide Farmer-Based Corn Pest	
Surveillance/Monitoring. Forecasting and Decision Support System	
Bonifacio F. Cavabyab, Wilma R. Cuaterno, Melvin D.	
Ebuenga, Artemio M. Salazar and Pablito G. Gonzalez	6
Development of Tomato as a Suitable Plant System	
for Molecular Pharming	
Antonio C. Laurena, Marni E. Cueno and Lucita R. Laureles	7
Generating Novel Sources of Genes for Rice Tungro Disease	
Resistance through Anther Culture	
Nenita V. Desamero, Herminia R. Rapusan, Trinidad C.	
Fernando, Martha V. Chico, Emily R. Corpuz, Gerard B.	
Raveto, Emmanuel R. Tiongco and Thelma F. Padolina	8
Integration of Environmental Management System in the Overall	
R&D Management of PhilRicc	
Bernardo D. Tadeo, Rossana E. Espiritu, Leocadio S.	
Sehastian, Edilberto D. Redoña and Ronilo A. Beronio, et al	9

Hedgerow Systems and Livestock in Philippine Grasslands: GHG Emissions	
Damasa B. Magcale-Macandog, Edwin R. Abucay. Roberto G. Visco and Arsenio D. Calub	10
Alternative Land Use Options for Philippine Grasslands: A Bioeconomic Modeling Approach Using the Wanulcas Model Damasa B. Magcale-Macandog, Edwin R. Abucay and Princess Alma B. Ani	11
Multi-Agent Simulations of the Human Impacts and Landscape Dynamic of Agroforestry Adoption in the Uplands of Southern Philippines Damasa B. Magcale-Macandog. Princess Alma B. Ani, Marc M. Delgado and Paolo Campo	12
Village Level Integration of Direct Seeded Rice (DSR) Technologies and Practices: The Case of Maragol Rowena G. Manalili, Bernardo D. Tadeo, Wilfredo Collado, Emmanuel R. Tiongco, Mario dela Cruz, Ulyssess Duque, Aurora M. Corales, Rodolfo V. Bermudez, Marvin F. Adap and Constancio A. Asis Jr.	13
Identification of Erosion-Prone Areas in the Province of Aklan using Geographic Information System Alan Dino Moscoso	14
Growth and Yield Performance of Napier Grass (Pennisetum purpureum) Under Ilocos Conditions Corazon Diana A. Pastor, Roseminda R. Sair, Rogelio R. Caluya, Benito B. Balneg and Alfredo S. Bagaoisan	15
Vulnerability of Philippine Orchids to Land Use Changes: A Case Study in Rizal Province. Philippines Carnette C. Pulma and Daniel A. Lagunzad	16
Acclimatization of Tissue Cultured Banana CV. 'Lakatan' in Different Organic Potting Mix Alex B. Ouilang and Norberto R. Bautista	18
Species Identification and Damage Assessment of Borer on Sugar Cane Julieta D. Recuenco	19

Spatial Distribution of Seaweeds in the Littoral Zone of Five Municipalities of Biliran Island During the Wet Season of 2004 Richa Marie B. Tan and Leni G. Yap-Dejeto	20
Anthropogenic Activities in the Mangrove Areas of Camote Islands, Central Philippines: Basis for a Proposed Mangrove Management Plan Serapion N. Tanduvan	21
Tolerance of the Two Species of Clownfish (Amphiprion Clarkii and Amphiprion Perideraion) to Limuetic Waters: Basis for an Improved Tropical Fish Industry Plan Serapion N. Tanduyan Sr. and Serapion C. Tanduyan Jr.	22
Macropopagation of Guijo [Shorea guiso (Blanco) Blume] Using Stem Cuttings Henry P. Patricio, Yolina T. Castañeto, Arvin P. Valesteros and Elmer T. Castañeto	23
Biological Sciences	
Molecular Characterization of Beef (Zebu) Cattle (Bos indicus L.) in Agroecological Zones of the Philippines Genevieve Mae B. Aquino, Rita P. Laude, Cesar C. Sevilla J. Hon and O. Hanotte	27
Predation of Copepod Mesocyclops aspericornis On Aedes aegypti First Instar Larvae Soledad L. Bautista	28
Isolation and Screening for Bacteria with Amylolytic. Proteolytic or Lipolytic Activity from Oral and Anal Swabs of Selected Birds from Polillo Islands Roxanne II. Belen and Noel G. Sabino	29
Alternative Media for Culture of Tetrahymena thermophila Corazon C. Buerano, Genriech N. Reoyan, Mark Pierre S. Dimamay, Jose Christopher E. Mendoza and Filipinas F. Natividad	30
Spider Webs: Diversity in Architectural Designs within and Between Seven Orb-Weaving Species Cesar G. Demayo, Mark Anthony J. Torres and Lloyd N. Bordeos	31

Differentiation in Fifteen Selected Species of Nymphalid Butterflies	
Cesar G. Demayo. Mark Anthony J. Torres	
and Wilson F. Alad-ad	32
Landmark Analysis of Skull Shapes of Four Species of Bats from Mindanao	
Leonard Patrick D. Gabato. Mark Anthony J.	
Torres and Cesar G Demayo	33
Systematics of Bat Species from the Philippine Islands	
Cesar G. Demayo, Mark Anthony J. Torres	
and Leonard Patrick D. Gabato	34
Fluctuating Asymmetry in Leg Trait Characters in the ORB- Weaving Spider <i>NEPHIL</i> 1 SP	
Cesar G. Demavo, Mark Anthony J. Torres	
and Lloyd N. Bordeos	34
Taxonomic Study of Diatoms from Selected Sites In Sorsogon Bay	
Erwin P. Elazegui, Ana Leah L. Rada and Maricel T. Peniano	35
Primary Productivity and Biomass Production of teh Phytoplankton	
Community of Paoay Lake. Ilocos Norte, Philippines	
Flordeliza R. Estira and Marjun P. Balinzon	36
The Immune System of Nile Tilapia: Effects of Starvation in Newly Hatched Fry	
Annabelle A. Herrera, Ana Tiongco, Melodina Fabillo	
and Jose Abucay	37
Levels of Prolactin and Growth Hormone in the Brood Pouch	
of the Gravid Male Seahorse Hippocampus barbouri	
Jessica Patron, Edna Ocomer and Annahelle A. Herrera	.38
Spatial Disribution of Echinoids (Echinodermata) in the Intertidal	
Zones of Five Coastal Municipalities of Biliran Island During	
the Wet Season of 2004	
Erickson Casiles Lanuza, Ma. Odezsa D. Tibre	
and Leni Yap-Dejeto	38
Preliminary Studies on Lypolytic Activity of Endogenous Thermophilic <i>Bacillus</i> Sp.	
Amor P Mogtibay Marinar J. Pana, J.P. Maghanua	
and Veronica P. Nigo	39

Isolation. Screening and Characterization of Acidophiles from Philippine Acid Mine Drainage for Anti-Microbial and Enzymatic Activities	
Clarissa M. Ocampo, Lei Lanna C. Mendoza, Sonia Jacinto. Gem D. Encarnacion and Asuncion K. Raymundo	40
Male Vitellogenesis: A Biomarker of Endocrine Disruption in Reef Fishes of Iligan City Olga M. Nuñeza, Henry I. Rivero and Maricris Gay P. Garcia	41
Complementation of the lvs3 Mutation in Penicillium chrysogenumL2 Using the lvsF Gene from Aspergillus nidulans: Demonstration of Cross-Species Functionality of the Homoaconitase Gene Franco G. Teves, Javier B. Casqueiro, Axel A. Brakhage, Asuncion K. Raymundo and Juan F. Martin	42
Biodiversity Resources in Mountain Ecosystems: Opportunities for Livelihood and Ecotourism in Northern Philippines Nelson M. Pampolina, Raymundo M. Lucero, Dexter L. Bautista. Dhioce A. Celadiña, Anthony C. Alcantara, Lorenzo V. Cordova and Jennifer C. Dimas	43
Geometrid Moths of the Mount Makiling Forest Reserve (Lepidoptera: Geometridae) Aimee Lynn A. Barrion	++
Taxonomy of Philippine Stick Insects of the Subgenus Aretaon (Trachyaretaon) (Phasmatodea: Phasmatida: Obrimini) Ireneo I. Lit.Ir. and Orlando I. Fusebio	45
Taxonomy, Distribution and Host Ranges of Recent Outbreaks and New Records of Scale Insects (Coccoidea. Hemiptera) in the Philippines Ireneo L. Lit Jr. and Merdelvn T. Caasi-Lit	46
Applications of Ordination Methods in Statistics in Assessing the Relative Importance of Geography and Landscape Structural Complexities in the Community Structures of Dragonflies Mark Anthony J. Torres and Cesar G. Demayo	47
Linear Distance-Based Methods in Studying Diversity in Body Shapes of Four Species of Crab Spiders Gasterachanta spp. Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demavo	48
Elliptic Fourier Shape Analysis of Body Shape Changes in Four Species of Crab Spiders Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demavo	-49

Monitoring of Microbiological Potability and Detection of Potentially Diarrheagenic Bacteria from Hand-Pumped Water in Selected Barangays of Los Baños. Laguna Geralyn P. Garcia and Bernadette C. Mendoza	50
Biotechnology	
Mutationaly Analysis of Serine 556 and Serine 557 in Domain III of Bacillus Thuringiensis Cry1 AB Protein Aileen Bayot, Leonardo Cadiente and Edwin Alcantara	53
 Development of Yellow Stemborer and Bacterial Blight Resistant Rice Hybrids Through Genetic Engineering Antonio A. Alfonso. Xianhua Shen, Xiao Yulong, Mariechelle M. Rosario, Melanie I. Revita, Nelson S. Garcia, Dominique Galam, Dianne de Jesus, Sarah Rose Dimen, McWilliam P. Catungal, Edelissa Pavumo, Eleanor S. Avellanoza, Genaro Rillon and Rhodora R. Aldemita 	54
Identification of the Rice Restorer of Fertility Gene for Hybrid Breeding Antonio A. Alfonso, Melanie I. Revita, Nelson S. Garcia, Eleanor S. Avellanoza, Melanie C. Fajardo and Jerry C. Serapion	55
Genetic Transformation of Abaca by Microprojectile Bombardment Vermando M. Aquino, Maria Armila D. Ruiz and Evalor T. Aspuria	5 6
Sequence Diversity of Banana Bunchy Top Virus (BBTV) Coatprotein Gene in the Philippines Vermando M. Aquino, Teresa B. de Leon, Marivi G. Colle and Glovinite 4, Paulo	57
Screening for ree A Genes from <i>Vibrio harveyi</i> IFO 15634 and Philippine Vibrio Isolates Prima Fe B. Franco and Cynthia T. Hedreyda	58
Molecular Markers of High Ethanol-Producing Yeast Isolates Using Repetitive Sequence-Based Polymerase Chain Reaction (REP-PCR) and Ribosomal DNA (RDNA) Analysis Irene F. Gabrido, Asuncion K. Raymundo, Ma. Theresa T.	50
Detection of Foreign Genes in Genetically Modified Corn (Zea mays) and Soybean (Glycine max)	59
Cynthia T. Hedreyda and Jennifer L. Roxas	60

Use of Gyrase B Gene Sequence Analysis to Confirm Identity of Philippine Vibrio Isolates Implicated in Shrimp Disease	
Diana Rose E. Rañoa and Cynthia T. Hedreyda	61
GFP-Like Proteins in Philippine Marine Species	
Cynthia P. Palmes-Saloma, Marvin A. Altamia,	
Cristina M. Garcia and Arlene T. Lim	62
Sequence and Structure Conservation in the Bone Morphogenetic	
Protein (BMP) 4 Genes of Milkfish and Cichlids	
Cynthia P. Palmes-Saloma, Jonathan S. Banawa	
and Edgar Naoe Tafaleng	63
Comparative Sequence Analysis of Partial Hemolysin Gene From	
Two Philippine Vibrio Isolates and Nine Vibrio Reference Strains	
Boris B. San Luis and Cynthia T. Hedreyda	64
A Novel Legume Mutant Defective in the Infection Thread	
Growth During Root Nodule Development	
Myra L. Tansengco, Makoto Hayashi, Masayoshi Kawaguchi,	
Haruko Imaizumi-Anraku and Yoshikatsu Murooka	65
Phylogenetic Relationship of Pythium and Phytopthora Species	
Based on its RDNA. Cytochrome Oxidase Hand B-Tubulin	
Gene Sequences	
Neilyn O. Villa and Koji Kageyama	66
Utilization of Cloned and Expressed Rice Tungro Virus Coat Protein	
Genes for RTBV-and RTSV-Specific Antisera Production	
Ma, Gina Maramara Babb, Arlen A, dela Cruz.	
and Ma. Johna C. Duque	67
Cloning and Ontogenetic Expression of the Genes Involved in	
Fatty Acid Synthesis in Coconut (Cocos nucifera L.)	
Marni Eusebio Cueno, Rita P. Laude, Antonio C. Laurena,	
and Evelvn Mae Tecson-Mendoza	68
Cloning and Partial Characterization of a Protease-Encoding	
Gene from Serratia marcescens Biotech 1749	
Geraldine P. Muncada, Teresita M. Espino and Antonio C. Laurena	69
Isolation and Screening of Crude Oil-Degrading Microorganisms	
for Bioremediation of Oil Snills in Water or Wastewater Effluents	
Fileen S Estrada Christine 4 Calolot Jose Ricardo F Po	
Romeo M. Cabacang, Maximiano Malabanan, and Claro Mamaril	70
~	

Progress in the Development of PRSV-P Resistant Papaya (Carica papaya L.) Through Intergeneric Hybridization Simeona V. Siar, Andres Godwin S. Sajise, Lorna E. Herradura.	
Sofia A. Covacha, Roderick A. Drew and Christopher M. O'Brien	71
Comparative Study of the Mercuric Reductase (Mera) Genes of an Archaeal and a Bacterial Isolate From a Mercury-Rich Hot Spring Jessica F. Simbahan and P. Blum	72
Evaluation of Copper(II) Adsorption Capacities of Cyanobacteria from Water Samples in Marinduque Geoffrey C. Li, Lorele C. Trinidad and Veronica P. Migo	73
Mykovam and Plant Growth Promoting Rhizobacteria as Biofertilizers for Enhanced Growth of Three Coffee Cultivars	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Nelly S. Aggangan and Jose Marie P. Segismundo	75
Copper Tolerance of Non-Mycorrhizal and Mycorrhizal Eucalyptus and Acacia Seedlings	
Nelly S. Aggangan and Brian James S. Aggangan	76
Potential Phytoremediation Species in Selected Mine Tailing Areas Nina M. Cadiz, Rafael T. Cadiz and Niño B. Vidal	77
Chemical, Mathematical and Physical Sciences	
A Theoretical Study on the Reaction Rate Coefficients of Three-Particle Systems Using Classical Trajectory Calculation and Transition State Theory Christopher E. Ambe, Edgar W. Ignacio, Dante D. Dinawanao and Jingle B. Magallanes	81
Biochemical Assessment. Characterization and Gene Cloning of a Tuber-Specific Protein fom Cassava (Manihot esculenta Crantz) Vivian A. Azucena, Eugenia M. Castillo and Antonio C. Laurena	82
Polarized-Transmitted Light Microscopy of Asbestos in Drinking Water in Selected Areas in Iligan City	
and R.C. Tudio	83
Evaluation of Ammonia Removal and Oxidant Formation in a Continuous Electrolytic Reactor Using a Model System of Artificial Seawater Mark Louis Sidney Capanzana, Catalino Alfafara, Veronica P. Migo, Jovita Movillon, Ronald Navarro and Masatoshi Matsumura	ध

Method for the Determination of Carbamate Pesticides in Soil Samples Abigail P. Cid and Maria Pythias B. Espino	85
Utilization of Essential Oils as Modifier of Carbon Paste Electrodes for Voltammetric Determination of Lead (II) <i>Rolando O. Elviña Jr., Myleen C. Bagan, Jose Rene L.</i> <i>Micor and Elmer-Rico E. Mojica</i>	86
A Nueral Network Model for Splice-Site Recognition of Human Genome Sequences Elmer-Rico E. Mojica, Jose Rene L. Micor, Custer C.	07
Deocaris and Jaderick P. Pabico	8/
XRD and SEM Morphology of Calcined Pure Alumina (Al ₂ O ₃) Rodrigo V. Dejeto and Herman D. Mendoza	88
Development of An Electrically Conductive Polyaniline/Polyester Composite Fabric for Electromagnetic Interference (EMI) Shielding Lizah B. Dorao and Christina A. Binag	89
An <i>Abinitio</i> and Density Function Theory Studies on the Structures. Energetics. and Mechanism of the Cycloaddition of 1.1-Dicyanoethyene with Cyclopropylethylene <i>Armando D. Estillore and Edgar W. Ignacio</i>	90
Emoving Copper(II) from Mining Wastewater Using EPS Biopolymer and Moringa oleifera (Malunggay) Seed Extract Gvro Mitchelle I. Mendoza, Estela T. Paner and Fidel Rev P. Nawe Jr.	92
Development and Characterization of Polypyrrole-Based Chemiresistor Milagros A. Perez and Christina A. Binag	93
Physical and Chemical Characterization of Steatite Deposits at Bangui. Ilocos Norte Dionesio C. Pondoc	94
An Abinitio Study on the Structure, Mechanism, and Reaction Thermochemistry of the Thermal Intramolecular Cyclization of N-Substituted 2-Aminobiphenyls and 2 Aminobenzophenones Mark Tristan J. Quimque, Marvin Jose F. Fernandez and Evelyn C. Creencia	95

Optimization and Characterization of Polypyrrole-Coated Poly(Ethylene Terephthalate) Films for Packaging of Electric Materials	
Felicidad Christina Ramirez and Christina A. Binag	96
PAn/I-Potentiometrric Membrane's Electrochemical and Surface Characteristics	
Karen S. Santiago and Christina A. Binag	97
Supercritical (SC) - Carbon Dioxide (CO ₂) Extraction of Polar and Non-Polar Compounds from <i>Ganoderma applanatum</i> : Model for Pre-Bioassay Processing of Biological Materials for Drug Development Aldrin Wendell H. Suarez, James G. Mercado, Roberto M.	
Malaluan and Franco G Teves	98
Detection of Indoor Air Particulate Elemental Pollution by Impaction- GFAAS and Aircon Filter Dust ICP	
Leni L. Quirit, Robert Michel, Belen B. Bello and Leonard dela Cruz	99
Comparative Study on the Heavy Metal Concentration of the Sediments of Pasig River, Napindan River and Laguna Lake	
Adelante and Macario R. Caynila Jr.	100
Isolation and Purification of the Extract of the Active Component from the Leaves of Syzyguim cumini (Jambolan) As an Antimicrobial Agent Lorna T. Enerva, Ramona Tabang, Karen Patricia M. Cruz and Christopher Y. Estigoy	101
Extraction of Rheing Clycoside from the Leaves of Cassia alata Linn. (Acapulco)	
Abigail P. Cid, Lorna T. Enerva, Joy G. Hofilena, Ramona T. Tabang, Chevalier Paul T. Rayo and Ioni Mai L. De Lim	102
Bench Scale Production of Biosurfactant from a Local Yeast Isolate. <i>Candida Tropicalis</i>	
Virgie A. Alcantara, Michelle P. Yabes, Victoria P. Migo, and Fidel Rey P. Nawe	103
Electrolytic Removal of Suspended Solids from White Water	
Jeffren Argame, Catalino Alfafara, Veronica P. Migo, Jovita L. Movillon, Ronald Navarro and Masatoshi Matsumura	104

Clique Partition Number of Graphs Esperanza B. Arugay and Sushela C. Undang	105
Bounds for the Geodetic Number of the Cartesian Product of Graphs Gilbert B. Cagaanan and Sergio R. Canov Jr.	106
Existence and Stability of Fixed Points and Limit Cycles for a Predator- Prey System Gloria L. Calio, Zing Zhu-Jun and Polly W. Sy	107
Characterization of Monophonic Hull Sets in the Join and Composition of Graphs Esamel M. Paluga and Sergio R. Canoy Jr.	109
Convex Hulls of Subsets in Graphs Under Some Binary Operations Sergio R. Canoy Jr. and Rolito G. Eballe	110
m-Convex Simple Graphs Sergio R. Canoy Jr. and Elmer Castillano	111
On the Convexity. Geodetic and Hull Numbers of the Composition K _N [G]* Sergio R. Canoy Jr., Alice Comahig and Dennis Tarepe	112
On the Three Chromatic Number of Some Graphs Sergio R. Canoy Jr. and Esamel M. Paluga	113
Steiner Sets in the Join and Composition of Graphs Rolito G. Eballe and Sergio R. Canoy Jr.	114
Comparative Study of the Octonion and Quasi-Octonion Loops Raoul E. Cawagas, Sheree Ann Gutierrez and Maridel Gob	115
Multivariate Analysis of Body Shapes of Four Species of Crab Spiders Using Partial Warp Scores Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demayo	115
On GV-Groups Véronica B. Florida, Gaudencio C. Petalcorin Jr. and Helen M. Rara	116
Folding Wheels and Fans Severino V. Gervacio, Romulo C. Guerrero and Helen M. Rara	117

Singularity of Unicyclic, Bicyclic and STC-Graphs Helen M. Rora	119
Bounds fo the Subdivision Numbers of Generalized Wheels and Fans Alben P. Sagpang and Rowena T. Isla	120
On the Edge Clique Covering Number of Graphs Joselito A. Uy	122
Relation of Dimension of Graphs with some Graph Invariants Rowena T. Isla	123
On the Existence of a Subgroup of Sq_3 Acting Imprimitively	
$\operatorname{Aurea} Z. \operatorname{Rosal}$	124
White Noise Path Integral with Periodic Constraints: Relativistic Aharonov-Bohm Setup Plus a Uniform Magnetic Field Jinky B. Bornales, Christopher C. Bernido and Maria Victoria Carpio-Bernido	125
dE/dx Measurement Using Time Projector Chamber	
Rosario L. Reserva, Hermogenes C. Gooc Jr.,	
Angelina M. Bacala, Salosni Aral, Kelsuki Fujii, Takashi Matsuda, Katsumasa, Ikamatsu, Bonald Daan	
Settles and Markus Hamann	127
Regional Model Simulation of Summer Rainfall over the Philippines: Effect of Choice of Driving Fields and Ocean Flux Schemes	
Jeremy Pal, Xunqiang Bi and William J. Gutowski	128
Engineering Sciences and Technology	
Potential of Lignocellulosic Mat as Filter for Industrial Wastewater	

Shirley C. Agrupis and Bernard Benjamin P. Albano	133
Studies on the Preparation of Banana Pulp for Vulcanized Fiber Shirley C. Agrupis	134

Degradation of Oil in Gasoline Engine Lubricants Nelia G Autor and Roberto M. Malaluan	135
Production of Fuel from Briquetted Newspaper and Sawdust	
Char Using Cassava Starch as Binder	
Myra G. Borines, Robyn Joy C. Alcanzare, Jovita L. Movillon,	
Catalino G Alfafara and Melissa M. Manguiat	136
The Making of an Interneet-Based Rice Information Service (IRIS): Piloting in the Philippines	
Cheryll B. Casiwan, Suan Peng Kam, Holecz Francesco,	
Eric van Valkengoed, Massimo Barbieri, Sonia L. Asilo,	
Larry A. Santos, Rowena G. Manalili, Wilfredo B. Collado,	
Sherwin A. Adriano and Aileen Maunahan	137
Characterization and Cementitious Solidification/Stabilization	
of a Sludge Generated by a Metal Coatin/Plating Plant using	
Rex B Demafelix Renace' P Promentilla Ronald R	
Navarro and Albert A. Samuela	138
Rheological and Casting Properties of Sanitary Ware Slips	
with Rice Hull Ash	120
Samuel S. Franco and Rowelyn C. Aganus	139
Synthesis and Characterization of Polyaniline-Coated ITO Glass	
as a Starting Material for the Production of Smart Windows	
Katherine Marie G. Marcial and Christina A. Binag	140
Removal of Lead from Electroplating Wastewater Using	
Phosphonomethylated Polyethyleneimine (PPEI)-Ca ²⁺	
Jovita L. Movillon. Ronald R. Navarro. Casiano S:	
Abrigo Jr., Myra G. Borines, Elson R. Montibon	
and Myriam L. Perez	141
Development and Performance Evaluation of a Brush Cutter Rice Reaper-Harvester	
Devter I. Ornilla Bernardo D. Tadeo Leonardo R. Anigo	
Rodolfo S. Juliano, Ben B. Pugong, Madonna C. Casimero	142
Biomass Resource Recovery Systems for Sustainable Agriculture	
Bernardo D. Tadeo, Jocel C. Cordero, Rizal G. Corales	
Dexter L. Orpilla, Larry A. Santos and Ailon V. Capistrano	143
Development of Transparent Leadless Glaze for Low-Fired Ceramic	
ware Utilizing Local Raw Materials in flocos None	144
JIME C. FURIALI	144

Design and Development of a Microcontroller-Based Temperature Controller Thomas D. Ubiña, W.M. Manzanas, V.I.P. Baided,	
M.M. Cuepo, M.G. Cajas, M.A. Damian, G. Duldulao,	
M.C. Llaguno, J. Pascual, F. Perdido, A. Quitoriano,	
J. Raceles and M.L. Urubio	145
Production of Hydrogen from Ethanol Through Steam Reforming Using a Fabricated Catalytic Reactor	
Sixto A. Valencia, Jovita L. Movillon, Catalino G. Alfafara and Erli Eros D. Lee	146
Testing and Evaluation of Rice Husk Gasification Systems	
Bernardo D. Tadeo, Dexter L. Orpilla, Jocel C. Cordero,	
Joselito A. Damian, Hanshel Z. Layaoen, Cesar M. Macalinao,	
Makoto Hoki, Yoshiaki Umezawa, Hirovuki Monobe and Akira Mori	147
Electrolytic Removal of Suspended Solids from White Water	
Jeffren Argame, Catalino Alfafara, Veronica P. Migo,	
Jovita L. Movillon, Ronald Navarro and Masatoshi Matsumura	148
Treatability Studies on the Electrochemical Treatment of Piggery Wastewater	
Monet Concepcion Maguvon, Catalino Alfafara, Veronica	
P. Migo, Jovita L. Movillon, Ronald Navarro and	
Masatoshi Matsumura	149
Electrolytic Treatment of Coconut Processing Wastewater	
Joyce Masilungan, Catalino Alfafara, Veronica P. Migo,	
Jovita L. Movillon, Ronald Navarro and Masatoshi Matsumura	150
Health Sciences	
Occupational Risk Assessment of Trace Metals to Workers of PUP Welding Shop	
Theresita V. Atienza, Lorna T. Enerva, Rome J. Jarlego,	
and Grace Hazel Paglingaven	153
Investigation of Polymerase Chain Reaction of Gastric Aspirates	
as an Adjunct Diagnostic Method for Pediatric Pulmonary Tuberculosis	
Alicia Cornista, Vivienne Cabreza, Marlon Sanchez,	
Dolores Quieng, Cynthia Mapua, Maria Celeste Cortes,	
Ma. Darlene Deang, Epifania Simbul, Agnes Rico-Mendoza	154
ana rupinas r. Nauviaaa	154

Body Morphometics of Diabetics, Hypertensive, Alcoholics and Healthy Individuals from Iligan City Cesar G. Demavo, Mark Anthony J. Torres, Charmaine Xv-za Yane, Capull Low Edubos and Erlene Grace Salvacion	155
Tape, Caryn Lou Eduoos and Errene Grace Sarvacion	155
Heterotrophic Plate Count (HPC) of Bottled Waters from Refilling Stations Based in Iligan City	
Lucilvn D. Lahoylahoy, Olive S. Anles, Christine Cherry	
E. Solon. Annielvn H. Deocampo and Sasha Anne L. Valdez	155
Prevalence of Candida Colonization and Distribution of Candida Species from Papanicolaou (PAP) Smear Tested Women in	
Los Baños. Laguna	
Lucilyn D. Lahoylahoy and Bernadette C. Mendoza	156
The Prevalence of Methicillin-Resistant Staphylococcus aureus (MRSA) from Patients of Batangas Regional Hospital (BRH)	
Carina R. Magbojos and Delta C. Ongtengco	157
Solid Phase Extraction and HPLC Analysis fo Cocaine and Benzovlecgonine in Urine	
Ma. Cristina B. Portilla, Mary Jane S. Masculino and Cherrie B. Pascual	158
Analyses of Ceruloplasmin and Copper in Both Serum and Urine for Detection of Wilson's Disease	
Ma. Cristina B. Portilla, Cherrie B. Pascual and Abdias Aquino	159
Characterization. Identification and Antibiotic Susceptibility	
Testing of Aerobic and Facultatively Anaerobic Bacteria	
Isolated from Wound Dehiscence Cases at the Laguna	
Provincial Hospital Jerico T. Ramos, Leah B. Flores and Bernadette C. Mendoza	160
	100
Antimutagenic and Antibacterial Secondary Metabolites from the Leaves of Viola odorata Linn. (Violeta)	
Diana Rose M. Pesigan, Byron Michaelangelo M.	171
Montano, Ramona 1. Tabang ana Joy G. Hojitena	101
Lead (Pb) Content of Seaweeds Caulerpa racemosa and Kappaphycus edulis in Samar and Leyte	
Diana Cerbito Liguid-liguid and Leni G. Yap-Dejeto	162
Efficacy of Floral Extracts of Four Gumamela (Hibiscus rosa-sinensis) Cultivars against Staphylococcus Aurens	
Blessie T. Jimeno, Jenny U. de Guzman and Cynthia	
N. Paet-Lopez	163

Monitoring of Microbiological Potability and Detection of Potentially Diarrheagenic Bacteria from Hand-Pumped Water in Selected Barangays of Los Baños. Laguna Geralyn P. Garcia and Bernadette C. Mendoza	5 1
 Hypolipidemic Activity of Momordica Charantia L. (Ampalaya) Leaf Extracts on the Blood Cholesterol Level of White Mice (Mus musculus L.) Flordeliz R. Estira. Ma. Teresa A. Blanco and Erick L. Medrano 	65
Responding to the Threat of Antimicrobial Resistance Caused by Extended-Spectrum β Lactamases Delia C. Ongtengco, Roberta S. Santiago, Leilani A. Baltazar and Wilfredo M. Verar	56
Social Sciences	
Farmer Field School: A Vehicle fo Accelerating Dissemination of Grafted Tomato Technology for Off-Season Production Teotimo M. Aganon, Clarita P. Aganon, Aurea C. Roxas, Eduardo G. Marzan and Rolando V. Pagaduan	59
Why are Rice Marketing Margins so Much Higher in the Philippines than in Thailand David Dawe, Chervll B. Casiwan, Jesusa C. Beltran, and Pie Moya	70
Women Participation in Coconut-Based Farming Systems Program in Quezon, Philippines Eleuterio G. Bernardo, Jeffrey Goh and Michael Loehvinsohn	71
Public Knowledge. Attitude. and Perceptions on Rice Biotechnology Research in the Philippines Alice Mataia, Grace Cataquiz, Ruth Francisco. Iva Sebastian, Maricar Bernardino, Mahabub Hossain and Lolita Garcia	72
Sustainable Food-Feed Systems and Improved Livelihood of the Poor in Rainfed Rice Areas: Socioeconomic Component (Philippine Case) Rowena G. Manalili, Grace C. Cataquiz, Guadalupe O. Redondo and Mary Jane Nievera	73
Enhancing Crop-Livestock Productivity among Smallhold Rainfed Farmers in Pangasinan Fe L. Porciuncula, Edwin C. Villar, Sonny N. Domingo, Edgar A. Orden, Marilvn D. Lilagan, Angelita G. Fabia, Arcely B. Robeniol, Alice D. Noche and Richard Dulay	.74

AGRICULTURAL SCIENCES

AGRINo.1

ENHANCING NODULATION AND BIOLOGICAL N₂-FIXATION OF SOYBEAN BY COINOCULATION OF PLANT GROWTH-PROMOTING RHIZOBACTERIAAND BRADYRHIZOBIA

Constancio A. Asis Jr,*1, Vladimir K. Chebotar, and Shoichiro Akao³

¹Philippine Rice Research Institute, Science City of Muñoz, 3119 Nueva Ecija ² All Russia Research Institute for Agricultural Microbiology, St. Petersburg, Russia ³Faculty of Agriculture, Miyazaki University, Miyazaki 889-2192, Japan

Legumes are an important component of rice-based farming systems. Inoculation of legumes, however, is needed to ensue rapid colonization of inoculants and nodulation of the plant. This study aimed to elucidate the coinoculation effect of *Bradyrhizobium japonicum* Ai017 and plant growthpromoting rhizobacteria (PGPR) on N₂-fixation and nodulation of soybean. PGPR strains (*Pseudomonas fluorescens* 2137, *P. fluorescers* WCS365, *Azomonas agilis* 125, and *Azospirillum lipoferum* 137) were GUS-marked by inserting mTn5SgusA20 from *Escherichia coli* S17-1 λ -pir to the genome of the PGPR strains by triparental mating. Moreover, kasugamycin (1,000 µg ml⁻¹) resistant *B. japonicum* A1017 was constructed and inoculated alone or coinoculated with gusA-marked PGPR strains in axenically grown soybean.

The gusA-marked rhizobacteria effectively colonized the root tips and surfaces near the root tips with a colonization rate ranging from 7.5 to 8.6 log colony forming unitsgram fresh weight¹. The gusA-marked strain *P. fluorescens* 2137 had the highest colonization activity on soybean roots whether inoculated alone or coinoculated with *B. japonicum* A1017. Coinoculation of *P. fluorescens* 2137 and *B. japonicum* A1017 increased the colonization of *3. japonicum* A1017 on soybean roots, nodule number, and acetylene reduction activity (ARA) at 10 and 20 days after inoculation. Moreover, addition of sterile spent medium of *P. fluorescens* 2137 increased the growth of *B. japonicum* A1(17 in yeast extract mannitol broth, indicating that *P. fluorescens* 2137 may have eleased substances that increased rhizobial population. The results of this study suggest that the enhanced nodulation and ARA of soybean owing to the colonization of *P. fluorescens* on soybean roots could depend on the production of growthpromoting substances that stimulate the growth of *B. japonicun*. Coinoculation of *P. fluorescens* WCS365, however, decreased the nodule number and ARA of soybean despite its slight stimulation of the growth of *B. japonicum*, indicating that coinoculation effects are strain dependent.

Keywords: Bradyrhizobium, coinoculation, nitrogen fixation and nodulation, plant growth promoting rhizobacteria, Pseudomonas fluorescens

AGRI No. 2

EGGPLANT FARMING AFTER RICE: SCREENING PEST-RESISTANT EGGPLANT FOR A MORE PRODUCTIVE, PROFITABLE AND SUSTAINABLE FARMING IN THE PHILIPPINES

Merdelyn T. Caasi-Lit

Entomology Laboratory, Institute of Plant Breeding, College of Agriculture, University of the Philippines Los Baños, College, Laguna 4031, Philippines;

Eggplant, Solanum melongena L. is the number one vegetable in the Philippines today (BAS 2003). It is becoming a popular crop planted after rice in many parts of the rice growing regions of the country. Because of the additional income and food consumption derived from this practice, many rice farmers are now going into this venture. Some farmers even shifted to eggplant growing throughout the year. However, eggplant production after rice is constrained by the two major insect pests namely, the leafhopper (*Amrasca biguttula* Ishida) and the shootfruit borer, *Leucinodes orbonalis* (Guenee). In the past, farmers relied manly on pesticides to control them and even to the extent of mixing a "cocktail" of two or more insecticides. Recently, to address this serious problem, the search for alternative methods is focused on the use of resistant farmers' and commercial varieties of eggplant.

The aim of this paper is to screen and identify eggplant varieties with resistance to both insect pests under after-rice cropping system in three eggplant growing regions and present significant observations that eggplant farming after rice can be a productive and profitable venture for rice farmers. It is also aimed at promoting the diversity of eggplant for backyard and commercial consumption.

Several promising varieties showed resistance to both or either pests: "Mansanitas", "Parat" and Abar in Aliaga, Nueva Ecija while A300 (Tisay), EG203 and Casino in Asingan. Pangasinan. To generate more income, many rice farmers are now practicing mixed/intercropped vegetable cropping using indigenous crops like "saluyot", pepper, sweet potato or assorted legumes. Likewise, old and modern cultural management practices are adapted for a more sustainable eggplant production.

Keywords: eggplant, Solanum melongena, leafhopper, Amrasca biguttula, shoot/ fruit borer, Leucinodes orbonalis, host plant resistance, multiple cropping, ricebased cropping system

AGRI No. 3

PRODUCTION OF IMPROVED PLANTING STOCKS OF IPIL (Intsia bijuga Colebr.) USING STEM CUTTINGS

Yolina T. Castañeto^{1*}, Minda F. Edmiston², Axel H. Arriola³, and Elmer T. Castañeto⁴

 ^{1.4}NVSU College of Forestry Bayombong, 3700 Nueva Vizcaya
 ²Saving Trees at Risk Foundation, Carson, CA 90745 USA
 ³Biological Sciences Department, College of Arts and Sciences University of the East, Manila

Vegetative propagation by stem cuttings is an important tool for forest tree improvement activity and for the establishment of clonal plantation. It is also an effective way of saving endangered species like ipil (*Intsia bijuga* Colebr.) for genetic conservation and upland rehabilitation or for propagation of selected clones. Studies were conducted to find out an alternative propagation technique for ipil. Ipil is one of the potential reforestation species and produce high quality timber. The main objective of the study is the formulation of standard procedures in the mass production of improved planting stocks of macropropagated ipil. Macropropagation is an alternative method that utilizes stem cuttings taken from seedlings for mass production. Successful rooting of ipil stem cuttings was undertaken. Cuttings collected from healthy seedlings in hedge garden were cut into two-nodes, placed in pail with tap water and soak in Benlate solution (fungicide) for one hour. Indolebutyric acid (ABA) was used to facilitate rooting of stem cuttings. The rooting media/potting media composed of coconut coir dust, sand and garden soil in 2:1:1 ratio, sundried for three days and placed in Hiko trays. Treated cuttings were planted in prepared Hiko trays filled with rooting media. The media was wetted and cuttings were inserted in the prepared rooting media in Hiko trays. The planted cuttings in Hiko trays were placed in a large plastic chamber for one month and sprayed with tap water using plastic hand sprayer. Afterwhich, individual 5" x 8" cm black polyethylene bags was 1/ 3 filled with sundried potting media and added with 0.50 g complete fertilizer before planting the rooted cuttings. The plastic bags were then filled with potting media and were returned back to plastic chamber for another month. The chamber was gradually open for acclimatization of seedlings for another month. Macropropagated ipil seedlings were maintained in the nursery for eight months for field planting operation. The macropropagated seedlings were more vigorous than the seedling raised from seeds.

Keywords: cuttings, indolebutyric acid, naphthalene acetic acid, macropropagation technique, *Intsia bijuga*, clonal plantation, nursery, plantation, genetic conservation

AGRI No. 4

PESTEX: PHILIPPINES COUNTRYWIDE FARMER-BASED CORN PEST SURVEILLANCE/MONITORING, FORECASTING AND DECISION SUPPORT SYSTEM

Bonifacio F. Cayabyab¹, Wilma R. Cuaterno², Melvin D. Ebuenga¹, Artemio M. Salazar³ and Pablito G. Gonzalez¹

 ¹National Crop Protection Center, University of the Philippines Los Baños, College, Laguna 4031
 ²Bureau of Plant Industry, San Andres, Manila
 ³Institute of Plant Breeding, University of the Philippines Los Baños, College, Laguna 4031

Text messaging is now a popular kind of mass communication with uses ranging from plane ticket reservations, banking and finance through mobile text transactions and recently it is even used in medical cases via mobile phone image transmissions and interpretations later. Currently, there are twenty million mobile users in the Philippines and the trend is increasing. Protection Center, the Bureau of Plant Industry, the Regional Crop Protection Centers and the Department of Agriculture Corn Program. It was discussed and refined through series of consultations with stakeholders such as corn farmers, policy makers, technicians, researchers and scientists. It is a national program that aims to: institutionalize the surveillance monitoring and forecasting of corn pest in the country; provide real-time corn pest situation; identify pest-prone areas and provice timely decision support for current pest problems; provide pest forecasts and risk assessment for the next cropping season; provide data support for government policy makers and other concerned or interested groups and individuals. It was tested and proven effective as a communication and advisory tool in pest outbreak such as the occurrence of *Stenocracus pacificus* Kirkaldy, a new pest of corn in Mindanao.

