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*AGRICULTURE FOR THE 3s: Economy, Environment and Energy*

**ABSTRACTS OF PAPERS**

**PLENARY SESSION**

**EXAMINING ENERGY – ECONOMY – ENVIRONMENT LINKAGES TO SUPPORT  
RURAL DEVELOPMENT INTRODUCING ENVIRONMENTALLY FRIENDLY  
AGRO-INDUSTRIAL CLUSTER BASED ON LOCAL SPECIALTY**

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As the global climatic change is arisen, many are beginning to see that there is a unity of the single system of energy, environment, and economics. Many questions arose, what is the state of global climatic change and the country dependency on fossil fuels? What effort should the country do on conservation and renewable energy resources? What is the CER trading? Who will get the benefits? Do we need to make tradeoffs in balancing these values along with the imperatives of energy supply, economic growth, environmental sustainability? The answers to these questions require new tools of analysis and a model of energy-environment-economy linkages is a tool, may be useful for policy in formulating the development focused on sustainability.

This paper presents one possible framework for describing energy-economy-environment linkages to support rural development. The model will be based on some considerations: 1) all economic activity requires materials and energy drawn directly and indirectly from the environment and, these materials and energy are returned to the environment as waste materials, 2) the economy consists of the activities : as production, distribution and consumption undertaken by humans, and 3) there is a dependent relationship of sustainable development and the requirement of improving living standards of rural people. Having the target of improving standard of living of rural people without ignoring the linkages to the environment, then the idea of introducing environmentally friendly agro-industrial cluster based on local specialty may be one alternative to promote rural development in Indonesia.

The development of the agro-industrial cluster based on local specialty will attract a group of businesses concentrating on the same economic activity in one region, consolidating this social and productive network and strengthening it to develop a suitable economy of scale in the region which will adopt environmentally friendly technology in the production process both on-farm and off-farm. And further, re-grouping major local agribusiness/agro-industries, research institutions and all other support organizations will foster an efficient sharing of resources, information and know-how and at the same time maintaining the specificity of the region. Such a mechanism, through an integrated national effort, will impart a better competitive advantage to local entrepreneurs to access bigger market shares. The implication of such movement is for better rural growth and minimizing environmental impact.

## **SUSTAINABLE DEVELOPMENT FOR PADDY INDUSTRY IN MALAYSIA**

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Two of Malaysian major policy challenges are to feed its increasing population and to increase the income of farmers in order to eradicate poverty. This is in addition to the growing population, urbanization and higher living standards and the associated increase in demand for land exert great pressure on food production (Roetter and Van Keulen, 2007). These challenges are faced against the background of decreasing availability of natural resources for agriculture such as water and arable land, and declining labour availability, as a result of rapidly increasing competition from other sectors. Moreover, the policies aimed at conservation of environmentally vulnerable areas also decrease the availability of farmland resources.

As a result of the Green Revolution, Malaysia has increased the level of self-sufficiency in rice, but the associated use of fertilizers and biocides causes increasing public concern. The high inputs of fertilizers and biocides increase production costs, and cause serious environmental, occupational and public health problems, which all bear significant social costs. Loss of N and P from farmland is one of the major causes of eutrophication of rivers and pollution of groundwater. Another possible consequence of the intensive use of biocides is that pest organisms develop resistance to insecticides, reducing their efficiency in protecting crops. To stimulate paddy production, increase farmers' income and alleviate the adverse effects of agrochemicals on the environment and human health, the Malaysian government has implemented various policy measures in recent years. Priority has been given to agricultural research and price support to increase yields and mitigate the adverse effects on the environment and human health caused by the use of agrochemicals. Therefore, the effectiveness needs to be assessed of different crop and livestock production technologies in attaining rural development goals, i.e. increasing paddy production, increasing farmer's income and reducing negative environmental impact. The recent price increase in rice, which was mainly due to limited supply and energy crisis, were a reason for great concern for the Malaysian government. As self-sufficiency in rice is a long-term national policy objective of Malaysia, favourable policies, i.e. a tax reduction, direct subsidy on seed, subsidy on purchase and a minimum farm gate price for rice, were implemented in 2006 (DOA,2007). Another, equally important goal is to increase farmers' income. In addition to rice self-sufficiency, Malaysian policy also pays attention to protection of the environment through research on and extension of input-saving technologies such as improved nutrient management and integrated pest management. Therefore, the sustainable agriculture involved production methods of paddy that are healthy, do not harm the environment, respect workers, provide fair wages to farmers, and support farming communities. Sustainable agricultural practices can both feed people and protect the environment include the land that use to plant the paddy, source of water and other ecosystems that harbour biological divers, sustainable agriculture can be measured also in two main concepts that include economic and healthy environment .

However, in order to practice this sustainable agriculture in paddy production, there are some challenges that must be faced such as limitation of land, low yield, pest and disease, suitable variety of paddy, encourage the corporate sector to invest in sustainable agriculture, high cost of production and application of mechanization, automation and technology and low involvement of young generation in this sector. To achieve sustainability, the constraints that threaten it must be alleviated, and major efforts must be made in increasing productivity to meet immediate demands of growing global population. 10 Matrix Tone Paddy Production Project is one of the projects that has been established by the government in order to promote sustainable paddy production in Malaysia.

**PHILIPPINE AGRICULTURAL EDUCATION FOR THE 3E'S: ECONOMY,  
ENVIRONMENT AND ENERGY**

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After World War II concerted efforts have been exerted by countries in search for an approach to increase yield and boost agricultural production to end global hunger. One ground breaking approach is the development of genetically modified crops and high yielding varieties. A package of technology that includes improved seeds, fertilizers, pesticides and new-farm technologies which rely on heavily irrigated system was promoted especially to the so-called third world countries. This approach indeed has increased crop yield; however, environmentalists realized that it is not economically and environmentally sustainable. In the Philippines, agriculture is one sector of the national economy that is strategically important for the developing countries. It accounts for 20% or one-fifth of the gross national product (GNP) and supplies the major source of raw materials on which the whole economy of the country depends. It is also the second biggest contributor to employment with 37% of the country's labor force engaged in it. However, the phenomena that pose threats to agriculture itself and to the natural environment are the existing agricultural ill-practices and climate change. These phenomena must be addressed by responsive agricultural education. Agricultural education is a critical tool for social transformation wherein agricultural production must consider the context of sustainable development. Unfortunately however, there has been a progressive decline in enrollment in agricultural colleges and universities in the Philippines wherein the environment stewards- the agricultural educationists are dwindling in number. Its one hundred seventy (170) agricultural colleges and universities have been experiencing declining enrollment with young high school graduates going for business courses as number one choice and new interest in medical and allied courses especially nursing as second choice.

Another phenomenon that must be addressed by agricultural education is climate change, the country being at the receiving end of its effects like sea level rise, strong rains and typhoons of calamity proportion. Greater consciousness on climate change is pushing more countries to look for alternative fuel such that those that can be contributed by biofuel. The Philippines' carbon footprint is minimal but much is required to adapt to this phenomenon. Given these challenges, the paper shall then discuss the initiatives of Bicol University and other state colleges and universities in the Philippines to address the declining enrollment in agriculture, forestry and natural resources in order to sustain the vital manpower resource for agriculture as well as to redirect agricultural education interest toward agribusiness and sustainable development.

**DIVERSIFICATION AND VALUE CREATION OF AGRICULTURE IN THAILAND  
SUGARCANE: A CASE STUDY 3ES**

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Thailand is a major exporter of agricultural commodities like rice and sugar. Thailand's agriculture based economy with an area of 21 million hectares contributing to the GDP and generating employment to majority of the population (approx. 5.8 Million households; OAE 2006). Through government policies and investment in research and development there has been a major emphasis on the increased productivity and value creation in major crops in Thailand. Though increased use of farm chemicals are consequences for increased agricultural growth, steps to move towards use of bio control agents, IPM and mechanization to reduce the use of chemicals have made the agriculture sustainable and environment friendly.

The depletion of fossil fuel and the rising cost of imported fuel necessitated the utilization of alternative sources of energy with agricultural based bio- energy as the ideal choice. Thailand has been the major player in this sector. Though the controversy of food crops against the energy crops came into light, sugarcane, cassava and oil palm and sugar industry is a fore runner in meeting the demands of the 3Es economy, environment and energy. Sugar cane and sugar industry has seen a great growth through a number factors *viz.*, technological advances and diversification in situ.