The operational guidelines, scope, pest monitoring procedures, reporting protocol decision support strategies, data summaries, reports, forecasts and risk assessments are presented.

Keywords: PESTEX, surveillance, forecasting, corn, mobile phone

AGRI No. 5

DEVELOPMENT OF TOMATO AS A SUITABLE PLANT SYSTEM FOR MOLECULAR PHARMING

Antonio C. Laurena, Marni E. Cueno and Lucita R. Laureles

Institute of Plant Breeding, College of Agriculture, University of the Philippines Los Baños, College, Laguna 4031, Philippines

The tomato is one of the most common vegetables in almost every country like the Philippines. It has a relatively small genome, relative ease of handling in tissue culture, amenability to genetic transformation either by particle gun bombardment or *Agrobacterium*-mediated transformation, and proof of concept (efficacy) of transgenesis make the tomato an ideal model organism for genetic and molecular studies. With the advent of drug discovery. one of the most often sought after strategies of molecular pharming is the development of a plant system (green factory) capable of producing xenogenic proteins that have practical and/or significant importance in human health/nutrition and industry. In this study, a particular local variety was identified at IPB suitable for molecular pharming. This variety was previously used to develop salt-tolerant tomatoes by somaclonal variation. The tissue culture protocol for particle gun bombardment was optimized to fast-track the genetic transformation process from the start to DNA transfer up to the regeneration of whole plants. Transient expression analysis using the uid gene (gus) was employed to evaluate gene expression. In the future and upon approval by the appropriate regulatory agency, stable transformation will be done using the nptII (kanamycin resistance gene) to determine stability of inserted genes and expression.

Keywords: tomato, molecular pharming, callus, bombardment, zeatin, GUS

AGRI No. 6

GENERATING NOVEL SOURCES OF GENES FOR RICE TUNGRO DISEASE RESISTANCE THROUGH ANTHER CULTURE

Nenita V. Desamero*, Herminia R. Rapusas, Trinidad C. Fernando, Martha V. Chico, Emily R. Corpuz, Gerard B. Ravelo, Emmanuel R. Tiongco, and Thelma F. Padolina

Philippine Rice Research Institute Maligaya, Science City of Muñoz, 3119 Nueva Ecija

Anthers from the F, progeny of the cross R2-8 x IR65 were cultured in vitro. Eleven of the 3,914 anthers regenerated 19 plantlets, of which 10 were fertile doubled haploids. Ninety-two doubled haploid lines were generated from the doubled haploid plants and developed into breeding lines. The breeding lines were shuttled in Midsavap (Mindanao), a tungro hot spot area, for evaluation of field resistance to rice tungro disease (RTD) for five seasons. Three breeding lines (PR29264 AC-10, PR29264 AC-31 and PR29264 AC-47) were identified resistant to RTD by conferring resistance to rice tungro viruses (RTV), which causes the disease. The resistance to RTV infection of these lines was confirmed by greenhouse evaluations for three seasons, using no choice and free-choice methods. It was further supported by ELISA (enzyme linked immunosorbent assay) assay. One of the RTD resistant lines (PR29264 AC-31) exhibited resistance to GLH, the RTV vector. Combining vector and virus resistance in a variety produces a more durable resistance, and is likely to improve the efficiency, stability and sustainability of RTD management. The RTD resistant lines yielded 2.8 to 3.8 tha-1, matured from 116-120 days from seeding and stood 103-111 cm. Agronomically, the AC-derived lines need further improvement, for them to become potential varieties for commercial release. Nevertheless, these lines serve as novel sources of genes for RTV and GLH resistance. We now use them as parents for crosses in our rice breeding work to transfer the genes for RTV and GLH resistance to high yielding elite lines and commercial varieties.

Keywords: anther culture, rice tungro disease, rice tungro virus, ELISA

AGRI No. 7

INTEGRATION OF ENVIRONMENTAL MANAGEMENT SYSTEM IN THE OVERALL R&D MANAGEMENT OF PHILRICE

Bernardo D. Tadeo*, Rossana E. Espiritu*, Leocadio S. Sebastian, Edilberto D. Redoña, and Ronilo A. Beronio, et. al.

Philippine Rice Research Institute Maligaya, Science City of Muñoz, 3119 Nueva Ecija

The agricultural sector is recognized as primary steward of the nation's natural resources. With the emerging environmental scenario on land, air, and water, greatest leverage for change and improvement in the PhilRice Central Experiment Station was accomplished by improving overall management and environmental performance of its activities, products and services through the establishment of an Environmental Management System (EMS).

Guided by four core goals of productivity, profitability, capacity enhancement and sustainability, PhilRice recognized its corporate responsibility to the environment and this was formalized through the ISO 14001 Certification. This EMS Standard brought a comprehensive and programmable means of managing activities, processes and operations within the Institute.

The scope of the registration are Laboratory Services; Visitor's & Conference Services; Machinery Development, Management & Support Services; and Rice-Based Information and Technology Design, Development & Promotion. The EMS resulted to the management of significant aspects such as solid waste, chemical waste, spillage, wastewater, fume, dust, resource use, noise, smoke and odor that drove to the establishment of an environmental management program to address the impacts of these aspects. Among other projects are the solid waste management, and energy and water conservation.

The cost incurred in the development and implementation of EMS was outweighed by the motley of benefits, from monetary to incalculable returns, tangible and intangible. Savings from solid waste amounted to more than P320,000. Implementation of energy and water conservation measures gave the Institute savings of more than P4 M for 2 years. Moreover, international prestige and recognition directly or indirectly put PhilRice in a higher degree of advantage in terms of fund sourcing.

PhilRice commits to influence its R&D network to adhere to sound environmental policies toward sustainable development in the field of agriculture.

Keywords: environmental management system, sustainable development, environmental policy

AGRI No. 8

HEDGEROW SYSTEMS AND LIVESTOCK IN PHILIPPINE GRASSLANDS: GHG EMISSIONS

Damasa B. Magcale-Macandog*1, Edwin R.Abucay1, Roberto G. Visco2 and Arsenio D. Calub3

¹Institute of Biological Sciences, ²Institute of Renewable Natural Resources University of the Philippines Los Baños ³Manuela Development Corporation (MADECOR) Group of Companies College, Laguna, Philippines 4031

Hedgerow systems are widely adopted in the smallholder farms in the sloping grassland areas of Claveria, Misamis Oriental. These systems may serve as source and sink of methane (CH₄) and nitrous oxides (N₂O), depending on the management practices, tree component and crops of the system. This study aims to estimate CH₄ emissions from livestock holdings and N₂O emissions through fertilization, tree litterfall and decomposition, maize residue and livestock manure from *G arborea* and *E. deglupta* hedgerow systems. Experimental plots were established for *E. deglupta*- and *G arborea*- hedgerow systems with different combinations of tree species, age and spacing with maize planted in the alleys. Maize biomass, grain yield, tree litterfall and leaf litter decomposition were measured. A survey of 300 households in Claveria was conducted to gather information on livestock holding and management. The study showed that the major sources of nitrogen inputs in the different hedgerow systems are the maize

crop residues (FCR) and synthetic nitrogen fertilizer (FSN). Other sources were animal manure (FAW) and tree leaf litter. Direct soil N₂O emissions from the plots range from 2.11 to 5.17 kg N ha⁻¹yr⁻¹. Local values for total nitrogen excretion for cattle and carabao were 12.3 kg and 14.2 kg respectively, while IPCC (1997) default values were 40 kg for both livestock. Discrepancies in the estimates were evident, thus, it is advisable to examine and if possible, use local values in the computations. Enteric fermentation of cattle (11,352 kg) and carabao (3,410 kg) and swine manure management (2.786 kg) were the main sources of CH₄ emissions from livestock holdings. This study showed that the sources of nitrogen inputs in tree-based hedgerow systems were crop residue, synthetic fertilizer and animal manure. Use of local values for N excretion factors will reduce uncertainties in the estimates of N excretion from livestock manure.

Keywords: hedgerow system, livestock, N_2O emission, CH_4 emission, GHG emissions, enteric

AGRI No. 9

ALTERNATIVE LAND USE OPTIONS FOR PHILIPPINE GRASSLANDS: A BIOECONOMIC MODELINGAPPROACH USING THE WANULCAS MODEL

Damasa B. Magcale-Macandog*, Edwin R. Abucay and Princess Alma B. Ani

Institute of Biological Science University of the Philippines Los Baños College, Laguna, Philippines 4031

In the Philippines, pure grasslands occupy 1.8 million ha and another 10.8 million ha (33% of the country's total land area) mixed with grasslands and scrub is under extensive cultivation. Portions of these grasslands are used as pasturelands/rangelands but majority is under-utilized and dominated by *Imperata cylindrica*, which are degraded, acidic, low organic matter and susceptible to soil erosion. Conversion of these grassland areas into upland farms planted to annual crops and perennial trees are proliferating at a fast rate. The Water, Nutrient and Light Capture in Agroforestry Systems (WaNuLCAS) model was used to examine the biophysical and economic consequences of land-use change from *Imperata* grasslands to continuous maize and agroforestry (*Eucalyptus deglupta* + maize hedgerow) systems. Simulation results showed

differences in the dynamics of nutrients and water among the systems simulated. More than half of the total nitrogen in the three systems is tied up in the soil organic matter (SOM). Leaching and lateral flow are the main avenues of nitrogen losses. Much of the P (90%) is tied up in SOM and immobilized in the Imperata grasslands. Eucalyptus-maize hedgerow system had the highest subsurface flow and surface run-off compared with the other two systems. Maize cropping and Imperata grassland had significantly higher drainage compared with agroforestry system. Maize yield was initially higher in the continuous annual cropping system (2.4 t ha⁻¹) as compared with Eucalyptus-maize hedgerow system (1.8 t ha⁻¹). Cost benefit analysis showed that the Eucalyptus-maize hedgerow system had the highest NPV after 9 years of simulation (P 304,323) compared with the Imperata grassland (P 10,722) and continuous maize (P 20,872). Results of this study have shown that land-use change from Imperata grasslands or continuous maize cropping system to Eucalyptus-maize hedgerow systems provide significant improvements to a range of biophysical and economic measures of productivity and sustainability.

Keywords: *Imperata cylindrica, Eucalyptus deglupta*, hedgerow, WaNuLCAS model, land-use change, bioeconomic modeling

AGRI No. 10

MULTI-AGENT SIMULATIONS OF THE HUMAN IMPACTS AND LANDSCAPE DYNAMICS OF AGROFORESTRY ADOPTION IN THE UPLANDS OF SOUTHERN PHILIPPINES

Damasa M. Macandog*¹, Princess Alma B. Ani¹, Marc M. Delgado¹ and Paolo Campo²

¹Institute of Biological Sciences, University of the Philippines Los Baños College, Laguna, Philippines ²University of the Philippines Diliman, Quezon City, Philippines

A large and rapidly expanding portion of the Philippine upland landscape is being converted to permanent annual cropping resulting in fragmentation of upland areas. Human settlements rapidly developed and the need for food increased. Annual crops were continuously cultivated to meet the increasing food demand. However, these farming systems pose a great threat to the stability, productivity and sustainability of upland regions while agroforestry is an



ecologically sound approach to managing upland landscapes. A model using the Common Pool Resources and Multi-Agent Systems (CORMAS) was developed to help understand the impacts of agroforestry adoption on landscape changes in Claveria. Misamis Oriental, southern Philippines. The multi-agent system model was developed following an iterative process based on a repetitive back and forth steps between the model and field activities. Ideas, information and knowledge about the study area were gathered and accumulated using a combination of participatory rural approaches (PRA), household surveys and case studies. Farmers decide on the type of agroforestry system, the trees and crops to be planted. The model simulates changes in the landscape as farmers shifted to agroforestry from annual cropping. Influence of neighbor farmers' adoption of agroforestry, market knowledge and the impacts of establishment of tree seedlings nursery on tree planting were determined. The more farmers adopting agroforestry in the neighbor network the greater is its influence to motivate the non-agroforestry farmers. About 15% of the farmers shifted from annual cropping to agroforestry. Farmers with greater market knowledge were able to optimize income. Planting banana (Musa spp.) is more preferred than planting gmelina (Gmelina arborea). The iterative process with the model is useful in probing deeper into the decision-making process of farmers in adopting agroforestry. Simulation results served as a tool to facilitate interactions between stakeholders and scientists towards sustainable management of resources.

Keywords: multi-agent systems, agroforestry, annual cropping, simulation, upland landscape

AGRI No. 11

VILLAGE LEVEL INTEGRATION OF DIRECT SEEDED RICE (DSR) TECHNOLOGIES AND PRACTICES: THE CASE OF MARAGOL

Rowena G. Manalili⁺, Bernardo D. Tadeo, Wilfredo Collado, Emmanuel R. Tiongco, Mario dela Cruz, Ulyssess Duque, Aurora M. Corales, Rodolfo V. Bermudez Marvin F. Adap and Constancio A. Asis

> Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines

The village level model project envisions a community of direct seeded rice farmers utilizing ecologically sound, sustainable and affordable technologies and practices that could produce quality products for local and international
market. Socioeconomic and biophysical characterization of barangay Maragol, Muñoz, Nueva Ecija has been conducted. It was also geo-referenced using the Global Positioning System. Matured technologies for direct seeding has been introduced with closed supervision of an interdisciplinary team of researchers. With the establishment of the Community Trap Barrier System (CTBS), a similar pattern in the number of field rats trapped relative to the rice growth stages was obtained in four successive cropping seasons. An abrupt increase in the level of rat catches occurred a week after the start of the field operations and gradually declined when most of the fields were established until harvest. There was a low insect pest population. Nutrient omission plot trials showed that N and K were limited in supply but not in P. Minus One Element Test showed that most of the fields were macronutrient deficient but not in micronutrients. Farmers were also trained on the production and utilization of carbonized rice hull and organic fertilizer. Handtractor-drawn leveler and drum seeder, including the manually drawn drum seeder were also used in the establishment of organic trials. Most of the farmers belonged to the medium (3-5 mt/ha) and high yield group (>5 mt/ha). The average yield for direct seeded rice (DSR) was 6.67 mt/ha for dry season and 4.3 mt/ha for wet season, while transplanted rice (TPR) got 6.46 mt/ha for dry season.

Keywords: rice farmers, village model, direct seeded rice, Maragol

AGRI No. 12

IDENTIFICATION OF EROSION-PRONE AREAS IN THE PROVINCE OFAKLAN USING GEOGRAPHIC INFORMATION SYSTEM

Alan Dino Moscoso

School of Technology, University of the Philippines in the Visayas 5023 Miagao, Iloilo

This study used the Universal Soil Loss Equation (USLE) model to compute the rate of soil erosion in the 17 municipalities of the province of Aklan, Philippines. About half of the land area in this 181,790-hectare province is allotted to agriculture, thus, proper management of its land resources is of great importance.

The erosion factors in the USLE model (rainfall crosivity, soil erodibility, slope length and steepness and land cover and management) were computed from data gathered from various agencies and institutions. Data on vegetation cover were interpreted from a Landsat 7 image acquired on July 30, 2001. Geographic Information System was then used to integrate these factors to come up with the erosion potential map in terms of mass of soil loss per area of land. Digitizing of paper maps was done through Arcview v8.3 while interpolation and overlaying of values were done using IDRISI v14. The results of the study show that the average soil loss in the province was 5.8 ton/ha/yr, a bit higher than the national average of 2.69 ton/ha/vr. The erosion map was further classified into five different classes of crosion intensity. Results further showed that 82% of the province had a low soil loss rate (less than 7.4 ton/ha/yr). Areas with severe erosion rate (>37 ton/ha/vr) comprised 2.5% and were located on steep (>30% slope) hills and mountains, and on grassy areas. Thirty-nine percent of these areas are found in the municipalities of Madalag and Libacao. In terms of vegetation cover, grasslands had the highest average soil loss of 19.8 ton/ha/vr. This study concluded that, for Aklan province, the slope length and steepness factor had the highest correlation with soil loss.

Keywords: geographic information system. erosion. soil, remote sensing, USLE

AGRI No. 13

GROWTH AND YIELD PERFORMANCE OF NAPIER GRASS (Pennisetum purpureum) UNDER ILOCOS CONDITIONS

Corazon Diana A. Pastor¹, Roseminda R. Sair², Rogelio R. Caluya², Benito B. Balneg³, and Alfredo S. Bagaoisan⁴

Mariano Marcos State University Batac, 2906, Ilocos Norte

The agronomic characteristics, dry matter yield and nutritive value of different *Pennisetum purpureum* accessions were evaluated under semi-arid conditions. The study aimed to identify *Pennisetum purpureum* accessions with high herbage yield and to compare the agronomic characteristics, herbage yield and nutritive value of the newly introduced accessions with MMSU accession (Control). The accessions compared were MMSU, Capricorn, Ex CIAT,

Ex Cuba, Ex Indonesia, Ex Local, Ex Madagascar, Florida DTRI, FLORIDA FSP, Florida Zamboanga, Giganta de Columbia, Guaco, Merker, Miniero, and Mott. The experiment was laid out in Randomized Complete Block Design with three replications.

Based on the results of the study, Ex Local, Ex Indonesia and Capricorn were the most promising *Pennisetum purpureum* accessions in terms of dry matter yield and nutritive value such as protein content (CP) and in-vitro dry matter digestibility (IVDMD).

Pennisetum purpureum cv Ex Local. Ex Indonesia and Capricorn produced mean dry herbage yield of 2.08, 1.67 and 1.70 t ha⁻¹ per 45 days cutting interval during dry season while 6.56, 6.22 and 5.57 t ha⁻¹ during wet season, respectively. Accession Ex Local had a CP content of 8.99 to 9.64%, 7.86 to 10.50% for Ex Indonesia and 6.85 to 9.38 for Capricorn. The IVDMD of the three accessions ranges from 50.92 to 52.33%.

Keywords: Pennisetum purpureum, napier, accessions, nutritive value, dry matter

AGRI No. 14

VULNERABILITY OF PHILIPPINE ORCHIDS TO LAND USE CHANGES: A CASE STUDY IN RIZAL PROVINCE, PHILIPPINES

Carnette C. Pulma*1,2 and Daniel A. Lagunzad3

¹Plant Biotechnology Laboratory, Research and Development Center, Rizal Technological University, Boni Avenue, 1550 Mandaluyong City ²Institute of Environmental Science and Meteorology, College of Science ³Institute of Biology. College of Science, University of the Philippines Diliman, 1101 Quezon City

There are about 1,200 orchid species in the Philippines and 90% among them are endemic. Orchids are interdependent with other parts of the ecosystem and their endemicity makes them more vulnerable to serious depletion from land use changes than other plant families. This study attempts to recognize the endemic species and determine their degree of distinctiveness, endemicity and habitat association in Rizal Province; identify the land use activities in the area; and predict the number of threatened species in the Philippines through speciesarea relationship. Relative distinctiveness score of this flora is low due to the large number of genera and species in the country. Relative endemicity scores range from 36.15% (Trichoglottis latisepala) to 0.43% (Dendrobium cerinum, D. pristinum, Paphiopedilum roebbelenii and Oberonia toppingii). It means that the former is distributed to the other regions while the latter species are restricted to the province. Habitat types' categories are uncertain to endangered along with their own species, which were ranked from being critically endangered to vulnerable. Localities are being continuously transformed into agricultural/ urban lands and even protected areas are being utilized indicating the nonimplementation or non-sustainability of comprehensive land use plan within LGUs. Meanwhile, the estimated number of species in the entire archipelago that could become extinct based from the species-area relationship (from pre-Spanish time to 2002) is 340. Species loss is proportional to forest cover reduction. However by looking at the Philippines' forestry experience, an increase in forest cover (from 1990-2002) brings the computed extinct species similar to 1987. Hence, the model is too dependent on cover without acknowledging quality and resilience to bring the forest into its former state. Private organizations and academic institutions promote orchid conservation but there are few studies on it. Review and update of the CITES list is important to enable to prioritize the threatened species.

LGU-Local Government Unit

CITES - Convention of International Trade in Endangered Species of Wild Fauna and Flora

Keywords: orchids, Philippines, endemic, relative endemicity score, relative distinctiveness score, endangered species, threatened species, vulnerable, LGU, species-area relationship, forest cover, CITES, conservation

ACCLIMATIZATION OF TISSUE CULTURED BANANA CV. 'LAKATAN' IN DIFFERENT ORGANIC POTTING MIX

Alex B. Quilang* and Norberto R. Bautista

Plant Biotechnology Laboratory, Research and Development Center Rizal Technological University, Boni Avenue, Mandaluyong City, Philippines

Plant tissue culture is the fastest and efficient way of propagating bananas (Musa sp.). Acclimatization of its plantlets is one of the most important stages and a critical period in the process. Banana growth and development is mostly toward those sites showing high organic matter content. For this reason, soil and different commercial organic materials were compared in search for a better potting medium for growth and survival of in-vitro cultured 'Lakatan' banana. Initially hardened micro plantlets were removed from culture vessels. dipped in fungicide solution, sorted out, and planted in transparent plastic cups with different substrates (soil and commercial organic potting mix) for forty-five days. Results showed that plantlets grown in Treatment 1/Control (Soil/sand). Treatment 3 (Grow Quick[™]), Treatment 4 (Growell[™]), and Treatment 8 (Vermi[™]) have the highest percentage survival (100%, 95%, 90% and 90%) as well as in the means of growth rate (1.92 cm, 2.10 cm, 1.94 cm, and 2.20 cm) and plant height (22.48 cm, 23.60 cm, 25.76 cm, and 25.80 cm). The abovementioned values have insignificant differences but are highly significantly different when compared to Treatment 2 (Enrico[™]), Treatment 5 (Nutriplex[™]), Treatment 6 (Plantastik[™]), and Treatment 7 (Sagana 100[™]) as revealed in the one-way classification of analysis of variance. Treatments that have provided zero survival usually have high water retention. The said organic potting mixes still have an indication of decomposition and fermentation resulting to mortality of planting materials. Hence, application of organic materials and the regulation of the soil cover show the possibility to favor an adequate environment for root development, consequently promoting survival of banana plantlets.

Keywords: acclimatization, tissue culture, banana, 'Lakatan', organic potting mix

SPECIES IDENTIFICATION AND DAMAGE ASSESSMENT OF BORER ON SUGARCANE

Julieta D. Recuenco

Sugar Regulatory Administration Luzon Agricultural Research and Extension Center Floridablanca, Pampanga

Borg infested stalks sampled from eleven sugarcane farms of three mill districts (Pampanga, Balayan and Nasugbu) and LAREC experiment station showed that the white top borer. Scirpophaga nivella (F_{i}) was the predominant species infesting three-to-eight-month sugarcane of different Phil and VMC varieties. The stemborer, Chilotraea infuscatella Sn., had lower incidence. In the field experiment testing the predominant borer species through natural infestation, top borer infestation started three months after planting on all seven sugarcane varieties used at varying levels with highly significant differences. Mean % infestation started at 2.5 at three MAP, peak at 4.6 at six and declined at 2.3 at eight. Tillers per furrow increased on varieties highly infested with top borers. Varieties with high top borer infestation from three to six MAP had higher loss in cane and sugar yield at maturity than those infested at eight MAP. Among the varieties tested. Phil 93-2349 had the lowest top borer infestation, highest % germination, more tillers, longest stalk with small diameter and highest cane and sugar yield with lighest ROI of 1.68. Linear correlations of growth and yield parameters with % top borer infestation indicated that the higher the % infestation, the lower the cancand sugar yield while varieties with bigger stalk diameter had higher % infestation which reduced stalk length. Based on the results, it is recommended that top borer infestation on three-to-six-month sugarcane should be monitored to detect borer damage trends for timely application of control strategies especialy on early maturing varieties.

Keywords: top borer, Scirpophaga nivella, borer damage, sugarcane

SPATIAL DISTRIBUTION OF SEAWEEDS IN THE LITTORAL ZONE OF FIVE MUNICIPALITIES OF BILIRAN ISLAND DURING THE WET SEASON OF 2004

Richa Marie B. Tan and Leni G. Yap-Dejeto

Department of Natural Sciences and Mathematics University of the Philippines in the Visayas Tacloban College Tacloban City, Leyte, Philippines, 6500

There is a call for fast seaweed production to meet high global demand of economically important seaweeds. Thus it is necessary to find areas most suitable for seaweed farming of these species. This study aimed to identify and determine the spatial distribution of existing algal species of the undocumented island of Biliran. Five municipalities and two barangays in each municipality were chosen as sampling stations and in every sampling station, fifty sampling sites were made from a transect line, which measured, 50 meters in height and two meters in width. In every sampling station, two transect lines which were 10 meters apart were made. Using the Global Positioning System (GPS), exact coordinates of each location were obtained. Temperature, sali nity and pH of the water column and substrate of every sampling station were measured. Species that was found in the study area was counted and representative species of seaweeds were collected on each sampling station, pictures; were taken, and samples were preserved using a 40% ethyl alcohol. It was observed that, seaweed of the genus, Halimeda, Sargassum, and Padina were abundant in the study area

Keywords : spatial distribution, littoral zone, seaweed, Biliran, Halimeda, Sargassum, Padina, Global Positioning System (GPS)

ANTHROPOGENIC ACTIVITIES IN THE MANGROVE AREAS OF CAMOTES ISLANDS, CENTRAL PHILIPPINES: BASIS FORA PROPOSED MANGROVE MANAGEMENT PLAN

Serapion N. Tanduyan

Cebu State College of Science and Technology 6050 San Francisco, Cebu Campus

Camotes Islands have 717 hectares of mangroves areas with 30 mangrove species. Because of its great use to human beings these are explored by the fisher folks of Camotes Islands. The extent of the use, extraction rate and other anthropogenic activities were studied. Actual observation, interview, market survey and market flow of the catch were used to gather data.

Results show that cutting of the mangroves was a common activity in the three islands as housing materials, firewood and the leaves as food of animals like goats pigs and cows. *Avicennia* and *Rhizophora* are the species being cut. Nypa fruticans was made into shingles and is dominant in Tiguis. Poro, Cebu. Gathering of mangrove clam (*Anodontia edentula*) was considered the most destructive to soil structure because the soil is turned upside down during gathering. Fishing with the use of scoop net and kerosene lamp during at night was the common activity collecting small fishes, crabs and shrimps.

Results further shows that the declined catch was experienced by the gleaners for the last ten years. Miracle holes locally known as "balerong" were constructed in mangroves areas where Tiguis, Poro, Cebu has the highest number. Market flow of the catch that 90% usually goes to the kitchen of the gleaners with only 10% goes to the market sold to consumers. CPUE on fish catch is 1.5 kilos per three hours fishing and 2 mobil oil can per 2 hours shellfish gleaning... Mostly the gleaners are part time farmers.

Keywords: Camotes Islands, Mangroves, Anthropogenic Activities

TOLERANCE OF THE TWO SPECIES OF CLOWNFISH (AMPHIPRION CLARKHAND AMPHIPRION PERIDERAION) TO LIMNETIC WATERS: BASIS FOR AN IMPROVED TROPICAL FISH INDUSTRY PLAN

Serapion N. Tanduyan Sr.¹ and Serapion C. Tanduyan Jr.²

¹Professor, Cebu State College of Science and Technology 6050 San Francisco, Cebu Campus ²Doctor of Veterinary Medicine student, Southwestern University 6000 Cebu City

Marine tropical fish industry is a developing industry in the Philippines and is gaining popularity. One of the problems of the freshwater aquarists is the tolerance of the marine tropical fishes to less saline condition most especially in areas where the seawater is far. This study was conducted to determine the tolerance level of the marine fish to freshwater in the aquaria.

Specifically, this study aims is to know out what salinity that these two species of clown fishes could tolerate through desalination of salt water, their reactions, survival and mortality rates.

There were six treatments in the study with four replicates. One is control where salinity is 26-30 ppt followed by treatment 1 21-25 ppt; treatment 2 16-20; treatment 3 is 11-15; treatment 4 is 6-10 and treatment 5 is 0-5. The two kinds of clown fishes were placed in aquaria fed with meat of the hermit crabs. All the water placed in each aquarium was salt water. DO (dissolved oxygen) pH (hydrogen- ion concentration) and salinity were monitored everyday and desalination is done everyday by getting 1 liter of salt water from the aquaria and added with I liter freshwater. to each aquaria.

Results show that in treatment 1 the movement of the fishes is up and down, a slight difference from the normal salinity. Treatment 2 shows that the fishes are uneasy with upward movement where breathing was done at the surface until they stayed in surface and don't move anymore. Treatment 3 the fishes are transferring from one place to another and the same movement shown in treatment 4 only that it showed slow movement. and gape to breath. In all the treatments the fishes tend to lie down and sometimes want to secure hold at the sides of the aquarium. Breathing was faster in all the treatments than the control. There was only 1 *Amphiprion clarkii* died at 9 ppt and 1 *Amphiprion perideraion* died at 5 ppt.

Analysis of Variance (ANOVA) shows that there is no significant difference on the tolerance level to desalination of the two species of clown fishes.

Keywords: Tolerance, *Amphiprion clarkii*, *Amphiprion perideraion*, limnetic water salinity

AGRI No. 20

MACROPROPAGATION OF GUIJO [Shorea guiso (Blanco) Blume] USING STEM CUTTINGS

Henry P. Patricio¹, Yolina T. Castañeto^{*2}, Arvin P. Valesteros¹, and Elmer T. Castañeto⁴

¹DENR- ERDS – 02, Carig Tuguegarao City ^{2.3,4}Nueva Vizcaya State University, College of Forestry, Bayombong, 3700 Nueva Vizcaya Philippines

Macropropagation technique using stem cuttings is an alternative method of propagation and considered as an important tool in forest tree improvement activity. This offsets the problem for species with recalcitrant seeds and long seed-off years like *Shorea guiso*. Thus, a study on macropropagation using stem cuttings of guijo (*Shorea guiso*), rooted in pure river sand, partly decomposed rice hull and mixture of river sand and partly decomposed rice hull (1:1 ratio) as rooting media and treated with 0 ppm, 500 ppm and 1.000 ppm indolebutyric acid (IBA) was conducted. The study sought to determine the best rooting media, best IBA concentration and its combination that will enhance better rooting and survival of cuttings.

The best survival of guijo stem cuttings was obtained using a mixture of pure river sand and partly decomposed rice hull applied with 500 ppm IBA as the best concentration, which favored best rooting of guijo cuttings. The number of adventitious roots that came out from guijo stem cuttings treated with 500 ppm IBA was significantly higher than those stem cuttings treated with 1,000 ppm and 0 ppm. The longest adventitious roots were observed from cuttings treated with 500 ppm IBA and planted in a partly decomposed rice hull.

Results of the study showed that survival of rooted guijo stem cuttings is affected by the rooting media, concentration of IBA and the interaction effect of rooting media and concentration of IBA. For rooting guijo stem cuttings, combined pure river sand and partly decomposed rice hull and applied with 500 ppm IBA was found best and therefore recommended for future use. Macropropagation of guijo using cuttings was found feasible and can be an alternative propagation when seeds are not available. However, further study is hereby recommended to verify results, before finally giving the technology to the end-users.

Keywords: macropropagation, rooted cuttings, indolebutyric acid, recalcitrant seeds, hedge garden, *Shorea guiso*, rice hull, rooting media

BIOLOGICAL SCIENCES

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MOLECULAR CHARACTERIZATION OF BEEF (ZEBU) CATTLE (Bos indicus L.) IN AGROECOLOGICAL ZONES OF THE PHILIPPINES

Genevieve Mae B. Aquino¹, Rita P. Laude², Cesar C. Sevilla³, J Han⁴, and O Hanotte⁴

¹Animal Breeding Division, Animal and Dairy Sciences Cluster.
²Genetics and Molecular Biology Division. Institute of Biological Sciences.
³Animal Production Division, Animal and Dairy Sciences Cluster, University of the Philippines, Los Baños, Laguna, Philippines
⁴International Livestock Research Institute, Nairobi, Kenya

The success of the smallholder beef industry in the Philippines has been limited by a lack of knowledge on the true nature of the genetic composition of present-day Philippine Native cattle. To identify and characterize the genetic variation of the generally accepted types of the Philippine Native breed of cattle, namely the Ilocos. Batangas, Ilo-ilo, and Philippine Bali types, 16 autosomal microsatellite markers were surveyed in blood samples of 127 individuals from selected regions of the country. Genotypic data was analyzed through various software programs for population genetics. A total of 175 alleles were detected in all four populations over the 16 microsatellite loci. Allelic frequencies revealed the presence of possible diagnostic population-specific alleles for all four types of native cattle, including alleles that differed by one base pair in length from the other alleles. Intrapopulation genetic diversity based on the mean number of alleles. allelic richness and heterozygosity was highest in the Batangas population, closely followed by the llocos, llo-ilo and Philippine Bali populations. Estimation of genetic subdivision using F-statistics indicated 15.7% to 16.0% genetic differentiation among populations, and 5.4% to 6.7% genetic differentiation within populations. Interpopulation genetic diversity was evident in the phylogenetic trees based on the standard genetic distance (D), modified Cavalli-Sforza distance (D_x) and shared-allele distance (D_x) matrices. Principal components analysis of allelic frequencies indicate that 86% of the variation reveals the split between Philippine Bali Cattle and the other types, while 10% of the variation is between Ilo-ilo cattle from the Luzon populations and 4% separates the Batangas and Ilocos types. Analysis of population admixture suggests that the Philippine Native breed descended from three parental populations, namely the banteng (Bos banteng), zebu (Bos indicus) and taurine (Bos taurus) cattle. The Philippine Bali type, shown to be a banteng-zebu hybrid. could be described as a separate breed from the Philippine Native breed, composed of the indigenous zebu-taurine hybrids from the other populations included in this study. This provides basic information for the development and implementation of rational and effective breeding programs in the Philippines.

Keywords: cattle, microsatellites, genetic diversity, Philippine Native breed

BIO No. 2

PREDATION OF COPEPOD Mesocyclops aspericornis ON Aedes aegypti FIRST INSTAR LARVAE

Soledad L. Bautista

Emilio Aguinaldo College, College of Medical Technology 1113-1117 San Marcelino Street Paco, Manila

Dengue Fever/Dengue Hemorrhagic Fever (DF/DHF), continues as a public health problem in the Philippines. Since there is yet no available vaccine against dengue, vector control is one of the most important strategies to prevent the disease.

In the study, the potential of the adult female Aesocyclops as pericornis (Daday) as predator of A. aegypti (L.) first instar larvae (L₁) was determined in phases as follows: I – under laboratory conditions, II – outside the grounds of Emilio Aguinaldo College – Early Learning Center, and III – in small scale field trials at the "Estero de Tanque", Paco, Manila.

Predatory capacity of M. aspericornis was based on the number of surviving A. aegypti (L₁). Preliminary studies indicate that the volume of water and bottom surface area of the container did not affect the predatory capacity of M. aspericornis. However, prey and predator densities affected the predation capacity but only to a certain extent. Starvation of M. aspericornis did not in anyway affect its predation capacity.

Results of Phase I showed the mean number of A. aegypti L_1 that survived using one and 10 M. aspericornis vs. 50 and 500 L_1 was significantly lower in the experimental groups that in control group without M. aspericornis. The same results were obtained in Phase II where conditions reflect the domestic household breeding conditions of A. aegypti. The mean number of surviving (L_1) was significantly lower in the experimental group than in the control groups. Small-scale field trials conducted during Phase III showed similar results. The number of larvae recovered from the experimental drums was significantly lower than in the control drums without *M. aspericornis*.

All results showed the predatory capacity of M. aspericornis on A. aegypti L₁ and its potential ability to control the vector of DF/DHF upon the introduction of M. aspericornis in key breeding sites.

Keywords: biological control. *A. aegypti*. copepods. dengue hemorrhagic fever, predation

BIO No. 3

ISOLATIONAND SCREENING FOR BACTERIA WITH AMYLOLYTIC, PROTEOLYTIC OR LIPOLYTIC ACTIVITY FROM ORALANDANAL SWABS OF SELECTED BIRDS FROM POLILLO ISLANDS

Roxanne H. Belen and Noel G. Sabino

Institute of Biological Sciences University of the Philippines Los Baños. College Laguna

Fourteen birds belonging to nine different genera were captured from the Polillo Islands. These were identified to be Emerald dove. Luzon-Bleeding heart, Philippine Bulbul, Yellow-wattled Bulbul. White-throated kingfisher. Indigobanded kingfisher. White-browed shama. Mangrove blue flycatcher and Lovely sunbird. Sixty-six bacteria were obtained from the birds. 40 from the oral swabs and 26 from the anal swabs. Thirty-three bacteria were gram positive and the rest were gram negative. Six were cocci in shape, five gram negative and one gram positive. Twenty-six isolates were positive for amylolytic activity as indicated by clear zones around the bacterial growth on starch agar (SA) flooded with Lugol's iodine. Seventeen isolates exhibited proteolytic activity, nine isolates were lipolytic as indicated by zones of clearing and precipitation, respectively, around bacterial growth on egg yolk agar (EYA).

Three isolates exhibiting the highest activity for each test were further characterized. Isolates ACO1 and ACO2, are members of either the Family Enterobacteriaceae or Vibrionaceae. HS2O1 could be a member of the Family Pseudomonaceae. Azotobacteraceae or Acetobacteraceae. Five isolates (Cl2O1. HP101. ASO1. ACA 1 and Cl2A 1) are probably members of the Family Bacillaceae and cound be of the genus *Bacillus*.

Keywords: Polillo Islands, birds, oral and anal swabs, anylolytic, proteolytic, lipolytic activity

ALTERNATIVE MEDIA FOR CULTURE OF Tetrahymena thermophila

Corazon C. Buerano^{1,2}, Genriech N. Reoyan¹, Mark Pierre S. Dimamay², Jose Christopher E. Mendoza¹, and Filipinas F. Natividad²

¹Institute of Biology, University of the Philippines, Diliman, Quezon City ²Research and Biotechnology Division, St. Luke's Medical Center, E. Rodriguez Sr. Blvd, Quezon City

Tetrahymena is a ubiquitous, free-living, freshwater protozoa, which is very useful in the laboratory and the classroom. The objective of this study was to find alternative, readily available culture media that may be used even in areas where there are no available defined media. Growth and maintenance of Tetrahymena thermophila were assessed in three different alternative media: (a) liquid endosperm from the fruit of coconut (Cocos nucifera), (b) juice from the fruit of watermelon (Citrulus lanatus), and (c) juice from the enlarged root of turnip (Pachyrhizus erosus). Various concentrations of the alternative media were compared with the standard defined medium composed of proteose peptone. yeast extract and glucose, and hay infusion medium from the grass, Panicum maximum. Fifty-ml replicates of each medium were prepared in separate Erlenmeyer flasks. Five-ml replicates of each medium were also prepared in separate test tubes. Enough cells were inoculated to get a starting concentration of 5 x 10^3 cells/ml in both flasks and tubes. The flasks were used for monitoring the growth of the organism for the first 40 hours after inoculation. The culture tubes were used for monitoring the length of time cells were still viable. Results showed that the diluted preparations of the alternative media were comparable with the standard media in promoting growth and maintaining the organism for more than a month without subculturing.

Keywords: Tetrahymena thermophila, Cocos nucifera, Citrulus lanatus, Pachyrhizus erosus, Panicum maximum, growth, culture media, hay infusion

SPIDER WEBS: DIVERSITY IN ARCHITECTURAL DESIGNS WITHIN AND BETWEEN SEVEN ORB-WEAVINGSPECIES

Cesar G. Demayo, Mark Anthony J. Torres and Lloyd N. Bordeos

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

Webs within and between seven species of spiders were described based on quantitative and qualitative descriptions of the web's traits bridge thread, height from the ground, diameters from north to south and east to west, number for anchor points and threads, radii count, subsidiary radii count, capture spiral count, auxiliary spirals, primary and secondary frames, bridge thread counts, hub spiral count, U-turn and stabilimentum count served as quantitative characters while subsidiary radii location. Uturn location and direction, stabilimentum location and direction, web and spider position, spider location, presence and absence of the hub, spiral shape, silk color and presence or absence of web occupants served as qualitative traits. Data were subjected to hierarchal cluster analysis to determine between the spider species. Euclidean distance measure and single linkage clustering algorithm were used in the cluster analysis. Results showed variability between and among spider species based on web architectural designs. Results also showed variability within two species or orb-weaving spiders based on stabilimentum design. The observed variation in stabilimenta design in the spiders represent trade-offs the spider must make between prey attraction and predator defense. Variability in the formation of these structures could also be attributed to age differences between individual spiders.

Keywords: spider web diversity, spiders

DIFFERENTIATION IN FIFTEEN SELECTED SPECIES OF NYMPHALID BUTTERFLIES

Cesar G. Demayo, Mark Anthony J. Torres, and Wilson V. Alad-ad

Department of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

This study was conducted to understand morphological differentiation among species of Nymphalid butterflies using phenetics and cladistics methods of analysis. Sixty (60) characters were used to compare fifteen (15) species of Nymphalids excluding the outgroup, argynniti. Based on phenetic analysis which expressed natural relationships among organisms by analyzing large numbers of equally weighted, non-correlated characters, the dendrogram obtained showed those species belonging to the same general clustered together. Since phenetics makes no assumption of phylogeny, implications about ancestry and evolution of the group cannot be made. Cladistic analysis was therefore conducted. This method was applied to have good knowledge of the primitive characters and derived states of all or some of the characters used. Character reconstruction for all the 60 traits revealed only 14 traits showed no homoplasy. Based from the tree constructed, the related groups of Nymphalid species were recognized having shared a set of apomorphic feature not present in distant ancestors but which are shared by most or all of the organisms within the group (synamomorphies). While both methods have some pitfalls of their own as argued by many systematists, their applications in understanding differentiation of the Nymphalid species as shown in this study were most helpful.

Keywords: nymphalids, butterflies, cladistic analysis, synamomorphies

LANDMARK ANALYSIS OF SKULL SHAPES OF FOUR SPECIES OF BATS FROM MINDANAO

Leonard Patrick D. Gabato, Mark Anthony J. Torres and Cesar G. Demayo

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

We investigated the skulls of several individuals of four species of fruit-eating bats from Mindanao. Seventy-four anatomical landmarks were selected from the cranium and the visceral skeleton. The data was used to determine species-specific shape differences in bats. X/Y coordinates of the different landmarks were recorded and plotted. Because the variation in landmark positions is large, we standardize the landmarks to Procrustes coordinates, where size and rotation has been removed and that the residual variance in the results was attributed to shape only. The Procrustes fitting has oriented the skulls upside down. The shape variation was then visualized using the technique of thin-spline transformation where the first specimen was taken as reference and the thin-plate transformation from this to all specimens was viewed and to see where there are consistent differences between the reference skull shape and the others. A special version of Principal component analysis of Procrustes-fitted landmark data using the variance-covariance matrix for PCA was used as the data is also converted to Procrustes residuals (by subtracting the mean shape) prior to analysis. For cluster analysis using Ward method, the landmark coordinates were also first transformed to Procrustes residuals by subtracting the mean shape. The four species were shown to form good clusters. For discriminant and significance test, the Procrustes residuals were used in the analysis. The species were significantly discriminated and the Hotelling's r² test showed significance at P>0.001.

Keywords: bats, skull, Procustes coordinates

SYSTEMATICS OF BAT SPECIES FROM THE PHILIPPINE ISLANDS

Cesar G. Demayo, Mark Anthony J. Torres and Leonard Patrick D. Gabato

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

Character matrices for several groups of bat species in the Philippines based on published records of collected species and individual descriptions were constructed. A matrix of characters of seventy (70) species of bats belonging to thirty three (33) genera and six (6) families was constructed. Parsimony analysis using the "Branch-and-bound" algorithm with Fitch (unordered character states) optimization was done. Reconstruction as to how a character evolved along the branches of the tree was also done. Bootstrap analysis was done to determine which of the groups in the tree are well supported or not. Cluster analysis of the matrix was also conducted (the old "numerical taxonomy" approach) using the Euclidean similarity measure just to see if when compared to the cladogram we will be able to see differences and make an assessment as to the best method, that is, gives results in best correspondence with traditional classification. Results from both the cluster and parsimony analyses showed clear-cut differentiation between genera and families of bats. Also, the results from the parsimony analysis revealed derived and homoplasious characters.

Keywords: bats, systematics, cluster analysis, parsimony analysis

BIO No. 9

FLUCTUATING ASYMMETRY IN LEG TRAIT CHARACTERS IN THE ORB-WEAVING SPIDER NEPHILA SP.

Cesar G. Demayo, Mark Anthony J. Torres and Lloyd N. Bordeos

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

Fluctuating asymmetry (FA) is defined as the non-directional difference between left and right (R-L) sides of paired bilateral traits and is often used as a measure of an organism's ability to buffer its development against disturbances. Because the same genes control paired morphological characters on the left and right sides of the organism, the random deviations from bilateral symmetry that produce FA maybe used as indicator of developmental stability. In this study, we used three asymmetry indices namely, mean trait asymmetry, between sides variance and sum of squared deviations from symmetry in the leg trait characters of the orb-weaving spider *Nephila sp.* Scatter plots were constructed to determine size-dependency of traits. In addition, significance test for size dependency of traits was conducted using Spearman and Kendall's coefficients of rank correlation. Results also showed variation between left and right sides of female and male individuals of *Nephila sp.* based on selected asymmetry measures. Between sides variation in leg characters of this species could be attributed to developmental instabilities. Differences in asymmetry values between and among different leg characters reveal the existence of character-specific homeostasis.

Keywords: fluctuating asymmetry, spider. Nephila sp.

BIO No. 10

TAXONOMIC STUDY OF DIATOMS FROM SELECTED SITES IN SORSOGON BAY

Erwin P. Elazegui *, Ana Leah L. Rada and Maricel T. Peniano

College of Science. Technological University of the Philippines Ayala Blvd., Manila

A diatom study was conducted for classification and identification purposes in four stations in the months of November & December 2003. Diatoms are phytoplanktons which use sunlight to metabolize inorganic nutrients and convert them to complex organic materials which can be available to organisms to higher trophic level. They are indicator species which monitors water quality. Large communities of diatoms are signs of unpolluted water. Diatom collection was done vertically and horizontally. Collected water samples were placed in a container preserved with 4 % formalin. Plankton species present were analyzed using the Sedgewick Rafter Counting Chamber and a Binocular microscope. Photographs were also taken for verification. The study obtained 11 Families. 18 genera and 37 diatoms species. Identified species belongs to Divison Bacillariophyta. Order Centrales and Order Penales. *Rhigsolenia imbricata* was the most abundant species of diatoms. The Simpson index of diversity is 0.9 indicating high diversity of diatoms. Other biological parameters such as density. frequency and relative frequency was also noted. Abiotic parameters such as pH, temperature, dissolved oxygen, salinity, turbidity, depth and current was recorded and correlate with the number of diatoms counted during the sampling period

Keywords: diatoms, phytoplanktons, taxonomic, water quality

BIO No. 11

PRIMARY PRODUCTIVITY AND BIOMASS PRODUCTION OF THE PHYTOPLANKTON COMMUNITY OF PAOAY LAKE, ILOCOS NORTE, PHILIPPINES

Flordeliz R. Estira and Marjun P. Balinzon

Biology Department , College of Arts and Sciences Mariano Marcos State University, Batac 2906 Ilocos Norte

Eutrophicated lakes often exhibit deteriorated water quality due to high phytoplankton biomass. An essential prerequisite to a successful management of this problem is a knowledge of the phytoplankton composition, abundance, production and seasonal variation of the phytoplankton community in the lake.

This study on phytoplankton community of Paoay Lake, Ilocos Norte was conducted to describe the community's species composition, primary productivity and biomass production. Five stations of 50 meters each were established. Plankton collection was done by column sampling method from one meter depth to the maximum depth of the euphotic zone. Seven parameters were observed and correlated with the primary productivity and biomass production: pH, temperature, transparency, current, carbonate, bicarbonate and dissolved oxygen. Gross primary production (GPP) in mg carbon fixed/m³ and biomass production in mg chlorophyll a /m³ were determined using light and dark bottle method and spectrophotometry, respectively.

The study obtained 12 species of phytoplankton belonging to 3 phyla: Chlorohyta, Chrysophyta and Cyanophyta. GPP of the lake was comparable in all the stations. Primary productivity ranged from 2337.75 mg C/m³/hr to 3611.25 mg C/m³/hr. Stepwise regression analysis of the data revealed GPP to be a function of the lake's surface water temperature with a regression coefficient of $r^2 = 0.5127$. Likewise, the phytoplankton biomass production was comparable in all the stations and this ranged from $0.021 \text{ mg chl a}/\text{m}^3$ to $0.038 \text{ mg chl a}/\text{m}^3$. However, this was not revealed to be a function of any of the parameters considered.

The high primary production but low algal biomass of the phytoplankton community that was obtained is an indication of the fast turn over of nutrients in the lake reflecting a high state of internal order in the lake.

Keywords: phytoplankton. primary productivity, biomass production, lakes

BIO No. 12

THE IMMUNE SYSTEM OF NILE TILAPIA: EFFECTS OF STARVATION IN NEWLY HATCHED FRY

Annabelle A. Herrera*1, Ana Tiongco1, Melodina Fabillo2, and Jose Abucay3

¹Institute of Biology. University of the Philippines Diliman. 1101 Quezon City ²University of the Philippines Visayas, Tacloban City ³Central Luzon State University, Munoz, Nueva Ecija

For a developing organism, the immune system is very important to provide protection against diseases. To determine if tilapia has an immune system comparable to that of higher vertebrates and if stressful conditions such as starvation have any effect on the immune organs, the effects of delayed initial feeding on the development of the immune system was evaluated using histological techniques. Results showed a general decrease in the size of the thymus and spleen, Gut-associated lymphatic tissue (GALT) also showed delay development. Starvation inhibits development of immune organs making the fish more prone to diseases.

Keywords: tilapia, starvation, thymus. spleen, GALT.immune system

LEVELS OF PROLACTIN AND GROWTH HORMONE IN THE BROOD POUCH OF THE GRAVID MALE SEAHORSE *Hippocampus barbouri*

Jessica Patron¹, Edna Oconer² and Annabelle A. Herrera¹

¹Institute of Biology, College of Science, University of the Philippines, Diliman, 1101 Quezon City ²Mindanao State University, General Santos City

The presence of prolactin and growth hormone in the pouch tissues and pouch fluid at different stages of gestation of the male seahorse. *Hippocampus barbouri* was determined using immunohistochemistry and radioimmunoassay. Growth hormone was determined by cross-reaction with rabbit anti-chum salmon growth hormone. Prolactin was determined using rabbit anti-chum salmon prolactin. Radioimmunoassay was carried out using Coat-a-Count Prolactin IRMA and radioimmunoassay was done with double antibody Human Growth Hormone (hGH) radioimmunoassay. Prolactin and growth hormone were detected in the pouch tissues at all stages of gestation. Radioimmunoassay results showed increasing growth hormone levels as gestation progresses. Prolactin was detected only in the early and late stages. The absence of prolactin in the pouch fluid during midterm gestation may be due to binding to osmoregulatory receptors to prevent the hypoosmotic activity of the growth hormones as protection to the embryos.

Keywords: *Hippocampus barbouri*, prolactin, growth hormone, radioimmunoassay, immunohistochemistry

BIO No. 14

SPATIAL DISTRIBUTION OF ECHINOIDS (ECHINODERMATA) IN THE INTERTIDAL ZONES OF FIVE COASTAL MUNICIPALITIES OF BILIRAN ISLAND DURING THE WET SEASON OF 2004

Erickson Casiles Lanuza¹, Ma. Odezsa D. Tibre, and Leni Yap-Dejeto*²

Division of Natural Sciences and Mathematics University of the Philippines in the Visayas Tacloban College Tacloban City, Leyte, Philippines, 6500

This study aimed to determine the spatial distribution of echinoids and starfishes found within the intertidal zones of two barangays in each coastal municipality of five coastal municipalities of Biliran Island.

This is the first time that echinoderms of the Biliran Island were surveyed. It involved the use of Global Positioning System (GPS) to find exact coordinates of sampling stations. The transect-quadrat method and statistical analysis were used to determine the distribution of species. Different physico-chemical parameters, salinity, pH and temperature were taken in both water column and substrate. Different species of echinoderms found were collected and preserved for proper identification. A total of nine (9) echinoid species were observed. The most dominant and dense echinoid was the black sea urchin of the Genus Diadema.

Eight (8) species of starfish were observed. Five important species were: Protoreaster nodosus (horned sea star), Acanthaster planci (crown of thorns), Linckia laevigata (blue linckia), Choriaster granulatus (granular sea star) and Pentaceraster alveolatus. The L. laevigata was found to be the most occurring species in all stations. The area where starfish species were most diverse was in Almeria. Biliran Echinoids are good environmental indicators. The black sea urchin Diadema is the only echinoid species found to be resistant to environmental stresses.

Keywords: spatial distribution, echinoid, starfish, Echinodermata, GPS (Global Positioning System), Biliran Island

BIO No. 15

PRELIMINARY STUDIES ON LIPOLYTIC ACTIVITY OF ENDOGENOUS THERMOPHILIC BACILLUSSP.

Amor P. Magtibay, Marinar J. Papa, J.P. Magbanua and Veronica P. Migo

National Institutes of Molecular Biology and Biotechnology (BIOTECH), University of the Philippines Los Baños. College, Laguna 4031

Bacterial lipases (triacylglycerol acylhydrolases) catalyze the hydrolysis of triglycerides into diglycerides. monoglycerides, glycerol and fatty acids. Aside from their potential uses in various industrial processes, lipases and lipolytic organisms can also be used for lipid wastewater treatment. During microbial growth on hydrophobic substrates, lipases are secreted which renders the lipid substrates available to the cells, resulting to lipid biodegradation. Thermophilic microorganisms show great potential in the biodegradation of lipids. Thermophilic conditions promote changes in most of the lipids' physical properties, which contribute to faster lipid degradation. Five thermophilic aerobic eubacteria with lipolytic activity were isolated from hot springs in the Philippines. These organisms are Gram-positive rods that exhibited high growth rates at 60–65°C and pH 6.5–pH 7.0. Lipase activity obtained after 30 minutes was at the levels of 3.1 to 4.04 U ml⁻¹. The isolate with maximum activity was identified by 16S rRNA analysis and used for further studies on lipase assay. Using eubacterial specific primer, 27F, and universal primers. 533F and 1492R, 16S rDNA was amplified and sequenced. The isolate shared 99% homology with *Geobacillus thermoleovorans* BGSC 96A6 (formerly *Bacillus thermoleovorans*). The optimum pH of the crude enzyme was determined to be at pH 7.0.

Keywords: bacterial lipase, Geobacillus thermoleovorans, thermphilic bacteria

BIO No. 16

ISOLATION, SCREENINGAND CHARACTERIZATION OF ACIDOPHILES FROM PHILIPPINE ACID MINE DRAINAGE FOR ANTI-MICROBIAL AND ENZYMATIC ACTIVITIES

Clarissa M. Ocampo¹, Lei Lanna C. Mendoza¹, Sonia Jacinto² Gem D.Encarnacion¹ and Asuncion K. Raymundo¹ *

¹Institute of Biological Sciences. University of the Philippines Los Baños, College, Laguna ²Institute of Biology. University of the Philippines Diliman, Quezon City

Bacteria isolated from acidic environments were assayed for production of antimicrobial, anticancer and industrial metabolites. Out of the more than 100 isolates assayed, 14 isolates were antagonistic against kanamycin-resistant strain of *Bacillus subtilis 1116*, *rifampicin*-resistant *Escherichia coli 1366* and *Staphylococcus aureus subsp. aureus 1644* while eight other isolates were found to inhibit growth of *S. aureus subsp aureus 1644*. Selected bacterial isolates found to have antimicrobial property were assayed and found to have no anticancer activity against T-24 (bladder carcinoma) and A549 (non-small cell lung adenocarcinoma). Some isolates were also tested for antimicrobial activity against the opportunistic human pathogen, *Candida albicans*. Based on the assay performed on their intracellular as well as extracellular metabolites, these isolates were also assayed for proteolytic and amylolytic activities. Five out of the 60 bacterial isolates were found to be protease-producers, based on clearing zones formed around the bacterial colonies on Frazier Gelatin Medium and Skim Milk Agar when assayed under neutral condition. Two out of the 60 isolates were found to be amylase-producers based on the clearing zones formed around the colonies on Starch Agar plates. Preliminary morphological and physiological tests established these isolates to be under the Gram-positive, chemolithotrophic group of bacteria.

Keywords: antimicrobial, anticancer, protease, amylase, chemolithotroph

BIO No. 17

MALE VITELLOGENESIS: A BIOMARKER OF ENDOCRINE DISRUPTION IN REEF FISHES OF ILIGAN CITY

Olga M. Nuñeza¹, Henry I. Rivero²⁺, and Maricris Gay P. Garcia²

¹Department of Biological Sciences, College of Science and Mathematics 2Office of the Vice-Chancellor for Research and Extension MSU-Iligan Institute of Technology, Iligan City 9200 Philippines

lligan City, the industrial city of the south, is home for processing industries such as cement, chemicals, PVC pipes, coconut edible oil and flour products, all believed as sources of effluents containing endocrine disrupting compounds (EDCs) that mimic the endogenous estrogen function. These industries are in the localities of six coastal villages of lligan city that served as sampling sites from June to July 2004.

This work is a continuing effort to validate sensitive biomarkers for endocrine disruption by looking at male vitellogenin expression. Livers of selected sexually mature male and female reef fishes were homogenized in 63mM Tris-HCl pH 6.8 to obtain crude cytoplasmic extracts and subsequently subjected to electrophoration in 12% Tris-glycine pre-cast gels against standard markers and lyophilized carp vitellogenin to show the comparative vitellogenesis in female and male fish livers, with special concern on male vitellogenin expression.

Results showed livers of male *Lutjanus* spp., *Sphyraena* sp., *M. cephalus*, *Parupeneus* sp., *Leiognathus* sp., and a non-commercial species are expressing the putative vitellogenin as shown by distinct high molecular weight (HMW) bands. The first band near the 200 kDa was approximately 175 kDa; the second and third were both close to the 97.3 kDa marker or approximately 101.4

kDa and 94 kDa fractions, respectively. These bands correspond to three of the four distinct vitellogenin fractions of standard carp vitellogenin and imply possible disruption of male endocrine function by expressing apparently identical proteins to the female samples. These findings confirm the previous observations in *M. cephalus* and suggest wider extent of still unidentified EDCs in the surrounding waters of Iligan as clearly indicated by male *Lutjanus* spp. Further purification of male hepatic fractions must be carried out to elucidate the identity of male vitellogenin while histopathological analysis is presently being undertaken to further establish endocrine and reproductive alterations in these fishes.

Keywords: vitellogenin, male vitellogenesis, endocrine disruption, liver, reef fish, Iligan City

BIO No. 18

COMPLEMENTATION OF THE lys3 MUTATION IN Penicillium chrysogenumL2 USING THE lysF GENE FROM Aspergillus nidulans: DEMONSTRATION OF CROSS-SPECIES FUNCTIONALITY OF THE HOMOACONITASE GENE

Franco G. Teves*¹, Javier B. Casqueiro², Axel A. Brakhage³, Asuncion K. Raymundo⁴ and Juan F. Martin²

¹Department of Biological Sciences, MSU-Iligan Institute of Technology, lligan City, Philippines; ²Area de Microbiologia, Universidad de León, Spain; ³Lehrstul für Mikrobiologie, Universität München. Munich, Germany; ⁴Microbiology Laboratory, Institute of Biological Sciences, University of the Philippines, Los Baños, Laguna, Philippines

Being able to regulate the a-aminoadipate pathway (a-AAA) in filamentous fungi, responsible for b-lactam and lysine biosynthesis, would be a major feat in the pharmaceutical, food and agricultural industries. The potential to shift the industrial production from mainly pharmaceutical to agricultural, and vice-versa, based on the fungal a-AAA pathway is made possible because of the finding that one of its components, the homoaconitase gene, exhibits a regulatory function. The expression of the homoaconitase gene from one fungal species in another has not been demonstrated to date. The Aspergillus nidulans lysF (homoaconitase) gene contained in the plasmid pLYSF1 was used to transform *Penicillium chrysogenum* L2, which has a non-functional mutant form of the homoaconitase gene. Efficiently controlled protoplasting was obtained using Caylase *in lieu* of the more commonly used Novozyme, which gave variable efficiency. Complementation assay was performed following standard protocols for fungi. Potential transformants were regenerated using Czapek-KCl as regeneration medium. Transformation efficiency was more than 90%, almost the same as that of the control set up using the functional lys3 (homoaconitase) gene from *Penicillium chrysogenum*. Southern blot analysis also showed possible integration of the *lysF* gene into the *P. chrysogenum* L2 chromosome by homologous recombination. Cross-species expression of the homoaconitase gene is clearly demonstrated in this study for the first time. The result also shows that a significant portion of the homoaconitase gene is not essential for its catalytic function given only 63.191% similarity and 45.319% identity of the *lysF* and *lys3* genes.

Keywords: a-aminoadipate, b-lactam, lysine, *Penicillium chrysogenum*, *Aspergillus nidulans*, complementation, homoaconitase

BIO No. 19

BIODIVERSITY RESOURCES IN MOUNTAIN ECOSYSTEMS: OPPORTUNITIES FOR LIVELIHOOD AND ECOTOURISM IN NORTHERN PHILIPPINES

Nelson M. Pampolina, Raymundo M. Lucero, Dexter L. Bautista, Dhioce A. Celadiña, Anthony C. Alcantara, Lorenzo V. Cordova, and Jennifer C. Dimas

Department of Forest Biological Sciences College of Forestry and Natural Resources University of the Philippines Los Baños. College, Laguna 4031

Biodiversity refers to richness of life forms that include flora, fauna. microorganisms and the inhabitants. Mountain ecosystems in Northern Philippines are one of the highest biodiversity regions in the country that blend with scenic landscapes. These resources are vital for the culture and existence of historical Bungkalot tribe in the highland, notwithstanding their importance as component of watershed in Quirino Province. This paper will assess the biological diversity and evaluate their potential for livelihood and ecotourism projects for two villages. The different ecosystems (river and creek, mossy forest, agricultural area, waterfalls, and caves) in the area were traversed and 1-2 kilometer transect was established per site. The identity, ecological status, and population of flora, fauna, and fungi were determined from 3-9 quadrants (10 x 10m established at 200m interval along transect depending on the length of the ecosystem. Biodiversity was computed using Shannon-Weiner diversity and evenness indices. There were a total of 164 plant species, 118 genera, and 60 families. Plant diversity was moderately high and dominated by ecologically threatened and vulnerable species (Dracontamelon dao, Pterocarpus indicus, and Afzelia rhomboidea). The habitat was home to 39 Aves, 9 Mamalia, 5 Reptilia, 61 Insecta, 11 Arachnida, and 2 Mollusca. Among the wildlife list include critically endangered Philippine eagle (Pithecophaga jefferyi), Hornbill (Buceros hydrocorax), Philippine Deer (Axis calamianensis), and Wild Pig (Sus cebifrons). Fungal diversity was also high consisting of 28-33 genera with index of 2.4711-2.5944. The presence of the above taxa were indicator that mountain ecosystem is still within the health range. Overall, biodiversity resources are relatively high, offering great opportunity to uplift the economy in the region. However, it is currently at risk because of uncontrolled harvesting of premium wood species purposely for furniture industries. It is important that policies on extraction of natural resources will be strictly implemented following the concept of sustainable development.

Keywords: biodiversity, ecotourism, ecosystems, Northern Philippines

BIO No. 20

GEOMETRID MOTHS OF THE MOUNT MAKILING FOREST RESERVE (LEPIDOPTERA: GEOMETRIDAE)

Aimee Lynn A. Barrion

Museum of Natural History University of the Philippines Los Baños, College, Laguna 4031

Geometridae mainly pertains to looper caterpillars or inchworms which are so-called because of their unique way of moving about. While most current researches center on birds and mammals, taxonomic works on geometrids are entirely lacking. In view of this, field-collected geometrid moths from Mount Makiling including specimens maintained at the UPLB Museum of Natural History are taxonomically treated. Ennominae, Geometrinae, Sterrhinae and Larentiinae were the subfamilies to which these moths belonged. Meanwhile, wing pattern and genitalia were used for species delimitation. From these, 23 species placed in 16 genera were identified. Ennominae was the most represented subfamily with 16 species in 11 genera. Genera of Ennominae were: *Amblychia, Biston, Chiasmia, Cleora, Coremecis, Hypephyra, Hyposidra, Opthalmitis, Petelia, Ruttellerona* and Zeheba. In Geometrinae, five species placed in four genera were identified. These were namely: *Aporandria, Dysphania, Pingasa,* and *Tanaorhinus.* A single *Antitrygodes* species represented Sterrhinae while an unidentified species represented Larentiinae. A total of 13 new records were determined. There were also seven suspected new records, five of which are probably new species.

Keywords: geometrid moths, Lepidoptera, Geometridae, taxonomy

BIO No. 21

TAXONOMY OF PHILIPPINE STICK INSECTS OF THE SUBGENUS ARETAON (TRACHYARETAON) (PHASMATODEA: PHASMATIDAE: OBRIMINI)

Ireneo L. Lit, Jr.* and Orlando L. Eusebio

Entomology Section, Museum of Natural History University of the Philippines Los Baños, 4031 College, Laguna

Stick insects of the *Trachyaretaon* group, a subgenus of *Aretaon*, are often spinose and belong to the Philippine endemic tribe Obrimini. Descriptions of available stages are given for two recently discovered new species: one from Mount Apo on Mindanao Island, specifically near the Lake Agco Area, politically a part of the municipality of Kidapawan, North Cotabato Province and the other from Babuyan Islands in Northern Philippines. Taxonomic notes are also given for *Trachyaretaon gatla* Zompro as well as characters that differentiate *Trachyaretaon* from typical *Aretaon* species are also given. This study lays down groundwork for a more extensive revision of the tribe as well as phylogenetic and biogeographic studies.

Keywords: Phasmatodea, Phasmatidae, Obrimini, Aretaon, Trachyaretaon, stick insects, Philippine endemic insects

TAXONOMY, DISTRIBUTION AND HOST RANGES OF RECENT OUTBREAKS AND NEW RECORDS OF SCALE INSECTS (COCCOIDEA, HEMIPTERA) IN THE PHILIPPINES

Ireneo L. Lit, Jr.1 and Merdelyn T. Caasi-Lit2

¹Entomology Section, Museum of Natural History and ²Entomology Laboratory, Institute of Plant Breeding, College of Agriculture University of the Philippines Los Baños, 4031 College, Laguna

Scale insects, including the mealybugs, are small sucking insects that often pass through quarantine unnoticed, due to their small size and usually cryptic behavior. Once introduced, however, they become important dry season pests that cause great economic losses to the country. In the last three years, two species have caused alarm among farmers that made initial studies necessary. The taxonomy, host plant records, local and international distribution of two scale insects that recently caused pest outbreaks in several places in the Philippines are here documented and formally reported. These two are the pit scale, Asterolecanium sp. (Asterolecaniidae) infesting citrus plantations in Naujan on the island of Mindoro and palm mealybugs, Nipaecoccus sp. (Pseudococcidae) infesting coconuts and other palms, fruit trees and ornamentals in the Southern Tagalog Region. The latter is of great concern among lambanog makers, with farmers reporting great decrease in *tuba* yield especially during the dry months. Asterolecanium sp. and Nipaecoccus sp. are new faunal records and their previously known distribution as well as apparent aggressive colonization of several plant species belonging to several families in the regions where they were first noticed, suggest that they are of recent introduction.

Keywords: Hemiptera, Coccoidea, scale insects, Pseudococcidae, mealybugs, *Nipaecoccus* sp., Asterolecaniidae, pit scales, *Asterolecanium* sp., taxonomy, biogeography, plant quarantine

APPLICATIONS OF ORDINATION METHODS IN STATISTICS IN ASSESSING THE RELATIVE IMPORTANCE OF GEOGRAPHY AND LANDSCAPE STRUCTURAL COMPLEXITIES IN THE COMMUNITY STRUCTURES OF DRAGONFLIES

Mark Anthony J. Torres and Cesar G. Demayo

Department of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

It is argued that dragonflies as well as other macroinvertebrates assemblages structures differ across a range of spatial scales (i.e. geography and landscape structure). Sample locations were classified accordingly into (1) geographical units and (2) ecological units based on landscape type/structural complexity as described in the field during sampling (e.g. creek, stagnant canals, farms. etc.). Habitat teterogeneity was then roughly assessed based upon these landscape types. To investigate at what spatial scale these observed differences in dragonfly community structures could be related to, data on occurrence and species abundance from forty seven (47) sampling sites in Mindanao and the islands of Camiguin and Negros Occidental were analyzed using three (3) ordination methods namely detrended correspondence analysis (DCA), principal coordinate analysis (PCO) and non-metric multidimensional scaling (NMMDS). DCA was performed on the species abundance data while PCO and NMMDS were performed on the presence/absence data. Sample locations with similar species assemblage structures are plotted close together in an ordination plot. Next, two classifications of sample locations were overlain on this plot to ascertain if there is a relationship between these classifications and the dragonfly assemblage.

Result of the DCA analysis of the sampling sites based on geographical classification and on counted data revealed some sites that showed no overlap in dragonfly species assemblage. This indicates that to some extent geography contributes to differences in anisopteran species assemblage. Biplot analysis of dragonfly assemblage structure in terms of abundance of taxa in each of the sites however is not determined solely by geography. Result of the PCO and NMMDS analysis of the presence/absence data points classified based on geographic locations are in conformity with that of the DCA analysis that differences and similarities in dragonfly species assemblages are not at all attributable to geography alone. Same pattern were observed when the community structures were tested if they are in any way related to the type of environment (ecological units).

The results of the tests performed generally show that dragonfly faunal assemblages are, to some extent, related to the type of environment and land-scape structure of the area. The results imply that the amount of structural complexities in habitats influence to some extent the community structures of the dragonflies.

Keywords: ordination methods, detrended correspondence analysis, dragonflies

BIO No. 24

LINEAR DISTANCE-BASED METHODS IN STUDYING DIVERSITY IN BODY SHAPES OF FOUR SPECIES OF CRAB SPIDERS Gasterachanta spp.

Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demayo

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

Differences between forms among four species of crab spiders were investigated using linear distance (LD) -based method. LD method compare linear distances that connect the 24 landmark pairs in one form with the corresponding linear distances in antoher form, and provide information pertaining to the difference in length of these linear distances. By comparing linear distances rather than landmarks coordinate data, these methods require no a priori assumption: no rule of superimposition; no discretization of the form into smaller units that comprise a finite element model; and no adoption of arbitrary rules such as minimum bending energy used with thin-plate spline. For each specimen of the four species, the landmark coordinate matrix was rewritten as a matrix of the linear distances between all unique pairs of landmarks (the form matrix). This transformation allowed for the multivariate analysis (PCA, cluster analysis) of the data which showed significant differentiation between and among species of the crab spiders.

Keywords: linear-distance method, diversity, cluster analysis, crab spiders, Gasterachanta spp.

ELLIPTIC FOURIER SHAPE ANALYSIS OF BODY SHAPE CHANGES IN FOUR SPECIES OF CRAB SPIDERS

Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demayo

Department of Biological Sciences, College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City

Shape changes in the cephalothoraxes in four species of crab spiders, Gasterachanta sp., from Iligan City were studied using Elliptic Fourier Shape Analysis. Elliptic Fourier Shape Analysis permits comparison of outlines of biological structures disregarding the effects of size discrepancies and rotational translation. Digitized x/y coordinates around an outline were collected using an image analysis tool and the outline analysis was carried out using the Paleontological Statistics Software written by Hammer. Analysis of the outlines using Elliptic Fourier Shape analysis resulted in Fourier coefficients for each individual spider, which were then subjected to cluster analysis using Ward's method and multivariate analysis of variance (MANOVA) to see whether the cephalothorax shapes of the different species of Gasterachantha were significantly different from each other. Likewise, the same Fourier coefficients were subjected to principal component analysis (PCA) to determine how the most important components are related to low harmonic numbers. A scatter diagram was constructed and the 95% confidence ellipses were examined to see morphological differentiation among the four species of spiders. Results showed significant differences int eh cephalothorax shapes of the four species of Gasterachanta.

Keywords: elliptic fourier shape, crab spiders, Gasterachanta sp.
BIO No. 26

MONITORING OF MICROBIOLOGICAL POTABILITY AND DETECTION OF POTENTIALLY DIARRHEAGENIC BACTERIA FROM HAND-PUMPED WATER IN SELECTED BARANGAYS OF LOS BAÑOS, LAGUNA

Geralyn P. Garcia and Bernadette C. Mendoza*

Microbiology Division, Institute of Biological Sciences University of the Philippines Los Baños, College, Laguna 4031

Hand-pumped water samples obtained from five barangays of Los Baños, Laguna (coded SA, PU, MY, MH and LK) were monitored monthly for seven months (from July 2003 to January 2004) for microbiological potability testing using the Most Probable Number Technique and the Heterotrophic Plate Count (HPC) method. Potentially diarrheagenic bacteria namely, *E. coli, Salmonella, Shigella and Vibrio*, were monitored for in some of the samples using the Membrane Filter Technique and by plating on selective agar media.

In general, total MPN coliform and *E.coli* counts (expressed as MPN/ 100 ml) varied with the barangay source of the water and with the month of sampling. Majority of the water samples (68.6%) were confirmed to have coliforms; 52.3% had fecal coliforms (i.e., *E. coli*). The LK water samples consistently had the highest total coliform and *E. coli* counts during the entire sampling period. No water sample obtained from LK was, thus, accepted as safe for drinking whereas most of the samples from the PU source were microbiologically potable. It was also observed that coliform levels (including *E. coli*) in the samples collected generally peaked during the months of July to November.

The Heterotrophic Plate Counts (HPC) of the water samples ranged from 2.55×10^1 (from the PU pump) to 5.04×10^4 (from the LK pump). In accordance with the standards set by the Department of Health for the HPC of drinking water (10 CFU/ml), no water sample collected was potable.

E. coli and *Salmonella* were detected in 64% and 88%, respectively, of the water samples tested while isolates likely to be *Shigella* and *Vibrio* spp. were found present in all of such samples.

Keywords: microbiological potability, diarrheagenic bacteria, hand-pumped water. Most Probable Number (MPN), heterotrophic plate count

BIOTECHNOLOGY

MUTATIONALANALYSIS OF SERINE 556 AND SERINE 557 IN DOMAIN III OF *BACILLUS THURINGIENSIS* CRY1AB PROTEIN

Aileen Bayot, Leonardo Cadiente, and Edwin Alcantara

National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Baños, 4031 College, Laguna

The functional role of amino acid residues Serine 556 and Serine 557 in the loop region connecting b-sheet 19 and b-sheet 20 in domain III of Cry1Ab protein was investigated by replacing these amino acids with alanine site-directed mutagenesis. Insecticidal activity of mutants was measured by artificial diet surface contamination assay. The estimated median lethal concentration (LC_{so}) of S556A (1365 ng/cm²) and S557A (1198 ng/cm²) was 6-fold and 5-fold lower, respectively than wild type Cry IAb ($LC_{50} = 226 \text{ ng/cm}^2$) to neonate larvae of Asian corn borer (ACB) Ostrinia furnacalis. The double alanine scanning mutant S556S557AA (LC $_{\odot}$ = 1027 ng/cm²) and the deletion mutant S556S557D (LC $_{\odot}$ = 1015 ng/cm²) were 4.5-fold lower in insecticidal activity to ACB as compared to the wild type Cry1Ab. The bioassay results suggest that S556 and S557 have an important role in insecticidal activity to ACB. Brush border membrane vesicles (BBMVs) were prepared from isolated larval miodguts of ACB. SDS-PAGE analysis of detergent-solubilized BBMVs revealed four major protein bands with molecular sizes ranging from 80 kDa to greater than 250 kDa. Ligand blot analysis of the PVDF membrane-immobilized BBMV proteins revealed that the >250 kDa receptor cross-reacted with gypsy moth Lymantria dispar anti-aminopeptidase N antibody.

Keywords: Bacillus thuringiensis; Cry1Ab; site-directed mutagenesis; Ostrinia furnacalis; midgut receptor

DEVELOPMENT OF YELLOW STEMBORER AND BACTERIAL BLIGHT RESISTANT RICE HYBRIDS THROUGH GENETIC ENGINEERING

Antonio A. Alfonso^{*1}, Xianhua Shen², Xiao Yulong², Mariechelle M. Rosario¹, Melanie. L. Revita¹, Nelson S. Garcia¹, Dominique Galam¹, Dianne de Jesus⁴, Sarah Rose Dimen⁴, McWilliam P. Catungal⁴, Edelissa Payumo⁴, Eleanor S. Avellanoza¹, Genaro Rillon² and Rhodora R. Aldemita¹

¹Plant Breeding and Biotechnology Division, ²Crop Protection Division Philippine Rice Research Institute, Maligaya Science City of Muñoz, Nueva Ecija ³Department of Plant Breeding, Jiangxi Academy of Agricultural Sciences, Jiangxi, China ⁴Department of Biology. College of Arts and Sciences University of the Philippines Manila

The 20-30% yield advantage exhibited by hybrid rice varieties over inbreds may not be realized if the parental lines lack important traits, including resistance to pests. Some of the commercial hybrids currently under cultivation are susceptible to bacterial blight. Also observed in some areas are damages caused by stemborer. This research aims to improve the parental lines of several public rice hybrids and promising hybrids by incorporating the Xa21 gene for bacterial blight resistance, and the potato proteinase inhibitor2 (pin2) gene for stemborer resistance through genetic transformation. Based on tissue culture response of 21 lines, five highly responsive B lines (PR2B, IR70370B, IR68901B, IR58025B and PR3B) and a Chinese restorer line (752R) were bombarded with the pin2 gene. Two B lines (IR58025B and PR3B) were likewise transformed with the Xa21 gene. Transformation using the pin2 gene resulted in the production of 54, nine and 10 regenerants from IR58025B, IR68901B and 752R, respectively. Xa21 transformation produced 185 and 134 regenerants from IR58025B and PR3B, respectively. The transgenic status of the regenerants and their progenies was verified through PCR using gene-specific primers. Furthermore, young seedlings were subjected to in vitro herbicide or antibiotic resistance assay. Evaluation of agro-morphological traits between the untransformed and transformed plants and their progenies revealed insignificant differences. Screening for resistance to bacterial blight was done using the leaf clipping method. Resistance to the vellow stemborer Scirpophaga incertulas Walker was evaluated through larval *in vitro* feeding assay using cut nodes. Direct inoculation of YSB larvae into individual plants at vegetative and early reproductive stages under screenhouse condition was also performed. For both genes, preliminary results identified some promising lines that need further evaluation.