Thai sugar industry (46 sugar mills) with core business is sugar, where capacity expansion to high productions, improvement in cane area and cane productivity was brought about by initiation of eesearch and development for "sustenance"and "development"

Diversification of core business of sugar into various by products has paid dividends to the Thai economy. With major players like Mitr Phol group where the diversification has been into particle boards (utilization of fiber, bagasse) which can replace wood for furniture, cogeneration (the use of bagasse or fiber to generate electricity) supplying electricity to the government, and ethanol (using molasses through fermentation). The ethanol is the green energy for a clean world. The environmental impacts are clearly seen in the particle board and ethanol plants by reducing felling of trees and reduced carbon dioxide and green house gases. The future contribution of sugarcane to the economy of the country is envisaged through value creation by diversification into functional foods and nutritional food.

*In a nut shell, sugarcane plays an important role in Thailand agriculture in sustenance and development of the economy through sugar and bio-energy in a safer environment.*

**EFFECT OF ENVIRONMENTAL FACTORS ON BIOLOGICAL CHARACTERS AND GRAIN QUALITY OF VIETNAMESE FOXTAIL MILLET (*SETARIA ITALICA* L.)**

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Foxtail millet (CM), a plant with high nutrient and higher heavy metal content in grain, is suitable under drought conditions. Using millet grain to produce food nutrient for human is necessary. In this study, we collected foxtail millet germplasm and selected variety with high grain yield and grain quality in each ecological region as well as build up cultivation technique in Vietnam. Total of 11 varieties of foxtail millet collected in Vietnam were described and distinguished their botanical characters. Among them, 4 varieties (CM1, CM9, CM10 and CM11) were selected to estimate the correlations among photosynthetic rate, stomatal conductance, transpiration rate and dry matter accumulation under irrigated, drought and recovering condition in a pot experiment.

A field experiment was conducted to estimate the affection of three ecological regions such as Gialam (Red River Delta with at altitude of 5 – 20 meters), Bacha (Northern mountainous region with at altitude of 600 - 1000 meters) and Sapa (Northern mountainous region with at altitude of 1500 – 1800 meters) on several agronomic characters *viz.*, growth duration, dry matter accumulation, grain yield and grain quality in four varieties. The average growth duration of all millet varieties were longer in Sapa (136 days) than in Bacha (130 days) and Gialam (108 days). The average grain yield of all millet varieties was the highest in Sapa (2.7 ton ha<sup>-1</sup>) than in Bacha (2.0 ton ha<sup>-1</sup>) and Gialam (1.1 ton ha<sup>-1</sup>), contributed to both the larger number of spikelets per panicle and the higher 1000-grain weight. The highest grain yield was observed in CM1 in Gialam, whereas it was found in CM9 in Bacha and Sapa. This was due the different varietal response to temperature, water supply and/or radiation. It was found that ecological regions affected protein, lipid and amylose content in millet grain.

Another field experiment was conducted to study the effect of nitrogen (N) fertilizer on grain yield and grain quality of two foxtail millet varieties (CM1 and CM9) in Gialam. As application four levels of N fertilizer (0, 30, 45 and 60 kgN per ha), grain yield was the highest in CM1 at 60 kgN level (2.78 ton per ha), but highest in CM9 at 45N level (3.02 ton per ha). This was due to the higher chlorophyll content at vegetative growth stage and dry matter accumulation at heading stage. However, at high N fertilizer the grain quality decreased.

Further technology would be studied on using millet grain for commercial food nutrient product.

## SCIENTIFIC SESSIONS

### PERFORMANCE OF THE DIFFERENT VARIETIES OF CUCUMBER (*CUCUMIS SATIVUS*) USING KAKAWATE LEAVES AS MULCHING MATERIAL

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Cucumber is known for its edible fruits because it is delicious, crispy, high in nutrients, low in calories and excellent source of fiber needed for a healthy digestive system. Since this is a warm temperature vine vegetable, it is then imperative to produce carefully the crop in order to maintain better quality for maximum production. This could be possibly achieved by using kakawate leaves as mulching material because of the multiple benefits derived from it. Evidently, it could be utilized as botanical pesticides, as green manure, not withstanding its regular usage as firewood and could be used as post due to its durability. The study was conducted from September to December 2007 in Naglaoa-an, Sto. Domingo, Ilocos Sur, Philippines. It aimed to compare the response of the different varieties of cucumber using kakawate as mulching material and to determine the yield performance of promising varieties of cucumber. The variety trials were laid out in a Randomly Complete Block Design (RCBD) with four replications as follows: *Variety 1–Ilocos White*, *Variety 2–Batangas White*, *Variety 3–Poinsett 76* and *Variety 4–Governor (Hybrid)*. Based on the four varieties of cucumber harvested, there were no significant differences on the yield. *Governor (hybrid)* yielded the best result with a total harvest of 36,195.23 kg/ha, followed by *Batangas white* and *Poinsett 76* with total harvests of 32,680.95 and 18,428.58 kg/ha respectively. *Ilocos white* had the lowest yield, 16,390.17kg/ha. Yield differences were attributed to varietal differences and potentials.

### PHENOLOGY AND YIELD OF FENNEL (*FOENICULUM VULGARE L.*) AT DIFFERENT PLANTING PATTERNS

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Fennel (*Foeniculum vulgare L.*) is a plant from Apiaceae family, and its essential oil is used for soothing, cleansing and toning effects on the skin, while at the same time improving circulation and fighting water retention and puffiness. Effects of different planting patterns on phenology and yield of fennel was evaluated at Islamic Azad University of Tabriz, Iran, in 2007. Studied factors were row spacing (80, 90, 100 cm) and intra-row spacing (5, 10, 15, 20 cm). The treatments were arranged factorially based on randomized complete block design in three replications. Seed essence was extracted by steam water distillation method. Data were analyzed by MSTAT-C software and means were compared with Duncan's multiple range test. Results revealed that plant phenology were delayed, when density increased, and time to 50% flowering stage and harvesting time in planting pattern of 80\*5 cm were happened 5 and 11 days later than 100\*20 cm, respectively. Number of umbrellas per plant was influenced by plant spacings, and was greater in 90 cm row spacing treatments. Thousand seed weight increased in spaced treatments, that was expected. Seed yield of fennel ranged from 989 kg ha<sup>-1</sup> to 849 kg ha<sup>-1</sup> (14% reduction), which was related to higher side branches per plant of fennel, with increasing of intra-row spacing. Essence yield of fennel reduced 33% in 100\*5 cm compared with 90\*20 cm planting pattern. It is recommended for fennel growers in region with planting pattern of 90\*20 cm they will obtain higher grain and essence yield.

## **RESPONSE OF RICE YIELD TO CONTROLLED RELEASE UREA**

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High nitrogen (N) loss is one of the key problems faced by rice farmers. Nitrogen use efficiency in rice is often low due to high N loss through volatilization, leaching and denitrification. One of the approaches to improve N efficiency is by using Controlled Release Urea (CRU). The CRU generally out-performed the granular urea fertilizer in reducing N losses, stimulating plant growth, releases nutrients during the entire growing-season, increases N concentrations and yield. The performance of different types of CRU was therefore compared with granular urea in a field experiment with rice variety MR220. This study compared the effect of six different types of CRU fertilizers on rice yield with urea (control). Bakau series (Typic Tropaquept) was used in this study. Rice plants were grown in cylindrical culverts measuring 90 cm in diameter x 60 cm in height. The soil was filled up to 40 cm height and 20 cm space from the top of the culvert was to hold water. Flow regulators were attached to the culvert for adjusting required water level. The soil was flooded and pre-incubated for three weeks to stabilize their physio-chemical properties before sowing. The experiment was conducted using a completely randomized design (CRD) and replicated three times. Six different types of CRU evaluated for two planting seasons on the same plot. Fertilizer was applied once throughout the study. For both seasons, CRU treated plants had a significantly higher rice yield, 6 t/ha and 6.2 t/ha, than urea-treated plants 3.7 t/ha and 2.2 t/ha, for first and second planting harvest, respectively. It can be inferred that CRU performs significantly better than granular urea. This is important, considering the usually high N losses in rice growing area. From this study, Meister-20, Meister-27, CDU Uber-10 and CRU Duration Type-V can be used as single application for 2 seasons in rice planting. There is a prospect of using CRU to increase rice yield and N efficiency and can be used for two season planting with single application of CRU fertilizers.

## **EFFECTS OF ETHYLENE STIMULATION ON RUBBER BIOSYNTHESIS GENES EXPRESSION IN *HEVEA BRASILIENSIS* LATICIFERS**

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Ethrel<sup>®</sup>, an ethylene releaser, is widely used in rubber estates to enhance latex yield production. However, stimulation induces a decrease in the latex dry rubber content (DRC). Our research focused on how ethylene might affect the expression of the genes involved in the rubber biosynthesis pathways. Kinetic effects of ethylene on untapped and 4 months-tapped trees of the PB217 rubber clone were studied, using 1/2S d2. Seven batches of 3 trees were set up: two batches for control (no stimulation) and 5 batches with 5% Ethrel<sup>®</sup> treated for 4, 8, 16, 24 and 40 hours before the first tapping. The second tapping was performed 2 days later. The same experiment was performed on the same trees 4 months later. Latex total RNA were extracted and the cDNA were synthesized. Randomized Complete Block Design with 3 replications was set up for gene expression analysis by real time RT-PCR. Results showed that the genes involved in the isoprene unit synthesis through the mevalonate rubber biosynthesis pathway, were markedly down-regulated by ethylene from both the 1<sup>st</sup> and 2<sup>nd</sup> tapping of virgin and tapped trees. Only HMGR3 was up-regulated. The genes involved in

polymerization of isoprene units into rubber molecules showed down-regulation by ethylene. In addition, the genes involved in isoprene unit synthesis through the DXP/MEP isoprenoids pathway such as DXPS and DXPR were also down-regulated by ethylene in both the 1<sup>st</sup> and 2<sup>nd</sup> tapping of virgin and tapped trees. Conversely, the invertase gene encoding the enzyme involved in the entry of glycolysis, which produces the carbon skeleton for the whole cell anabolism and rubber biosynthesis, was up-regulated by ethylene in both virgin and tapped trees. Ethylene stimulation might favor the whole latex cell cytoplasm regeneration through increase in primary metabolism, at the expense of rubber synthesis.

#### **EFFICIENT AMPLIFICATION OF HEAVY AND LIGHT CHAIN VARIABLE REGIONS FOR THE CONSTRUCTION OF NON-IMMUNE PHAGE SCFV LIBRARY**

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The system of non-immune phage scFv library is one of the most attractive technologies currently available for therapeutics, diagnostics and basic scientific research. It offers rapid isolation of the antibodies of interest that could be applied directly to drug delivery systems, antibody therapy and disease diagnostics. However, the success in construction of this library has limitation due to the inefficient cloning of antibody genes from non-immune donors. One problem is caused by inability to design RT-PCR primer sets to cover all of the antibody diversity. In order to overcome this problem, we described two-step amplification of VH and VL by PCR method. First, we generated total cDNA by using Oligo dT primer, then VH and VL genes were amplified from the signal sequence to joining region. Second, the VH and VL products from the first step were amplified by using degenerate primer sets which could amplify the VH and VL genes from framework region 1 (FWR1) to joining region (J). Finally the scFvs were obtained from PCR overlapping extension method. Fifteen transformants were submitted to sequencing and the diversity of full-length scFv sequences belonged to 36-60.2pg51, 61-1P, 7183.9, D6.96 and J558.32, J558.81.87, J558.32 of heavy chain families and V<sub>κ</sub> 4-57, 19-13, 19-15, 19-17, 19-32, 21-12, at4 and kk4 of light chain families were obtained. Colony hybridization assay showed that eighty percents could be expressed which confirmed the efficiency of this strategy and primer sets for construction and expression of antibody library.

#### **MODELING OF *PSEUDOMONAS* SP. GROWTH IN COOKED DICED CHICKEN MEAT FROM POULTRY INDUSTRY**

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Ready to eat chicken is easily to spoil when it was stored under unsuitable temperature. A specific model for assessing shelf-life of cooked chicken meat at difference temperature could be useful decision-making tool. Experiments were conducted to validate a predictive model for describing the growth of spoilage microorganism in ready to eat chicken. The cooked diced chicken meat samples from poultry industry were used in the study. *Pseudomonas* sp. was determined to be



specific spoilage microorganism (SSO) of cooked diced chicken meat. Growth rate measurements of isolated *Pseudomonas* sp. on cooked chicken meat at 9 temperatures ranging from 5 to 25 °C were collected to compare to *Pseudomonas* spp. growth rate at difference temperatures extracted from published data. Initial concentration of *Pseudomonas* sp. used was 3 Log CFU/g. The square-root or Ratkowsky equation was used to model the data. The accuracy and bias factors between the growth rates on cooked diced chicken meat and the model relating published *Pseudomonas* spp. growth rates and temperature were 1.097 and 0.91, respectively. The validation parameters showed close agreement between the model and observation. However, the bias factor indicated model under-predicts growth rate. Plots of observation vs. predictions revealed the higher experimental growth rate of *Pseudomonas* sp. on cooked diced chicken meat, as points above the equivalence line. The residual plot for predictions vs. observations had almost positive residuals. Therefore, when the predictive model will be used to predict shelf- life of cooked diced chicken meat, other factors beside temperature should be taken into account.

### **EXPRESSION OF RECOMBINANT COAT PROTEIN (CP) OF *CITRUS TRISTEZA VIRUS***

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*Citrus tristeza virus* (CTV) is one of the major threats for the production of citrus worldwide. Polyclonal antibodies either produced from the recombinant coat protein (CP) of CTV or purified viral particles from infected midrib used for the detection of virus. In comparison, the purified virion was a laborious procedure and with contamination from plant proteins, when use of recombinant CP antigen resulted in highly specific polyclonal antibodies without cross reaction with plant protein. A CTV *cp* gene clone contained 666bp long from Thailand MSh-141 isolate collection was used for expression of recombinant protein. A forward primer CTV-CP1 and reverse primer CTV-CP2 was designed to amplify and clone and express the *cp* gene into pET160/GW/D-TOPO vector and transformed to  $\alpha$ DH5 *E. coli* competent cell. Two clones harboring the correct orientation insertion were selected for transformation into BLD21 star (DE3) expression *E. coli* cell and their recombinant protein expressions capacity and optimum length of time were studied after inducing with 1mM IPTG. The optimum time for recombinant protein production was investigated. The large scale production of recombinant CP and produced protein was purified using Ni-NTA resin. Result on sequence analysis of extracted plasmid used for mass protein was similar to MSh-141 isolate. Moreover the expression of recombinant CP was very high for the cloned CP with pET160/GW/D-TOPO vector expressed in BLD21 star (DE3) *E. coli* cell compared with the initial clone induced. Inducing protein for 4 hour after addition of 1mM IPTG gave optimum amount of recombinant protein expression with molecular weight approximately 25 kDa which is similar to previous research works. The purified protein from this experiment will be used to immunize rabbit or chicken for production of polyclonal antibodies for detection of CTV using ELISA or immunochromatography.

### **FINITE ELEMENT MODELING OF STAINLESS STEEL FIN PLATE FOR MICROWAVE-VACUUM DRYING OVEN**

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The objective of this research was to study, design and determine the stainless steel fin plate that is used to support the microwave domestic oven structure to apply for microwave-vacuum drying

chamber in laboratory level by using finite element method (FEM). A detailed three-dimensional finite element model has been created using the Solidwork software and simulated using the COSMOS software. The fin plate size base on the best simulated result has been selected for testing in the strength experiment. Then, the simulated result was compared with the experimental result. The compared results showed a good agreement between both methods. From analysis results, the stainless fin plate size 254x330x3 mm is the best size to apply for microwave-vacuum drying chamber in laboratory level.