Keywords: hybrid rice, yellow stemborer, bacterial blight, genetic engineering

BIOTECH No. 3

IDENTIFICATION OF THE RICE RESTORER OF FERTILITY GENE FOR HYBRID BREEDING

Antonio A. Alfonso*, Melanie I. Revita, Nelson S. Garcia Eleanor S. Avellanoza, Melanie C. Fajardo and Jerry C. Serapion

Genetic Transformation Lab, Plant Breeding and Biotechnology Division Philippine Rice Research Institute, Maligaya, Science City of Muñoz, Nueva Ecija

Hybrid rice varieties attract many farmers because they usually yield 20-30% more than the inbred varieties. One major adoption constraint is the intricate seed production method based on cytoplasmic male sterility (CMS). This costly and cumbersome 3-line method provides low seed yield due to poor outcrossing rate. Additional obstacles are the lengthy process of improving parental lines and identifying those that can produce hybrids with excellent vigor. This project aims to facilitate hybrid rice breeding by cloning the rice Restorer of fertility (Rf) gene for the wild abortive (WA) cytoplasm through Agrobacterium-mediated transgenic complementation. Candidate genes have been identified and their function is being determined by their ability to make CMS lines capable of producing viable pollen. A cloned Rf gene would allow (1) rapid identification of restorer (R) lines by DNA marker-aided screening for the Rf gene, (2) rapid breeding for useful R lines by transferring the Rf gene to elite breeding lines through marker-aided backcrossing or genetic transformation, and (3) development of a simpler 2-line F, seed production method by using an inducible tapetum-specific promoter to drive the expression of an introduced Rf gene in CMS lines. Under this scheme, induction of the Rf gene makes the CMS lines fertile and produce many CMS seeds through self-pollination. Without Rf induction, the CMS line will be pollinated with an appropriate R line to produce the F, seeds. Two candidate genes from IR64 identified using clues obtained

from the cloning of the petunia *Rf* gene (Bentolila et al., 2002; Alfonso et al., 2003) are currently being tested. At least 28 primary transformants have been transferred to the greenhouse, mostly at early vegetative stage. Using bioinformatics tools, two additional candidate genes have been identified. Efforts to clone these genes and establish their association with fertility restoration are underway.

Keywords: hybrid rice, heterosis, restorer of fertility gene, cytoplasmic male sterility, genetic transformation

BIOTECH No. 4

GENETIC TRANSFORMATION OF ABACA BY MICROPROJECTILE BOMBARDMENT

Vermando M. Aquino", Maria Armila D. Ruiz' and Evalor T. Aspuria²

 ¹National Institute of Molecular Biology and Biotechnology University of the Philippines Diliman, 1101 Quezon City
²Department of Horticulture, University of the Philippines Los Baños, 4031 College, Laguna

Optimization of gene transfer protocol for abaca using microprojectile bombardment was conducted. Meristematic buds and embryogenic cells of abaca were transformed using a construct carrying the *uidA* and *npt*II genes. Meristematic buds of abaca were derived from shoot tip cultures and embryogenic cells were obtained from cell suspension cultures. The different physical bombardment conditions, such as rupture disc pressure, gap distance from rupture disc to macrocarrier, macrocarrier and microcarrier travel distance, were optimized. Selection of transformants was done by subculturing tissues onto medium containing antibiotic kanamycin. The tissues were assayed for the expression of *uidA* gene. The putative transformants were further confirmed by polymerase chain reaction (PCR) detection.

Keywords: abaca, transformation, microprojectile bombardment, uidA gene, nptll gene

SEQUENCE DIVERSITY OF BANANA BUNCHY TOP VIRUS (BBTV) COATPROTEIN GENE IN THE PHILIPPINES

Vermando M. Aquino'', Teresa B. de Leon, Marivi G. Colle and Gloricita A.Romo

¹National Institute of Molecular Biology and Biotechnology University of the Philippines Diliman, Quezon City

Banana bunchy top virus (BBTV) is an important viral pathogen of bananas in the Philippines. The virus causes stunting and significant reduction in vield. An enhanced understanding of the genetic diversity of Philippine strains of BBTV will contribute greatly to the development of effective control measures against the disease, particularly those strategies using pathogenmediated resistance. Thus, the genetic diversity of BBTV in the Philippines was examined by molecular cloning and nucleotide sequence analysis of the coat protein gene of different BBTV isolates. Thirteen BBTV isolates were collected from the following provinces; Albay, Palawan, Quirino, Nueva Viscaya, Nueva Ecija, Quirino, Laguna and Tarlac. Total DNA was extracted from young BBTVinfected banana leaves. Oligonucleotide primers based on published BBTV sequences were synthesized and used in polymerase chain reaction (PCR). The DNA fragment containing the full-length BBTV coat protein gene of about 525 bp was amplified and cloned using TOPO TA cloning kit. Both amplified PCR products and CP clones were sequenced. Multiple sequence alignment of CP gene from the 13 local BBTV isolates showed 90-97% homology. Sequence comparison of Philippine isolate with those in nucleic acid databases showed that Philippine isolates are more related to one another than to isolates from other countries. Several phenograms were generated using the neighbor-joining method based on CP sequences.

Keywords: BBTV, sequence diversity, banana, coat protein gene

SCREENING FOR rec A GENES FROM Vibrio harveyi IFO 15634 AND PHILIPPINE Vibrio ISOLATES

Prima Fe R. Franco*1.2 and Cynthia T. Hedreyda1

¹National Institute of Molecular Biology and Biotechnology College of Science, University of the Philippines Diliman, Quezon City 1101 ²Mariano Marcos State University College of Arts and Sciences. Batac, Ilocos Norte 2906

The recA gene produces the RecA protein essential for homologous recombination. The ability of Vibrio isolates in this study to undergo homologous recombination was explored in order to determine the possibility of using this process to introduce and express genes in such isolates. The presence of recA genes in the reference strain Vibrio harvevi IFO 15634 and the Philippine Vibrio isolates was observed when expected amplicons approximately 800 bp were obtained via Polymerase Chain Reaction (PCR) using recA-specific primers. Optimized PCR conditions for 30 cycles include initial denaturation at 94°C for 5 minutes, denaturation at 94°C for 1 minute, annealing at 57°C for 1 minute, elongation at 72°C for 1.5 minutes and final elongation at 72°C for 5 minutes. The PCR products were purified using NucleoSpin purification kit and subjected to sequence analysis. BLAST search results show that the obtained recA sequence of *U harvevi* had 92% sequence similarity to *U parahaemolyticus*. Similarly, the recA sequences of the Philippine isolates had 87% sequence similarity to U parahaemolyticus. It is therefore possible to perform genetic manipulation study where desired genes could be incorporated into 1. harvevi and Philippine local isolates using homologous recombination.

Keywords: recA, Vibrio harveyi Philippine Vibrio isolates, homologous recombination

MOLECULAR MARKERS OF HIGH ETHANOL-PRODUCING YEAST ISOLATES USING REPETITIVE SEQUENCE-BASED POLYMERASE CHAIN REACTION (REP-PCR) AND RIBOSOMAL DNA (RDNA) ANALYSIS

Irene E. Gabrido.¹, Asuncion K. Raymundo², Ma. Theresa T. Perez¹, and Francisco B. Elegado³

¹National Institutes of Molecular Biology and Biotechnology (BIOTECH), ²Institute of Biological Sciences. University of the Philippines Los Baños 4031 College, Laguna

Ten locally-isolated yeast strains belonging to the species of *Saccharomyces cerevisiae* and *Saccharomyces coreanus* were selected for high ethanol productivity after 24 hours of fermentation using unsterile molassesbased medium. Molecular approaches were then used to be able to differentiate these organisms at the strain level in order to provide molecular markers or fingerprints of the organisms. The usefulness of rep-PCR and analysis of ribosomal DNA (rDNA) in fingerprinting the strains were evaluated.

Rep-PCR amplification of repetitive elements using REP (Repetitive extragenic palindromic), ERIC (Enterobacterial repetitive intergenic consensus) and BOX primers indicated that these repetitive elements, which are highly conserved in the bacterial kingdom, are also present in fungal genomes, such as veast. REP-PCR was able to provide useful markers for S. cerevisiae A3 and A4 by the presence of a unique fragment (1.650 bp) present only in these two strains. Amplification of the region spanning the internal transcribed spacers (ITS 1 and ITS 2) and the 5.8S rRNA gene using the primer pair ITS1 and ITS4 produced an 850-bp product for all the yeast strains tested. Restriction analysis of the amplified fragment using Cfol. Haelll, Hhal. EcoR1, Maelll, and Mspl did not reveal intraspecific variability in Saccharomyces spp However, by amplification of the mitochondrial small subunit ribosomal DNA (mt SSU rDNA) using primer pair MS1 and MS2, polymorphisms even in closely related strains of S. cerevisiae were detected. Cluster analysis using UPGMA-SAHN revealed 10 clusters that were able to separate strains of S. cerevisiae and coreanus. The ten high ethanol producers were grouped together in Cluster I, while low alcohol producers S. cerevisiae A19 and A20 were clustered together. Amplification of this mt SSU rRNA gene provided specific fingerprint for each of the ten strains identified and these can serve as molecular markers for the yeast isolates.

Keywords: rep-PCR, genetic fingerprinting, yeast, Saccharomyces

species. However, further verification is required for the identification of PIZ-9806 since biochemical test results did not agree with data obtained from 16S rDNA and gyrase b gene sequence analyses.

Keywords: Vibrio, gyrase B gene, identification, sequence analysis

BIOTECH No. 10

GFP-LIKE PROTEINS IN PHILIPPINE MARINE SPECIES

Cynthia P. Palmes-Saloma*, Marvin A. Altamia, Cristina M. Garcia and Arlene T. Lim

Laboratory of Molecular and Cell Biology National Institute of Molecular Biology and Biotechnology University of the Philippines, Diliman, 1101 Quezon City

Green fluorescent protein (GFP) was first identified from the jellyfish, *Aequorea victoria* and it has since been exploited to track gene expression and the dynamics of protein trafficking in living systems. Since its discovery in the jellyfish, GFP-like proteins have been cloned from a variety of organisms from corals to sea anemones to copepods. In this study, we screened several Philippine marine species for possible GFP-like proteins by first using epifluorescence microscopy followed by molecular analysis. Total RNA samples were collected from fluorescent specimens and then subjected to reverse transcriptionpolymerase chain reaction using consensus-degenerate hybrid oligonucleotide primers to amplify GFP-like protein homologs that may potentially have unique spectral characteristics. Here we report some of the cDNA sequences of GFP homologs we isolated from some of our samples. We also performed phylogenetic analysis using 18S ribosomal DNA sequences to aid in classifying samples that are hard to categorize by merely using morphological criteria as basis.

Keywords: fluorescent proteins, corals, sea anemones, jellyfish, copepods, reverse transcription-polymerase chain reaction, epifluorescence microscopy, 18S ribosomal DNA, phylogenetic analysis

SEQUENCE AND STRUCTURE CONSERVATION IN THE BONE MORPHOGENETIC PROTEIN (BMP) 4 GENES OF MILKFISH AND CICHLIDS

Cynthia P. Palmes-Saloma', Jonathan S. Banawa, Edgar Naoe Tafaleng

Laboratory of Molecular Cell Biology National Institute of Molecular Biology and Biotechnology University of the Philippines, Diliman

Bone morphogenetic proteins (BMPs) play a critical role in the establishment of the vertebrate body plan, in cell differentiation and during the elaboration of structures in organogenesis. BMPs have been known to induce differentiation of cells into the osteoblast lineage and promote endochondral bone formation. Interestingly, milkfish retain a substantial number of intramuscular bones in contrast to other fish species. As a start in understanding the presence or potential persistence of these intramuscular bones, we isolated a key BMP gene, BMP4, to follow its expression at various stages of bone development. We used rapid amplification of cDNA ends (RACE)-PCR to isolate milkfish BMP4 cDNA and 5'- and 3'- untranslated regions (UTRs) using primers based on conserved BMP regions of zebrafish and other fish species. We obtained a 1.2 kB cDNA product and no alternatively spliced BMP4 mRNA transcripts. Sequence analysis showed that milkfish BMP4 gene include conserve regions for the signal peptide, the RX(K/R)R cleavage site and the mature peptide domain. It also has an average of 79% nucleotide homology and 82% amino acid homology with African cichlid fishes and lower homology with mammalian BMP4.

Keywords: bone morphogenetic protein 4. Chanos chanos, rapid amplification of cDNA ends.

COMPARATIVE SEQUENCE ANALYSIS OF PARTIAL HEMOLYSIN GENE FROM TWO PHILIPPINE Vibrio ISOLATES AND NINE Vibrio REFERENCE STRAINS

Boris B. San Luis' and Cynthia T. Hedreyda

National Institute of Molecular Biology and Biotechnology College of Science, University of the Philippines, Diliman, 1101 Quezon City

This study compares partial hemolysin gene sequences from two Philippine Vibrio isolates SW-9702 and NRW-9805-previously identified by conventional methods as V. harvevi and V. campbellii, respectively; and associated with mortality in pond-cultured shrimp Penaeus monodon-with the hemolysin gene sequences of nine other *Vibrio* species. Primers targeting a 600-bp hemolysin gene fragment were used to amplify partial hemolysin genes from the two Philippine isolates. The resulting PCR products were shotgun cloned, sequenced and subjected to pairwise alignments with hemolysin gene sequences of known Vibrio species available in the GenBank. Surprisingly, Philippine isolate SW-9702 (previously identified as V. harvevi) exhibited highest hemolysin gene sequence similarity with V. campbellii (96%) followed by V. harveyi (84%), V. parahaemolyticus (78%), V. vulnificus (74%), V. mimicus (68%), V. anguillarum (5%), V. hollisae (4%), V. cholerae (2%) and V. fluvialis (2%). Isolate NRW-9805 (previously identified as V. campbellii) is consistent with the previous identification showing highest hemolysin gene sequence similarity with V. campbellii (93%) followed by U harvevi (82%), V. parahaemolyticus (77%), V. vulnificus (77%), V. mimicus (67%), V. anguillarum (5%), V. hollisae (2%), V. cholerae (2%) and V. fluvialis (2%). While isolate NRW-9805 showed consistent classification under V. campbellii, results suggest a need to confirm classification of isolate SW-9702. Moreover, multiple sequence alignment of the partial hemolysin genes of the Philippine Vibrio isolates and Vibrio reference strains reveals hemolysin gene sequence diversity among Vibrio species, showing only few conserved regions.

Keywords: hemolysin, Vibrio harveyi, Vibrio campbellii, multiple sequence analysis

A NOVEL LEGUME MUTANT DEFECTIVE IN THE INFECTION THREAD GROWTH DURING ROOT NODULE DEVELOPMENT

Myra L. Tansengco*¹, Makoto Hayashi², Masayoshi Kawaguchi³, Haruko Imaizumi-Ant'aku⁴, and Yoshikatsu Murooka²

 ¹Microbiology & Genetics Division, Industrial Technology Development Institute, Department of Science and Technology, Bicutan, Taguig, 1631 Metro Manila
²Osaka University, Graduate School of Engineering, Department of Biotechnology, Yamadaoka 2-1 Suita, Osaka 565-0871, Japan
³Niigata University, Faculty of Science, Department of Environmental Sciences, Ninomachi 8050, Ikarashi, Niigata City, Japan
⁴National Institute of Agrobiological Sciences, Kannondai 2-1-2, Tsukuba, Ibaraki 305-8602 Japan

Nitrogen-fixing root nodules develop on legume plants as a result of symbiotic interaction between host plants and soil bacteria called rhizobia. The process of nodule development is triggered by the bacteria but genetically controlled by the host plant genome. Using chemical mutagenesis as a tool to identify novel plant genes that regulate nodulation, several symbiotic mutants were identified in the model legume Lotus japonicus. We have examined one mutant named crinkle (crk), which exhibits abnormal nodulation due to defects in the early stage of nodule development. Microscopic analysis of infected roots showed that nodulation in crk mutant is blocked at the stage of the infection process. Infection threads in crk extended in the roothair, however, their growth into the cortex was inhibited. Most infection threads were arrested at the base of epidermis and led to the formation of bumps and small, white, uninfected nodulelike structures. Crk mutant also developed other morphological alterations, including wavy trichomes, swollen roothair base, and short pods with many unfertilized ovules. Cytological and histological analyses of gametophytic process showed defects in pollen development and pollen tube growth. These phenotypes of crk mutant indicate that Crk gene is important not only in root nodule symbiosis but also in other aspects of plant growth and development. For positional cloning of Crk gene, mapping was done using existing polymerase chain reaction-based markers. Crk was located at chromosome 5 of the L. japonicus linkage map between deletion marker TM1336 and derived cleaved amplified polymorphic sequence marker TM1495 (~450 kb apart). Map-based cloning and analysis of Crk gene will help to uncover its function in the infection process during nodule development and in other aspects of plant biology. Information gained from the model legume will provide tools for the comparative studies on important crop legumes to maximize their efficiency and potential.

Keywords: root nodule, legume, legume mutant, Lotus japonicus, infection thread, pollen tube growth, mapping

BIOTECH No. 14

PHYLOGENETIC RELATIONSHIPS OF PYTHIUM AND PHYTOPTHORA SPECIES BASED ON ITS RDNA, CYTOCHROME OXIDASE II AND B-TUBULIN GENE SEQUENCES

Neilyn O. Villa*1 and Koji Kageyama2

¹Genetics and Molecular Biology Division, Institute of Biological Sciences College of Arts and Sciences, University of the Philippines Los Baños ²River Basin Research Center, Gifu University, Gifu City, Japan

Pythium and Phytopthora of the kingdom Chromista are two of the very harmful plant pathogens worldwide. Over the past decades, traditional taxonomic groupings of these fungal-like genera depended solely on morphological criteria and are thus polyphyletic assemblages. Advancements in molecular methods have permitted a more rational study of phylogenetic relationships within various organisms. Hence, 59 isolates representing 40 Pythium species and 18 isolates representing 7 Phytopthora species were chosen to investigate intra- and intergeneric relationships using sequence analysis of three genomic areas. The internal transcribed spacer regions (ITS 1 and ITS2), including the 5.8S gene of the ribosomal DNA repeat were PCR-amplified using the universal primers ITS1 and ITS4, as described by White et al. (1990). On the other hand, 563 bp of the cytochrome oxidase II (cox II) gene was amplified using the primer pair FM66 and FM58 for Pythium (Martin, 2000) and FM75 and FM78 for Phytopthora (Martin and Tooley, 2003). Lastly, the 658 bp partial beta tubulin gene was amplified using the forward primer BT5 and reverse primer BT6. Sequencing was then performed using an Applied Biosystems ABI 3100 DNA Sequencer. Generally, maximum parsimony analysis of the three DNA regions revealed four major clades, reflective of sporangial morpohology. Clade 1 was

composed of of *Pythium* isolates that bear filamentous to lobulate sporangia. Clade 2 represents *Pythium* isolates which bear globose to spherical zoosporangia or spherical hyphal swellings. Meanwhile, *Phytopthora* isolates were lumped into Clade 3 wherein the papillate, semi-papillate and non-papillate species occupied separate subclades. Lastly, Clade 4 was composed of *Pythium* species that bear subglobose sporangia resembling the papillate sporangia observed in *Phytopthora*. Hence, a number of species (i.e. *Ph. undulata, P. helicoides, P. ostracodes, P. oedochilum and P. chamaehyphon*) have been proposed to be the elusive intermediate species in the *Pythium*-to-*Phytophthora* evolutionary line.

Keywords: Pythium, Phytophthora, ITS rDNA, cytochrome oxidase II gene, beta tubulin gene, phylogeny

BIOTECH No. 15

UTILIZATION OF CLONED AND EXPRESSED RICE TUNGRO VIRUS COAT PROTEIN GENES FOR RTBV- AND RTSV-SPECIFIC ANTISERA PRODUCTION

Ma. Gina Maramara Babb*, Arlen A. Dela Cruz, Ma. Johna C. Duque

Philippine Rice Research Institute, Maligaya Science City of Muñoz, Nueva Ecija

Tungro is the most important virus disease of rice today. It is caused by a joint infection of rice tungro bacilliform virus (RTBV) and rice tungro spherical virus (RTSV). In this study, we successfully used the RTBV coat protein (CP) gene for RTBV-specific antisera production in lieu of the difficult and cumbersome whole virus particle purification.

We cloned the Maligaya strain CP gene of RTBV in a previous study. This gene was successfully expressed in *Escherichia coli* cells shown as a 55 kDa protein on SDS-PAGE. The CP transcript, bound to a Maltose-Binding Protein, was affinity-purified and used to induce RTBV-specific antisera production in rabbit. The RTBV-CP from immune bleed was successfully detected by indirect enzyme-linked immunosorbent assay (ELISA) and Western blot using both the anti-Maltose Binding Protein serum and anti whole-RTBV serum. The **RTBV-specific** antisera is now being optimized for large-scale application while the **RTSV-CP**, cloned from a Maligaya strain of the tungro virus is currently being affinity purified to produce **RTSV-specific** antisera.

Keywords: cloning, rtbv, rtsv, coat protein gene, expression in *escherichia coli*, antisera production

BIOTECH No. 16

CLONINGAND ONTOGENETIC EXPRESSION OF THE GENES INVOLVED IN FATTY ACID SYNTHESIS IN COCONUT (Cocos nucifera L.)

Marni Eusebio Cueno¹⁺, Rita P. Laude¹, Antonio C. Laurena², and Evelyn Mac Tecson-Mendoza²

¹Institute of Biological Science, College of Arts and Sciences ²Institute of Plant Breeding, College of Agriculture University of the Philippines Los Baños, College, Laguna 4031, Philippines

Coconut (Cocos nucifera L.) is the major export crop of the Philippines due to its vegetable oil which is rich in medium-chain fatty acids. Several genes are involved in fatty acid synthesis in coconut. Among them: acyl-ACP thioesterase (TE), phosphatidic acid phosphatase (PAP), acyl carrier protein (ACP), acetyl CoA carboxylase (ACCase), lysophosphatidic acid acyl transferase (LPAAT) and B-ketoacyl (ACP) synthase 3 (KAS 3). To clone and determine the ontogenetic expression of the genes involved in fatty acid synthesis, the 3'RACE method was used.

For TE, two bands were detected in the 5 and 6 mo-old coconut endosperms. For PAP, three bands were detected in the 6 mo-old coconut endosperm. For ACP, a single band was detected in the 4 mo. old coconut endosperm. For ACCase, 2 bands from the 4 mo-old and 8 bands from the 6 moold coconut endosperms. For LPAAT, 2 bands were detected in the 6 mo-old coconut endosperm. For KAS 3, 2 bands were detected from the 5 and 6 mo-old coconut endosperms. Bands produced by each of the genes that were suspected to be involved in fatty acid synthesis were further cloned and characterized.

The results obtained show a high homology of each of the cloned genes to other known published sequences. Furthermore, the results obtained

show an ontological pattern of significance in the expression of genes involved in fatty acid synthesis in coconut.

Keywords: coconut, medium chain fatty acid, isoform, RACE (Randomly Amplified Cdna Ends), fatty acid synthesis, cloning

BIOTECH No. 17

CLONINGAND PARTIAL CHARACTERIZATION OFA PROTEASE-ENCODING GENE FROM SERRATIA MARCESCENS BIOTECH 1749

Geraldine P. Muncada¹, Teresita M. Espino² and Antonio C. Laurena³

¹MBB Program, University of the Philippines Los Banos Graduate School ²NIMBB, University of the Philippines Los Banos ³Institute of Plant Breeding, College of Agriculture University of the Philippines Los Banos, College, Laguna 4031

Some bacteria such as *Serratia marcescens* can infect certain fungi and insects through the production of hydrolytic enzymes such as chitinases and proteases. In another study, the strain BIOTECH 1749 of *Serratia* was shown to produce more than 5 different chitinases which can affect the growth and development of plant pathogenic *Aspergillus flavum* and *A. parasiticus*. This study was made to determine whether this particular strain also produces another hydrolytic enzyme that targets fungal or insect proteins.

Serratia marcescens strain Biotech 1749 was observed to produce an extracellular alkaline protease in culture. This was confirmed through the production of clear lytic zones when grown in bacterial agar with skim milk at different pH conditions. The putative gene encoding the protease was isolated from genomic DNA of *Serratia* using subtilisin-specific primers gpmapr1 and gpmapr2 by PCR. The 780-bp PCR generated DNA fragment was cloned in TOPO-TA vector and the insert sequenced.

One of the clones, p1749SP6 had an insert of approximately 570 bp after removing the plasmid backbone of the cloning vector. BLAST homology searches and multiple sequence alignment (Vector NTI, Informax) of the deduced amino acid sequence of the insert revealed the protein domains HGTHVAG and GTSMATPHVAG which are highly conserved regions in subtilisin and other serine proteases from bacteria.

Keywords: cloning, Serratia marcescens strain Biotech 1749, PCR, Aspergillus flavum, A. parasiticus

BIOTECH NO. 18

ISOLATION AND SCREENING OF CRUDE OIL-DEGRADING MICROORGANISMS FOR BIOREMEDIATION OF OILSPILLS IN WATER OR WASTEWATER EFFLUENTS

Eileen S. Estrada*1, Christine A. Calolot², Jose Ricardo F. Po², Romeo M. Cabacang¹, Maximiano Malabanan¹ and Claro Mamaril³

¹Microbiology and Genetics Division, Industrial Technology Development Institute DOST Complex, Bicutan, Taguig City ²Department of Biology, College of Arts and Sciences University of the Philippines, Manila

An environmental waste management project to address oil spills incidents in water or wastewater effluents is currently being undertaken. Isolation and screening of oil-degrading microorganisms was done as a preliminary study for the oil spills bioremediation project. Soil and water samples were collected from different sites that have been exposed to hydrocarbon pollutants. Oildegrading microorganisms were isolated by the standard plating technique. Four crude oil-degrading microorganisms were selected on the basis of their high % Oil Conversion(%OC). These isolates were identified to be *Pseudomonas aeruginusa*, *Bacillus sp., Corvnebacterium sp.*, and *Aspergillus sp.*

The oil biodegradation activities of selected microbial strains were further screened by inoculating in test tube microcosms simulating oil spills. The test tube microcosms were set-up at different oil-inoculum ratios (1:1,1:2,2:1). Microbial growth, pH and presence of carboxylic acids were monitored. The Percent Oil Conversion (%OC) were computed and samples were subjected to gas chromatography. Results showed that *Pseudomonas aeruginusa* has the highest activity of 44% OC in 18 days and an oil-inoculum ratio of 1:2. Evidence of hydrocarbon degradation was indicated by the decrease in peak heights of hydrocarbons in the oil mixture as shown by gas chromatography results. Initial results showed a 96.3% OC for an organic absorbent inoculated with the *Aspergillus sp.* The isolated microorganisms were used for the subsequent bioremediation experiments.

Keywords: Bioremediation, Hydrocarbon degradation, % Oil Conversion (%OC), Oil-degrading microorganisms, Oil spills

BIOTECH No. 19

PROGRESS IN THE DEVELOPMENT OF PRSV-P RESISTANT PAPAYA (*Carica papaya L.*) THROUGH INTERGENERIC HYBRIDIZATION

Simeona V. Siar^{1*}, Andres Godwin C. Sajise¹, Lorna E. Herradura² Sofia A. Covacha³, Roderick A. Drew⁴ and Christopher M. O'Brien⁴

 ¹Fruit and Ornamental Crops Division-Institute of Plant Breeding College of Agriculture, University of the Philippines Los Baños, College, 4031 Laguna
²Bureau of Plant Industry-Davao National Crop Research and Development Center, Bago-Oshiro, Davao City
³Bureau of Plant Industry-National Mango Research and Development Center, Barangay San Miguel Jordan, Guimaras
⁴School of Biomedical and Molecular Science
Griffith University, Nathan Campus, Brisbane 4111, Queensland, Australia

Vasconcella quercifolia is a wild relative of C. papaya that carries gene/genes for resistance against Papaya Ringspot Virus Type P (PRSV-P) - the most dreadful disease of papaya worldwide. Successful production of fertile F_1 intergeneric hybrids of C. papaya x V. quercifolia was done in Australia and six intergeneric hybrid lines (401, 404, 410, 468, 469 and 507) were introduced in the Philippines to introgress PRSV resistance to four inbred lines of the Institute of Plant Breeding (IPB).

This study aims to develop the first PRSV resistant papaya inbred lines with good horticultural traits by conventional breeding through a series of backcrossings and evaluation of the resulting progenies. Two intergeneric hybrids (410 and 468) remained virus-free in IPB experimental field two years after planting. Susceptible intergeneric hybrids (401, 404, 469 and 507) succumbed to PRSV seven months to two years after field planting. PRSV symptoms were observed and confirmed by ELISA test results. Backcrossing activities were focused on intergeneric line 410 as pollen source because of its ability to consistently produce viable pollen (1.2 to 2.2 %) in sex-stable male trees. Seven hundred fifty six fruits were harvested and 100.096 seeds were dissected from the different crosses made. Among the four papaya inbred lines (4108, 4172, 5648 and 5893), inbred line 5648 comprised the highest portion of the embryos rescued (64.76 %) and did not show severe PRSV symptoms after two years in the field. Viable embryos were also recovered from the other three inbred lines. Out of 315 genotypes screened, one genotype (BC, 5648 x 410) showed putative resistance to PRSV after three mechanical inoculations. ELISA test confirmed the absence of the virus in the promising resistant genotype three months after field planting. The morphological characteristics of the BC, hybrid are similar to papaya's however; it has a shorter juvenile stage.

Keywords: Papaya Ringspot Virus Type P(PRSV-P), intergeneric hybrid, inbred lines, PRSV resistance

BIOTECH NO. 20

COMPARATIVE STUDY OF THE MERCURIC REDUCTASE (MERA) GENES OF AN ARCHAEALAND A BACTERIAL ISOLATE FROM A MERCURY-RICH HOT SPRING

Jessica F. Simbahan¹ and P. Blum²

¹National Institutes of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Baños. College, Laguna ²Beadle Center, University of Nebraska Lincoln, Lincoln, NE, USA

Hot spring environments support a variety of microorganisms that have evolved unique biogeochemistries and metabolic processes. Coso Hot Springs located in California lies within a vast cinnabar region. Cinnabar is mercuric sulfide, the most common and widespread form of mercury found in nature. The hot spring of interest, characterized by its deep red color due to cinnabar, has an average temperature of 80°C and pH of 1.7. Under these conditions, the solubility of cinnabar is enhanced resulting in the release of toxic Hg2+ into the pool water. It is expected that the microorganisms living in the hot spring have evolved mercury resistance mechanisms that allow them to survive in this toxic environment. A microbial diversity survey of the microorganisms in the pool by 16S rRNA analysis and fluorescence in situ hybridization (FISH) analysis showed the presence of both archaea and bacteria in the hot spring. For bacteria, the most common mechanism of mercury resistance involves an enzyme called mercuric reductase. The enzyme is able to convert Hg²⁺ into Hg⁰ which is less toxic. Mercuric reductase is encoded by the merA gene which is part of the mer operon. Since it was found that both archaea and bacteria inhabit the hot spring, this study was undertaken to determine if these archaea and bacteria shared the merA gene by lateral gene transfer. The merA gene from a cultured representative from each of the domains was sequenced and compared. The mer A gene of the bacterial isolate, Alicyclobacillus vulcanalis, shared the closest identity to the merA genes of other gram + bacteria while the merA gene of the archaeal isolate. Sulfolobus solfataricus, shared the closest identity to the merA genes of other archaea. These results show that the mercury resistance mechanism employed by the archaeal and bacterial isolates from Coso Hot Springs evolved separately and was not shared by lateral gene transfer.

Keywords: merA, Sulfolobus solfataricus, Alicyclobacillus vulcanalis

BIOTECH No. 21

EVALUATION OF COPPER(II) ADSORPTION CAPACITIES OF CYANOBACTERIA FROM WATER SAMPLES IN MARINDUQUE

Geoffrey C. Li¹, Lorele C. Trinidad*² and Veronica P. Migo²

¹Biochemistry Department, University of the Philippines Manila *²BIOTECH, University of the Philippines Los Baños

The large quantity (around 1.5 million cubic meters) of mine tailings accidentally released from the Tapian Pit of Marcopper had significantly affected the water and soil systems of Marinduque. Mine tailings contain a number of toxic heavy metals, copper included. The release of these heavy metals to the ecosystem led to adverse effects to plants and animals including humans.

The study investigated the use of naturally thriving cyanobacteria from the waters of Marinduque for sequestering the potentially harmful copper (II). In addition, the cyanobacteria *Hapalosiphon welwitschi* Nagel, known to bind cadmium, was also tested for capability to adsorb copper (II). Among the cyanobacteria obtained from Marinduque, the cultures containing *Westiollopsis* and *Gloecystis* were utilized.

The biosorption experiments were carried out to determine optimum conditions (pH, contact time, amount of biomass) for copper adsorption. The optimum pH for copper adsorption of both *Westiollopsis* and *H. welwitschi* was found to be 5-6, while that of *Gloecystis* was only 4. Metal adsorption can be effected in only two (2) hours using as low as 0.1 g (fresh weight) of cyanobacteria. Both Freundlich and Langmuir adsorption isotherms were used as models. For the *Westiellopsis* organisms and *H. welwitschi*, the Langmuir isotherm represented the adsorption process better that the Freundlich. On the other hand, the adsorption of copper(II) by the culture *Gloecystis* did not exhibit a good fit in either Freundlich ar Langmuir adsorption isotherms.

Application of the *Westiellopsis* organisms to actual wastewaters, namely from Tapian pit and Bol river, gave 78.3% and 93% copper(II) removal, respectiviely. On the other hand, application of *H. welwitschi* to Tapian and Bol waters gave 52 % and 70 % copper removal respectively. The results showed that cyanobacteria could be employed as biosorbents in the bioremediation of Marinduque. It is suggested to be effective in other mine-tailings contaminated sites as well.

Keywords: bioremediation, cyanobacterial sorbents, copper removal

MYKOVAM AND PLANT GROWTH PROMOTING RHIZOBACTERIA AS BIOFERTILIZERS FOR ENHANCED GROWTH OF THREE COFFEE CULTIVARS

Nelly S. Aggangan¹ and Jose Marie P. Segismundo²

¹National Institute of Molecular Biology and Biotechnology (BIOTECH), University of the Philippines Los Baños (UPLB), College, Laguna 4031 ²Lipa City National Science High School, Lipa City, Batangas.

The efficiency of mycorrhizal inoculant "Mykovam" and plant growth promoting rhizobacteria (PGPR) in promoting growth of three coffee cultivars was determined under nursery and field conditions. These microbial fertilizers can be an alternative or substitute to chemical fertilizers. The three cultivars were: *Coffea liberica*, *C. robusta* and *C. excelsa*. Due to unavailability of seeds, young wildlings (with first one pair of round leaves) were collected under coffee plantations in Batangas. Under screen house conditions at BIOTECH, *C. robusta* and *C. excelsa* were inoculated with Mykovam and/or PGPR. The soil used was collected in a grassland area in Batangas. Under field conditions, nursery treated *C. robusta*, *C. excelsa* and *C. liberica* seedlings were out planted in Rosario, Batangas.

Generally, C. robusta and C. excelsa responded positively to inoculation with Mykovam unlike C. liberica, which was not responsive to Mykovam. In the nursery, Mykovam significantly increased height of C. robusta and C. excelsa by 30% and 100%, respectively, relative to the uninoculated seedlings. The height of C. robusta seedlings inoculated with PGPR alone and PGPR in combination with Mykovam was similar to the uninoculated counterpart. By contrast, height of C. excelsa was significantly increased (29% over the control) by PGPR. Under field conditions, Mykovam significantly increased (114%) growth of C. excelsa as early as four weeks after inoculation, and the effect became more evident thereafter (up to 165%). In C. robusta, significant increased (30%) in height was observed eight weeks after inoculation. In terms of shoot and root dry weight, inoculation with PGPR promoted the heaviest plant biomass, followed by Mykovam inoculation. The positive response of Coffea liberica to inoculation was not observed in spite of its being colonized with mycorrhizal fungi. Mycorrhizal colonization was positively correlated with plant growth.

Keywords: mykovam, mycorrhiza, biofertilizers, coffee

COPPER TOLERANCE OF NON-MYCORRHIZALAND MYCORRHIZAL EUCALYPTUS AND ACACIA SEEDLINGS

Nelly S. Aggangan¹ and Brian James S. Aggangan²

¹National Institute of Molecular Biology and Biotechnology ²University of the Philippines Rural High School Los Baños, College, Laguna 4031

This study was conducted to screen ectomycorrhizal (ECM) fungi that can increase Cu tolerance of Eucalyptus urophylla and Acacia aulacocarpa seedlings for the phytoremediation of Cu mine tailings. Two laboratory experiments were done following a Completely Randomized Design (CRD) with four replicates. Pisolithus 23-01 vielded the highest mycelial growth and unaffected by Cu addition up to 750 µM. Likewise, Pisolithus H6394, Scleroderma sp. and Astreus sp. were not affected by Cu but the growth was slower than Pisolithus 23-01. Under nursery conditions, E. urophylla and A. aulacocarpa seedlings inoculated with Pisolithus (23-01 and H6394), Scleroderma and Astreus and planted in garden soil amended with 250, 500 and 750 µM Cu and no Cu. grew better than the non-mycorrhizal ones. Root colonization (10 to 30%) by ECM fungi was not affected by Cu. Seedlings inoculated with Pisolithus (23-01 and H6394) and Scleroderma promoted the greatest height increment, stem diameter and dry weight, Pisolithus H6394 consistently gave the highest seedling growth, dry weight, P and Cu uptake irrespective of Cu level. Phosphorus uptake was inversely related with Cu uptake in E. urophylla, The addition of 750 µM Cu reduced the growth of non-mycorrhizal seedlings and those inoculated with Astreus. In Cu mine tailing soil, A. aulacocarpa survived and grew better than E. urophylla, E. deglupta, and A. mangium. Pisolithus 23-01 promoted the best growth. Hence, A. aulacocarpa could be a potential species in reforesting Cu mine areas coupled with inoculation with Cu tolerant ECM fungi particularly with Pisolithus species.

Keywords: copper tolerance, ectomycorrhiza, acacia, eucalyptus, **phytoremediation**

POTENTIAL PHYTOREMEDIATION SPECIES IN SELECTED MINE TAILINGS AREAS

Nina M. Cadiz¹, Rafael T. Cadiz² and Niño B. Vidal¹

¹Institute of Biological Sciences, University of the Philippines Los Baños College, Laguna 4031 ²ERDB-Department of Environment and Natural Resources Los Baños, Laguna

A study was conducted to study plant diversity in some mine tailings areas and to look for potential species for phytoremediation (i.e. rehabilitation through selected tolerant plant genotypes). Results of this study could be used as baseline information in a sound rehabilitation strategies and or environmental management of mine tailings sites.

Plants growing in some mine tailings areas in Paracale, Camarines Norte, and Toledo, Cebu were surveyed and identified. The growth habit and conservation status of the species were also determined. Soil and plant samples were brought to the National Institute of Molecular Biology and Biotechnology (BIOTECH, UPLB) for analysis. Area covered and elevation of the mine tailings sites were measured using a Global Positioning System.

The soil in mine tailings area in Paracale is alkaline, while in Toledo, Cebu is acidic. Gold is mined in Paracale, while copper in Toledo. Both areas are positive for lead and cadmium contamination. Vegetation analysis in Paracale tailings area showed the presence of Morinda citrifolia, Lantana camara, Commersonia bartramia, Saccharum spontaneum, Paspalum stachyum, Dracontomelon edule, Leucaena leucocephala, Stachytarpheta jamaicensis, Ornithogalum caudatum, Borreria ocymoides, Grewia multiflora, Ardisia pyramidalis, Callicarpa cana and Eleusine indica, Ipomea pes-caprae, Imperata cylindrical, Pterocarpus indicus, Fimbristylis sp., and Chloris barbata, Casuarina equisitifolia and Acacia auriculiformis. A similarity in vegetation composition, particularly the grass species were found in Toledo tailings dams. In addition, Chromolina odorata, Astrocalyx calycina and the ferns Nephrolepis and Pteris were noted.

The listed species show their potential for phytoremediation, but there is still a need to identify and screen for more indicator species because vegetation composition changes with the kind of metal/mineral being mined and mining operations.

Keywords: phytoremediation, mining operations, alkaline, acidic, mine tailings

CHEMICAL, MATHEMATICAL AND PHYSICAL SCIENCES

CHEM No.1

A THEORETICAL STUDY ON THE REACTION RATE COEFFICIENTS OF THREE-PARTICLE SYSTEMS USING CLASSICAL TRAJECTORY CALCULATION AND TRANSITION STATE THEORY

Christopher E. Ambe¹, Edgar W.Ignacio², Dante D. Dinawanao³, and Jingle B. Magallanes⁴

³Department of Chemistry, College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City ²Northern Mindanao State Institute of Science and Technology Ampayon, 8600 Butuan City ³Department of Computer Science, MSU-Iligan Institute of Technology 9200 Iligan City ⁴Department of Physics, College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City

Chemical reaction is essentially a dynamical situation and is a problem which needs an investigation of the motion of the electrons and nuclei interaction. This study aims to look into the dynamics of a simple bimolecular reaction through the use of computers. One of the requirements of trajectory calculation is the potential energy surface (PES) which also forms a central concept in the application of transition state theory (TST) to study the molecular structures, vibrational frequencies, partition functions and nature of chemical reactions.