#### **ACHIEVEMENTS IN COST REDUCTION AND EFFICIENT OPERATION OF THE THAI SUGARCANE SUPPLY CHAIN VIA OPTIMIZATION MODELING**

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More effective cost reduction and efficiency improvement in sugarcane harvesting and transportation are needed to maintain current status of the Thai sugar industry in a competitive international market. A mechanized resources allocation plan provides one such opportunity. This study found that the allocation of mechanical harvesters and trucks to reduce the cost in sugarcane harvest influenced the profit distribution among the three groups involved: sugarcane farmers, the owners of the trucks and mechanical harvesters, and sugar factories. These groups usually do not have common interests. A mechanized resources allocation plan should be considered together with acceptance of the plan gained from the engaged groups. Therefore, multi-objective optimization (MOO) was applied in this study to find a compromise solution. The parameters used in the MOO model were evaluated by using a simple sugarcane harvesting and transportation simulation derived from the field study in Udon Thani province, northeastern Thailand. An area of 10 km by 10 km, covering 248 sugarcane fields, was used in our computational experiment. The compromise solution obtained from MOO was more acceptable than the solutions obtained from single-objective optimization. The main factors influencing cost were the distance to a sugar factory, field size, and their interaction. In addition, cost reduction and efficient operation in mechanical harvesting and transportation were achieved. The percentage of reduction in operating cost was 4 to 9% while the percentage of decrease in the number of working days per unit area was 4 to 43%.

#### **PRODUCTIVITY AND EFFICIENCY OF SUGARCANE PRODUCTION IN NORTHERN THAILAND**

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Sugarcane, one of Thai major export crops has recently received great attention as an important bio-energy. Since demand for cane increases so as to meet sugar and ethanol demand, the rise in total production of cane is expected from higher productivity rather than expansion of cultivated land. This paper aims at investigating yield of sugarcane in response to fertilizer, technical efficiency and factors determining efficiency levels. Production data of crop year 2004/05 were collected from interviewing 98 sugarcane growers in Sukhothai Province, the major cane producing area of Northern Thailand. The yield of cane was nonlinearly responsive to nitrogen (N), and

phosphorus (P). The average efficiency at 87% indicates substantial room for efficiency improvement. Whilst production size caused diseconomy and thus reduced efficiency, use of farm machinery, education and experience levels boosted efficiency significantly.

### **EFFECTS OF IRRIGATION INTERVALS, NITROGEN RATE AND SPLITTING ON ESSENCE YIELD OF GERMAN CHAMOMILE (*MATRICARIA CHAMOMILLA* L.)**

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German chamomile (*Matricaria chamomilla*), is a very important medicinal plant. In order to study the effect of irrigation intervals and nitrogen on the yield and essential oil content of German chamomile, split plot factorial experiments were established in the university of Tabriz, Iran. Treatments were irrigation intervals ( $I_1=6$ ;  $I_2=12$ ,  $I_3=18$  days), nitrogen rate ( $N_1=23$ ;  $N_2=46$ ,  $N_3=70$  kg  $ha^{-1}$ ) and nitrogen splitting ( $T_1= 100\%$  at planting time;  $T_2= 50\%:50\%$  at planting and stem elongation stages,  $T_3= 25\%:50\%:25\%$  at planting, stem elongation and early flowering stages, respectively). The highest heads per plant observed in  $I_2T_2$ , but reduced 53%, when irrigation intervals increased up to 18 days and total amount of nitrogen was applied at planting or at planting (25%), stem elongation (50%) and early flowering (25%) stages. Equally application of nitrogen at planting and stem elongation stages increased dry flower yield up to 351 kg  $ha^{-1}$ . Flower essence increasing value in  $I_2N_2$  was calculated 75%, in comparison with three limited irrigation treatments. Essence yield ranged from 1.56 l  $ha^{-1}$  up to 3.63 l  $ha^{-1}$ . Addition of nitrogen from 23 to 46 kg  $ha^{-1}$  increased essential oil yield from 2.3 to 2.9 l  $ha^{-1}$ . Nitrogen splitting had significant effect on essence yield. Irrigation interval of 12 days and equally application of 46 kg nitrogen/ha at planting and stem elongation stages of German chamomile would insure higher essential oil yield.

### **PERFORMANCE OF SIX CHICKPEA ACCESSIONS UNDER BENGUET AND MT PROVINCE CONDITION**

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Chickpea (*Cicer arietinum* L.) is a new introduced crop in the Cordillera and has one of the highest nutritional compositions of any edible legume. The study sought to introduce, evaluate yield performance of chickpea accessions in Benguet and Mt. Province condition. These six accessions had been evaluated in nine sites under different elevations (720 to 1,525 meters) above sea level. The percentage pod setting ranged from 54-57%. Kabuli type had 54% pod setting while desi type had 57% pod setting. Occurrence of fog with long cloudy condition and very close planting distance tend to lower pod setting and average seed yield/plant. Kabuli type varieties had higher seed yield than desi type varieties because of its bigger seed size. Total seed yield showed that desi type varieties had lower yield with 800 to 900 kg/ha than kabuli type with 1,000 to 1,200 kg/ha. Cutworm (*Agrotis ipsilon*) had 20% infestation during the vegetative stage while pod borer (*Helicoverpa armigera*) had 30% infestation during the pod development and at harvest. Chickpea stunt caused by virus had 10% infection, while collar rot (*Sclerotium rolfsii*) and Sclerotinia stem rot (*Sclerotium sclerotiorum*) showed 5% infection during the vegetative and early reproductive growth stage. Chickpea was found to be adaptable under Benguet and Mt Province conditions.

## ECONOMY PARTICIPATORY EVALUATION OF SWEETPOTATO FOR WINE AND JUICE PROCESSING IN THE CORDILLERA

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Sweetpotato is a plant with diverse features, such as: its skin and flesh color vary from white, cream, yellow, orange, red, purple, dark pigmentation with anthocyanins. Sweetpotato was described based on these characters to come up with a good quality processing type cultivar for wine and juice making. This study was done to collect sweetpotato cultivars in sweetpotato growing areas of the Cordillera, characterize, evaluate yield and select the cultivar suitable for wine and juice processing. This has been conducted in Sagada, Mt. Province; Banaue, Ifugao and La Trinidad, Benguet. Forty-seven (47) sweetpotato cultivars were collected and evaluated. The collections from Mt. Province cv. *Ayotan* had the highest yield of 13.85 tons/ha. In order to add more varied colors, cvs. *Bengueta*, *JK 27*, *JK 2001*, and *Tinipay* were included because of their dark-orange, yellow flesh colors, a carotene-rich source, and are high yielding cultivars. These cultivars were selected for wine and juice processing and found acceptable. However, cv. *Haponita* had the highest acceptability ratings for wine and juice making. The acceptability rating was influenced by the color, appearance, taste and flavor. Sweetpotato wine had higher ROI as compared to sweetpotato flavored juice. Sweetpotato juice had an ROI of 4.49% - 7.60%, while 29.45% to 51.28% for sweetpotato wines. The alcohol and sugar content of wines evaluated ranged from 7.04 - 9.36% and 15.3 to 17.0 brix<sup>0</sup>, respectively. These wines were found acceptable by the consumers.

## CHANGES IN THE PHYSICO-CHEMICAL PROPERTIES AND ASSIMILATE PRODUCTION OF DEVELOPING YOUNG *ZINGIBER OFFICINALE* RHIZOME INTRODUCED TO SOILLESS CULTURE

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Recent study to exploit an alternative method for year round and sustainable production of young or green *Zingiber officinale* had adopted the soilless-fertigation culture under controlled environment system. Initial finding had shown enhanced early growth at 14 week after planting, increased fresh rhizome weight at 47~87%, abundant, good quality sized rhizomes and possibility of year-round production. The finding on the quality of rhizome was, however, not conclusive and hence requires immediate attention. Rhizome quality having high content of flavonoids, is an important determinant of the final use and the economics of rhizome. Quality rhizome is also measured as having good physico-chemical such as fiber-free rhizome as in high quality young or green *Z. officinale*, a designated choice grade that fetches a premium price. Rhizome growth and quality are, however, easily influenced by growing micro-environment especially moisture. However, information bridging the micro-environmental factors with physico-chemical qualities, assimilate production and flavonoid contents, especially in soilless culture of *Z. officinale*, are still lacking for proliferation of commercial value and interest. The paper discusses the changes in the quality of developing young *Zingiber officinale* rhizome in terms of the physico-chemical properties and assimilates production, when introduced to soilless-fertigation culture. The finding serves as basic information for continued study to establish precise cultivation technique for sustainable production of quality young *Z. officinale* production under soilless-fertigation culture in the tropical lowlands, particularly for anticancer activity.

**WILL ELECTRIC FIELD ENHANCE GERMINATION RATES AND SEEDLINGS GROWTH OF SOYBEAN (*GLYCINE MAX* L.), RADISH (*RAPHANUS SATIVUS* L.) AND PAPAYA (*CARICA PAPAYA* L.)?**

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Electromagnetic field (EMF), a non-ionizing radiation exists in abundant in the vicinity of high voltage power lines, which covers a large area of the agricultural land. The study on the effects of EMF on biological system has been rare in Malaysia. Therefore, the study on high voltage effect on seed germination would provide new and important knowledge to the agricultural industry. The effect of high electric field as a seed treatment on soybean, radish and papaya was simulated at the High Voltage Lab, Universiti Teknologi Malaysia. The high electric field strength used in the study was 0, 10, 20, 40, 60, 80, 100 and 120 kVm<sup>-1</sup>. The results on germinating soybean seeds showed increased germination rates at 10, 60 and 100 kV/m, while increased germination rates for radish and papaya were obtained from the treatments at 100 and 60 kVm<sup>-1</sup>, respectively. High electric field (60 kVm<sup>-1</sup>) treatment on germinating seeds also resulted in increased seedling growth of soybean, radish and papaya.

**EFFECT OF PIG MANURE EXTRACT AS FOLIAR APPLICATION ON PLANT GROWTH, CHLOROPHYLL CONTENTS, LEAF EXPANSION AND YIELD OF CASSAVA (*MANIHOT ESCULENTA* CRANZ) CV. HAUYBONG 60**

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Pig manure is a problematic farm waste but containing all nutrients required by plants. This study sought to utilize pig manure extract (PME) as source of nutrient for cassava production. The plants were subjected for five treatments as follows; 1. No fertilizer, 2. Chemical fertilizer 21-10-10 at 40 kg/rai applied at 45 days after planting, 3. Foliar application of PME, 4. Soil application of PME, and 5. Foliar and soil application of PME. PME as foliar or soil application was done every month from 45 until 245 days after planting and harvested after 10 months. The plants with foliar and soil application of PME had the highest yield of 12.73 ton/rai. Chlorophyll contents in all fertilizer applications decreased in the first 4 months, increased until 6 months and decreased again at 8 months after planting. There were significant differences in chlorophyll a, chlorophyll b and total chlorophyll content at 4 months after planting where foliar and soil application of PME showed the highest chlorophyll contents. Leaf expansion (LAI) gradually increased from 3 to 6 months after planting but was reduced after 6 months due to the reduction of leaf canopy except those on chemical fertilizer application. There were no significant difference in plant height and stem diameter of the plants. Soil and foliar applications of PME provided higher starch content of roots. The difference in soil strength was 39%. The higher yield always found in the low soil strength plots. The application of PME as a soil and foliar fertilizer could provide higher roots yield than chemical fertilizer application.

**EFFECT OF TEMPERATURE ON MASS DIFFUSIVITIES IN DRAGON FRUIT  
(*Hylocereus undatus*)**

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Mass diffusion of water and solids during osmotic dehydration of dragon fruit flesh was studied. Dragon fruits with commercial maturity that had average total soluble solids to titratable acidity ratio equal to 46.65 were used in the experiment. Dragon fruit flesh were cut into a rectangular shape with a dimension of 5×5×1 cm, then osmotically dehydrated in the solution of sucrose, sodium chloride, calcium chloride, potassium sorbate, and potassium metabisulphite in the amount of 55, 2, 0.15, 0.25, and 0.25 grams, respectively in 100 grams of water for 5 hours at the temperature of 30, 40 and 50°C. It was found that the moisture contents of dragon fruit flesh decreased rapidly at the first 30 minutes and slowly decreased when the time increased. The solution temperature significantly had an effect on the moisture content ( $p < 0.05$ ). Water diffusivity increased with increased temperature and had a value of  $6.45 \times 10^{-10} \pm 0.48 \times 10^{-10}$ ,  $7.17 \times 10^{-10} \pm 0.32 \times 10^{-10}$  and  $10.02 \times 10^{-10} \pm 1.88 \times 10^{-10}$  m<sup>2</sup>/s for 30, 40 and 50°C respectively. Arrhenius model could be used to describe the effect of temperature on the diffusivities. The results showed that the temperature of the osmotic solution significantly increased solids gain percentage, and water loss percentage ( $p < 0.05$ ).

**EFFECT OF FOLIAR APPLICATION OF SUGARS AND PLANT GROWTH  
REGULATORS ON FLOWER QUALITY OF JASMINE (*JASMINUM SAMBAC AIT*) IN  
COOL SEASON**

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Flower carbohydrate contents had effects on flower quality of jasmine. NAA and GA<sub>3</sub> can promote elongation of plant organ. The objective of this study was to determine the concentration of glucose fructose and sucrose on flower quality and additive effect of NAA and GA<sub>3</sub> on enhancement jasmine flower size. The experiment was divided into two parts. In part I, the concentration of sugars on flower quality were examined. One percent aqueous solution of glucose, fructose and sucrose and the mixture of glucose and fructose at 0.5% each were sprayed to the jasmine trees when the flower was 2 mm. during cool period in November. The result showed that foliar spray of sugars increased flower width and length when harvested at fully mature unopened stage. However, flower weight and petal length of the treated plants were not improved by such treatment. In part II, aqueous solution of 1% sucrose and 1% fructose, mixture of 1% sucrose and 0.1 ppm NAA, 1% sucrose and 0.1% ppm GA<sub>3</sub>, 1% fructose and 0.1 ppm NAA, 1% fructose and 0.1% ppm GA<sub>3</sub> were sprayed to jasmine trees for 3 days intervals within 3 weeks when the flowers had the same stage as in part I. In the 1<sup>st</sup> week after the last application (WALA), sugars and plant growth regulator applications increased the quality of flowers especially increased flower fresh weight, flower width, petal length when compared to the untreated plants. The mixture of sugars and NAA or GA<sub>3</sub> gave better results than spraying each sugar alone. In the 2<sup>nd</sup> WALA, sugar and plant growth regulator applications increased only flower width. In the 3<sup>rd</sup> WALA, there was no difference between chemical treated plants and untreated plants. The results indicated that additive effects of plant growth regulators and sugars could improve flower quality of jasmine better than only sugar application.

## EFFECT OF CHEMICAL SUBSTANCES ON INDUCING BUD BRAKE AND IMPROVE FLOWER QUALITY OF JASMINE (*JASMINUM SAMBAC* AIT) IN COOL SEASON.

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The main problem during growing jasmine (*Jasminum sambac* Ait) is inhibition of growth during cool season, which a few blooming and decreasing in flowers size. This problem affected diminishment of yield and caused high price during this season. The purpose of this experiment was to control flower bud dormancy using different types of dormancy regulating chemicals (DRCs) and study the role of sorbitol and gibberellic acid (GA<sub>3</sub>) on improvement flower quality in cool season. The effect of potassium chlorate (KClO<sub>3</sub>), thiourea and potassium nitrate (KNO<sub>3</sub>) on hastening flower bud break were studied. Foliar application of 1% thiourea, 2.5% KNO<sub>3</sub>, and 2000 ppm KClO<sub>3</sub> when the flower was 2 mm. during cool period in November were more effective in inducing flowering than untreated plants. Although thiourea could induce 100 % flowering but it gave the lowest flower weight, flower length, flower width and petal length. The effects of sorbitol and GA<sub>3</sub> on improvement flower quality were also studied. Before treatment, thiourea was sprayed to induce abundant flower in cool season. When flower reached 2 mm. in length, 0.25 % and 0.50 % sorbitol and 0.1, 0.5 and 1.0 ppm GA<sub>3</sub> were sprayed to jasmine tree for 3 days intervals in 4 times. Factorial in completely randomized design was used in this experiment. Interaction of sorbitol and GA<sub>3</sub> was not found in this experiment. However, sorbitol alone increased flower length and flower width and GA<sub>3</sub> alone increased flower length, increased petal length and flower width. In the cool season, DRCs particularly thiourea may be used to regulate flower bud break, after flower buds reach 2 mm., spray of sorbitol and sugar increase flower size. This method can overcome the problem of reduced flowering and flower quality of jasmine in cool season.