In this paper, the rate coefficients of prototype reactions involving three particles, A + BC a AB + C, are determined theoretically using London-Eyring-Polanyi-Sato (LEPS) potential energy function. Geometry optimization of the equilibrium structures for the transition states was done using Newton-Raphson Method. The rate coefficient obtained using transition state theory for the $H + H_2 a H_2 + H (1)$. $F + H_2 a HF + H (2)$, and $I + H_2 a HI + H (3)$ reactions were 4.8087×10^9 , 1.3768×10^{13} , and 6.76×10^{-12} cm³mol⁻¹s⁻¹, respectively. These were within the range of the experimental rate constant values presented in the paper of Moss and Coady. It has also been observed that for the reactions (1). (2) and (3), the activation energies are at the minimum when the angle of approach (\dot{e}) is 180°. These results confirm the prediction made by London and the ab initio calculation done by Siegbahn and Liu that $\dot{e} = 180^\circ$ corresponds to the minimum barrier height. The classical trajectory calculations for the reactions of interest were also considered to trace the motion of the reacting species along the minimum energy path of the potential energy surface. These were carried out by solving the four differential equations derived from Hamiltonian's equation of motion using two numerical integration methods: Fourth-Order Runge-Kutta method and Predictor-Corrector method. The significance of these calculations is that they permit examination of the detailed dynamics of individual reactive collisions. In this study, all equations and calculations were coded using an appropriate programming language like Fortran 77 and Mathematica 3.0.

Keywords: geometry optimization: rate coefficient: trajectory calculation; transition state theory.

CHEM No. 2

BIOCHEMICALASSESSMENT, CHARACTERIZATION AND GENE CLONING OF A TUBER-SPECIFIC PROTEIN FROM CASSAVA (Manihot esculenta Crantz)

Vivian A. Azucena¹, Eugenia M. Castillo² and Antonio C. Laurena³

¹Division of Physical Sciences and Mathematics. College of Arts and Sciences University of the Philippines in the Visayas. Miag-ao. Iloilo, Philippines ²Institute of Chemistry, University of the Philippines Los Baños ³Institute of Plant Breeding. College of Agriculture University of the Philippines Los Baños Laguna 4031, Philippines

Cassava is an important agricultural crop in developing countries such as the Philippines. Molecular approaches to increase protein content in cassava tubers and to utilize cassava as a green factory to produce pharmaceutical proteins have been initiated at IPB.

Total soluble proteins of cassava root samples prepared as cylindrical and radial tissue sections were extracted using 200 mM Tris-HCl pH 8.2 and assayed by Bradford method. The middle cylindrical section (MCS) and the mid radial section (RS-M) showed higher total soluble proteins, 0.79% and 0.86% respectively. Most of the proteins (10.6 μ g/mL) were isolated by ammonium sulfate (AS) fractionation at 60% saturation. Two peaks were obtained (one major and one minor) when the AS-purified fraction was further fractionated in a gel filtration column using Sephadex G-150. SDS-PAGE of the pooled fractions showed a single band at 40kDa.

Fractionation of the total soluble proteins gave $1.85 \ \mu g/mL$ globulin, $1.11 \ \mu g/mL$ prolamine and traces of glutelin and albumin. The protein fractions were run on Sephadex G-150 and the globulins showing a single peak while the

prolamines had one major and a minor peak. SDS-PAGE of the pooled globulin fractions confirmed that the single band (40 kDa) is a major component of the cassava globulin protein.

Amino acid analysis of the purified 40 kDa protein showed that the predominant amino acids were glycine (16.43%), alanine (13.00%) and serine (10.70%) but 2-D gel electrophoresis indicated that the protein was acidic (pI 4.5 – 6.5). PAS staining showed that the protein was not glycosylated. The N-terminal sequence was determined to be DINGXN. A forward primer was designed based on DINGXN to clone the gene encoding the 40 kDa protein from both gDNA and total RNA. A 600 bp PCR product was obtained in both cases, indicating the absence of introns. *In silico* analyses of DNA sequences as compared with available genes and multiple sequence alignment of existing genes using the VectorNTI Suite (Invitrogen) revealed that the cloned cassava gene had minimal homology with other storage proteins. We are now in a position to clone the gene of full length tuber-specific protein and its promoter of the gene by inverse PCR, genome walking or promoter trapping strategy.

Keywords: biochemical assessment, gene cloning, cassava, tuber-specific, PCR

CHEM No. 3

POLARIZED-TRANSMITTED LIGHT MICROSCOPY OF ASBESTOS IN DRINKING WATER IN SELECTED AREAS IN ILIGAN CITY

Lydia M. Bajo¹, Marilou T. Dacutan,¹, Franco G. Teves², and Ruben C. Tudio³

¹Department of Chemistry, College of Science and Mathematics MSU-Iligan Institute of Technology. Iligan City. 9200 ²Department of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology, Iligan City 9200 ³Central Laboratory. Refractories Corporation of the Philippines. Iligan City

This study aimed to develop an inexpensive but accurate technique of determining asbestos concentration in water. The microvisual counting of asbestos expressed as structures per liter by Polarized- Transmitted Light Microscope coupled with Scanning Electron Microscope has been used in an investigation of asbestos concentration in drinking water from selected areas in lligan City. Replacement of asbestos cement pipes (which generates fibrous minerals of asbestos) in the water distribution system has led to the determination as well as to the wide distribution of serpentine in the crust. Eight sampling sites

were employed in this drinking water examination. This investigation subjected the samples to comparison with the reference and interference asbestos minerals, identification of extinction position with respect to the polarizer or the analyzer of the Polarized-Transmitted Light Microscope, and then mounting the selected sample in Scanning Electron Microscope for morphology analysis.

The optical asbestos structure count data gave tolerable asbestos concentration in all eight (8) sampling sites. Of all selected sites, asbestiform and filiform structures of asbestos showed the highest concentrations. These predominantly long asbestos habits are excreted more slowly than other forms and are not metabolized in the body; instead they tend to accumulate in the digestive system with time.

The results show similar characteristics of the asbestos standard and of the sample in drinking water both in the Polarized Transmitted Light Microscopy and Scanning Electron Microscopy analyses. More importantly, this study has developed and shown an inexpensive technique of determining asbestos concentration which also gave accurate and reliable results.

Keywords: asbestos, serpentine, drinking water, microvisual counting, extinction position

CHEM No. 4

EVALUATION OF AMMONIA REMOVALAND OXIDANT FORMATION IN A CONTINUOUS ELECTROLYTIC REACTOR USING A MODEL SYSTEM OF ARTIFICIAL SEAWATER

Mark Louis Sidney Capanzana¹, Catalino Alfafara¹⁺, Veronica Migo² Jovita Movillon¹, Ronald Navarro¹, and Masatoshi Matsumura³

 ¹ Department of Chemical Engineering. University of the Philippines Los Banos. College. Laguna 4031
² National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Banos. College. Laguna 4031
³ Institute of Applied Biochemistry. University of Tsukuba Tennodai 1-1-1, Tsukuba City 305-0006, Japan

Ammonia destruction and oxidant formation were investigated in a model system of artificial seawater (ASW) in a continuous (indirect) electrolysis reactor. Continuous experiments were run to evaluate the behavior of the steady state concentrations of NH_4^+ -N and total residual oxidant (TRO) under conditions of low, high and "balanced" ammonia loadings, at constant operating currents of

1A and 2A. In addition, secondary effects of the process on water quality like pH, temperature and nitrate concentration were also determined.

At a constant operating current of 1A, the balanced flow rate, calculated by the charge dose from batch experiments gave a reasonable prediction of balanced ammonia destruction and oxidant formation. Low steady-state values of NH_4^+ -N concentrations in the effluent (96% removal efficiency at steady state) were obtained without an overproduction of excess oxidant. At ammonia loadings exceeding the balanced conditions, the ammonia levels were zero, but there was an overproduction of oxidant. At ammonia loadings exceeding the balanced conditions, k high values of steady-state NH_4^+ -N concentrations (corresponding to 50% removal efficiency) were obtained. Steady-state oxidant concentrations were zero, indicating an insufficient supply of electrolytically generated oxidants to oxidize the residual ammonia. At ammonia loadings lower than the balanced conditions, ammonia levels were zero, but there was an overproduction of oxidant.

The charge dose for the continuous system was determined to be 23.9 coulombs/mg NH_4^+ -N removed, and the energy requirement at the operating voltages used ranged from 20.6 kwh/kg NH_4^- -N removed to 28.6 kwh/ NH_4^+ -N removed.

Keywords: electroflocculation, electroflotation, coconut wastewater, charge dose

CHEM No. 5

METHOD FOR THE DETERMINATION OF CARBAMATE PESTICIDES IN SOIL SAMPLES

Abigail P. Cid and Maria Pythias B. Espino

Institute of Chemistry, College of Science University of the Philippines Diliman, 1101 Quezon City

An analytical procedure was developed for the determination of commonly used carbamates such as carbaryl, carbofuran and methomyl in soil by soxhlet extraction using high pressure liquid chromatography (HPLC) with UV detection. Agricultural soil previously subjected to soxhlet extraction with acetonitrile was used as blank sample. The extracts were analyzed for residues to ensure that the blank sample is free from possible interferences. A 20 g blank agricultural soil was spiked with carbamate standards at known concentrations. Soxhlet extraction was performed using solvents with different polarities such as acetonitrile. methanol, acetone, ethyl acetate and hexanes for 8 to 24 hours at solvent volumes ranging from 100 mL to 300 mL. The collected extract was evaporated to dryness under reduced pressure. The residue was dissolved in 1.0 mL hexane before silica cleanup. Almost all of the recoveries of the solvents tried gave good results. Acetonitrile was chosen because of the high solubility of the carbamates in this solvent while having low solubility of possible interfering substances. Recovery studies were performed using blank agricultural soil fortified with a mixture of carbamate analytes in replicates at 2.5 μ g g¹ concentration. The analytes were analyzed by employing the optimized HPLC parameters. A 20 μ L of sample and internal standard was injected into the C18 column and analyzed using UV wavelength of 220 nm, 1.0 mL min⁻¹ flow rate, 35 °C, and mobile phase composition of 50:50 (v/v) acetonitrile-water. The percent recoveries of the carbamates using acetonitrile ranges from 89 ±10% to 120 ±12%.

Keywords: Carbamates, carbaryl, carbofuran, methomyl, HPLC-UV, Soxhlet, soil

CHEM No. 6

UTILIZATION OF ESSENTIAL OILS AS MODIFIER OF CARBON PASTE ELECTRODES FOR VOLTAMMETRIC DETERMINATION OF LEAD (II)

Rolando O. Elviña Jr.*, Myleen C. Ilagan, Jose Rene L. Micor and Elmer-Rico E. Mojica

Institute of Chemistry. University of the Philippines Los Baños. College, Laguna 4031

Essential oils contain functional groups with metal binding ability. With this property, essential oils of citrus fruit rinds and eucalyptus leaves were utilized as modifier in the fabrication of carbon paste electrodes (CPE). The modified CPEs were then used for voltammetric analysis of heavy metals particularly lead (II). Cyclic voltammetry (CV) and differential pulse anodic stripping voltammetry (DPASV) were used in the voltammetric analysis of lead (II). Optimum conditions for lead (II) analyses were determined. For the CPE modified with citrus essential oil, the following are the optimized conditions: accumulation time of 240 seconds. 0.1 M HCl supporting electrolyte, deposition time of 300 seconds, 20% modifier composition and -1200 mV deposition potential. For the eucalyptus essential oil modified CPE, the following parameters gave the best results: 10% modifier

composition, pH 6, 120 seconds accumulation time. 150 seconds deposition time. -1500 mV deposition potential and 0.1 M HCl supporting electrolyte. Regeneration of electrode was achieved by multiple stripping in eucalyptus essential oil modified CPE and by combination of multiple stripping and use of 0.1M EDTA in citrus essential oil modified electrode. Determination of lead (II) concentration in laboratory waste using the fabricated electrodes gave comparable results with standard mercury vapor analysis by atomic absorption spectrophotometry (AAS).

Keywords: essential oils, carbon paste electrode. lead

CHEM No. 7

A NEURAL NETWORK MODEL FOR SPLICE-SITE RECOGNITION OF HUMAN GENOME SEQUENCES

Elmer-Rico E. Mojica*1, Jose Rene L. Micor¹, Custer C. Deocaris² and Jaderick P. Pabico³

 ¹ Institute of Chemistry. University of the Philippines Los Baños. College, Laguna 403 1
² Gene Function Research Center, 1-1-1 Higashi, AIST Central 4 Tsukuba 305-8562, Japan
³ Institute of Computer Science, University of the Philippines Los Baños. College, Laguna 4031

The regulation of transcription and subsequent gene splicing are crucial to correct gene expression. Accurate splicing depends on the canonical consensus sequences that define exon-intron boundaries, as well as on information present in the coding regions. A published dataset of primate exonintron boundaries was used as training set for a "hybrid" learning algorithm (KBANN) to perform two recognition tasks: (a) exon/intron boundaries (EI) and intron/exon boundaries (IE). Our proposed trained artificial neural network (ANN) has been applied to interpolate splice-site junctions of tumor suppressors genes p53 and BRCA1 as well as an artificial mRNA generated by a randomized function.

Keywords: exon, intron, artificial neural network
XRD AND SEM MORPHOLOGY OF CALCINED PURE ALUMINA(ALO,)

Rodrigo V. Dejeto1 and Herman D. Mendoza*

 ¹Department of Ceramic Engineering, College of Engineering, Mariano Marcos State University. 2906 Batac. Ilocos Norte
 *Department of Mining Metallurgy and Materials Engineering, University of the Philippines Diliman. 1101 Quezon City

The aluminum oxide (Al_2O_3) used in this study was Baker Analyzed powder reagent having an actual analysis of assay Al_2O_3 (98.7%), and Loss of Ignition (LOI) (0.31%). The material was subjected to grinding process using mortar and pestle for three hours. The fine homogeneous alumina powder was pelletized into disk with a dimension of 5 mm thick by 10 mm diameter using hydraulic press of 3000kg/cm² applied pressure for 10mins.

The Limberg Blue electric furnace was used to calcine the sample with settings at 3° C/min ramping rate (r₁) until 700°C without dwelling time (d₁). The calcined temperature was 1150°C, with 10°C/min ramping rate (r₂) and dwelling time (d₂) of 7 hrs. The JEOL XRD and EDX-Scanning Electron Microscope (SEM) were employed to characterized the sample with setting at system resolution of 62 eV. quantitative method of ZAF (3 iterations), analyzed all elements and normalized results. 1 peak possibly omitted: 0.00 keV.

The XRD pattern of calcined pure alumina (Al_2O_3) reveals that the áalumina was the predominant nuneral present as detected in all the samples indicated by the relatively stronger reflections at 2.10, 2.58 and 1.61A° spacings. The SEM photomicrograph also reveals large, hexagonal, elongated tabletshaped and tabular form alpha-Al_2O_3 crystals (40 to >200µm median in sized). The tabular form alumina is the product of recrystallization of alpha-Al_2O_3 during calcination.

Keywords: alumina, alpha-Al,O, calcined, recrystallization

DEVELOPMENT OF AN ELECTRICALLY CONDUCTIVE POLYANILINE/ POLYESTER COMPOSITE FABRIC FOR ELECTROMAGNETIC INTERFERENCE (EMI) SHIELDING

Lizah B. Dor ao' and Christina A. Binag^{1,2}*

¹Department of Chemistry. College of Science ²Research Center for the Natural Sciences University of Santo Tomas, España. Manila

Electromagnetic interference (EMI) that arises from electronic equipments has damaging effects on other electrical devices and mutagenic effects on humans: hence the need for EMI shielding. Shielding is enabled by the use of electrically conductive materials. In this study, an electrically conductive textile based on polyaniline/polyester (PAn/Polyester) composite fabric for application in EMI shielding was prepared *in situ* via oxidative chemical polymerization. The effects of various conditions and methods for the preparation of the electrically conductive composite fabric on the conductivity (ó) were investigated.

An optimum set of conditions and methods for the preparation of the PAn/Polyester composite fabric was established in this study that yielded of values up to 2.799 S/cm. an improvement of five orders of magnitude over the previously reported of values for the same PAn/Polyester composite fabric. The optimum conditions and methods were the following: (1) drying (110°C) and heating of polyester fabric at elevated temperature before monomer diffusion; (2) polymerization with constant agitation; (3) use of 0.5 M concentration of animonium persulfate as oxidant; and (4) rinsing of the resulting composite fabric with methanol. Scanning electron micrographs showed uniform coating of PAn on the fibers of the polyester. This composite fabric has the hybrid properties of conducting polymers - the conductivity for EMI shielding, as well as the mechanical stability of the polyester

Keywords: polyaniline, polyester, composite fabric, EMI shield

AN AB INITIO AND DENSITY FUNCTIONAL THEORY STUDIES ON THE STRUCTURES, ENERGETICS, AND MECHANISM OF THE CYCLOADDITION OF 1,1-DICYANOETHYENE WITH CYCLOPROPYLETHYLENE

Armando D. Estillore^a and Edgar W. Ignacio^b

*Department of Chemistry, CSM, MSU-IIT, 9200 Iligan City *NORMISIST, Ampayon, 8600 Butuan City

The thermal [2+2] cycloaddition of 1.1-dicyanoethyene and cyclopropylethylene have been studied using *ab initio* and DFT methods. *Ab initio* geometries and partial charges of the reactants, complex, transition states, and products were obtained with the 3-21G* basis set at the Restricted Hartree-Fock level. Electron correlation effects were included via the Becke3LYP DFT method at 6-31G* basis set.

The reaction is a donor-acceptor type cycloaddition with cyclopropylethylene as the donor and 1.1-dicyanoethyene as the acceptor. Three possible mechanisms were proposed all of which proceeded concertedly (single barrier) with no intermediate. The energy profile shows that the reaction is predicted by the HOMO-LUMO interaction.

The optimized geometries, reaction mechanisms, energetics, and reaction thermochemistry are also presented.

Keywords: ab initio, DFT, cycloaddition, 1.1-dicyanoethylene, HOMO-LUMO

CHEM No. 11

REGIONAL MODEL SIMULATION OF SUMMER RAINFALL OVER THE PHILIPPINES: EFFECT OF CHOICE OF DRIVING FIELDS AND OCEAN FLUX SCHEMES

Raquel V. Francisco, Josefina Argete, Filippo Giorgi, Jcremy Pal³, Xunqiang Bi³ and William J. Gutowski

PAGASA WFFC Building. Agham Road Dilinan. Quezon City The latest version of the Abdus Salam International Centre for Theoretical Physics (ICTP) regional climate model RegCM is used to investigate summer monsoon precipitation over the Philippine archipelago and surrounding ocean waters. The sensitivity to driving lateral boundary conditions (NCEP and ERA40 reanalyses) and ocean surface flux scheme (BATS and Zeng) were assessed for 5 monsoon seasons, namely June. July and August (JJA) of 1992, 1996, 1997, 1998 and 1999. This leads to a total of 20 simulations.

The model-generated rainfall was compared with rainfall observations from three different sources, namely PAGASA, CRU and CMAP. PAGASA data consist of gauge data from 40 synoptic stations. CRU data is derived from global station-based monthly rainfall over land at 0.5° regular latitude-longitude grids. CMAP is an analysis of global monthly precipitation on $2.5^{\circ} \ge 2.5^{\circ}$ grid derived from gauge observations, satellite estimates and numerical model predictions. Although of coarse resolution, this dataset provides observed rainfall over ocean areas, which comprise the largest portion of our domain.

The ability of the RegCM to simulate the spatial patterns and magnitude of monsoon precipitation is demonstrated, both in response to the prominent large scale circulations and to the local forcing by the physiographical features of the Philippine islands. This provides encouraging indications concerning the development of a regional climate modeling system for the Philippine region.

On the other hand, the model shows substantial sensitivity to the forcing analysis fields as well as the ocean surface flux schemes, with different combinations of these factors providing good matches to observations. The effect of forcing analysis fields is of the same order of magnitude as that of surface flux parameterizations in the model. As a result it is difficult to unambiguously establish which of the model configurations is best performing.

Acronyms used:

NCEP - National Center for Environmental Prediction, USA ERA40 - European Centre for Medium-Range Weather Forecasts (ECMWF) 40-year remalysis project BATS - Biosphere-Atmosphere Transfer Scheme PAGASA - Philippine Atmospheric. Geophysical and Astronomical Services Administration CRU - Chimate Research Unit of the University of East Angla, UK CMAP - Climate Prediction Center Merged Analysis of Precipitation

Keywords: Regional climate modeling, summer monsoon rainfall

EMOVING COPPER(II) FROM MINING WASTEWATER USING EPS BIOPOLYMER AND Moringa oleifera (Malunggay) SEED EXTRACT.

Gyro Mitchelle L. Mendoza¹, Estela T. Paner and Fidel Rey P. Nayve Jr.²

¹Department of Physical Sciences and Mathematics University of the Philippines. Padre Faura Street. Ermita. Manila ²National Institute of Molecular Biology and Biotechnology (BIOTECH). University of the Philippines Los Baños. College, Laguna 4031

Marinduque surface waters specifically from Tapian Pit and Bol River still remains laced with high concentrations of toxic heavy metals particularly copper which has the highest concentration among the heavy metals analyzed. This condition was brought about by the mining operations and the mining waste leakage incident in the area during the early 90s.

In this study, the copper removal potential of *Rhizobium sp.* (BJVR-12) exopolysaccharide (EPS) in combination with the flocculating proteins from Moringa oleifera seeds was investigated. Our results showed that EPS coupled with the polycationic proteins of Moringa oleifera seeds is capable of reducing the concentration of copper (11) ions from mining wastewater via flocculation of polyelectrolyte complex. Qualitative evaluation of the process revealed that Moringa seed extract enhanced the flocculation of EPS-Cu complex. Flocculation efficiency is influenced by several factors such as pH. EPS/Moringa flocculant mass ratio and dosage. Optimization of the aforementioned factors was performed on two synthetic wastewaters I and II. simulating the concentrations of the three major cations of Tapian Pit and Bol River water respectively. Flocculation was most efficient at pH's 6 and 5 for wastewaters I and II respectively. Optimum EPS/ Moringa seed extract mass ratios were 0.50 and 0.25 mg EPS/mg Moringa seed extract for wastewaters I and II respectively. At these optimum ratios, copper removal was pronounced and filtrate was clear and there was efficient solid/ liquid separation. At optimum conditions, copper removal was enhanced by increase of flocculant dosage. The maximum adsorption capacity (Langnuir approximation) for EPS on synthetic wastewater was 35.97 mg Cu/g EPS. Upon application of the EPS-Moringa flocculant to actual mining wastewater, there was 61.89% copper reduction for Tapian Pit and 88.83% copper reduction for Bol River. Flocculation conditions using actual wastewater will be optimized to further enhance the efficiency of the flocculant system. Also, multi-stage copper removal process using EPS-*Moringa* flocculant may be tried next to reduce copper concentration to effluent standard.

Keywords: heavy metals: copper: exopolysaccharide (EPS): Malunggay: *Moringa oleifera*. flocculation

CHEM No. 13

DEVELOPMENT & CHARACTERIZATION OF POLYPYRROLE-BASED CHEMIRESISTOR

Milagros A. Perez^{1,2} and Christina A. Binag^{2,3*}

¹Department of Chemistry. College of Arts and Sciences Central Luzon State University. Science City of Munoz. Nueva Ecija ²Graduate School. University of Santo Tomas. España. Manila ³Research Center for the Natural Sciences University of Santo Tomas. España, Manila

The conducting polypyrrole (PPy) has been recognized as an electronic conductor. However, the electrochemical, chemical and structural properties of PPy still need to be further investigated for other potential uses. Thus, the analytical utility of PPy as the active sensing element in a chemiresistor device was studied.

Polypyrrole as a chemiresistor was polymerized at constant current on platinum wires (0.50 mm Ö) for one hour using 0.1 M pyrrole monomer. 3.0 mg bovinc scrum albumin (BSA) as dopant in 0.1 M phosphate buffer (pH 7.0). The fabricated PPy-coated chemiresistor was evaluated in terms of the effect of pH. dopant concentration, polymerization temperature and applied potential. A twoprobe technique was utilized to measure changes in the resistance of PPy films brought by an electrical signal in the direct current (DC) mode.

At low pH solutions, the film resistance decreases (125.0 &! to 142.8 &!), hence conductivity increases. While the reverse is true at high pH, there is higher resistance of 142.8 &! to 166.6 &!. A greater amount of dopant (0.009 g) and lower polymerization temperature (~ 0°C) exhibited also an increase in conductivity. Polypyrrole is insulating at sufficiently negative potentials (-

0.20V to -1.2V), but, becomes conducting at positive potentials (+0.20V to +1.2V). As the applied potential becomes more positive, the relative resistance of the PPy film also increases that resulted to lower relative conductivity values ranging from 4.0 to 1.5. Finally, it was found that PPy film remains conducting at any positive potential. Surface morphologies of PPy films at different parameters by Scanning Electron Microcopy (SEM) exhibited "cauliflower like" in appearance. This developed PPy-based chemiresistor showed that the electrical properties of the conducting polymer are influenced by pH. dopant. polymerization temperature and applied constant potential.

Keywords: chemiresistor, polypyrrole, conductivity, resistance. SEM

CHEM No. 14

PHYSICALAND CHEMICAL CHARACTERIZATION OF STEATTIE DEPOSITS AT BANGUI, ILOCOS NORTE

Dionesio C. Pondoc

Department of Ceramic Engineering, College of Engineering Mariano Marcos State University, Batac. 2906 Ilocos Norte

This study was conducted to evaluate the potential utilization of steatite deposits at Bangui, llocos Norte in the manufacture of commercial ceramic products. The experimental activity includes optical microscopy to determine the major mineral constituent present; conventional chemical analysis and x-ray analysis to examine the mineral purity and quality; scanning electron microscopy analysis to identify the morphology.

Results show that the major mineral constituent present of Bangui steatite deposits was tale mineral, and its main mineral component was based on hydrated magnesium silicate (3MgO-4SiO₂-4H₂O). The shape of internal microstructure was mostly of platy tale particles with microfabric amphibole mineral.

Based on the results of this study, steatite deposits at Bagui, llocos Norte can be utilized in the manufacture of ceramic products particularly ceramic tiles and also as extenders in paints.

Keywords: optical microscopy, x-ray analysis, scanning electron microscopy, mineral constituent. internal microstructure

AN AB INITIO STUDY ON THE STRUCTURE, MECHANISM, AND REACTION THERMOCHEMISTRY OF THE THERMAL INTRAMOLECULAR CYCLIZATION OF N-SUBSTITUTED 2-AMINOBIPHENYLS AND 2 AMINOBENZOPHENONES

Mark Tristan J. Quimque, Marvin Jose F. Fernandez¹, and Evelyn C. Creencia

Department of Chemistry. College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City ¹Department of Chemical Engineering Technology MSU-Iigan Institute of Technology, 9200 Iligan City

Heterocycles dominate in the fields of photographic science, dyestuffs. polymers, adhesives, molecular engineering, and especially in biochemistry and medicinal chemistry. N- and O-containing heterocycles are among the most bioactive natural products. This paper evaluates computationally the structures and mechanisms of the direct conversion of N-substituted 2-aminobiphenyls and 2-aminobenzophenones to yield N- and O- containing heterocycles: carbazole, phenanthridine, 9(10H)-acridone, 11H-dibenzo[b, e]azepin-11-one, and 10-methyl-9(10H)-acridone. Calculations were done at the Restricted Hartree Fock level of theory using 3-21G* as basis set.

The intramolecular cyclization reactions of 2-aminobiphenyl, N-methy-2-aminobiphenyl, N,N-dimethyl-2-aminobiphenyl, 2-aminobenzophenone, Nmethyl-2-aminobenzophenone, and N,N-dimethy-2-aminobenzophenone are all endothermic.

Substantial structural parameters and reaction thermochemical properties are also investigated in this paper.

Keywords: *ab initio*, heterocycles, 2-aminobiphenyl, 2-aminobenzophenone, intramolecular cyclization

OPTIMIZATION AND CHARACTERIZATION OF POLYPYRROLE-COATED POLY (ETHYLENE TEREPHTHALATE) FILMS FOR PACKAGING OF ELECTRIC MATERIALS

Felicidad Christina Ramirez' and Christina A. Binag1.2'

¹Department of Chemistry, University of Santo Tomas ²Research Center for the Natural Sciences. University of Santo Tomas

This research aims to produce and characterize conducting poly(ethylene terephthalate) (PET) films coated with polypyrrole (PPy) for packaging of electric materials. The composite PET was prepared through chemical deposition of pyrrole (Py) at varying conditions. Various concentrations of Py, FeCl₃, and HCl were used to optimize the conductivity of the films. The PET/PPy composite films' conductivity, transmittance and surface morphology were studied by using the four-point conductivity method. Ocean Optics and Scanning Electron Microscope (SEM), respectively.

The PET/PPy composite films polymerized with 0.06 M FeCl₃ and 0.018M Py produced the highest conductivity of 2.92 x 10⁻² Scm⁻. The RSD observed was 34.71%, which was probably caused by the unevenness of the PPy coating on the films. Generally, increasing the Py and FeCl₃ concentration during the chemical polymerization produces films with higher conductivity and lower transmittance. This may be due to the fact that at high monomer concentrations, more PPy is produced and deposited onto the base non-conducting PET film. SEM micrographs showed that PET/PPy films produced in the presence of HCl were unevenly coated with large PPy particles, while PET/PPy films developed without HCl had evenly coated smaller PPy particles on the host polymer. The presence of HCl had little effect on the conductivity and transmittance of the PET/PPy film. The composite PET/PPy film showed good conductivity and high transmittance indicative of promising materials for electronic packaging.

Keywords: polypyrrole, conducting polymer, composite films, SEM, PET

PAN/F POTENTIOMETRRIC MEMBRANE'S ELECTROCHEMICAL AND SURFACE CHARACTERISTICS

Karen S. Santiago12 and Christina A. Binag1.2.3*

¹College of Science. University of Santo Tomas. Manila ²Graduate School, University of Santo Tomas. Manila ³Research Center for the Natural Sciences, University of Santo Tomas. Manila

Iodide monitoring is very important because low levels may lead to several iodine deficiency disorders (IDD) like cretenism, brain damage, goiter and many others. Although there are lots of known detection methods available. most of them include expensive equipment, tedious process of sample preparation and dangerous chemicals. Hence, this research was focused on the development of Polvaniline/Iodide (PAn/I) potentiometric membrane. It was prepared by galvanostatic electrochemical polymerization using the following optimized conditions: 1:1 mole ratio of aniline monomer and potassium iodide, 0.10 M potassium hydrogen phthalate buffer solution at pH 4, 30-minute polymerization time (T_p) without stirring. Pt wire support and 9.34 mA cm⁻² current density. The fabricated sensor's potentiometric performance was assessed and correlated with its surface properties. Its response revealed a hyper-Nernstian response $(m = 87.5 \text{ mV}/-\log a_i)$ and a very good linearity (r=0.9994) at a concentration range of 10^{-4} to 10^{-2} M with an average response time (t_p) of 2.3 minutes. Its membrane prepared at various conditions was likewise investigated via Scanning Electron Microcopy (SEM) with Energy Dispersive X-ray (EDX) and X-ray Photoelectron Spectroscopy (XPS) techniques. SEM micrograph at 1000x and 5000x magnifications depicted its semi-fibrous morphological structure, while EDX results provided the elemental concentrations of the film's components. The XPS data unveiled various chemical species of both the polymeric and mobile core electrons of the membrane.

Keywords: iodide. potentiometric membrane, SEM, EDX, XPS

SUPERCRITICAL (SC) - CARBON DIOXIDE (CO₂) EXTRACTION OF POLAR AND NON-POLAR COMPOUNDS FROM Ganoderma applanatum: MODEL FOR PRE-BIOASSAY PROCESSING OF BIOLOGICAL MATERIALS FOR DRUGDEVELOPMENT

Aldrin Wendell H. Suarez¹, James G. Mercado¹, Roberto M. Malaluan² and Franco G. Teves^{1*}

¹Department of Biological Sciences, College of Science and Mathematics Mindanao State University-Iligan Institute of Technology 9200 Iligan City Philippines ²Department of Chemical Engineering Technology School of Engineering Technology, MSU-Iligan Institute of Technology 9200 Iligan City Philippines

Traditional bioassay-guided isolation of bioactive substances requires the use of a panel of polar and non-polar extraction solvents. most of which are toxic and hazardous. in addition to being costly. The elimination of several preparatory steps for the extraction of bioactive compounds has become one of our goals, without sacrificing the quality and quantity of yield.

Mature fruiting bodies of Ganoderma applanantum, a ubiquitous bracket fungus related to the more popular reishi or Ganoderma lucidum, were collected from a semi-forested area in Tandag, Surigao del Sur, Approximately 500 g of fresh sample was ground using a pre-cleaned Wiley Mill. One hundred gram-aliquot was placed in a 500-ml beaker and loaded to a supercritical fluid extractor (SFE) with compressed high-grade CO., High pressure of approximately 300 atmospheres (atm) was employed to obtain polar extracts whereas a pressure of 120 atm was used to obtain the non-polar fraction. The extracts were stored in dark storage bottles kept at 4°C when not in use. Bioassay for immune response modification was performed using intraperitoneally-injected white mice, indicated by differences in total white blood cell (WBC) counts and differential leukocyte counts compared to controls. Using SC-CO, extraction, we were able to localize the potential immunosuppressant fraction in the polar extract and the immunostimulant fraction in the non-polar extract. Our process can serve as an excellent model for pre-bioassay processing of other types of biological samples with the aim of discovering new pharmaceuticals.

Keywords: supercritical-CO₂. *Ganoderma applanatum*, polar. non-polar. immune response modification, WBC. immunosuppressant. immunostimulant

DETECTION OF INDOORAIR PARTICULATE ELEMENTAL POLLUTION BY IMPACTION-GFAAS AND AIRCON FILTER DUST ICP

Leni L. Quirit¹, Robert Michel², Belen B. Bello³ and Leonard de la Cruz³

¹Institute of Chemistry. College of Science University of the Philippines Diliman. 1101 Quezon City ²Department of Chemistry. University of Connecticut. Storrs ³Natural Sciences Research Institute. College of Science University of the Philippines Diliman. 1101 Quezon City

Two types of sites were studied for elemental indoor air particulate pollution. The first was a very clean laboratory site adjacent to a clean room. Near real time data was collected using a fabricated impaction set-up which samples room air particulates by impaction on to the inner surface of a graphite furnace tube. Thirty minutes sampling time was enough to detect Pb in air particulates in ng/m³ levels, by directly firing the impacted graphite tube using Graphite Furnace Atomic Absorption Spectrometry (GFAAS). Results will be presented showing the near real time sensitivity of the method for Pb, to the extent that even soldering activities in an adjacent room was quickly detected. The method was also compared to the standard but non-real time method of collecting air particulates by a filter.

The second site type was composed of rooms impacted by chemicals at higher levels compared to the first site. Air-con filter dust samples were collected for each room and analyzed by the multi-clemental method of Inductive Coupled Plasma (ICP) Spectrometry. Majority of the room dust samples were found to have Hg and Cd levels considerably higher than average Metro Manila soil levels. Air-con filter dust samples in control sites (which were remotely located from laboratory chemical sources) were also collected and analyzed by ICP. The control sites had non-detectable Hg levels but had Cd levels comparable to the laboratory sites, with the exception of two relatively high Cd level laboratory sites. Soil enrichment factor calculations and sites inspection were done to help analyze and explain apparent room contamination by Hg. Cd and other elements (notably As in some of the samples).

Keywords: Pb, GFAAS, air-con filter. Inductive Coupled Plasma

COMPARATIVE STUDY ON THE HEAVY METAL CONCENTRATION OF THE SEDIMENTS OF PASIG RIVER, NAPINDAN RIVER AND LAGUNA LAKE

Lorna T. Enerva, Ramona Tabang, Edgar Ireneo S. Adelante and Macario R. Caynila Jr.

College of Science, Polytechnic University of the Philippines Sta. Mesa, Manila

This research aimed to determine the status of heavy metals in the sediments of Pasig River. Napindan River and Laguna Lake. Samples were collected by an Eckman Dredge and the metals were determined by atomic absorption spectroscopy. These metals included arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

In the three rivers, the sediments were found to contain accumulation of arsenic in low quantities. The highest concentration recorded was 10 ppm obtained from Laguna Lake but this does not exceed the prescribed concentration of 20 ppm. The concentration of Cd ranged from 0.1 ppm to 0.51 for Pasig River near the Polytechnic University. For chromium the highest value of 213.6 ppm was in Pasig River. The allowed value for chromium is only 90 ppm. The values obtained for the three rivers for copper ranged from 80.0 to 128.78 ppm greater than the allowed 45 ppm. Lead ranged from 21 to 65 ppm in sediments of Pasig River within the Oil Depot. Station 1 of Napindan had a value of 40 which was high since the allowable concentration is only 20 ppm. The values obtained for Laguna Lake ranged from 12 to 17 ppm. The highest value of Hg recorded was 0.16 ppm of station 2 of Pasig River which may be regarded as very low. The deposition of Ni values in sediments of Pasig River. Taguig. Napindan River and Laguna Lake was in small concentrations. The highest concentration was found in Station 2 of Pasig River which was 24 ppm.

Keywords: heavy metals, atomic absorption spectroscopy, sediments

ISOLATION AND PURIFICATION OF THE EXTRACT OF THE ACTIVE COMPONENT FROM THE LEAVES OF Syzyguim cumini (Jambolan) ASAN ANTIMICROBIALAGENT

Lorna T. Enerva, Ramona T. Tabang, Karen Patricia M. Cruz and Christopher Y. Estigoy

College of Science, Polytechnic University of the Philippines Sta. Mesa, Manila

This study was conducted to isolate and purify the active component from the leaves of jambolan by percolation. The leaves steeped in alcohol are prescribed for diabetes. The leaf juice is effective in the treatment of dysentery. Jambolan leaves may be helpful as poutices on skin diseases. About 1.230 grams of dried leaves from Angono, Rizal were placed in a percolator, soaked with 4500 ml of ethyl acetate for three days. The crude extract was concentrated using a rotary evaporator purified by column chromatography with 10% ethyl acetate in petroleum benzene. The eluents obtained were checked by thin layer chromatography.

The pure extract studied was a thin film of oil, with pungent odor, orange to yellow in color and soluble in ethanol, acetone, methanol, ethyl acetate. dichloromethane and insoluble in water. The infrared spectra gave the following peaks at 2946.7, 2926.8, 2852.55 for CHaliphatic, 1668.11 for = CH, 1079.97.1004.08 for a C-O. 3337.20 for OH bending. The lmax at 212 nm further supported the presence of chromophoric and auxochromes. The structure of the compound could be further elucidated by nuclear magnetic resonance and gas chromatography-mass spectra analysis.

The extract had a positive inhibition to *Candida albicans* with an activity index of 0.2 and negative for *Staphylococcus aureus* and *Trichopyton mentagrophytes*. The isolated compound can be used as an antimicrobial ointment or cream. Other bacteria and fungi could be used to test its antimicrobial property.

Keywords: saponin. sapogenin. reflux. column chromatography, thin layer chromatography, chromophoric groups, auxochromes, microbiological assay

EXTRACTION OF RHEIN GLYCOSIDE FROM THE LEAVES OF Cassia alata Linn. (ACAPULCO)

Abigail P. Cid*, Lorna T. Enerva, Joy G. Hofilena, Ramona T. Tabang Chevalier Paul T. Rayo and Toni Mai L. De Lim

Department of Natural Sciences College of Science Polytechnic University of the Philippines Sta. Mesa, Manila

A simple method to extract an anthraquinone, rhein glycoside, from the leaves of Acapulco was carried out. The leaves were air-dried for two days and the ground dried leaves were percolated in ethyl acetate for four days. The crude extract was fractionated using silica gel column chromatography and the fractions obtained were monitored by silica gel thin layer chromatography. The rhein glycoside was separated using acetone-dichloromethane system. The physical properties of the pure extract were determined by solubility test and melting point determination. Results showed that the pure extract is slightly polar and has a melting point of 263.19°C. The chemical tests such as authraquinone test. Fehling's test and Barfoed's test of the sample indicate the presence of anthraquinone and glycoside. UV-Vis spectrum showed that the extract possessed absorption bands at 267 nm and 324 nm, as also observed on most anthraquinones. IR spectrum showed that the pure extract contains aromatics, carbonyl, acidic and phenolic groups, as well as meta-substituted aromatics. All of these evidences supported the physical and chemical nature of rhein glycoside.

The toxicity test of the rhein glycoside was conducted on albino mice. There were no changes on their behavioral and autonomic activities. No mortality was observed up to a dose of 2.5g l°. Laxative property of the rhein extract was compared to standard laxative drug (senna). The results showed that the rhein glycoside from Acapulco leaves has comparative laxative property as senna.

Keywords: Acapulco, rhein glycosides, leaves, laxative

BENCH SCALE PRODUCTION OF BIOSURFACTANT FROMA LOCAL YEAST ISOLATE, CANDIDA TROPICALIS

Virgie A. Alcantara, Michelle P. Yabes, Victoria P. Migo, and Fidel Rey P. Nayve

National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Baños, College, Laguna 4031

Microorganisms capable of emulsifying and utilizing wastes containing plant oils and animal fats have a significant impact on disposal. This type of waste although not toxic poses a significant disposal problem due to the large amount of waste generated and slow rate of decay. Fats and oils are among the more stable organic compounds and are not easily degraded. This study aims to isolate indigenous microorganisms which can degrade and/or emulsify plant oils and animal fats and to formulate a cocktail of microorganisms and/or biosurfactants that can be used for treatment of lipid-containing wastes. A yeast isolate designated Y42 isolated from an oil processing plant in Lucena. Quezon was found to produce high lipase and emulsifying activities. Optimization of media composition for high biosurfactant vield and emulsification activity was done. Y42 exhibited high emulsifying activity when grown with 5% waste cooking oil and an additional carbon source such as coconut water, glucose, and table sugar. Emulsification activity of the biosurfactant was highest using coconut water (61.25%) and glucose (58.33%). The biosurfactant was intracellular in location and heat stable. Emulsification activity was absent in the culture supernatant. Disruption of whole yeast cells by heat treatment (121°C. 15 min) resulted to high emulsification activity. The biosurfactant was effective in stabilizing oil-in-water emulsion rather than in reducing surface tension. It is capable of producing stable emulsions with water immiscible compounds. The identity of Y42 strain was established as Candica tropicalis by 18S rDNA analysis.

Keywords: Candida tropicalis; biosurfactant

ELECTROLYTIC REMOVAL OF SUSPENDED SOLIDS FROM WHITE WATER

Jeffren Argame¹, Catalino Alfafara^{1*}, Veronica Migo² Jovita Movillon¹, Ronald Navarro¹, and Masatoshi Matsumura³

 ¹Department of Chemical Engineering. University of the Philippines Los Banos, College, Laguna 4031
 ²National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Banos. College, Laguna 4031
 ³ Institute of Applied Biochemistry. University of Tsukuba Tennodai 1-1-1, Tsukuba City 305-0006, Japan

The electrolytic removal of suspended solids in whitewater was evaluated as an alternative process towards the reuse of the effluent in the paper recycling industry. The mechanism involved the utilization of electrodes that allow the electrochemical generation of flocculation and flotation agents in the wastewater. The suspended solids removal efficiencies at different operating currents were evaluated in a batch system and the charge dose was determined as a factor which may be useful for operation and scale-up.

Complete removal of suspended solids could be achieved by electroflocculation/electroflotation (through the use of an aluminum alloy electrode): a clear effluent was obtained. The removal of suspended solids was accompanied by a decrease in BOD and COD (by 70% to 90%), indicating the dominant contribution of suspended solids on the organic content of the wastewater. The use of flotation mechanisms alone without flocculation (through the use of a carbon electrode) could not completely remove the suspended solids in whitewater.

The charge dose of the process was determined to be 2.23 coulombs per mg suspended solids removed. The energy cost was estimated to be 2 centavos to 4 centavos per cubic meter of whitewater.

Keywords: electroflocculation. electroflotation. whitewater. charge dose

CLIQUE PARTITION NUMBER OF GRAPHS

Esperanza B. Arugay and Sushela C. Undang

Department of Mathematics, MSU-Iligan Institute of Technology Tibanga, Iligan City 9200 Department of Mathematics Northern Mindanao State College of Science & Technology

Let G be a graph. A subset S of the vertex-set in G is a clique of G if S induces a complete graph. The product of two graphs G and H. GXH, is the graph with V(G)XV(H) as vertex set. and (a,b) is adjacent with (c,d) if and only if either a=c and [b,d] ^a E(H) or b=d and [a,c] ^a E(G). The graph $P_m X P_n$ is a planar grid. A collection &! of cliques of G is a clique partition if every edge of G is contained in exactly one member of &!. The clique partition number of G cp(G). is the cardinality of a minimum clique partition. This paper aims to find the clique partition number of the product of two graphs. The following results are obtained:

- Let G and H be any two graphs such that |V(G)| = n and |V(H)|=m. Then GXH contains exactly n edge-disjoint subgraphs isomorphic to H and m edge-disjoint subgraphs isomorphic to G.
- 2. $cp(P_r X P_s) = |V(P_r)| cp(P_s) + |V(P_s)| cp(P_r)$. for r, s e^{**} 2, where P_r and P_s are both paths of order r and s respectively.
- 3. $cp(P_r X C_s) = |V(P_r)| cp(C_s) + |V(C_s)| cp(P_r)$, for r e 2 and s e 4, where P_r is a path of order r and C_s is a cycle of order s.
- 4. $cp(C_r X C_s) = |V(C_r)| cp(C_s) + |V(C_s)| cp(C_r)$, for r. s e 4. where C_r and C_s are both cycles of order r and s respectively.
- 5. $cp(K_r X K_s) = |V(K_r)| + |V(K_s)|$ for r . s e" 2, where K_r and K_s are both complete graphs of order r and s, respectively
- 6. $cp(P_r X K_s) = |V(P_r)| cp(K_s) + |V(K_s)| cp(P_r)$. where P_r is a path of order r and K_s is a complete graph of order s.

Keywords: product, clique, partition, cycle, path, complete graph

BOUNDS FOR THE GEODETIC NUMBER OF THE CARTESIAN PRODUCT OF GRAPHS

Gilbert B. Cagaanan** and Sergio R. Canoy Jr.

Related Subjects Department. School of Engineering Technology and Department of Mathematics. College of Science and Mathematics MSU-Iligan Institute of Technology. 9200 Iligan City

Let G be a connected graph and u and v be two vertices in G. $I_G[u, v]$ denotes the closed interval consisting of u, v and all vertices lying on some u-v geodesic of G. A subset S of U(G) is called a geodetic cover of G if $I_G[S] = U(G)$, where $I_G[S] = \tilde{E}_{uvis}I_G[u, v]$. A geodetic cover of minimum cardinality is called a geodetic basis. A geodetic number g(G) of G is the minimum order of its geodetic covers. In this paper, we give the bounds for the geodetic number of the Cartesian product any two connected graphs.

If $C \hat{I} U(G \times H)$, then we denote $C_G = \{x \hat{I} V(G) : (x, v) \hat{I} C$ for some $v \hat{I} U(H)\}$ and $C_H = \{v \hat{I} U(H) : (u, v) \hat{I} C$ for some $u \hat{I} U(G)\}$. The major results obtained in this study are the following:

- (1) Let G and H be connected graphs and $C \downarrow V(G \times H)$ a geodetic basis of $G \times H$. Then C_G and C_H are geodetic covers of G and H, respectively.
- (2) If G and H are connected graphs, then max $\{g(G), g(H)\} \pounds g(G \times H)$.
- (3) Let G be a connected graph of order at least 3 and A a geodetic basis of G with a vertex v₀ Î.A such that for every u Î V(G), u Î I_G [v₀w] for some w Î.A \ {v₀}. Then g(G × P_m) = g(G).
- (4) Let *n* and *m* be positive integers. Then $g(C_n \times P_m) = n$ for $n^3 4$.
- (5) Let G and H be connected graphs. If S_1 and S_2 are geodetic bases of G and H. respectively, then $S_1 \times S_2$ is a geodetic cover of $G \times H$.
- (6) If G and H are connected graphs, then $g(G \times H) \pounds g(G) \cdot g(H)$.

Keywords: cartesian product, geodetic basis, geodetic cover, geodetic number

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EXISTENCE AND STABILITY OF FIXED POINTS AND LIMIT CYCLES FOR A PREDATOR-PREY SYSTEM

Gloria L. Calio*, Zing Zhu-Jun and Polly W. Sy

Department of Mathematics. MSU-Iligan Institute of Technology, Iligan City Institute of Mathematics, Academia Sinica, Beijing 100080, PROC Department of Mathematics. University of the Philippines Diliman 1101 Quezon City. Philippines

A predator-prey system that can be modelled by the equations

(1)
$$\begin{cases} \frac{dx}{dt} = x(1-k_1x-k_2x^2) - \frac{xy}{1+ax} \\ \frac{dy}{dt} = y(-\delta_0 - \delta_1y) + \frac{yxy}{1+ax} \end{cases}$$

where x and v represent respectively, the prey and predator population, and parameters $k_1, k_2, a, \delta_0, \delta_1, \gamma$ are positive constants with $k_2 \neq 0$ and is considered. Biologically, the authors consider the dynamics of system (1) in region D = and call the fixed point of (1) a positive fixed point if it is in region D₀ =. In this study the authors determine conditions for the existence and stability of fixed points of (1) and show that there is at least one limit cycle in D₀.

The study has generated the following results: 1. The solutions of system (1) are bounded eventually.

2. If $0 < \frac{\delta_0}{\gamma - \alpha \delta_0} < k$ then system (1) has two trivial fixed points (0,0) and

(k,0), and one positive fixed point (x_0, y_0) satisfying the equations

(2)
$$\begin{cases} 1 - k_1 x_0 - k_2 x_0^2 - \frac{y_0}{1 + a x_0} = 0 \\ -\delta_0 - \delta_1 y_0 + \frac{\gamma x_0}{1 + a x_0} = 0 \end{cases}$$

108 Trans. Nat. Acad. Sci. & Tech. (Philippines) Vol. 27 (No.1)

where
$$\frac{\delta_0}{\gamma - a\delta_0} < x_0 < k_{\text{and}} \quad 0 < y_0 < \frac{\gamma - a\delta_0}{a\delta_1}$$

3. If $0 < \frac{\delta_0}{\gamma - a\delta_0} < k$ then the fixed points (0,0) and (k,0) are saddle.

4. Let (x_0, y_0) be a positive fixed point of (1). Put $r(x_0) = \frac{\gamma}{\delta_1 (1 + ax_0)^2}$

and
$$g(x_0, y_0) = \frac{x_0 q(x_0, y_0)}{y_0 (1 + a x_0)}$$
,

where
$$q(x_0, y_0) = \frac{ay_0}{1 + ax_0} - (1 + ax_0)(k_1 + 2k_2x_0)$$
.

(i) If $\delta_1 > g(x_0, y_0)$ and $r(x_0) - q(x_0, y_0) > 0$ then (x_0, y_0) is locally asymptotically stable.

(ii) If $\delta_1 < g(x_0, y_0)$ and $r(x_0) - q(x_0, y_0) > 0$ then (x_0, y_0) is unstable (unstable node or focus).

(iii) If $q(x_0, y_0) > r(x_0) > 0$ then (x_0, y_0) is unstable (saddle).

(iv) If $\delta_1 \equiv g(x_0, y_0)$ and $r(x_0) - q(x_0, y_0) > 0$ then (x_0, y_0) is a (Hopf) bifurcation point.

(v) If $r(x_0) = q(x_0, y_0)$ then there is a degenerate fixed point with one zero eigenvalue root.

5. If the positive fixed point (x_0, y_0) is an unstable focus then there is at least one limit cycle in the region $D_1 = \{(x, y) \mid 0 \le x \le n, 0 \le y \le m\}$, where

$$m = \frac{-\delta_0}{\delta_1} + \frac{\gamma}{a\delta_1} \quad n > k \text{ and } k \text{ is the positive root of the equation}$$
$$1 - k_1 x - k_2 x^2 = 0.$$

Keywords: fixed point, stability, limit cycle

CHARACTERIZATION OF MONOPHONIC HULLSETS IN THE JOIN AND COMPOSITION OF GRAPHS

Esamel M. Paluga * and Sergio R. Canoy, Jr.

Department of Mathematics. NORMISIST. Butuan City Department of Mathematics. College of Science and Mathematics Mindanao State University - Iligan Institute of Technology, Iligan City

The m-convex hull $[S]_m$ of a subset S of V(G) is the smallest m-convex set in G containing S. If $[S]_m = V(G)$, then we call S an m-hull set (monophonic hull set). The m-hull number of G denoted by mh(G) is the minimum cardinality of an m-hull set in G

In this paper, the authors characterize m-hull sets in the join and composition of two connected graphs and give their respective m-hull numbers. The following are the main results generated in this study.

1) Let G be a connected non-complete graph. A subset S I $V(G+K_n)$ is an in-hull set in G+K_n if and only if S V(G) is an m-hull set in G

2) Let G be a connected graph of order p and K_n the complete graph of order n. Then $mh(G+K_n) = p + n$ if $G = K_n$ and $mh(G+K_n) = m(G)$ if otherwise.

3) Let G and H be non-complete graphs. A subset S of V(G+H) is an m-hull set in G+H if and only if there exist a, b î S with $d_{H+G}(a,b) = 2$. In this case, either a, b î V(G) or a, b î V(H).

4) Let G and H be non-complete graphs. Then mh(G + H) = 2.

5) Let G be a connected graph, K_p the complete graph of order n and C I V(G[K_n]). Further, let (V(G))° be the set of all monophonic interior points of V(G). Then C is an m-hull set in G[K_n] if and only if C_G is an m-hull set in G and T_a = V(K_n) whenever a I C_G \(V(G))°.

6) Let G be a connected graph, K_n the complete graph of order n. and $(V(G))^\circ$ be the set of all monophonic interior points of V(G). Then

 $mh(G[K_n]) = min\{n|S\setminus (V(G))^{\circ}| + |S C (V(G))^{\circ}| : S \text{ is an } m \text{-hull set in } G\}.$

* Research supported in part by the Department of Science and Technology-Philippine Council for Advanced Science and Technology Research and Development

Keywords: join, composition, monophonic, m-convex, m-hull set, m-hull number

CONVEX HULLS OF SUBSETS IN GRAPHS UNDER SOME BINARY OPERATIONS*

Sergio R. Canoy, Jr¹ and Rolito G. Eballe²

¹Mindanao State University - Iligan Institute of Technology 9200 Iligan City, Philippines ²Department of Mathematics. Central Mindanao University Musuan. Bukidnon

Given a connected graph G and two vertices u and v in V(G), $I_0[u,v]$ denotes the closed interval consisting of u. v and all vertices lying on some u-v geodesic in G. A subset C of V(G) is convex if $I_G[u,v]$ i C for every pair of vertices u.v î C. The convex hull of a subset S of V(G), denoted by $[S]_G$, is the smallest convex set in G containing S. In this paper, we give the convex hulls of subsets in the join, composition and cartesian product of two graphs.

The study has generated the following main results:

1. Let G be a connected graph, K_n the complete graph of order n, and S $I V(G+K_n)$. Then $[S]_{G-K_n} = S$ if $\langle S \rangle$ is complete and $[S]_{G+K_n} = g_2[S \setminus V(K_n)]_G \dot{E} V(K_n)$, if otherwise.

2. Let G and H be non-complete graphs and S I V(G+H). Then $\{S\}_{G+H} = S \text{ if } < S$. > is complete and $[S]_{G+H} = V(G+H)$ if otherwise.

3. Let G be a connected graph. A subset C of $V(G[K_n])$ is convex in $G[K_n]$ if and only if the G-projection C_g of C is convex in G where $\{u\} \ge V(K_n)$ i C whenever u $\hat{I} C_g$ and $< N_g(u) \subseteq C_g >$ is not a complete subgraph of G

4. Let G be a connected graph. K_n the complete graph of order n, S I V(G[K_n]), and E = Ext(<[S_g]_G>). Then S_{G[Kn]} = S if S is convex and S_{G[Kn]} = S È [([S_g]_G \ (E ζ S_G)) x V(K_n)]. if otherwise.

5. Let G and H be connected non-complete graphs, and S I V(G[H]). Then $S_{G[H]} = S$ if $\langle S \rangle$ is complete and $S_{G[H]} = V(G[H])$ if otherwise.

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Keywords: convex. convex hull, join. composition, Cartesian product. graph

m-CONVEX SIMPLE GRAPHS*

Sergio R. Canoy, Jr.¹ and Elmer Castillano²

¹Department of Mathematics. MSU-Iligan Institute of Technology 9200 Iligan City, The Philippines ²Department of Mathematical Sciences. Mindanao Polytechnic State College

A graph G is m-convex simple if the m-convex subsets of the vertex set V(G) of G are all trivial. In this study the authors give some characterizations of m-convex simple graphs. Specifically, m-convex simple graphs are investigated with respect to the concepts such as m-hull set and m-convexity number of a graph. As one of the main results, it is given that for any positive integer p the set of all connected graphs with independence number p contains only a finite number of m-convex simple graphs.

The study has generated the following results:

1. There exists an m-convex simple graph that is not convex simple.

2. Let G be a connected graph of order $n \in U$. Then G is m-convex simple if and only if every set S $\int P(V(G)) \setminus TC_{n}(G)$ is an m-hull set in G

3. Let G be a connected graph of order n e" 3. If G is m-convex simple, then mh(G) = 2 if G = P, or n > 3 and mh(G) = 3 if $G = K_{2}$.

4. Let G be a connected graph of order n e 3. Then G is m-convex simple if and only if $con_mG = 2$.

5. Let p and q be positive integers such that $4 \text{ d}^{\circ} q = p \text{ or } 3 \text{ d}^{\circ} q - 1 \text{ d}^{\circ} \text{ e}(p-1)/2 \hat{u}$. Then there exists a connected m-convex simple graph G with cV(G)c = p and g(G) = q.

6. Let G be an m-convex simple graph of order n e" 4. If vertices u.v, and w of G form a path of order 3, then there exist vertices a cycle Cr, where r e" 4, such that u,v, and w are vertices of this cycle.

7. For each integer p e^{**} 1. Ind(p) contains only a finite number of m-convex simple graphs and an infinite number of graphs that are not m-convex simple.

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Keywords: m-convex. m-convexity number, m-hull set. independence number

ON THE CONVEXITY, GEODETIC AND HULL NUMBERS OF THE COMPOSITION $K_{\rm \scriptscriptstyle N}[G]^{\star}$

Sergio R. Canoy, Jr., Alice Comahig, and Dennis Tarepe

Department of Mathematics Mindanao State University - Iligan Institute of Technology 9200 Iligan City. Philippines Department of Mathematical Sciences. Mindanao Polytechnic State College Cagayan de Oro City

Given a connected graph G and two vertices u and v in G $I_G[u,v]$ is the set consisting of u, v and all vertices lying on some u-v geodesic of G A subset S of V(G) is called a geodetic set of G if $I_G[S] = V(G)$, where $I_G[S]$ is the union of the intervals $I_G[u,v]$, where u,v i S. The geodetic number of G denoted by g(G) is the smallest cardinality of a geodetic set of G In this paper, the geodetic number of the composition of a complete graph K_n and a connected graph G is determined. More precisely, the following results have been obtained:

1. Let H be a connected nontrivial graph and G a non-complete graph. A proper subset C of V(H[G]) is convex in H[G] if and only if C induces a complete subgraph of H[G].

2. Let H be a connected nontrivial graph and G a non-complete graph. Then con(H[G]) = w(H[G]), where w(H[G]) is the clique number of H[G].

3. Let G be a non-complete graph and K_n the complete graph of order n cⁿ 2. Then $g(K_n[G]) = 2$ if and only if G is the complement of K-2 or G is connected with g(G) = diam(G) = 2.

4. Let G be a non-complete graph and K_n the complete graph of order n e^{*} 2 such that $g(K_n[G]) = 3$ if and only if one of the following holds:

(a) G is the complement of K_3 : (b) $G = K_1 \stackrel{.}{E} H$, where H is connected and g(H) = diam(H) = 2; and (c) G is connected and there exists a subset T of V(G) such that |T| = 3 and T is 2-path closure absorbing in G

5. Let G be a connected nontrivial graph and H a non-complete graph. Then h(G[H]) = 2.

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Keywords: convexity, geodetic, hull, complete, connected graph, composition

ON THE TREE CHROMATIC NUMBER OF SOME GRAPHS

Sergio R. Canoy, Jr. and Esamel M. Paluga

Department of Mathematics. College of Science and Mathematics Mindanao State University - Iligan Institute of Technology. Iligan City Department of Mathematics. NORMISIST. Butuan City. Philippines

The tree chromatic number of a graph. denoted by t(G). is the minimum number of subsets the vertex set of a graph can be partitioned so that each subset induces a tree. This paper seeks to determine the tree chromatic number of some simple graphs. It shows that the tree chromatic number of the sum of graphs does not exceed the sum of the respective tree chromatic numbers. For two graphs of orders at least three, it is shown that tree chromatic number of their sum is two if and only if the graphs are trees.

The major results generated in this study are the following:

1) If K_n is the complete graph of order n. then $t(K_n) = n/2$ if n is even and $t(K_n) = (n+1)/2$ if n is odd.

2) Let n be a positive integer. Then $t(P_n) = t(K_{1:n}) = 1$, and $t(C_n) = t(W_n) = 2$ for n ³ 3.

3) Let G and H be connected graphs. Then $t(G + H) \pounds t(G) + t(H)$.

4) Let G and H be connected graphs of orders at least 3. Then t(G+H) = 2 if and only if G and H are trees.

5) If G and H are nontrivial trees, then t(G + H) = t(G) + t(H). Let m and n be positive integers with m³ 3 and n³ 3. Then $t(C_n + W_m) = 4$ if n and m is odd. Otherwise, $t(C_n + W_m) = 3$.

6) Let G be a nontrivial tree and n be a positive integer. Then

- (a) $t(G+K_n) = 1 + t(K_n)$:
- (b) $t(G + C_n) = 3 (n^3 3)$; and
- (c) $t(G + W_{0}) = 3 (n^{3} 3)$.

Keywords: tree, chromatic number, minimum, partition, connected graph

STEINER SETS IN THE JOIN AND COMPOSITION OF GRAPHS*

Rolito G. Eballe¹ and Sergio R. Canoy Jr.²

¹Department of Mathematics Central Mindanao University. Musuan. Bukidnon ²Department of Mathematics Mindanao State University-Iligan Institute of Technology. 9200 Iligan City

Given a connected graph G and a nonempty subset W of V(G), a Steiner W-tree is a tree of minimum order that contains all of W. Let S(W) denote the set of all vertices of G that lie on any Steiner W-tree. If S(W) = V(G), then W is said to be a Steiner set of G. The Steiner number st(G) of G is defined as the minimum cardinality of a Steiner set of G. This paper gives necessary and sufficient conditions for subsets to be Steiner sets in the join G+H and composition G[H] of two connected graphs G and H.

Among other, this study has come up with the following results: 1. Let W be a nonempty subset of V(G+H), where G and H are connected graphs. Then W is a Steiner set of G+H if and only if (a) W = V(G+H), or (b) W is a proper subset of V(G), where V(G) W is an essential cutset of G or (c) W is a proper subset of V(H), where V(H) W is an essential cutset of H.

2. Let G and H be connected graphs. If G and H are both complete, then st(G+H) = |V(G)| + |V(H)|. If G is non-complete and H is the complete graph K_n , then $st(G+K_n) = \min\{|V(G) \setminus S^*|: S^* \text{ is an essential cutset of } G\}$. If G and H are both non-complete, then

st(G+H) = min{ $|V(G) \setminus S_1|$, $|V(H) \setminus S_2|$: S_1 and S_2 are essential cutsets of maximum cardinalities of G and H, respectively}.

3. Let G and H be nontrivial connected graphs. Let W IV(G[H]) such that $|W_G| = 1$. Then W is a Steiner set of G[H] if and only if the following conditions hold: (a) $W_G = \{u\}$ for some u IV(G) with $\deg_G(u) = |V(G)| - 1$ and (b) $V(H) \setminus W_H$ is an essential cutset of H.

**Research supported in part by the Commission on Higher Education (CHED) of the Philippines.*

Keywords: Steiner. W-tree. Steiner set. Steiner number. cutset

COMPARATIVE STUDY OF THE OCTONION AND QUASI-OCTONION LOOPS

Raoul E. Cawagas¹, Sheree Ann Gutierrez² and Maridel Gob²

¹SciTecli R&D Center and ²College of Science Polytechnic University of the Philippines. Sta. Mesa, Manila

The sedenions **S** is an algebra of dimension $n = 2^3 = 16$ obtained from the octonions **O** by the Cayley-Dickson process. This algebra **S** contains an embedded loop S_L of order 2n = 32. called the sedenion loop, generated by its 16 basal elements. Analysis of the sedenion loop has shown that it contains 15 maximal subloops of order 16 of which 8 are isomorphic to the octonion loop **O** while 7 are isomorphic to a newly identified loop which we have called the quasioctonion loop $\tilde{\mathbf{O}}_L$. These loops therefore form two distinct isomorphism classes: the class {**O**} of octonion loops and the class { $\tilde{\mathbf{O}}_L$ } of quasi-octonion loops. This paper deals with a comparative study of the loops **O** and $\tilde{\mathbf{O}}_L$ and shows, among other things, that both loops are C-loops but differ in one important aspect: **O** satisfies the Moufang identity while $\tilde{\mathbf{O}}_L$ does not.

Keywords: Octonion loops. quasi-octonion loops

MPS No. 11

MULTIVARIATE ANALYSIS OF BODY SHAPES OF FOUR SPECIES OF CRAB SPIDERS USING PARTIAL WARP SCORES

Sother C. Jala, Mark Anthony J. Torres and Cesar G. Demayo

Department of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City

Multivariate statistical methods can be combined with the graphically oriented methods in geometric morphometrics to test for statistical differences in shape and to visualize the differences as deformations. This study made use of relative warp analysis to investigate variations in body shapes of four species of crab spiders. *Gasterachantha spp.* Two-dimensional landmark coordinates were collected using image analysis software. Raw x/y coordinates were then transformed into Procrustes coordinates to remove the effects of position, size and rotation. A further transformation to Procrustes residuals (approximate tangent space coordinates) was achieved by subtracting the mean from the Procrustes coordinates. The Procrustes residuals were then subjected to thinplate spline analysis (TPS) generating partial warp scores, which were used as variables in multivariate statistical analysis such as principal component analysis. One of the important advantages of using partial warp scores as variables to capture shape variation rather than conventional linear measurement is that they allow one to visualize trends in shape variation as a continuous linear deformation. Principal component analysis of partial warp scores showed significant shape differences among the four species of *Gasterachantha*.

Keywords: multivariate analysis. image analysis. crab spiders. warp scores. *Gasterachantha*

MPS No. 12

ON GV-GROUPS

Veronica B. Florida, Gaudencio C. Petalcorin, Jr., and Helen M. Rara*

Department of Mathematics, MSU-Iligan Institute of Technology 9200 Iligan City, Philippines

A group G is a GV-group if there exists a proper normal subgroup N such that the quotient group G/N is cyclic. This study deals on non-simple groups in which some of the characterizations of a GV-group are presented. Moreover, properties for a non-simple group to become a GV-group are also given.

The following results on *GU*-groups hold:

1. Let G be a group and N a proper normal subgroup of G. Then G is a GI-group if and only if G/N is a GI-group.

2. Let G and H be finite GV-groups. If the orders of its existing cyclic quotient groups are relatively prime, then $G \times H$ is also a GV-group.

3. Let K and N be subgroups of G with N a proper normal subgroup of G. If K is a GV-group, then KN is also a GV-group.

4. Let G be a GV-group and N a proper normal subgroup of G such that is cyclic. If H is a subgroup of G with, then H is a GV-group.

5. Let G be a GV-group. If N and M are proper normal subgroups of G such that and are cyclic, then G is closed under the formation of subgroups.

Keywords: GU-group, normal subgroup, cyclic group, quotient group

MPS No. 13

FOLDING WHEELS AND FANS

Severino V. Gervacio¹, Romulo C. Guerrero² and Helen M. Rara²

¹Department of Mathematics. De La Salle University 2401 Taft Avenue. 1004 Manila ²Department of Mathematics. MSU-Iligan Institute of Technology Tibanga. 9200 Iligan City

If two non-adjacent vertices of a connected graph that have a common neighbor are identified and the resulting multiple edges are reduced to simple edges, then we obtain another graph of order one less than that of the original graph. This process can be repeated until the resulting graph is complete. We say that we have folded the graph onto a complete graph. This process of folding a connected graph G onto a complete graph induces in a very natural way a partition of the vertex-set of G. We denote by F(G) the set of all complete graphs onto which G can be folded. Here, we give results involving foldings of the wheel W and the fan F.

Among the main results generated are the following:

1. If p denotes the order of the smallest complete graph in F(W), then

$$P = \begin{cases} 3 & if n is even \\ 4 & if n is odd. \end{cases}$$

- 118 Trans. Nat. Acad. Sci. & Tech. (Philippines) Vol. 27 (No.1)
 - 2. Every complete graph between any two foldings of W_n is also in the fold of W_n ; similarly, every complete graph between any two foldings of F_n is also in the fold of F_n .
 - 3. If p be the order of the smallest complete graph in $F(F_{n})$, then

$$p = \begin{cases} 2 & if \ n = 1 \\ 3 & if \ n > 1 \end{cases}$$

4. Let $q = q(C_n)$ denotes the maximum number of sets into which $\Gamma(C_n)$ can be partitioned into independent and pairwise linked sets. Let $s \ge 1$ and $s(2s+1) \le n < (s+1)(2s+3)$. Then

$$q(C_n) = \begin{cases} 2s+1 & \text{if } n = s(s+1) \\ 2s & \text{if } n = s(2s+1)+1 \\ 2s+1 & \text{if } s(2s+1)+1 < n < 2(s+1)^2 \\ 2s+2 & \text{if } n = 2(s+1)^2 \\ 2s+1 & \text{if } n = 2(s+1)^2 + 1 \\ 2s+2 & \text{if } 2(s+1)^2 + 1 < n < (s+1)(2s+3) \end{cases}$$

5. If K_a is the largest complete graph in $F(W_a)$, then

$$q = q(\boldsymbol{W}_n) = 1 + q(\boldsymbol{C}_n).$$

6.
$$q(P_n) = \begin{cases} 2s & \text{if } 2s^2 \le n \le 2s^2 + s \\ 2s+1 & 2s^2 + s + 1 \le n < 2(s+1)^2 \end{cases}$$

7. If Kq is the largest complete graph in $F(F_{q})$, then

$$q = q(Fn) = 1 + q(Pn).$$

Keywords: fold of a graph, independent set, pairwise linked, complete graph, wheel W_{a} , fan F_{a} , order

SINGULARITY OF UNICYCLIC, BICYCLIC AND STC-GRAPHS

Helen M. Rara

Department of Mathematics. College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Andres Bonifacio, Iligan City

A graph G is singular if its adjacency matrix is singular. This study characterizes all singular unicyclic, bicyclic, and a special class of tricyclic graphs called an STC-graphs. The singularity of these graphs depends on the singularity of the cycles, paths and pendant trees, the order of the pendant trees, and the concept of the root of pendant trees that these graphs contained.

Specifically, this paper presents the following results:

- Let G be a unicyclic (bicyclic / STC)-graph and let T be any pendant tree of G with root a_i. Then G is singular if and only if one of the following is satisfied:

 T_i-a_i is nonsingular of even order for every i, and the unique cycle (subgraph (C_{in}, P_i, C_{in}) / [P_i, P_i, P_i]) of G is singular.
 There exists a nonsingular T of even order and G-U(T) is singular.
- 2. Let G be a unicyclic (bicyclic) graph and let T be any pendant tree of G with root a_i . Then each of the following is a sufficient condition for G to be singular.
 - (i) There exists a singular T_i - a_i of even order.
 - (ii) There exists a singular T_{i} of even order.
- 3. The bicyclic graph (C_m, P_q, C_n) is singular if and only if one of the following is satisfied:

(i) m or $n \equiv 0 \pmod{4}$:

(ii) m and n0(mod 2) and q is odd:

(iii) m and $n1 \pmod{2}$. (m-1)/2. (n-1)/2 have opposite parity and q is odd.

4. The graph $[P_r, P_s, P_t]$ is singular if and only if one of the following is satisfied:

(i) r. t. and s are all odd:

(ii) Exactly one of r, t, s is odd say s is odd and r/2, t/2 have opposite parity;

120 Trans. Nat. Acad. Sci. & Tech. (Philippines) Vol. 27 (No.1)

(iii) Exactly one of r, t, s is even say r is even, and r/2 and (s-1)/2, (t-1)/2 have opposite parity.

Key words: singular graphs, unicyclic, bicyclic, and STC-graphs, cycle, pendant trees, roots of pendant trees,

MPS No. 15

BOUNDS FOR THE SUBDIVISION NUMBERS OF GENERALIZED WHEELS AND FANS

Alben P. Sagpang and Rowena T. Isla

Math-Science Discipline, College of Arts and Sciences University of Mindanao, Matina. Davao City Department of Mathematics. College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City

A unit graph in the Euclidean *n*-space \mathbb{R}^n is a graph whose vertices are points in \mathbb{R}^n whose every pair of adjacent vertices x, y satisfy |x - y| = 1. where |x - y| denotes the Euclidean distance between x and y. The subdivision number of a graph G, denoted by sd(G), is the minimum number of vertices to be inserted into the edges of G to make it isomorphic to a unit graph in \mathbb{R}^n .

Gervacio and Maehara determined the subdivision numbers of complete graphs and complete bipartite graphs in 1998. In 2000. Gervacio and Isla found the subdivision numbers of wheels and fans. Bounds for the subdivision numbers of generalized wheels and fans are determined in this study.

The following upper bounds are obtained for the subdivision numbers of the generalized wheel $W_{m,n}$ and the generalized fan $F_{m,n}$, where $W_{m,n} = \overline{K_m} + C_n$ and $F_{m,n} = \overline{K_m} + P_n$:

$$scl(W_{m,n}) \leq \begin{cases} 2m & \text{if } n = 3, \\ 3m-1 & \text{if } n = 4, \\ 4m-3 & \text{if } n = 5, \\ 5m-5 & \text{if } n = 6. \end{cases}$$

For $7 \le n \le 12$.

$$sd(W_{m,n}) \leq \begin{cases} \left\lceil \frac{n}{6} \right\rceil + (m-1)(n-2) & \text{if } 2 \leq m \leq 2n-11, \\ \left\lceil \frac{n}{6} \right\rceil + mn - m - 3n + 13 & \text{if } m > 2n-11. \end{cases}$$

Moreover,
$$sd(W_{m,n}) \leq \left\lceil \frac{n}{6} \right\rceil + (m-1)(n-1)$$
 if $n \geq 13$.

ii.
$$sd(F_{m,n}) \leq \begin{cases} m-2 & \text{if } n=2, \\ (m-1)(n-1) & \text{if } 3 \leq n \leq 6. \end{cases}$$

For
$$7 \le n \le 12$$
,

$$sd(F_{m,n}) \leq \begin{cases} \left\lfloor \frac{n-1}{6} \right\rfloor + (m-1)(n-2) & \text{if } 2 \leq m \leq 2n-11, \\ \left\lfloor \frac{n-1}{6} \right\rfloor + mn - m - 3n + 13 & \text{if } m > 2n-11. \end{cases}$$

Moreover,
$$sd(F_{m,n}) \leq \left\lfloor \frac{n-1}{6} \right\rfloor + (m-1)(n-1)$$
 if $n \geq 13$.

Using the subdivision numbers of complete bipartite graphs, we obtain the following lower bounds of $sd(W_{m,n})$ and $sd(F_{m,n})$ for some m and n:

If
$$n \ge m(m-1)$$
 and $G = W_{m,n}$ or $F_{m,n}$, then $sd(G) \ge (m-1)(n-m)$

Keywords: generalized wheel, generalized fan, unit graph, subdivision number

ON THE EDGE CLIQUE COVERING NUMBER OF GRAPHS

Joselito A. Uy

Mathematics Department College of Science and Mathematics MSU-Iligan Institute of Technology 9200 Iligan City

An edge clique cover of graph G is a collection of complete subgraphs of G that include all the edges of G. The minimum cardinality q(G)of such collection is the edge clique covering number of G. If H is an induced subgraph of G and b(G) is the vertex independence number of G, then $\theta(H) \le \theta(G)$ and $\theta(G) \ge \beta(G)$. If G is nontrivial and connected, and $\langle V_1 \rangle$,

 $\langle V_2 \rangle, \dots, \langle V_{\Theta(G)} \rangle$ are the cliques of G, then $\Theta(G) = \beta(G)$ if and only if $V_i \setminus \bigcup_{j \neq i} V_j = \emptyset$ for each *i*.

Let G_1 and G_2 be graphs of orders n_1 and n_2 , respectively. For the product $G \times H$, $\theta(G \times H) = n_1 \theta(H) + n_2 \theta(G)$. Let p_1 and p_2 be the numbers of isolated vertices in and , respectively. For the sum and corona and Let denote the number of *n*-cliques in the graph *G*, and let denote the number of complete subgraphs of *G* of order *n*. For the conjunction

Keywords: edge clique covering number. independence number. sum and conjunction of graphs

RELATION OF DIMENSION OF GRAPHS WITH SOME GRAPH INVARIANTS

Rowena T. Isla

Department of Mathematics College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City

The dimension of a graph G, denoted by dim(G), is the smallest nonnegative integer k for which G is a unit graph in the Euclidean k-space \mathbb{R}^k : that is, G may be represented as a graph whose vertices are points in and the Euclidean distance between every pair of adjacent vertices is 1 unit. This paper demonstrates relationships between the dimension of a graph and several graph invariants, namely the vertex independence number, dominance number.

Let G be a graph. A set S of vertices in G is *independent* if no two vertices of S are adjacent. The largest number of vertices in such a set is called the *vertex independence number* of G. A set T of vertices in G is a *dominating set* if every vertex in is adjacent to a vertex in T. The *dominance number* of G is the minimum cardinality of a dominating set of G. A clique in G is a maximal complete subgraph of G. The *clique number* of G is the order of a largest clique in G.

The following results are obtained in this study, where the upper bounds

given are best possible:

i. For any graph G of order n and vertex independence number β_0 .

$$dim(G) = \begin{cases} n-1 & \text{if } \beta_0 = 1, \\ 1 & \text{if } \beta_0 = n \neq 1 \end{cases}$$

and for $n \geq 3$.

$$dim(G) \leq \begin{cases} n-2 & \text{if } \beta_0 = 2, \\ n-\beta_0 + 1 & \text{if } 2 < \beta_0 < n. \end{cases}$$
- ii. Let G be a graph of order n, dominance number σ , and clique number ω . Then
- a. $dim(G) \leq n \sigma + 1$.
- b. $dim(\overline{G}) \leq n \omega + 1$, and
- c. $dim(G) \le n \omega(\overline{G}) + 1$,

where \overline{G} denotes the complement of G

Keywords: dimension, unit graph, independence number. dominance number. clique number

MPS NO. 18

ON THE EXISTENCE OF A SUBGROUP OF SqACTING IMPRIMITIVELY ON $A(K_a)$ FOR q = 3

Aurea Z. Rosal

SciTech R&D Center Polytechnic University of the Philippines, Sta. Mesa, Manila

The action of group N on a set Ω is said to be imprimitive if and only if (i) the action is transitive and (ii) there exists a nontrivial subset D of Ω such that either $D = D^{g} \oplus$ or $D^{=} D^{g}$ for some g = N. D is called a nontrivial block of Ω on N. Also, the set $N_{\alpha} = \{x = N\} a^{\chi} = a$, for some $a = \Omega \cdot N_{\alpha}$ is called the stabilizer of a.