## EFFECT OF SELENIUM AND IODINE ON GROWTH PERFORMANCE AND SOME CARCASS CHARACTERISTICS OF MEAT GOATS

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Trace elements are minerals that in small quantities are essential for the normal health and function of humans and animals. Iodine is important in the synthesis of thyroid hormone that plays an important role in regulating growth. Selenium is important as an antioxidant and promotes health and immune status of animals. This study sought to determine the effect of supplementation of iodine and selenium at levels higher than the NRC requirement for growing goats on their growth performance and carcass characteristics. Twenty four male local crossbreed goat, 6-9 months of age and placed in individual pens, were randomly assigned to four dietary treatments namely, Treat C, control (60% guinea grass, 40% concentrate), Treat 2 (control + 0.6 mg/kg DM selenium), Treat 3 (control + 0.6 mg iodine) and Diet 4 (0.6 mg selenium and 0.6 mg iodine/kg DM), respectively. The concentrate contained 43% palm kernel cake, 30% rice bran, 25% corn, 1% CaCO<sub>3</sub>, 0.5% NaCl, 0.5% mineral-vitamins mix. At the end of the 100 day feeding trial, there were no significant differences in final weights among the treatments. However, the live-weights of goats fed Treat 3 (26.3 kg) and Treat 4 (26.7 kg) appeared to be higher than those of the control (25.7 kg) and Treat (25.7 kg). There were no

significant differences in the dressing percentages and hot carcass weights. The iodine supplementation, and iodine in combination with selenium may have a positive effect on the growth performance of meat goats.

### **PRELIMINARY STUDY OF PARTICLE BOARD PRODUCTION FROM RICE HUSK USING ALKALI PULPING PROCESS**

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Rice husk is an abundant waste material from agriculture in Thailand and utilization will be beneficial to both economy and environment. As a lignocellulosic material, rice husk should be able to be treated by alkali pulping process to produce rice husk pulp which can be used to form sheets. This research is intended to be preliminary study of using rice husk for particle board production. Rice husk pulp was produced by boiling rice husk with sodium hydroxide for 4 hours. The ratio of NaOH to rice husk is 1:10 dry weight. Rice husk pulp samples were refined with kitchen blender for 2, 5 and 7 minutes. The samples were spread on screen to form a sheet of about 3 mm. thickness to dry under sunlight for 5 days. The 7 minute sample was selected because of its most suitable appearances to form sheet. The sheet was cut, two sheets were pressed together using metallic pres and heated to 140, 160, 180, 200 and 220°C an electric oven for 3 hours. The strongest particle board was formed from heating at 220°C. So far, no bonding agent was used. There are also potential uses of pulping wastewater to obtain valuable products. After neutralized by using carbon dioxide, a gel-like material precipitated from the wastewater. Using baker's yeast for fermentation test, a small amount of gas was collected from the remaining wastewater flask.

### **INFLUENCE OF THE ANISOTROPY OF PLANT TISSUE AND THE ORIENTATION OF APPLIED ELECTRIC FIELDS ON ELECTROPERMEABILIZATION**

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The phenomenon called electropermeabilization of cell membranes has been known for several decades, and has recently received increasing attention for the manipulation of cells and tissue. The influence of the anisotropy of plant tissue and the orientation of applied electric fields on electropermeabilization was investigated. Apple parenchyma was selected as a model tissue since it contained a high degree of cell size distribution. Different tissue regions were viewed under the microscope to study cell size, shape and orientation. In a parallel experiment, cylindrical samples of tissue were subjected to pulsed electric fields and the change in electrical resistance was measured by the voltage-current method. The measured electrical resistance during pulsing was then converted into a permeability index which defined the relative change in electrical resistance compared to the electrical resistance of frozen/thawed tissue that served as a reference of completely damaged tissue. Electrical impedance was also measured to monitor the tissue changes as affected by pulsed electric fields. The results showed that elongated cells taken from the inner region of the apple parenchyma, responded to the electric fields in different ways. Fields of lower intensity were required to permeabilize these cells when the fields were applied parallel to the longest axis of the cells. Other field orientations resulted in greater applied electric fields being required to permeabilize the cells. No field orientation dependence was observed for round cells that belonged to the outer region of the apple parenchyma. A condition in which a high degree of permeabilization during pulsing and very



small change after pulsing were observed could be obtained at a low applied field intensity of about 200 V/cm.

### OPTIMIZATION OF IMMATURE EMBRYO TISSUE CULTURE IN IRANIAN BREAD WHEAT CULTIVARS

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Improvement of wheat (*Triticum aestivum*) by biotechnological approaches is currently limited by a lack of efficient and reliable tissue culture methodology. In this report, immature embryos of seven Iranian bread wheat cultivars were used to evaluate their ability of callus induction, green spot formation, shooting and regeneration frequency. Seven wheat cultivars were evaluated using four embryogenic callus induction medium and three regeneration medium in a split-split plot based on completely randomized design with 4 replications. Analysis of variance showed a significant difference between cultivars for all the *in vitro* traits studied except percentage of callus induction after 30 days from culture. Significant difference was found among callus induction media for all the studied traits. The cultivar X callus induction medium interaction was significant for percentage of callus induction, volume of callus, percentage of green spot, number of green spot per callus, percentage of shoot formation, and regeneration frequency. The effects of regeneration media and its interaction with cultivar and callus induction medium were significant for percentage of green spot, number of green spot per, percentage of shoot formation, regeneration frequency. The results showed that Atilla-50Y followed by Alvand were the best cultivars for callus and embryogenic callus induction. Mean comparison of callus induction mediums showed that medium B2 was not suitable for callus induction but this medium performed well for embryogenic callus induction. The medium containing MS (Macro+Micro) + Thiamine-HCl + L-Asparagine + 2,4-D + Maltose + Agar was best for callus induction as well as embryogenic callus production. Regeneration medium containing MS (Macro+Micro+vitamins) + myoinositol + IAA + BAP + Sucrose + Agar acted better than the others. Interaction of B\*C expressed that combination of B2C1, B2C3 and B3C3 medium were the best for callus induction, green spot and shooting in Atilla50Y, Atrak and Alvand/Tajan cv., respectively. *In toto* Atilla50Y and Alvand cultivars were better than others for callus formation and regeneration. The results suggest that by selecting only calluses producing early green spots the experimental efficiency will be increased.

### THE DESIGN AND FABRICATION OF A DUAL-POWERED FOLIAGE CHOPPER FOR BOTANOPESTICIDES PREPARATIONS

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In the Philippines, the search for environment friendly natural products from plants like kakawate (*Gliricidia sepium*) and other plants has conquered many farmers in the countryside through organic farming practices. But preparations of botanopesticides are hampered by the lack of equipment. Thus, a dual powered foliage chopper (DPFC) was designed and fabricated using a rotating shaft mounted with four (4) rotary chopping blades wrapped around the 16 inch long cylinder on its surface. It contains also eight (8) fixed chopping board plates mounted in the inner surface of

the assembly. It is powered by foot pedal and an electric motor. The machine chopped 1 kg leaves kakawate by foot and electric motor in 8 min. and 5.55 min. respectively while seaweeds (*Sargassum sp.*) by foot and electric motor in 10 min. and 8 min., respectively. The chopped materials can pass through a 0.02 cm mesh. One unit of the newly-designed DPFC costs P 30,465.00.

#### **THE EFFECTS OF SEED COATING SUBSTANCES ON CHEMICAL AND BIOCHEMICAL PROPERTIES OF RICE SEEDS CV. KDML 105**

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Fungicides may cause phytotoxicity induced seeds deterioration. Thereafter, during storage a number of biochemical and physiological changes occur. Loss of viability is associated with disturbances of the cell membranes, nutrients losses and losses of enzyme activities. This study sought to investigate the effects of various seed coating substances; chemical fungicide (captan; CA), and biological fungicide polymers [chitosan-lignosulphonate polymer (CL) and eugenol incorporated into chitosan-lignosulphonate polymer (E+CL)] on chemical and biochemical properties of rice seeds cv. KDML 105, which have been stored for 12 months. CA significantly affected the rice seed viability and the associated deterioration. Total protein content decreased accompanied by decline of lipid content, increase of free fatty acids and activation of lipoxygenase enzyme. In the case of biological fungicide coated seeds, the antioxidative scavenging enzymes were ascorbate peroxidase and superoxide dismutase and a high antioxidant activity protected them. The biological coated seeds were found to maintain high sugar contents inside the seeds which resulted in high seed storability significantly. In contrast, under fungicide stress (CA), those compounds were lost that directly affected seed vigor during storage. This results suggest that sucrose may serve as the principal agent of stress tolerance in the seeds, whereby the larger oligosaccharides serve to keep sucrose from crystallizing. The application of biological seed coating substances by CL and E+CL may be a promising strategy to improve the direct-seed rice production system.