This paper is about the existence of a subgroup N of the symmetric group S_q that acts imprimitively on the arc set $A(K_q)$ of the complete graph K_q , for q = 3. A complete graph K_q of order q is a graph consisting of q vertices such that every distinct vertices are joined by an arc.

Specifically, the following results were established.

1. There exists a subgroup Nd" S_q that acts imprimitively on the arc set $A(K_q)$ of the complete graph K_q , for all qe" 3.

- 2. If $N_{(u,v)} \le H \le N$, for (u,v) in $A(K_q)$ then $H = \{x | D^* = D\}$ for some nontrivial block D of $A(K_q)$ on N.
- 3. If D is a nontrivial block of $A(K_q)$, then D is an H-orbit of some element of $A(K_q)$.
- 4. For (u,v) and (w,z) in A(K_q),
 [i.] There exists a one to one correspondence between the sets H= {H | N_(u,v)<H<N} and D = {D | {(u,v)} I D I A(K_q) }.
 [ii.] There exists a one to one correspondence between the sets H= {H | N_(u,v)<H<N} and H`= {H`| N_(v,v)<H'<N}.
- 5. If $N_{(uv)} \le H \le N$, then there exists a unique nontrivial block D such that

$$|D| = q(q-1)/[N:H].$$

The above results find application in the homogeneous factorization of the Hamming graph $H_1(n,q) = (K_n)^n$, where n=[N:H].

Keywords: group action. transitive action, imprimitive action, nontrivial block, complete graph, arc set. stabilizer

MPS No. 19

WHITE NOISE PATH INTEGRAL WITH PERIODIC CONSTRAINTS: RELATIVISTIC AHARONOV-BOHM SETUP PLUSA UNIFORM MAGNETIC FIELD

Jinky B.Bornales*1, Christopher C. Bernido², and Maria Victoria Carpio-Bernido²

¹ Physics Department, MSU-IIT, 9200 Iligan City ² Research Center for Theoretical Physics, Central Visayan Institute Foundation, Jagna, Bohol

In this paper, we apply white noise analysis in the evaluation of the Feynman path integral for relativistic quantum systems with periodic constraints. We consider a Dirac particle of charge e and mass M constrained to move on

a circle of fix radius R outside an impenetrable solenoid containing a magnetic flux ϕ . Outside the solenoid, an additional magnetic field, $\overline{B} = B\hat{k}$, is applied. In polar coordinates $\overline{r} = (r, \theta)$, the vector potential \overline{A} for the system is given

by, $\vec{A} = \left(\frac{\phi}{2\pi r} + \frac{1}{2}Br\right)\hat{\theta}$ where $r > R_0$. R_0 being the radius of the solenoid.

The corresponding Green function for the iterated Dirac equation is given by

$$g(\theta^{\prime\prime},\theta^{\prime}) = \frac{i}{2M} \sum_{s} \eta_{s} \eta_{s}^{+} \int_{0}^{\infty} \left[\int \exp\left(i \int_{0}^{\Lambda} L_{s} d\lambda\right) D[\theta] \right] d\Lambda$$
(1)

where, $\eta_s = \langle \chi | m_s \rangle$ with χ a spinor. $m_s = \pm 1/2$, and L_s is the corresponding Lagrangian of the system.

The path integral
$$\int \exp\left(i\int_{0}^{\Lambda} \mathbf{L}_{s}\right) D[\theta]$$
 is evaluated by first

parametrizing the angular paths $\theta(\lambda)$ in terms of the white noise variable $\omega(\lambda)$. With the parametrization, the Feynman integrand can then be expressed as a generalized white noise functional and the flat "measure". $D[\theta]$, is translated into a well defined Gaussian white noise measure $d\mu(\omega)$. The final point \mathcal{G}'' is fixed by means of a Dirac-Donsker delta function $\delta(\theta(\Lambda) - \theta'' + 2\pi n)$, where *n* is the winding number. The path integration then becomes the T-transform of a white noise functional and from the poles of the Green function we obtain the energy spectrum

$$E = \pm \left[\frac{1}{R^2} \left(m + \frac{e\phi}{2\pi} + \frac{eBR^2}{2} \right)^2 - eBm_s + M^2 \right]^{1/2}$$
(2)

where $m = 0, \pm 1, \pm 2,$

The energy spectrum for the non-relativistic limit can also be obtained from Eq. (2), and for B = 0, the energy spectrum agrees with the expected result.

Keywords: White noise analysis. Feynman integral

MPS No. 20

dE/dx MEASUREMENTS USING TIME PROJECTOR CHAMBER

Rosario L. Reserva^{*1}, Hermogenes C. Gooc, Jr¹, Angelina M. Bacala¹, Satoshi Arai², Keisuki Fujii³, Takeshi Matsuda³, katsumasa Ikematsu³, Ronald Dean Settles⁴ & Markus Hamann⁵

 ¹Department of Physics. MSU-Iligan Institute of Technology, 9200 Iligan City
 ²Departments of Applied Physics. Tokyo University of Agricultural Technology, Tokyo, Japan
 ³High Energy Accelerator Research Organization (KEK) Tsukuba, Japan
 ⁴Max Planck Institute, Munich, Germany
 ⁵DESY, Hamburg, Germany

Time Projection Chamber (TPC), a promising central tracking system for the next generation linear collider, is a three-dimensional tracking detector which can identify particle species by energy loss or dE/dx measurements. The chamber is equipped with multi proportional counters with sense wires and rows of segmented cathode pads and is filled with a gas mixture of about 90% argon and 10% CH, at atmospheric pressure.

Charged particles passing through TPC sensitive region ionize gas molecules and liberate electrons along their trajectories. These electrons drift along the direction of magnetic and electric fields towards the counters and finally produced avalanches around sense wires inducing signals which are detected by cathode pads. The signals from wires and pads are amplified and shaped by electronics read-out system with several time projection digitizer channels from which the z-positions of the particles and the energy loss information are extracted.

In this study, energy loss of charged particles and particle identification capability of a prototype TPC were carried out at High Energy Accelerator Research Organization (KEK) in Tsukuba, Japan using ionizing hadrons test beam. The beam is equipped with a 1 Tesla magnet with trigger. Cherenkov and time-of-flight counters.

Preliminary TPC analysis with no applied corrections to dE/dx signals showed an energy loss resolution $s_{dE/dx} = 3.31\%$ at 4GeV/c. Within a momentum range of 1-4GeV/c. energy loss measurements with TPC technology, thus, have provided a good method of particle identification. Spectra of particles discriminated in the experiment were identified to be pions, proton and electrons.

Keywords: ionization, time projection chamber, trigger. Cherenkov counters & time-of-flight counters

MPS No. 21

REGIONAL MODEL SIMULATION OF SUMMER RAINFALL OVER THE PHILIPPINES: EFFECT OF CHOICE OF DRIVING FIELDS AND OCEAN FLUX SCHEMES

Raquel V. Francisco, Josefina Argete, Filippo Giorgi, Jeremy Pal³, Xunqiang Bi³ and William J. Gutowski

PAGASA WFFC Bldg. Agham Road. Diliman. Quezon City

The latest version of the Abdus Salam International Centre for Theoretical Physics (ICTP) regional climate model RegCM is used to investigate summer monsoon precipitation over the Philippine archipelago and surrounding ocean waters. The sensitivity to driving lateral boundary conditions (NCEP and ERA40 reanalyses) and ocean surface flux scheme (BATS and Zeng) were assessed for 5 monsoon seasons, namely June, July and August (JJA) of 1992. 1996, 1997, 1998 and 1999. This leads to a total of 20 simulations.

The model-generated rainfall was compared with rainfall observations from three different sources, namely PAGASA, CRU and CMAP. PAGASA data consist of gauge data from 40 synoptic stations. CRU data is derived from global station-based monthly rainfall over land at 0.5° regular latitude-longitude grids. CMAP is an analysis of global monthly precipitation on 2.5° x 2.5° grid derived from gauge observations, satellite estimates and numerical model predictions. Although of coarse resolution, this dataset provides observed rainfall over ocean areas, which comprise the largest portion of our domain.

The ability of the RegCM to simulate the spatial patterns and magnitude of monsoon precipitation is demonstrated. both in response to the prominent large scale circulations and to the local forcing by the physiographical features of the Philippine islands. This provides encouraging indications concerning the development of a regional climate modeling system for the Philippine region.

On the other hand, the model shows substantial sensitivity to the forcing analysis fields as well as the ocean surface flux schemes, with different combinations of these factors providing good matches to observations. The effect of forcing analysis fields is of the same order of magnitude as that of surface flux parameterizations in the model. As a result it is difficult to unambiguously establish which of the model configurations is best performing.

Acronyms used:

NCEP - National Center for Environmental Prediction, USA ERA40 - European Centre for Medium-Range Weather Forecasts (ECMWF) 40-year reanalysis project BATS - Biosphere-Atmosphere Transfer Scheme PAGASA - Philippine Atmospheric, Geophysical and Astronomical Services Administration CRU - Chinate Research Unit of the University of East Anglia, U.K CMAP - Climate Prediction Center Merged Analysis of Procepitation

Keywords: Regional climate modeling. summer monsoon rainfall

ENGINEERING SCIENCES and TECHNOLOGY

POTENTIAL OF LIGNOCELLULOSIC MATAS FILTER FOR INDUSTRIAL WASTE WATER

Shirley C. Agrupis¹ and Bernard Benjamin P. Albano

¹Biology Department . College of Arts and Sciences Mariano Marcos State University. Batac 2906 Ilocos Norte

The study was conducted primarily to develop a lignocellulosic mat from waste banana trunks for use as filter for industrial waste water effluent from a secondary fiber-based paper industry. The banana fibers were prepared by retting the material in four different retting times: 1, 2, 3 and 4 weeks. Activated carbon and unretted banana fibers were used as controls. The different treatments were fitted separately in an improvised water column for the run through trials. The filtration capacity of the lignocellulosic mats including the controls were used twice in 48 hours to evaluate their re-usabilities.

Retting time affected significantly the removal of extractives without considerably affecting the other biomass components of the material. The significant removal of extractives with prolonged retting time correspondingly favored defibrillation of the individual banana fibers for a much improved mat formation. In effect, the freeness (flow of water, mL/sec) of the mat decreased, favoring the filtration efficiency of the lignocellulosic mat.

The filtration performance of the banana fiber lignocellulosic mat (BCFM) is generally comparable with that of the activated carbon and even showed better filtration capacity than the latter during the second time run through trials. Data analysis using the orthogonal polynomial contrast showed that prolonged retting time had a direct effect on the ability of the BCFM to reduce or remove the water pollutants. Except for the microbial load, all the other pollution indicators: Total dissolved solid (TSS): Total suspended solids (TSS): Total suspended solids (TSS): biological oxygen demand (BOD); chemical oxygen demand: Calcium and calcium carbonate were reduced significantly by the BCFM filter.

Keywords: lignocellulosic mat, filter, waste effluent, banana fiber

STUDIES ON THE PREPARATION OF BANANA PULP FOR VULCANIZED FIBER

Shirley C. Agrupis

Biology Department . College of Arts and Sciences Mariano Marcos State University. Batac 2906 Ilocos Norte

Banana pulps were prepared by soda. soda AQ and retting process with two stage bleaching processes following the TAPPI standard procedures with some modifications to suit the fiber material. The pulps produced showed superior properties even before bleaching and beating. However, only those prepared by retting process met the criteria for vulcanization; e.g. low air permeability (40.70 sec/100ml) and superior strength properties. Hence, only those sheets prepared from retted pulp were used for the vulcanization trials.

Sufficient number of sheets at two different basis weights: 90 and 120 gsm were prepared and conditioned for the vulcanization. Two-ply sheet vulcanization was done by placing the two sheets on top of the other and passed them together in the vulcanization series. Their adjacent surfaces penetrated by the ZnCl, swelled and gelatinized making the two sheets to fuse homogenously. The same process was done for the one-ply sheet. Percent (%) ZnCl, absorption by the sheets was found higher in the 90 gsm- than the 120 gsm-sheets for both the one- and two- ply samples. Correspondingly, the plybond strength (3.33 lb/inch²) than the 120 gsm (2.86 lb/inch²). The values obtained were within the ranges obtained in previous studies using other materials like tobacco. kenaf, commercial softwood unbleached and bleached kraft pulps (Agrupis , 2000).

The physical appearance of the banana vulcanized fiber sheets closely resemble those of the commercial grade vulcanized fiber, but obviously showed the need to further improve the quality. Vulcanized fiber is a high grade cellulosic sheet, which is water- and heat-resistant. It is used in many industrial applications like electrical washers, heat insulators and the like.

Keywords: Vulcanized fiber. TAPPI(Technological Asso. of Pulp and Paper Industries) AQ (Anthraquinone). banana fiber

DEGRADATION OF OIL IN GASOLINE ENGINE LUBRICANTS

Nelia G. Autor¹ and Roberto M. Malaluan²

¹Department of Chemistry, MSU Marawi City ²Department of Chemical Engineering Technology MSU-Iligan Institute of Technology, 9200 Iligan City

Used oil from two leading gasoline lubricants Helix Super and Mobil oil were extracted with supercritical carbon dioxide at 300 atmosphere and 60 C. The extent of degradation in the extracted oil was determined using Fourier-Transform Infrared Spectroscopy (FT-IR). The chemical degradation processes in an engine lubricant were defined in terms of oxidation, nitration, sulfate-production and soot formation and the extent to which degradation processes occurred in used oil were measured in terms of severity indices.

Results showed that for the extract from used lubricant Helix Super, the oxidation, nitrate and sulfate indices were 19, 22 and 23 Absorbance per centimeter (Abs/cm), respectively. In comparison, the used Helix Super had indices of 40, 40, 57 Abs/cm, respectively and all of these values are above the allowable limit of 25 Abs/cm whereas the extract from Helix Super gave values below this limit. The observed change in the oxidation index from 40 to 19 accounted for only 47.5% of the oxidized products that were extracted together with the undegraded base oil. The change in the nitrate index from 40 to 22 also indicated that about 45% of the nitrates were extracted by supercritical carbon dioxide whereas the sulfate index showed only about 40% of the sulfated products that remained in the Helix Super extract.

The extract from the used Mobil oil showed similar decreasing trend in the change of its severity indices. The values for the used Mobil oil were 35.5, 56 and 46 Abs/cm for its corresponding oxidation, nitrate and sulfate indices as compared to 16, 43 and 18 Abs/cm that were obtained for the extract from the used oil. This accounts for 45% of the oxidation products. 77% of the nitrates and 39% of the sulfates that were still present in the oil after extraction.

Keywords: Helix Super extract, Mobil oil, Fourier-Transform Infrared Spectroscopy, extraction, oxidation

PRODUCTION OF FUEL FROM BRIQUETTED NEWSPAPER AND SAWDUST CHAR USING CASSAVA STARCH AS BINDER

Myra G. Borines, Robyn Joy C. Alcanzare, Jovita L. Movillon, Catalino G. Alfafara and Melissa M. Manguiat

Department of Chemical Engineering. CEAT-UPLB College, Laguna. 4031 Philippines

The use of crop residues and combustible waste products is one of the options to prevent depletion of the limited supplies of fossil fuels. This will also address solid waste disposal problems.

A study was conducted to produce fuel from briquetted newspaper and sawdust using cassava starch as binder. The effects of raw materials (newspaper. sawdust, and their combinations: 1:1, 1:2, and 1:3) and binder concentrations (10, 15, and 20%) on briquette characteristics such as proximate analysis, heating value, and bulk density were determined. Proximate analysis showed that the percent moisture content and percent volatile combustible matter of the briquettes decreased with increasing proportion of sawdust char. The percent fixed carbon on the other hand, increased with increasing proportion of sawdust char used. The percent ash was not influenced by the raw material used. Increasing binder concentration increased the moisture content and resulted in a negative effect on ash content. The percent heating value was directly influenced by the raw material and the binder concentration. Pure sawdust had the highest heating value of 9761"9882 BTU/lb at 15% binder concentration, while pure newspaper had the lowest (7728"7310 BTU/lb) at 20% binder concentration. The bulk density of the briquettes increased with increasing proportion of sawdust in the briquette. A binder concentration of 15"20% was found to be better than 10% for use in briquetting newspaper, sawdust, and their combinations. Briquette yield ranged from 74.11"77.32% for pure newspaper. 61.38-63.87% for pure sawdust and 65.86"74.38% for the different ratios of newspaper to sawdust. The flue gas resulted to the following: CO₂, 0.85"3.67%; O₂, 16.5"19.73%; and CO. 0.56"1.45%.

Keywords: fuel, briquetted newspaper, sawdust, cassava binder

THE MAKINGS OF AN INTERNET-BASED RICE INFORMATION SERVICE (IRIS): PILOTING IN THE PHILIPPINES

Cheryll B. Casiwan^{1*}, Suan Peng Kam², Holecz, Francesco.³, Eric van Valkengoed⁴, Massimo Barbieri³, Sonia L. Asilo¹, Larry A. Santos¹, Rowena G Manalili¹, Wilfredo B. Collado¹, Sherwin A. Adriano¹ and Aileen Maunahan²

¹Philippine Rice Research Institute, Munoz. Nueva Ecija. Philippines
 ²International Rice Research Institute, DAPO Box 7777. Metro Manila. Philippines
 ³sarmap s.a. Cascine di Barico, CH 6989 Purasca. Switzerland
 ⁴Synoptics Remote Sensing & GIS Applications. Wageningen. The Netherlands

A collaborative activity involving a private consortium, an international and a national rice research institution was conducted to validate the design of an internet-based information system that would provide more timely and objective data on rice area and production. This system consists of two components that make use of geospatial tools including remote sensing. GIS and GPS technologies. The remote sensing component comprises a largely automated protocol using multi-date SAR imagery for mapping and estimating rice area and planting dates. These outputs are fed into a production estimation component comprising a crop growth model that predicts harvest dates and crop yield using meteorological data. Rice area and yield estimates are summarized by administrative boundaries and are offered through a web-based service to subscribers.

Pilot testing of the data generation component of the system was carried out in 81 municipalities covering Nueva Ecija. Isabela and Pangasinan for the dry season rice crop of 2003"2004. Acquisition of RADARSAT and ENVISAT ASAR data at various dates throughout the rice-growing season permitted evaluation of the capacity of the automated SAR processing system to handle multi-platform data. Investigations were made on the minimum number of acquisition dates that would provide reliable rice area estimates. A field campaign was conducted covering 68 municipalities and 667 geo-referenced survey points to collect ground truth information. Daily weather data were collected from 5 surrounding weather stations for at least the past 10 years; data for the 2003"2004 season were available for 3 stations. Processing of the SAR data provided rice area and planting date estimates, which were fed together with the weather data into the crop model. The predicted yields and rice area are reported by municipality. The implications of operationalizing such an information system for rice is discussed based on the experience from this pilot study.

Keywords: IRIS. rice monitoring. crop growth model, rice area mapping

EST No. 6

CHARACTERIZATION AND CEMENTITIOUS SOLIDIFICATION/ STABILIZATION OF A SLUDGE GENERATED BY A METAL COATING/PLATING PLANT USING RICE HULL ASH AS ADDITIVE

Rex B. Demafelis, Renacel P. Promentilla, Ronald R. Navarro and Albert A. Samuela

Dept. of Chemical Engineering, CEAT-UPLB, College, Laguna 4031

The semiconductor industry is the top exporting industry in the Philippines. Sludges containing heavy metals from semi-conductor and metal coating/plating plants pose a grave threat to the environment that need to be given attention.

A treatability study was conducted to determine the feasibility of employing solidification/stabilization (S/S) technology to treat a heavy metalcontaminated sludge generated by the wastewater treatment facility of a metal coating/plating plant and evaluated the performance by conducting the Toxicity Characteristic Leaching Procedure (TCLP), compression and durability tests. The use of rice hull ash (RHA) as partial substitute to ordinary Portland cement (OPC) that will act as the S/S binder or reagent was also investigated.

Seven treatments of OPC, RHA and sludge were designed for the relative amounts of mixture components. Seven duplicate concrete blocks were molded and cured for 28 days. Three blocks were tested for unconfined compressive strength (UCS) using the universal testing machine (UTM). Two blocks were subjected to wetting and drying cycles to test the durability. TCLP was employed to determine the percent reduction in the nickel that leached after extraction.

The results of the study clearly show that the mobility of heavy metals can be effectively reduced the S/S process. Leaching of nickel can be minimized or retarded to meet standards by blending the waste with siliceous materials such as Portland cement and rice hull ash. Immobilization is more effective when the OPC is available at higher amounts as in higher formulations.

From the general comparison made on the seven mixture formulations. OPC-RHA-SLU ratio of 0.3/0.35/0.35 was rated the most outstanding composition after passing the leachability, compression, and durability test, having the highest OPC substitution with RHA hence highest binder cost reduction, and highest amount of sludge treated.

Keywords: metal coating-plating plants, nickel, heavy metals, solidification/ stabilization technology, sludge, rice hull ash

EST No. 7

RHEOLOGICALAND CASTING PROPERTIES OF SANITARY WARE SLIPS WITH RICE HULLASH

Samuel S. Franco and Rowelyn C. Aganus

Department of Ceramic Engineering. College of Engineering Mariano Marcos State University. Batac. 2906. Ilocos Norte

The manufacture of ceramic sanitary ware utilizes white clay, feldspar and quartz and these are usually imported. Rice hull ash is high grade amorphous silica when subjected to heat. We evaluated the progressive replacement of quartz by active silica obtained from rice hull ash for ceramic casting slips to determine the level of substitution to be used without affecting its rheological property.

Calcined rice hull ash was used to gradually replace the quartz content of the slip. at 3%, 6%, 9% 12% and 15%. Sodium silicate (NA_2SiO_3) as the electrolyte and deflocculant was added at a varying rate of 1.3%, 1.6% and 1.9%. Rheological properties such as viscosity, specific gravity and casting rate were determined

Results of the experiments indicate that the addition of rice hull ash significantly increased the viscosity (decrease in fluidity). Using 1.9%

deffloculant, all the formulations flowed while with 1.3% of deffloculant, only up to 6% quartz substitution was possible. Deflocculation level above 1.3% resulted in high viscosity that resisted flow. Increased percentage of rice hull ash also increased the thickness of the hollow cast specimen. However, increasing the percentages of deflocculant decreased the cast rate for all formulations.

Furthermore, results of the study revealed that the utilization of the calcined rice hull ash could be utilized for ceramic manufacturing particularly for slip casting but should not to exceed 3% to maintain an acceptable rheological characteristics and proper degree of deffloculation for ceramic sanitary ware casting slips.

Keywords: calcined rice hull, ceramic, deflocculant, feldspar, quartz, rheological properties, specific gravity, sodium silicate, viscosity, white clay

EST No. 8

SYNTHESIS & CHARACTERIZATION OF POLYANILINE-COATED ITO GLASS AS A STARTING MATERIAL FOR THE PRODUCTION OF SMART WINDOWS

Katherine Marie G. Marcial¹ and Christina A. Binag^{1,2*}

Department of Chemistry. University of Santo Tomas Research Center for the Natural Sciences. University of Santo Tomas

This work aims to develop and characterize a polymer coating for Indium-Tin Oxide (ITO) glass for smart windows application. Aniline (An) was electrosynthesized onto the ITO glass. A 2-mA current was maintained constant during polymerization for 20 minutes and the weight gain of ITO glass was monitored after electropolymerization. The ratio of 0.1M aniline monomer to 1M KCl dopant was varied in 1M HCl solution. Scanning Electron Microscopy (SEM) was utilized to investigate the surface of PAn-coated ITO glass. Fourpoint probe technique was used to measure conductivity and the optical property of the PAn-coated ITO glass was determined using the Ocean Optics.

The results showed that the ratio of 6:5 (An : KCl) gave the highest conductivity of 953.46 Scm⁻¹ and a transmittance that is distinct from those of other monomer to dopant ratios. Three replicates of the 6:5 monomer to dopant

ratio were made with an average conductivity of 701.2 Scm⁻¹ with 18.81% RSD. The varied conductivities obtained were observed to be caused by the steps done at the end of the polymerization method. SEM micrographs of the pristine ITO glass revealed uniform nodules on the surface, while that of the PAn-coated ITO glass had a layer of flaky, uneven coating on the surface of the glass. The PAn-coated ITO glass maintained good conductivity with good transmittance property as a starting material for smart windows.

Keywords: polyaniline. conducting polymer. composite glass. SEM. ITO

EST No. 9

REMOVAL OF LEAD FROM ELECTROPLATING WASTEWATER USING PHOSPHONOMETHYLATED POLYETHYLENEIMINE (PPEI)-Ca²⁺

Jovita L. Movillon¹, Ronald R. Navarro¹, Casiano S. Abrigo Jr.¹, Myra G. Borines¹², Elson R. Montibon², and Myriam L. Perez²

¹Sugar Technology and ²Chemical Engineering Department of Chemical Engineering. CEAT-UPLB. College, Laguna 4031

Lead contamination in the environment has long been recognized as a serious health problem. Lead, despite its toxic effect, is still being used by industries. This study aimed to evaluate the performance of phosphonomethylated polyethyleneinnine (PPEI) as chelating flocculant for the removal of lead from an actual electroplating wastewater. The effect of equilibrium pH conditions and the amount of PPEI used on lead flocculation using PPEI-Ca²⁺ as chelating flocculant was studied. The regenerative property of the PPEI polymer was tested and an absorption isotherm was established for Pb²⁺

Even at a low equilibrium pH condition (pH 3), the polymer was able to remove 66.93% of the initial 2.06 ppm Pb²⁺ concentration. At high equilibrium pH (pH 8, 9, and 10), almost 100% removal was obtained. The results showed that increasing equilibrium pH condition increased lead removal. This may be due to the improved affinity between PPEI and Pb²⁺ at high pH, where less hydronium ions would be available to compete with Pb²⁺ and Ca²⁺. The same trend was observed at increasing PPEI amounts. At equilibrium pH 10, even a small amount of 0.05 mL of PPEI can already remove more than half (59.08%) of Pb²⁺ in a 40mL electroplating wastewater and 0.50 mL PPEI can already remove almost 100% of Pb²⁺ in the solution.

This study showed that in lead flocculation using PPEI as chelating flocculant, the PPEI can be used up to the second cycle with an 85.99% regeneration and would still show satisfying results. It also showed that Pb²⁺ follows the Freundlich absorption isotherm with a 36.69037 mg/g absorptive capacity and 1.95413 l/mg stability constant. Therefore, lead flocculation using PPEI-Ca²⁺ as chelating flocculant is a good method for lead removal in wastewater.

Keywords: lead, PPEI-Ca²⁺, phosphonomethylated polyethyleneimine, flocculation

EST No. 10

DEVELOPMENT AND PERFORMANCE EVALUATION OF A BRUSH CUTTER RICE REAPER-HARVESTER

Dexter L. Orpilla*, Bernardo D. Tadeo, Leonardo R. Apigo, Rodolfo S. Juliano, Ben B. Pugong, Madonna C. Casimero

Philippine Rice Research Institute (PhilRice) Maligaya. Science City of Muñoz. 3119 Nueva Ecija

Harvesting is one of the major bottlenecks in rice production. Delayed harvest causes reduction of yield, quality and profitability. Some farmers can afford to own modern harvesting machine. However, still majority cannot cope with the costs. limiting them to stick to the traditional and tedious tasks of manual harvesting using old gadgets like sickle.

The availability and popularity of brush cutters were considered in the development of a simple, inexpensive, and versatile rice reaper-harvester. The machine operating at forward speed of 0.24 kph and cutting blade rotational speed of 6,600 rpm had a computed field capacity of 400 m²/hr with effective swath (cutting width) of 1.0~1.8 meters (6~10 hills per row). The harvester could cut paddy stalks near ground at 0.2~6.8 cm height in windrows. Fuel consumption of the machine was 0.69 liter per hour. Compared to manual harvesting, labor productivity was doubled.

The device is useful for small-scale rice-based cropping systems wherein rice stalks are extensively utilized as mulch. Ilocos Norte and Cagayan farmers have started using the device because of its effectiveness and efficiency in harvesting palay.

Keywords: Harvesting, brush cutter, rice reaper-harvester, rice stalks, rice-based cropping systems

BIOMASS RESOURCE RECOVERY SYSTEMS FOR SUSTAINABLE AGRICULTURE

Bernardo D. Tadeo, Jocel C. Cordero*, Rizal G. Corales*, Dexter L. Orpilla, Larry A. Santos, Ailon V. Capistrano

Philippine Rice Research Institute (PhilRice) Maligaya. Science City of Muñoz, 3119 Nueva Ecija

Through effective and practical conversion or transformation of wastes into resources such as biomass residues that contain abundant organic matter. nutrients and other components can be recycled beneficially into the soil as amendments or nutrient sources.

A close loop rice resource recovery system or 3RS in the agricultural production that considered turning waste into resource was developed. Stopgap technology using a carbonizer with smokestack can convert 182 kg rice husk into 119 kg carbonized rice hull (CRH) in 3 to 4 h with 65% conversion efficiency. On the other hand, fermentation-decomposition pathway using EM Technology reduced decomposition of biomass in 2 to 4 weeks.

The 3Rs technology was introduced to more than 10,000 farmers nationwide wherein 7 People's Organization engaged in the production and marketing of CRH and organic fertilizer. These resulted in additional profit and income of about 30%. Likewise, the utilization of organic fertilizers reduced the farm input cost of about 30 to 40%.

The technologies are simple and appropriate and can encourage the general public to increase the utilization of biomass to a level that would equal to less generation of wastes.

Keywords: Biomass. conversion, resource recovery system, carbonizer, EM technology

DEVELOPMENT OF TRANSPARENT LEADLESS GLAZE FOR LOW-FIRED CERAMIC WARE UTILIZING LOCAL RAW MATERIALS IN ILOCOS NORTE

Jime C. Portugal

Department of Materials Science and Engineering College of Engineering Mariano Marcos State University, Batac, 2906. Ilocos Norte

The ceramic industry in the Ilocos Region relies on glazes that are prepared by a company specializing in supplying industry. For this reason, potters are investing on expensive commercial (imported) glazes, since glazes are at one and the same time the area of most fascination and most difficult for the potters. Additionally, the producers do not usually have access to raw materials and its chemical analysis at reasonable prices.

The study focused on the development of transparent leadless glaze for low firing ceramic products utilizing local raw materials such as Solsona white clay. Ventura feldspar and red silica with the addition of commercial carbonates and boron compounds (borax). The compatibility of such materials as alternative replacement for commercial glaze materials was determined.

Raw materials were subjected to preliminary drying, grinding and screening to achieve even particle size of the glaze materials. The prepared slip glaze batched was applied on both red clay and earthenware (white ware) bodies made from slabbing and fired in gas fired (LPG) kiln at 1050°C based on the recording pyrometer of the kiln.

Results obtained from the formulated glaze show a clear transparent glassy surface appearance in the test ceramic clay bodies. The clay bodies and glaze formulation were found to be acceptable with some minor defect such as pin holes but these gave a unique artistic surface appearance especially for decorative artwares.

Keywords: transparent leadless glaze. slip glaze. red clay, earthenware, gas fired, recording pyrometer, slabbing.

DESIGN AND DEVELOPMENT OF AMICROCONTROLLER-BASED TEMPERATURE CONTROLLER

Thomas D. Ubiña, W.M. Manzanas, V.J.P. Baided, M.M. Cuepo, M.G. Cajas, M.A. Damian, G. Duldulao, M.C. Llaguno, J. Pascual, F. Perdido, A. Quitoriano, J. Raceles, and M.L. Urubio

Department of Electrical Engineering. College of Electrical Engineering Mariano Marcos State University Batac. 2906 Ilocos Norte

A microcontroller-based temperature controller (MTC) was developed to address the needs of local farmers and small and medium scale entrepreneurs for drying applications and for low temperature applications or setups.

The MTC was developed following the research and development methodology. Its development passed through four stages: these are design, construction, calibration and simulated testing. The main components of the MTC are the temperature sensor, analog to digital converter, one time programmable microcontroller and the three digit 7-segment display.

Calibration of the MTC was done to establish the accuracy of the readings and as well as the precision of controls. This was accomplished through simple experiments like comparison of temperature readings of commercially available digital thermometers to that of the developed MTC in a simulated setup. Results showed that the MTC reading was 99 percent accurate from 5°C to 150°C range of temperature. Temperature control was precise with 5% tolerance. The MTC was rated 1200¹ Watts, 230 Volts ac, 60 Hertz.

The cost of fabricating the MTC hardware was estimated to be PhP 2.025 as of March 2004 which is only about 20% of the cost of commercially available digital temperature controllers. It is stand-alone, easy to install, its setpoint is configurable, and mode of control is on/off.

Results of this study showed that the MTC can be used in any application and experiment where accurate monitoring and precise control of temperature within the range of 5°C to 150°C are needed like fruit drying, bamboo drying and ceramic firing at low temperatures.

Keywords: microcontroller-based, temperature, controller, calibration, simulated testing, accurate, precise control

¹The 1200 Watts rating can be augmented by adding an external relay to the output.

PRODUCTION OF HYDROGEN FROM ETHANOL THROUGH STEAM REFORMING USINGA FABRICATED CATALYTIC REACTOR

Sixto A. Valencia, Jovita L. Movillon Catalino G Alfafara, and Erli Eros D. Lee

¹Chemical Engineering, ²Sugar Technology and ^{3,4}Chemical Engineering Dept. of Chemical Engineering, CEAT-UPLB, College, Laguna, 4031

Developmental work on renewable energy source is imperative in the face of the threatening energy crisis. Hydrogen is a clean and good substitute to fossil-based fuel. This study focused on producing hydrogen from ethanol using a fabricated catalytic reactor with CuO/ZnO/Al₂O₃ catalyst. The effect of reaction temperature and reaction time on percent recovery of hydrogen were also tested. The catalyst used was prepared by first precipitating oxides of copper. zinc and aluminum. The precipitated oxides were then filtered, dried in an oven and calcined in a furnace at 400°C. The calcined precipitate was granulated after which a binder (graphite) was added and lastly it was pelletized.

During the ethanol reforming experiment, the catalyst packed in the reactor was divided into half to ensure good surface area of contact. An ethanol to steam mole ratio of 1:45.5 mole were passed on to the reactor at certain set of reaction temperature and reaction time. At each set of reaction temperature and reaction time, samples were collected by water displacement method. The samples were collected at reaction time at 200° C and 400° C. At each reaction temperature, reaction times were set at 10 seconds and 30 seconds. The samples collected were analyzed for its components by gas chromatography (GC).

Results of the GC analysis showed that the highest percent volume and percent recovery of hydrogen were obtained in the sample collected at reaction temperature of 400°C and reaction time of 10 seconds. The said sample contained 66.09% volume hydrogen giving a 34.30% recovery of hydrogen. The sample taken at 400°C too, but at longer reaction time, set at 30 seconds, had a lower percent recovery of 27.06%. Those samples gathered at a lower temperature of 200°C had a lower percent recovery of 16.40% and 4.48%. Percent recovery was calculated on the assumption that all the hydrogen in the ethanol prepared was totally recovered.

It was observed that the production of hydrogen was directly related to reaction temperature and inversely related to reaction time. Further, as the reaction temperature increased, percent recovery of hydrogen also increased. ZnO (an active agent of the catalyst used) activity at a higher temperature predominated because of its redox property, which promoted the steam reforming reaction, thus producing more hydrogen. On the other hand, percent recovery of hydrogen was observed to decrease as reaction time increased. At a longer reaction time. H₂ was given a chance to react with CO₂ via the reverse water gas shift reaction that resulted in the production of CO and H₂O; thus the recovery of hydrogen became smaller.

Keywords: hydrogen gas production, catalytic reactor

EST No. 15

TESTINGAND EVALUATION OF RICE HUSK GASIFICATION SYSTEMS

Bernardo D. Tadeo, Dexter L. Orpilla*, Jocel C. Cordero, Joselito A. Damian, Hanshel Z. Layaoen, Cesar M. Macalinao¹ Makoto Hoki, Yoshiaki Umezawa, Hiroyuki Monobe, Akira Mori²

¹Philippine Rice Research Institute (PhilRice) Maligaya. Science City of Muñoz. 3119 Nueva Ecija. Philippines ²Japan Biomass Consortium. Japan

The Philippine Rice Research Institute and the Japan Biomass Consortium have collaborated to develop modular small-scale cleaner technologies for resource recovery systems. The systems are aimed to generate power from rice biomass, specifically to produce gas, heat, mechanical & electrical power, and by-products such carbonized rice husk (CRH) and liquid materials that could be used for various agro-industrial applications.

A 5~10 kW gasification, carbonization, and combined heat & power generation system was initially operated for four hours with 15-kg/h rice husk input and 5 kW output. Refinement of some assemblies is being done. On the other hand, a 10~20 kW rice husk power plant model has been continuously tested for 24-hrs to evaluate the performance and durability of the system. The feeding capacity was 35.2-kg rice husk per hour with a power generation of 10.35 kW and CRH conversion of 33%. Improvement on the alternator and generator system capacity is being made to increase the power generation of the system.

148 Trans. Nat. Acad. Sci. & Tech. (Philippines) Vol. 27 (No.1)

The results showed that a modular type power gensets can be used for continuous operation providing lightings and mechanical power for agricultural machineries.

Keywords: Rice lusk. rice biomass. gasification system. power generation. agricultural machineries

EST No. 16

ELECTROLYTIC REMOVAL OF SUSPENDED SOLIDS FROM WHITE WATER

Jeffren Argame¹, Catalino Alfafara^{1*}, Veronica Migo² Jovita Movillon¹, Ronald Navarro¹, and Masatoshi Matsumura³

⁴Department of Chemical Engineering. University of the Philippines at Los Banos, College, Laguna 4031 ²National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Banos, College, Laguna 4031 ³Institute of Applied Biochemistry. University of Tsukuba Tennodai 1-1-1, Tsukuba City 305-0006, Japan

The electrolytic removal of suspended solids in whitewater was evaluated as an alternative process towards the reuse of the effluent in the paper recycling industry. The mechanism involved the utilization of electrodes that allow the electrochemical generation of flocculation and flotation agents in the wastewater. The suspended solids removal efficiencies at different operating currents were evaluated in a batch system and the charge dose was determined as a factor which may be useful for operation and scale-up.

Complete removal of suspended solids could be achieved by electroflocculation/electroflotation (through the use of an aluminum alloy electrode); a clear effluent was obtained. The removal of suspended solids was accompanied by a decrease in BOD and COD (by 70% to 90%), indicating the dominant contribution of suspended solids on the organic content of the wastewater. The use of flotation mechanisms alone without flocculation (through the use of a carbon electrode) could not completely remove the suspended solids in whitewater.

The charge dose of the process was determined to be 2.23 coulombs per mg suspended solids removed. The energy cost was estimated to be 2 centavos to 4 centavos per cubic meter of whitewater.

Keywords: electroflocculation. electroflotation. whitewater. charge dose

TREATABILITY STUDIES ON THE ELECTROCHEMICAL TREATMENT OF PIGGERY WASTEWATER

Monet Concepcion Maguyon^{1*}, Catalino Alfafara¹, Veronica Migo² Jovita Movillon¹, and Ronald Navarro¹, and Masatoshi Matsumura³

 ¹Department of Chemical Engineering, University of the Philippines Los Banos, College, Laguna 4031
 ²National Institute of Molecular Biology and Biotechnology (BIOTECH) University of the Philippines Los Banos. College, Laguna 4031
 ³Institute of Applied Biochemistry. University of Tsukuba Tennodai 1-1-1. Tsukuba City 305-0006, Japan

Two electrochemical processes, namely, electroflotation and electrooxidation were tested for the removal of total suspended solids (TSS), chemical oxygen demand (COD), biochemical oxygen demand (BOD) and color in piggery wastewater. In batch electrolysis experiments, the effect of operating current on the removal efficiencies of the target pollutants were evaluated for individual treatments of electroflotation and electrooxidation, and combinations of both processes.