#### **THE EFFECTS OF SOME PLANT GROWTH REGULATORS ON THE ROOTING OF NARIG (*VATICA MANGGACHAPOI BLANCO*) AND MAYAPIS (*SHOREA PALOSAPIS BLANCO*; MERR.) JUVENILE CUTTINGS USING NON-MIST PROPAGATION**

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Dipterocarps have erratic flowering and fruiting characteristics. To ensure continuous supply of quality planting materials of these economically important trees, a non-mist propagation study was conducted to assess the rooting responses of juvenile cuttings of two dipterocarp species - mayapis [*Shorea palosapis* (Blanco) Merr.] and Narig (*Vatica manggachapoi* (Blanco) - to various concentrations of indole butyric acid (IBA), naphthalene acetic Acid (NAA), and Superthrive Vitamin Hormone (StVH). It also aimed to develop rooting protocols for such species intended for mass

propagation. IBA induced the highest rooting percentage of mayapis and narig as compared with NAA and StVH. IBA 100 ppm and 150 PPM induced a high rooting percentage by 82.29 and 87.45%, respectively which was not statistically significant. In terms of the number of roots developed, no significant differences were observed among varying IBA concentrations tested (50ppm, 100ppm and 150ppm) but was significantly different from the control and StVH. Root lengths did not significantly differ among treatments. The rooting of narig, on the other hand, was 92.50%, 88.33% and 75.83% at 500 ppm, 250 ppm IBA and StVH, respectively. The lowest rooting percentage was obtained under 500 ppm NAA.

## **A REMOTE SENSING APPROACH TO ESTIMATE STAND DENSITY IN OIL PALM**

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The conventional method used to determine oil palm stand density is to perform tree census using manual labor. Typically, oil palm tree census is performed annually to quantify i) productive palms, ii) non-productive palms, iii) supply palms and iv) unplantable palm points. Information derived from tree census is used to determine allocation of crop inputs. In Malaysia, the cost of performing tree census manually ranges between RM1 and RM5 per hectare. Apart from the sizeable cost, this method is also prone to human error. This paper demonstrates the potential use of satellite imagery as a means to perform tree census in oil palm. This work was carried out in a commercial oil palm plantation located in Sagil, Johor, Malaysia. Archived satellite imagery (2005) of the plantation was obtained via Google Earth with a spatial resolution of 4 m, without any cost. Five study plots (polygons) were demarcated on the imagery based on planting year and soil type. Each polygon was geo-referenced and to aid ground truthing operations. Image processing was performed using MapInfo Professional Version 8. Tree counting on the imagery was done using the MapInfo 'mark' tool based on tree canopy pattern at nadir viewing. Ground truthing was done using a global positioning system (model: Trimble Geo Explorer XH). Results showed a high correlation between the number of trees counted on Google Earth imagery and that counted on the ground. This finding suggests that satellite remote sensing can offer an alternative means of estimating oil palm stand density. This technique is not only cost-effective but also reasonably accurate.

## **TREE TRUNK INJECTION TECHNIQUE: ENVIRONMENTAL AND COST EFFECTIVE METHOD OF CONTROLLING PINE SHOOT MOTH (*DIORYCTRIA RUBELLA* AND *PETROVA CRISTATA*) ON CARIBBEAN PINE (*PINUS CARIBAEA* VAR. *CARIBAEA*)**

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Every plant needs its own, specially-adapted method of pest protection. Caribbean pines (*Pinus caribaea* var. *caribaea*) are fast growing tropical pine species not native to the Philippines, mostly cultivated for its timber. At present, it has great potential as a landscape tree. Unfortunately, Caribbean pines in the Philippines are being destroyed by insects, notably pine shoot moths (*Dioryctria rubella* and *Petrova cristata*). These problems indicate the need for alternative pest control technique/procedure because these pests often occur sporadically. Conventional spraying of insecticides is seldom an appropriate means of pest control, either from an economic or environmental point of view. A pest control technique has been adapted involving injection the systemic insecticide directly into the trunk. An ArborJet Tree I.V. Kit Injection system was acquired and ArborJet "stinger

method” was used to treat the estimated five thousand 3 to 4 year old Caribbean pine trees planted as primary landscape trees at a high-end Swiss-inspired residential development project site. Infected pine trees were injected with acephate systemic insecticide solution at 5 milliliter per inch at DBH (diameter at breast height). Average DBH of pine trees is between 4 to 10 inches. Four treatments were performed during the study trial namely: control; trunk injection (Acephate); basal application (Furadan 3G); and conventional spraying (Cymbush). The trial showed that the tree trunk injection technique of delivering chemical pesticide is the most cost effective and environmentally sound method of controlling pine shoot moth infesting Caribbean pines in the Philippines.

## **TESTING FOR INTEGRATION IN BENGUET VEGETABLE MARKETS**

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The general objective of the paper is to determine whether the vegetable market for cabbage, potatoes and carrots is spatially efficient. It is efficient if prices are fully transmitted between farm-to-wholesale or farm-to-retail levels or if prices changes in geographically separated markets move in unison between market levels that prohibit traders from obtaining abnormal profit. Two approaches are used to test for market integration: (1) the Ravallion model, and (2) the cointegration analysis. Two sets of prices are used: the wholesale prices collected in La Trinidad, Baguio Hangar, Urdaneta, Pangasinan, Balintawak and Divisoria markets in November 2003 for testing cointegration and farm, wholesale and retail prices from January 1998 to March 2008 for the Ravallion model. The results of the cointegration analysis revealed that all original price series for the three vegetables are confirmed to have a unit root. Generally all price series are significant which implies that they are directly related to each other. The outcome of the Ravallion analysis confirmed the abovementioned findings. There is market integration between Benguet vegetable trading centers and their market destinations. Wholesale prices from reference markets were immediately transmitted to wholesale markets in Benguet. Local price history has a significant contribution to the formation of current wholesale prices albeit in low amounts. The market information system and communication facilities contributed to vegetable market integration in vegetable trading in Benguet and its market destinations. An efficient marketing information system is important to maintain and enhance the connectedness of Benguet markets with its various market destinations. The following recommendations can improve the connectedness between markets: (1) establishment of communication facilities in production areas; (2) adequate budget to be given to the Bureau of Agricultural Statistics (BAS) to ensure the collection and timeliness of needed market information; (3) market reporters to be trained on quality monitoring of prices and other relevant market information; and, (5) farmers and traders to be trained on proper postharvest practices and grading. A strict enforcement of a good grading system for vegetables increases the meaningfulness of price quotations reported in market news.

## **INCREASING THE PRODUCTION AND REPRODUCTIVE EFFICIENCY OF NATIVE GOATS**

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The project emphasis was to increase the production and reproductive efficiency of native goats as one of the options of increasing food production and agriculture development. The conception rate of native does mated with purebred buck like *Toggenburg* had increased; the gain and weaning weight of kids sired by purebred buck were also improved, compared to those mated with

native buck. Raising systems like the range, confinement, semi-confinement and tethering had the same effects in the final weight, gain in weight, dressing percentage and carcass quality of goats. However, goats raised in the range were most profitable. The mixing of 25% rice bran and 75% hog grower mash had effected the highest final weight, gain in weight, heart girth, dressing percentage, net profit and return of investment to grade goats given as feed supplements. The feeding of ground corn given as feed supplement in combination of tamarind leaves had improved the gain in weight, feed intake, dressing percentage and reduced cost of feed required per kilogram gain in weight. Furthermore, feeding of tamarind leaves combined to the basic diet effected highest Return of Investment. Napier was better soilage supplement than *Auri* leaves giving heavier final weight and higher dressing percentage of fattening goats. However, the 75% Napier + 25% *auri* leaves was the best mixing level and most economical. The mixture of 50% para grass and 50% peanut stover was the best forage combination for higher dressing percentage and more economical than giving native grasses. The mixture of 75% *Napier* and 25% *Lombay* leaves yielded higher final weight, gain in weight, feed consumption, dressing percentage, and require less cost per kilogram gain in weight, hence, more economical than giving native grasses.