In electroflotation/electroflocculation, a higher operating current resulted in higher removal efficiency and faster rate of removal due to higher production of flocculating and flotation agents. A three-hour operation of electroflotation/electroflocculation at 0.4A resulted in the following removal efficiencies: 49% TSS, 39% COD, 76% BOD and 51% color. Similarly, in electro-oxidation, higher removal efficiency at faster rate was observed at higher operating current due to its higher oxidizing power. Electro-oxidation at 0.4A was able to remove 57% TSS, 31% COD and 40% color after 5 hrs. Preliminary investigation on the effect of salt addition in the wastewater for electro-oxidation showed some potential for increasing the removal efficiencies for COD and color, but not for TSS.

The charge dose for electroflotation/electroflocculation was computed to be about 42.4 coulombs/ing pollutant removed, corresponding to an energy requirement of 2.36×10^{-5} kWh/mg to 4.72×10^{-5} kWh/mg pollutant removed. Charge dose for electro-oxidation, on the other hand, was approximately 41.6 coulombs/mg pollutant removed and energy requirement was in the range of 3.47×10^{-5} to 4.63×10^{-5} kWh/ing pollutant removed. The maximum energy cost was estimated to be about 43.62 PhP/m³ for electroflocculation and 62.78 PhP/m³ for electro-oxidation.

Keywods: electroflocculation, electrooxidation, piggery wastewater

ELECTROLYTIC TREATMENT OF COCONUT PROCESSING WASTEWATER

<u>Joyce Masilungan¹, Catalino Alfafara¹', Veronica Migo²</u> Jovita Movillon¹, Ronald Navarro¹, and Masatoshi Matsumura³

 ¹ Department of Chemical Engineering, University of the Philippines Los Banos. College, Laguna 4031
 ² National Institute of Molecular Biology and Biotechnology (BIOTECH). University of the Philippines Los Banos. College. Laguna 4031
 ³ Institute of Applied Biochemistry. University of Tsukuba Tennodai 1-1-1. Tsukuba City 305-0006. Japan

Performance evaluation of electrolytic methods (electroflocculation/ flotation and electrooxidation) was conducted for the treatment of coconut processing wastewater from a local factory. Removal efficiencies for total suspended solids (TSS), chemical oxygen demand (COD), biochemical oxygen demand (BOD) and fats/oils/grease (FOGs) were investigated at different operating currents. Experiments involving individual treatments (i.e. electroflocculation/ electrooxidation alone or electrooxidation alone) or combined treatments (electroflocculation/electroflotation followed by electrooxidation) were performed.

Electrolytic treatment could remove the target pollutants in the wastewater with varying removal efficiencies. Both electrochemical treatments (individual and combined) were efficient in nearly complete removal of TSS (90%) conforming to the DENR Class C effluent standards. FOGs were also removed efficiently, obtaining effluents within or slightly over the same effluent standards. Generally, a higher operating current resulted in a higher removal rate of removal efficiency for most pollutants. Individual electrolytic treatments removed more than 50% of organic matter (as COD or BOD) but reached a maximum level of 65% removal. Combined electrolytic treatments on effluents supplemented with NaCl gave better performance than individual treatments. One hour electroflocculation/ electroflotation followed by three hours of electrooxidation resulted in an effluent conforming to the DENR Class C effluent standards.

The charge dose and energy requirements for the different electrolytic treatments were also evaluated as indices which may be useful for scale up and operation.

Keywords: electroflocculation. electroflotation. coconut wastewater, charge dose

HEALTH SCIENCES

i.

HS No. 1

OCCUPATIONAL RISK ASSESSMENT OF TRACE METALS TO WORKERS OF PUP WELDING SHOP

Theresita V. Atienza, Lorna T. Enerva, Rome J. Jarlego and Grace Hazel Paglingayen

Department of Natural Sciences. College of Science Polytechnic University of the Philippines

Combustion of coal, wood and oil, vehicular traffic and fumes brought by welding and grindings contribute to air pollution.

This study was an occupational risk assessment of the trace metals in the air of the welders in the Polytechnic University of the Philippines. The Low Volume Sampler was used to collect the air samples in two welding sites through the assistance of two industrial hygienists of the Occupational Safety and Health Center. The samples collected were digested using a Flame Atomic Absorption Spectrophotometer.

The three trace elements were manganese, copper and lead. The average values of the concentration of manganese at two sampling sites were 0.1335 mg/m^3 and $4.18 \times 10^{-3} \text{ mg/m}^3$. Copper is essential to good health, however, very large intakes of this can be harmful. This can cause liver and kidney damage and even death. The values obtained at the two sampling sites were $.0178 \text{ mg/m}^3$ and $3.57 \times 10^{-3} \text{ mg.m}^3$. The last element analyzed was lead. Lead is a very toxic element, causing a variety of effects at low dose levels. The average values of the lead concentration were $2.16 \times 10^{-3} \text{ mg/m}^3$ and for the second site it was undetected.

The threshold limit values for manganese is 5 mg/m^3 , copper 0.1mg/m^3 and lead 0.15 mg/m^3 . The results of the study revealed that the concentration ranges obtained do not exceed the threshold limit value prescribed by the Occupational Safety and Health Center Standards and will not cause any harmful effect on human exposure. It is recommended for further studies that other trace metals that are known to be harmful to humans be analyzed.

Keywords: occupational risk, welding shop, trace metals, low volume sampler, managanese, copper, lead, threshold value

HS No. 2

INVESTIGATION OF POLYMERASE CHAIN REACTION OF GASTRIC ASPIRATES AS AN ADJUNCT DIAGNOSTIC METHOD FOR PEDIATRIC PULMONARY TUBERCULOSIS

Alicia Cornista¹, Vivienne Cabreza², Marion Sanchez³, Dolores Quieng⁴, Cynthia Mapua¹, Maria Celeste Cortes^{1*}, Ma. Darlene Deang⁵, Epifania Simbul⁵, Agnes Rico-Mendoza³ and Filipinas F. Natividad¹

 ¹Research and Biotechnology Division. ²Department of Pediatrics.
 ³Institute of Pulmonary Medicine. ⁴Institute of Pathology St. Luke's Medical Center. Quezon City, Philippines: ⁵National Children's Hospital. Quezon City, Philippines

Pediatric pulmonary tuberculosis (PTB) is difficult to diagnose because sputum production is minimal in children. resulting in a limited sample source from which Mycobacterium tuberculosis may be detected. With the increasing trend of PTB in children, polymerase chain reaction (PCR) of gastric aspirates was investigated as an adjunct diagnostic method. The validity of PCR of gastric aspirates was determined using acid-fast bacilli (AFB) smear as reference standard and culture of M. tuberculosis as gold standard. A cross-sectional study was done of pediatric patients admitted in 2 hospitals at Ouezon City. for suspicion of PTB. Gastric aspirates were collected for 3 consecutive days. AFB smear, Lowenstein-Jensen culture and PCR were done simultaneously. One hundred children, aged 3 months to 17 years (Mean=6.8 years, SD=5.1 years), were included in the study. Fifty-one had positive PCR results, nine were culturepositive and two had positive AFB smear. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of PCR compared with AFB smear were 100.0%, 50%, 3.9% and 100.0% respectively. Compared with culture, the sensitivity, specificity, PPV and NPV of PCR were 88.9%, 52.7%. 15,7%, and 98% respectively. The results show that PCR is moderately sensitive but only fairly specific in the diagnosis of PTB in children. Additional samples are being processed to further investigate PCR as an adjunct diagnostic method.

Keywords: *Mycobacterium tuberculosis*, pulmonary tuberculosis, cluidren, polymerase chain reaction, gastric aspirates

HS No. 3

BODY MORPHOMETRICS OF DIABETICS, HYPERTENSIVE, ALCOHOLICS AND HEAT THY INDIVIDUAL SEROM ILICAN CITY

Cesar G. Demayo, Mark Anthony J. Torres, Charmaine Xy-za Yape, and Caryll Lou Edubos, and Erlene Grace Salvacion

Department of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology, 9200 Iligan City

Body morphometrics of populations of known diabetics, hypertensive, alcoholics and healthy individuals from Iligan City were compared to determine if certain health conditions are correlated with quantitative changes in sizes and shapes of the body. Sixty-four morphometric characters in left and right hand. foot, ear, waist, arms, legs, and hips were measured and subjected to multivariate analyses to allow comparisons of relationships of variables and variations among populations. Members of the diabetic society of Iligan City and hypertensive medical patients from the city hospital, and known alcoholics from selected barangays were asked to participate in the study. Sex-dependent variation was considered in the study thus sexes were separated in the analysis of the body measurements. Multivariate analysis of morphometric data showed differentiation between populations as shown by the results generated by principal component (PCA) and discriminant function (DA) analysis. Significant differences were observed between healthy individuals and those who suffer from diabetes alcoholism and hypertension.

Keywords: body morphometrics, multivariate analysis, diabetics, alcoholics, heypertensive

HS No. 4

HETEROTROPHIC PLATE COUNT (HPC) OF BOTTLED WATERS FROM REFILLING STATIONS RASED IN ILIGAN CITY

Lucilyn D. Lahoylahoy, Olive S. Anies, Christine Cherry E. Solon, Annielyn H. Deocampo and Sasha Anne L. Valdez

Dept of Biological Sciences. College of Science and Mathematics MSU-Iligan Institute of Technology. 9200 Iligan City

The consumption of bottled water in the Philippines has skyrocketed in the recent years. It is largely due to the perception of teh general public that Regional Hospital (BRH) and to determine if the isolates are methicillin-resistant (MRSA). From November 2003 to July 2004, four hundred one (401) *Staphylococcus aureus* clinical isolates were identified based on morphological and biochemical characteristics.

According to the demography and clinical characteristics of the patients with *S. aureus* infections, many of the patients were newborns (26.18%) and children below 2 years old (37.91%); admitted in Pediatrics (47.63%) and Neonatal Intensive Care Unit (NICU) (22.94%); have stayed in the hospital for 4-7 days (29.68%) and 8-14 days (34.91%); and have one or more co-morbidities (49.88%). Seventy-eight point eight percent of the isolates were obtained from blood specimens.

Using the National Committee on Clinical Laboratory Standards (NCCLS) oxacillin-salt agar screening test and agar dilution method. 32.17% (129/401) of the isolates were confirmed to be MRSA. Data show that the demography and clinical characteristics of the patients with MRSA are newborns (30.23%) and children below 2 years old (34.11%); admitted in Pediatrics (45.74%) and Neonatal Intensive Care Unit (NICU) (27.13%); have staved in the hospital for 4-7 days (20.93%), 8-14 days (36.43%) and 15-21 days (15.50%); and have one or more comorbidities (51.94%). Most (75.97%) of the isolates were obtained from the blood specimens.

Keywords: Methicillin-resistant Staphylcoccus aureus, MRSA, prevalence

HS No. 7

SOLID PHASE EXTRACTION AND HPLC ANALYSIS OF COCAINE AND BENZOYLECGONINE IN URINE

Ma. Cristina B. Portilla², Mary Jane S. Masculino¹, and Cherrie B. Pascual*^{1,2}

¹Institute of Chemistry, University of the Philippines Diliman, Quezon Citv ²Research and Biotechnology Division, St. Luke's Medical Center 279 E. Rodriguez Sr. Blvd., Cathedral Heights, Quezon City

Cocaine is a drug of abuse extracted from the leaves of the coca shrub. This highly addictive drug is a strong central nervous system stimulant. Cocaine in the body is hydrolyzed in the bloodstream. One of its metabolites. benzoylecgonine, is more stable in the body than cocaine. Benzoylecgonine is also analyzed as a means to measure the extent of cocaine use.

HPLC analysis of cocaine and benzoylecgonine was carried out using a Luna C8 column: acetonitrile:phosphate buffer (pH 7.0) [70:30 v/v] mobile phase and UV detection at 275 nm. The retention times for cocaine and benzovlecgonine were 3.5 and 2.6 minutes respectively. Linear response was obtained within concentration range of 50-700 ng/mL for cocaine and 50-700 ng/mL for benzoylecgonine. The limit of detection was 1.88 ppb for cocaine and 1.50 ppb for benzoylecgonine. Solid phase extraction was utilized as sample pretreatment of urine samples spiked with cocaine and benzoylecgonine. Both compounds spiked in urine exhibited linear response over concentration range of 150-700 ppb added. Good recoveries were obtained for cocaine. However, low recoveries were obtained for benzoylecgonine in sample preparation have to be made for determination of benzoylecgonine in urine samples.

Keywords: cocaine, benzoylecgonine, HPLC, solid phase extraction, urine

HS No. 8

ANALYSES OF CERULOPLASMIN AND COPPER IN BOTH SERUM AND URINE FOR DETECTION OF WILSON'S DISEASE

Ma. Cristina B.Portilla¹, Cherrie B. Pascual*12 and Abdias Aquino³

 ¹Research and Biotechnology Division, St. Luke's Medical Center
 279 E. Rodriguez Sr. Blvd, Cathedral Heights, Quezon City 1102
 ² Institute of Chemistry, University of the Philippines Diliman, Quezon City 1101
 ³Institute for Neurosciences, St. Luke's Medical Center, Quezon City 1102

Wilson's disease is a relatively rare genetic disorder of copper metabolism, which affects one in 30,000 people worldwide. It is an autosomal recessive disease. In persons afflicted with this disease the mechanism of copper transport and excretion by the liver is impaired and there is progressive build-up of copper primarily in the liver. Multiple organ systems can be affected by these toxic levels of accumulated copper. Wilson's disease can cause irreversible damage to the brain and liver and may even cause death. In addition to evaluation of clinical symptoms, analyses of ceruloplasmin and copper in both serum and urine are utilized for detection of Wilson's disease. Ceruloplasmin is the copper containing protein, which normally binds 90% of copper present in the plasma. Ceruloplasmin analysis was carried out using a rate nephelometric analyzer while the copper in 24-hour urine and serum was determined using flame atomic absorption spectrophotometer (AAS).

This paper presents a case of Wilson's disease in a family of three male siblings. Two of them have the disease. Their ceruloplasmin and free serum copper and 24-hour urine copper levels were measured. Both have abnormally low serum ceruloplasmin (2 mg/dL vs. normal value of 25-63 mg/dL) and very high 24-hour urine copper levels (968 and 585 ig/day vs. max. of 60 ig/day for normal values). The serum free copper concentrations (0.21 ig/ml or less) were below normal values of 0.7-1.4 ig/ml. Their ceruloplasmin, free serum copper and 24-hour urine copper levels were monitored with drug therapy. Copper analyses of serum and urine was found effective in monitoring drug therapy.

This is the first documented case of Wilson's disease in a family in the Philippines.

Keywords: Wilson's disease; ceruloplasmin; free serum copper: 24-hour copper; genetic disorder

HS No. 9

CHARACTERIZATION. IDENTIFICATION AND ANTIBIOTIC SUSCEPTIBILITY TESTING OF AEROBIC AND FACULTATIVELY ANAEROBIC BACTERIAISOLATED FROM WOUND DEHISCENCE CASES ATTHE 1 AGUNA PROVINCIAL HOSPITAL

Jerico T. Ramos¹, Leah B. Flores¹ and Bernadette C. Mendoza²

¹Laguna Provincial Hospital. Sta. Cruz. Laguna ²Microbiology Division. Institute of Biological Sciences University of the Philippines Los Baños. College. Laguna 4031

A total of 36 bacterial strains were isolated and purified from the wound discharge specimens of seven wound dehiscence cases at the Laguna Provincial Hospital from July to October 2003 to determine the partial bacteriological profile. These were initially characterized using conventional methods and identified

through the appropriate Analytical Profile Index (API) system (API 20 E, API 20 NE or API Staph). The susceptibility of the clinical isolates to selected antibiotics was also determined using the Kirby-Bauer method.

Two out of the 36 isolates were Gram-positive, facultatively anaerobic and oxidase-negative cocci; the rest were Gram-negative bacilli. Six of the latter were obligately aerobic and oxidase-positive; the rest were facultatively anaerobic and oxidase-negative. All of the isolates were non-endosporeforming and catalase-positive. API identification revealed that ten of the 36 isolates were *Escherichia coli*, six were *Enterobacter cloacae*, five were *Enterobacter sakazakii*, three were *Proteus mirabilis*, two were *Staphylococcus aureus*, two were *Klebsiella pneumoniae*, one was *Klebsiella terrigena* and one was *Aeromonas salmonicida* subspecies *salmonicida*. Another was probably *Shewanella putrefaciens* while five were suspected to be *Burkholderia cepacia* strains. Majority (75%) of the isolates were members of the family Enterobacteriaceae.

In general, 66.7% (24/36) of the clinical isolates were susceptible to majority of the antibiotics to which they were tested against. However, 69.4% of the isolates (or 25 out of 36) also showed detectable resistance to at least one of the antibiotics used and that 85.7% (6/7) of the wound dehiscence cases harbored at least one antibiotic-resistant strain. Interestingly, 64% (or 16) of the 25 isolates tested against ampicillin. a commonly used antibiotic, showed resistance to the drug.

Keywords: wound dehiscence, bacteriological profile, antibiotic susceptibility. Analytical Profile Index (API). Kirby-Bauer method

HS No. 11

ANTIMUTAGENIC & ANTIBACTERIAL SECONDARY METABOLITES FROM THE LEAVES OF Viola odorata Linn. (Violeta)

Diana Rose M. Pesigan¹, Byron Michaelangelo M. Montaño¹, Ramona T. Tabang² and Joy G. Hofileña^{2*}

¹Department of Natural Sciences ²SCITECH R&D Center Polytechnic University of the Philippines, Sta. Mesa, Manila

Viola odorata, commonly known as Violeta is cultivated in the Philippines only for its fragrant flowers and as a border plant. Literature however
reported medicinal uses of various plant parts. We now report on the isolation of some bioactive secondary metabolites from the leaves of this plant.

The ethyl acetate extract of the leaves of *V* odorata was fractionated and purified by Gravity Column Silica Gel Chromatography to afford 33 mg of a semi-purified fraction labeled as **CD** and 1 mg of a pure isolate labeled as **A** appearing as a violet spot with an Rf value of 0.33 using 20% Ethyl acetate in Petroleum benzene as developer. The IR and UV-Vis spectrum of both isolates suggested the presence of ketonic and aromatic functionalities.

Fraction **CD** was evaluated for its antimutagenic potential by the Micronucleus Test. It was found to be antimutagenic with a percent reduction of 90.37% against Mitomycin-C induced mutations. These results are verified by Kruskal-Wallis statistics and Mean Comparison Test both at $\dot{a} = 0.01$ with 99% confidence level.

The TLC pure isolate A was evaluated for its antimicrobial properties. It was found that the pure isolate possessed moderate activity against *Pseudomonas aeruginosa* and inactive against *Escherichia coli* and *Staphylococcus aureus*.

Keywords: Viola odorata Linn. antimutagenic. antimicrobial

HS No. 12

LEAD (Pb) CONTENT OF SEAWEEDS CAULERPA RACEMOSA AND KAPPAPHYCUS EDULIS IN SAMARAND LEYTE.

Diana Cerbito Liguid-liguid1 and Leni G. Yap-Dejeto*2

Division of Natural Science and Mathematics University of the Philippines Tacloban College, Tacloban City, 6500

This study determined the lead content of the seaweeds *Caulerpa* racemosa and *Kappaphycus edulis* collected purposively from seaweed farms of Guiuan, Eastern Samar, Merida, Leyte and Leyte. Leyte. The seaweeds gathered were of the same age of planting to ensure equal rate of bioaccumulation from the environment. Determination was done by drying the samples. placing them in the furnace at 420°C, acid digesting in 4 ml concentrated nitric acid, filtering and adjusting the volume to 100 ml using deionized distilled water. Metal analysis was undertaken on standard atomic absorption spectrophotometer techniques.

The lead contents in the samples were compared using Q-tests and one-way analysis of variance. Differences were observed in lead content from the three different sites and between the different seaweed species.

Keywords: Lead (Pb). Seaweeds, *Caulerpa racemosa*, *Kappaphycus edulis*, Bioaccumulation. Leyte.

HS No. 13

EFFICACY OF FLORAL EXTRACTS OF FOUR GUMAMELA (Hibiscus rosa-sinensis) CULTIVARS AGAINST Staphylococcus Aureus

Blessie T. Jimeno¹, Jenny U. De Guzman¹ and Cynthia N. Paet-Lopez^{2*}

¹Department of Natural Sciences, College of Arts and Sciences ²Research and Development Management Office Lyceum-Northwestern University, Tapuac District, Dagupan City 2400

Gumamela (*Hibiscus rosa-sinensis*) flower is commonly used in the rural areas as a remedy for boils. The flowers are prepared into a poultice and applied directly over the affected area. An experiment was conducted to determine the efficacy of extracts from fresh, single-petal red, pink, orange and white gumamela flowers against *Staphylococcus aureus* the bacteria that causes boils and other skin infections. Crude ethanolic extracts were prepared and tested *in vitro* against *S. aureus* using disc diffusion method. CloxacillinTM was used as the control antibiotic.

Significant differences in the zones of inhibition were observed among the four floral extracts and control antibiotic. The highest zone of inhibition was obtained with CloxacillinTM (38.8 mm) followed by extracts from red flowers (21 mm) and orange flowers (10.5 mm). The extract from pink and white gumamela flowers showed no inhibition. The zone of inhibition produced by the red flower extract is not statistically different from CloxacillinTM. The results show that red gumamela flower is best for boils. Further experiments are being conducted utilizing other gumamela genotypes and test organisms.

Keywords: hibiscus. gumamela, floral extract

HS No. 14

MONTTORING OF MICRORIOU OCIC AL POTABILITY AND DETECTION OFPOTENTIALLY DIARRHEAGENIC BACTERIAFROM HAND-PUMPED WATER IN SELECTED BARANGAYS OF LOS BAÑOS, LAGUNA

Geralyn P. Garcia and Bernadette C. Mendoza*

Microbiology Division. Institute of Biological Sciences University of the Philippines Los Baños, College, Laguna 4031

Hand-pumped water samples obtained from five barangays of Los Baños. Laguna (coded SA, PU, MY, MH and LK) were monitored monthly for seven months (from July 2003 to January 2004) for microbiological potability testing using the Most Probable Number Technique and the Heterotrophic Plate Count (HPC) method. Potentially diarrheagenic bacteria namely. *E. coli, Salmonella, Shigella and Librio*, were monitored for in some of the samples using the Membrane Filter Technique and by plating on selective agar media.

In general, total MPN coliform and *E. coli* counts (expressed as MPN/ 100 ml) varied with the barangay source of the water and with the month of sampling. Majority of the water samples (68.6%) were confirmed to have coliforms: 52.3% had fecal coliforms (i.e., *E. coli*). The LK water samples consistently had the highest total coliform and *E. coli* counts during the entire sampling period. No water sample obtained from LK was, thus, accepted as safe for drinking whereas most of the samples from the PU source were microbiologically potable. It was also observed that coliform levels (including *E. coli*) in the samples collected generally peaked during the months of July to November.

The Heterotrophic Plate Counts (HPC) of the water samples ranged from 2.55×10^4 (from the PU pump) to 5.04×10^4 (from the LK pump). In accordance with the standards set by the Department of Health for the HPC of drinking water (10 CFU/ml), no water sample collected was potable.

E. coli and *Salmonella* were detected in 64% and 88%. respectively, of the water samples tested while isolates likely to be *Shigella* and *Vibrio* spp. were found present in all of such samples.

Keywords : microbiological potability, diarrheagenic bacteria, hand-pumped water. Most Probable Number (MPN), heterotrophic plate count

HS No. 15

HYPOLIPIDEMIC ACTIVITY OF MOMORDICA CHARANTIA L. (AMPALAYA) LEAF EXTRACTS ON THE BLOOD CHOLESTEROL LEVEL OF WHITE MICE(MUS MUSCULUS L)

Flordeliz R. Estira, Ma. Tereza A. Blanco and Erick L. Medrano

¹Biology Department . College of Arts and Sciences Mariano Marcos State University. Batac. 2906 Ilocos Norte

Hyperlipidemia is a condition in which the amount of cholesterol is relatively higher than the normal blood cholesterol level(BCL), which can lead to heart attacks. Heart attack happens when the blood supply to the part of the heart muscles is severely stopped or reduced within the arterial wall. The obstruction is a result of the formation of cholesterol plaque. The use of expensive commercial drug to prevent the occurrence of heart attacks is very common practice. This study aimed to find an herbal and less expensive but almost equally effective alternative to antihyperlipidemic drugs, in the form of *Momordica charantia* L.(Ampalava) leaf extract.

Crude leaf extracts of the plant were orally introduced in hyperlipidemic mice(*Mus musculus* L.) fed with boiled eggyolk for one week. BCL before and after induction of hyperlipidemia. and after introduction of the ampalaya leaf extracts(ALE) were determined. Three dosages of the ALE were used namely: Iml, 2ml and 5ml.Other set ups were also used namely: one for positive control(0.05 g/ml Lipigen) and one for negative control(Distilled Water).

Results showed a highly significant decrease in the BCL of mice on the first, second and third days after ALE introduction. The drug and 5ml ALE were comparable in lowering the BCL(BCL increment of .62mmol/L and .53 mmol/L respectively) on the first day of ALE introduction. Similarly, on the second day, the drug, 5ml ALE and 2ml ALE were comparable in their effect with BCL increments of .18..13 and .15 mmol/L respectively. However, on the third day, the 5ml and 2ml ALE were highly more effective than the drug in lowering the BCL of ALE treated mice with .123, .120 and .093 mmol/L BCL increments respectively. Results suggest longer BCL reducing effect of ALE than the drug.

Keywords: Hypolipidemia. Momordica charantia L. Mus musculus L

HS No. 16

RESPONDING TO THE THREAT OF ANTIMICROBIAL RESISTANCE CAUSED BY EXTENDED-SPECTRUM BLACTAMASES

Delia C. Ontengco*, Roberta S. Santiago, Leilani A. Baltazar, and Wilfredo M. Verar

Biological Sciences Department. Medical Affairs Division United Laboratories. Inc., Mandaluyong City

Multiple-drug resistance caused by extended-spectrum ß-lactamases (ESBLs) has emerged worldwide. ESBLs cause treatment failure with penicillins. cephalosporins and aztreonam despite in-vitro efficacy against Escherichia coli and Klebsiella pneumoniae. In 1998 we confirmed the presence of ESBLs using the Vitek ESBL test. Phase 1 of our 2000-2004 study showed that local ESBL-producing organisms have consistently increased from 2.1% to 6.2%. Susceptibility of these multiple-drug resistant isolates indicated few remaining treatment options: imipenem, amikacin, and tazobactam/piperacillin.

Early detection of ESBLs will prevent rapid spread of inter-species resistance within the hospital. During phase 2 of our study, we developed simple assays to detect ESBLs. Reduced sensitivity of these microorganisms to cefotaxime, ceffazidime. ceftriaxone. cefpodoxime, and/or aztreonam indicates ESBL-production. confirmed by an increased susceptibility in the presence of a ß-lactamase-inhibitor (BLI), usually clavulanic acid. Sulbactam, another BLI, is more stable at 37°C. Using sulbactam we modified the standard NCCLS ESBL test (MNC) and the inhibitor-potentiated disk diffusion test (MIP), employing cefotaxime, ceftazidime, and aztreonam (indicator drugs) against 45 ESBL-positive and 32 ESBL-negative isolates, with K. pneumoniae ATCC 700603 and E. coli ATCC 35218 as controls. In the MNC, the indicator drug disks. plus/minus sulbactam. were pressed on seeded MHA plates. A >5-mm increase in the inhibitory zone of the drug with sulbactam over that of the drug alone, was considered ESBL-positive. In the MIP, indicator drug disks were applied on inoculated MHA and subactain-supplemented plates. Augmentation zone widths of >10 mm were considered ESBL-positive. Results indicate that MNC and MIP are comparable in sensitivity, 97.8% (95% confidence level), to the Vitek test using aztreonam as indicator. With ceftazidime, MINC and MIP were sensitive at 95.7% and 93%, respectively; and with cefotaxime, 89.4% and 87.2%. Both methods exhibited 96.2-100% efficiency using aztreonam and ceftazidime. and 92.4-93.7% using cefotaxime. We conclude that these simple methods reliably detected ESBL-producing isolates.

Keywords: extended spectrum beta-lactamase, ESBL, *Escherichia coli*, *Klebsiella pneumoniae*, sulbactam

SOCIAL SCIENCES

SS No. 1

FARMER FIELD SCHOOL: A VEHICLE FOR ACCELERATING DISSEMINATION OF GRAFTED TOMATO TECHNOLOGY FOR OFF-SEASON PRODUCTION

Teotimo M. Aganon, Clarita P. Aganon, Aurea C. Roxas, Eduardo G. Marzan and Rolando V. Pagaduan

Central Luzon State University, Science City of Muñoz, Nueva Ecija

Tomato production in the country is generally a hit or miss enterprise and is fully dependent on climatic condition. This is because tomato production is concentrated during the dry months causing market glut from December to May and almost sky-rise price during wet-hot months. Seasonality occurs because existing tomato varieties are not tolerant of flooding and bacterial wilt problems.

Grafted tomato technology developed at the Asian Vegetable Research and Development Center was fine-tuned at CLSU and validated in different farmers' fields in Central Luzon. The technology is capable of producing tomato even during wet-hot months. The technology being new is confronted with skepticism from farmers and even agricultural technicians. To speed up adoption and dissemination it is necessary to convince the technicians of the utility of the technology so that they can convince farmers and entrepreneurs. Agricultural technicians and farmers underwent FFS as an extension approach to enhance adoption and dissemination of the grafted tomato technology. Increased number of adopters and volume of production enhancement of farmers' innovativeness and resourcefulness, improved commitment among state colleges and universities, local government units, and the Department of Agriculture were among the outcomes.

The increasing number of farmers adopting the grafted tomato technology is largely attributed to the actual experience during their participation in the FFS. because it is a "to see is to believe" approach in disseminating technology.

Keywords: grafted tomato, farmer field school, local government units, wet-hot months dissemination

SS No. 2

WHYARE RICE MARKETING MARGINS SO MUCH HIGHER IN THE PHILIPPINES THAN IN THAILAND?

David Dawe¹, Cheryll B. Casiwan^{2*}, Jesusa C. Beltran², Pie Moya¹

¹International Rice Research Institute, Los Baños, Laguna ²Philippine Rice Research Institute, Maligaya Science City of Muñoz, 3119 Nueva Ecija

Rice marketing margins are substantially greater in the Philippines than in Thailand despite many similarities between the two systems and despite findings by many analysts that Philippine rice marketing is competitive. This study attempts to explain the reasons for these higher marketing margins by measuring marketing costs in some detail in the two countries and interpreting those data in order to provide insights into the marketing process. We compared the rice marketing margin between Suphan Buri in the Central Plain and Bangkok (Thailand) with the margin between Nueva Ecija in the Central Luzon region and Manila (Philippines). We used data from semi-structured interviews with farmers, traders, millers, equipment manufacturers, and government officials in the two countries.

We found that rice marketing costs in the Philippines are higher than in Thailand, mainly due to higher interest rates in the financial system. However, the greater costs in the Philippines can only account for about a fourth of the difference in gross margins, leading to much higher returns to management. We conclude that the higher returns to management are in some sense "excess" profits. The persistence of these excess profits appears to be due to capital market imperfections and possibly restrictions on foreign investment.

Kevwords: rice. marketing margins. financial system

SS No. 3

WOMEN PARTICIPATION IN COCONUT-BASED FARMING SYSTEMS PROGRAM IN QUEZON, PHILIPPINES

Eleuterio G. Bernardo, Jeffrey Goh and Michael Loehvinsohn

SUNRISE International Inc. Manila, Philippines and International Service of National Agricultural Research (ISNAR), The Netherlands

Women in the locality have increased their role in managing coffee intercropped with coconut (30%), a cash crop that has generally been controlled by men compared with other intercrop, although it is not clear that this has translated into greater influence in deciding how proceed will be spent. However, diffusion of knowledge by graduates is strongly divided by gender, men diffusing mostly to men and women mostly to women. This fact heightens the importance of gender balance in the coconut-based farming systems (CBFC) approach/ composition, if benefits are to flow in roughly equal measure to men and women. The effect of these diffusion patterns on equity will depend to a considerable extent on the degree to which knowledge is shared within households. Uneven diffusion may well be a greater concern from the perspective of the resource poor coconut farmers in the area.

Keywords: coconut, gender, coconut-based farming systems, communication diffusion

SS No. 4

ARE RICE FARMERS THE POOREST OF THE POOR IN THE PHILIPPINES?

C. B. Casiwan^{1*}, J. C. Beltran¹, MJ.R. Nievera¹, A.B. Mataia¹, and David Dawe²

 ¹ Philippine Rice Research Institute. Maligava Science City of Muñoz. 3119 Nueva Ecija
² International Rice Research Institute. Los Baños. Laguna

Rice farmers are often perceived as poor. or among the poorest in the Philippines. Issues on food security and poverty alleviation revolve around rice

sufficiency and improved livelihood of the estimated 2.5 M rice farmers. While the anticipated lowering of domestic rice prices as a result of open trade will arguably benefit poor rice consumers. its potential negative impact on farmers' rice income is of great concern because rice is the staple food, and rice farmers and farm workers comprise an important part of the farming sector with key political and economic significance. This paper uses Family Income and Expenditure Survey (FIES 2000) and farm survey data to compare the living standards of rice farmers vis-à-vis other farmers. We use data not only on income, but also for expenditures and non-monetary indicators. We also locate geographic areas where poverty incidence among rice farmers is particularly high, and derive some implications for policy and research.

Results showed that while a significant percentage of rice farmers are undoubtedly poor as defined by the indicators used in this study, corn and coconut farmers, fishermen, and landless laborers are substantially poorer. These latter groups have less income, spend less money on dietary protein, are able to hire less labor to work their farms, have lower quality houses, are less likely to have electricity and water faucets in their homes, and are less likely to own a television or refrigerator. This implies that while policies in favor of rice farmers are very much in order, it is also important to consider the potential impacts on poorer segments of the society and strike a balance that is fair to all.

Keywords: rice farmers, poverty, living standards, poverty incidence

SS No. 5

PUBLIC KNOWLEDGE, ATTITUDE, AND PERCEPTIONS ON RICE BIOTECHNOLOGY RESEARCH IN THE PHILIPPINES

Alice Mataia*1, Grace Cataquiz¹, Ruth Francisco¹, Iva Sebastian¹, Maricar Bernardino¹, And Mahabub Hossain², and Lolita Garcia²

¹PhilRice, Maligaya, Science City of Munoz, 3119 Nueva Ecija ²International Rice Research Institute, Los Banos, Laguna

This study assessed the level of public awareness or knowledge, and determined the attitude and perceptions of key persons in research institutions, mass media, religious groups, private companies, farmer groups, the academe, and public organizations, and policymakers, legislators, and government officials on rice biotechnology research in the light of recent developments in the fieldtesting and commercialization of rice biotechnology and its products in the Philippines. Primary data were collected through mailed and group surveys among purposively selected respondents nationwide. Results indicated that although rice biotechnology is still new to them, a big percentage of the respondents had a high level of awareness, yet only close to half of them had correct understanding of the technology. They had ambivalent attitude toward rice biotechnology regardless of their level of knowledge of it. as affected by its perceived risks and tangible benefits such as on food safety and environmental impacts. Other concerns are on multinational corporations control over local agriculture and on ethical problems in gene manipulation and transfer. Their attitudes also differed based on the purpose of rice biotechnology research application. They were conditional about the field-testing and commercialization of transgenic pestresistant rice, while they supported the same for vitamin A- and iron-enriched rice. They see potential benefits of these rice products in meeting nutritional problems among Filipino children.

Keywords: rice biotechnology. attitude. perception, public awareness

SS No. 6

SUSTAINABLE FOOD-FEED SYSTEMS AND IMPROVED LIVELIHOOD OF THE POOR IN RAINFED RICE AREAS: SOCIOECONOMIC COMPONENT (PHILIPPINE CASE)

Rowena G. Manalili^{*}, Grace C. Cataquiz, Guadalupe O. Redondo and Mary Jane Nievera

Philippine Rice Research Institute Maligaya, Science City of Muñoz. 3119 Nueva Ecija

Given the domestic and international challenges faced by the rice sector, there is a need to explore potential cropping and livestock systems and modalities that can increase profitability and savings and ultimately reduced poverty. A good modality that appears to have a promising edge in upgrading the agriculture sector ability to hurdle its current challenges is the exploration of rice-based crop-animal systems. However, these systems have been fragmented and have lacked the holistic focus to address the constraints inhibiting the full exploration of its economic potential. The extent of interaction between crops and animals and the direction of development of integrated crop animal systems (ICAS) among rice-based farming households given the various changes in the socioeconomic environment were determined. Data used was from the community survey and profiles of target sites. Focus group discussion was conducted to elicit information from knowledgeable persons in the barangay. Optimal use of resources in crop-animal interaction at the household level was determined using Linear Programming, Animal production can augment the income of rice farmers. Sales from animals could be a source of capital for rice production and finance household expenditures. Animal by-products are also used as fertilizers while crop by-products serve as feeds of animals. Crops planted after rice increased income of rice farmers by 36%, depending on the crops planted and factors of diversification such as availability of adequate water, land suitability, climatic condition, availability of management technology, time constraints caused by the presence of rice crop. farmers' preference, resource base, influence of neighboring farmers or extension agents, and land tenure. Diversification towards feasible farm production combinations that yield the best economic returns over time is essential if the rice-based systems are to survive the basic levels of market competition: commodity markets and tight competition for the alternative uses of land resource base

Keywords: sustainable food-feed systems, integrated crop animal system, ricebased farming systems, linear programming, optimal use of resources, diversification, socioeconomics

SS No. 7

ENHANCING CROP-LIVESTOCK PRODUCTIVITY AMONG SMALLHOLD RAINFED FARMERS IN PANGASINAN

FeL. Porciuncula¹, Edwin C. Villar², Sonny N. Domingo², Edgar A. Orden¹, Marilyn D. Lilagan³, Angelita G. Fabia³, Arcely B. Robeniol³, Alice D. Noche³ and Richard Dulay¹

¹Central Luzon State University. Science City of Munoz, Nueva Ecija. ²Livestock Research Division, Philippine Council for Agriculture, Forestry Natural Resources Research and Development. Los Banos, Laguna ³Local Government Units of Pangasinan

Concerted efforts to boost smallhold farm productivity in rainfed areas need to be done. The Crop-Animal Systems Research Network (CASREN) Project works with farmers, extension workers, researchers and local government units (LGUs) to increase productivity of crop-livestock systems. The project targets to develop and disseminate technologies through participatory approaches and enhance the capability of farmers, extension workers and researchers. CASREN Phase I (1999-2001) focused on technology development in Umingan. Pangasinan and CASREN Phase II (2002-2004) which expanded in Balungao. Sta. Barbara and Calasiao. Pangasinan is development-oriented as it reaches out and serves many more smallhold rainfed farmers.

Participatory methodology was used in almost all activities to ensure proper fit between project interventions and needs/preferences of target clienteles. Rather than adopt the dole out scheme. CASREN focused on capability building and tapping of LGUs to gain semblance of local ownership.

A total of 477 farmers with 2.407 specific technology adoptions have been documented in the Pangasinan sites. The technologies adopted included feeds and feeding technologies for goat and cattle. sustainable parasite control. food-feed system and genetic upgrading. Livestock performance and economic benefits greatly improved during the cropping year 2003-2004. Income contribution per farm from crops remained higher at an average of 51% valued at P31.000.00. Contribution from livestock generally increased from a mere 10-15% in 1999 to an average of 49% in 2004 with an estimated net value of P29.000.00.

There is much potential in increasing the productivity of smallhold farmers through better crop-livestock integration and treating livestock production as an enterprise. The developed packages of technologies proved to be viable for wider dissemination using a workable participatory approach. Greater participation. support and commitment of farmers, extension workers, researchers and the LGUs, therefore allowed for effective and sustainable structure which proved critical in adopting technologies and in increasing crop-livestock productivity.

Keywords: crop-animal system. crop-livestock productivity, participatory approach