#### DETECTION OF HUANGLONGBING DISEASE OF CITRUS IN THAILAND BY MOLECULAR AND SEROLOGICAL TECHNIQUES

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Huanglongbing (HLB) disease, previously known as citrus greening disease, is one of serious disease of citrus cultivars in Thailand. The disease causes by *Candidatus Liberibacter asiaticus* (CLA), the uncultured on synthetic media, and phloem sieve tube restricted bacterium. Disease symptoms are resemble Zn-deficiency symptom, yellowing of new leaves, and molting with blotchy of fully expanded leaves and usually associated with corky veins which make difficulty to diagnose. HLB in Thailand was found in pomelo, tangerine, kaffir lime, sweet orange and lime. Three detection methods were developed and compared for specific detection of HLB from several *Citrus* spp. in Thailand. The detection techniques were polymerase chain reaction (PCR), DNA dot blot hybridization (DBH) and enzyme-linked immunosorbent assay (ELISA). Two specific primers and probe were used for PCR and DHB techniques whereas antiserum against RPLJ protein of HLB was produced for ELISA technique. Results demonstrated that all three developed methods were highly specific only to HLB disease of *Citrus* spp. throughtout Thailand. Therefore, all three developed methods could be used to detect and diagnose of HLB infected citrus samples, that is more accurate and reliable than symptom observation. However, further development of lateral flow serological method should provide an easy to use and accurate detection of HLB.

#### DETECTION OF *ACIDOVORAX AVENAE* SUBSP. *CITRULLI* IN PLANT SAMPLES USING ENZYME-LINKED IMMUNOSORBENT ASSAY

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The seed-borne bacterium *Acidovorax avenae* subsp. *citrulli* (Aac) causes fruit blotch in watermelons. The precise diagnostic techniques are essential to epidemiological studies, disease management and quality control for exporting disease-free seeds. In this study, we produced mouse monoclonal antibodies (MAb) against the sonicated cell suspension of Aac. MAb, designated 11E5, was selected for further immunoassay development since it reacted specifically with only Aac and did not cross-react with other bacteria including closely-related bacteria in the Family *Comamonadaceae*, other phytopathogenic bacteria, bacteria isolated from diseased cucurbits and saprophytic bacteria from watermelon seed. MAb 11E5 detected an Aac protein band at a molecular weight of approximately 170 kDa in western blot analysis. Plate-trapped antigen ELISA (PTA-ELISA) and sandwich ELISA were compared for detection of Aac in plant samples using MAb 11E5. The results from this study showed that plant sap somehow interfere the detection of Aac in PTA-ELISA. Sandwich ELISA could improve sensitivity to Aac detection in plant sap. The sensitivity of sandwich ELISA was at least 1000 times higher than that of PTA-ELISA in detection of Aac in plant sap. We successfully differentiated between Aac-infected and healthy plant samples using sandwich ELISA. Ultimately, we will apply this method to detect this bacterial disease in seed samples for export industries.

### ESTIMATION OF HEAVY METALS LOADING OF ANAEROBIC DIGESTED ANIMAL MANURE SLURRY

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Closed-system anaerobic digestion has the potential to eliminate most of the lagoon emissions while conserving more nutrients and producing a renewable energy source as an additional benefit. In addition, the anaerobic digestion process creates potentially valuable by-products with available nutrients and animal manure is a significant source of heavy metal input such as copper (Cu) and zinc (Zn) which have been used as feed additives. This study aims to estimate the heavy metal balances in anaerobic digested slurry (ADS), grass and forage crops, and grassland soil accumulation based on the loads of heavy metal from animal digested slurry to grassland and forage cropping area, and the uptake of these elements by grass and forage crops. Three feed crops; *Lolium perenne* L. (PRG), *Phleum pratense* L. (TY) and *Lolium multiflorum* Lam. (IRG) were grown. Feed crop field plots (1a turf-type) had been treated 2 years with dairy manure ADS, swine manure ADS, and chemical fertilizer included no added fertilizer as a control for each crop. Fertilizer application amounts  $200 \text{ kgN ha}^{-1}\text{y}^{-1}$  was determined by equalizing the ammonium nitrogen contained within the recommended commercial fertilizer with the ADS for each. Potassium (K)  $320 \text{ kg K}_2\text{O ha}^{-1}\text{y}^{-1}$  and phosphorus (P)  $240 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}\text{y}^{-1}$  were applied followed regional recommended rate; however in ADS, K was exceeded the application rate because of the high contents in ADS. Fertilizers were applied three times per year, 1/2 in spring and 1/4 in the summer and fall after harvesting. The loads of Cu and Zn from ADS to grassland and forage cropping area were 1474 and 2033 g/ha/y from dairy manure ADS, 11,344 and 12,972 g/ha/y from swine manure ADS, respectively. The Cu and Zn uptake in IRG and TY applied swine manure ADS were greater than that of PRG; applied dairy manure ADS, swine manure ADS and TY applied dairy manure ADS. The upper layer soil contained 58.5 kg/ha Cu and 40.0kg/ha Zn. To keep the environmental quality standards for soil pollution, dairy manure ADS could be applied around 43 years, and swine manure ADS could be applied 6 years to grass land soil.

## EFFICIENCY OF N<sub>15</sub> LABELED UREA APPLIED TO RICE AT REDUCING WATER REGIME

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Water shortage could be a threat to increasing rice production. This study was conducted to determine the effect of reducing flood water in rice production on fertilizer N balance and rice yield rice using N<sub>15</sub> labeled Urea. Five water treatments with four replications were arranged in Completely Randomized Design (CRD) as follows: W1 (flooding at 5 cm); W2 (flooding at 1 cm); W3 (flooding at 5 cm then 1 cm after 3 weeks); W4 (flooding at 5 cm then 1 cm after 6 weeks) and W5 (flooding at 5 cm then 1 cm after 9 weeks). The Bakau Series soil was filled in each cylindrical concrete culvert. The MR 220 rice variety were sown at the rate of 150 kg/ha. Urea labeled with N-<sub>15</sub> were applied at 120 kg N/ha in three splits, 60 kg P<sub>2</sub>O<sub>5</sub>/ha as Triple Super Phosphate and 60 kg K<sub>2</sub>O/ha as Muriate of Potash as basal dressings. The standard agronomic practices were applied and rice was harvested after 110 days. The N<sub>15</sub> atom excess in plant parts and in soil at different depth was determined by using an emission spectrophotometer. The NDFE (nitrogen derived from fertilizer) were calculated using isotopic dilution technique. The fertilizer N uptake ranged between 48.2 to 57.2 kg/ha fertilizer N recovered in soils ranged between 39.4 to 58.5 kg/ha. The reduction of water input did not have any significant effects on rice yield and fertilizer N balance as in earlier study. Reducing flooding water did not cause detrimental effect on rice yield, fertilizer N efficiency and N uptake. Thus there is a potential to produce rice under low water input to increase water use efficiency.

## PRODUCTION OF AN ATTENUATED STRAIN OF *KYURI GREEN MOTTLE MOSAIC VIRUS* BY LOW TEMPERATURE TREATMENT

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Cultivation of cucurbits is often hampered by virus diseases and at least 50 species of cucurbit-infecting viruses are known in the world (Fauquet et al., 2005). Among them, cucurbit-infecting viruses species in the genus *Tobamovirus* are well-studied for their biological or molecular characters. They have wide host range and geographical distribution, and include many strains or isolates. They can spread through seed, contact and soil, and become serious plant quarantine issue. To control *Kyuri green mottle mosaic virus* (KGMMV), one of the *Tobamoviruses*, the use of attenuated virus seems promising. Among several techniques to produce attenuated virus strains, low temperature treatment has not yet tried in KGMMV. Moreover, the method is advantageous than high temperature treatment which is prone to cucurbit plantlets. With KGMMV-C1 isolated in Japan, we treated KGMMV-C1 local lesions formed on *Chenopodium amaranticolor* at 15°C for 20 days and then inoculated them individually to zucchini (*Cucurbita pepo* cv. Diner) to detect mild symptom development. After continuous inoculation and selection using zucchini, an isolate (e73) that showed only very mild mosaic on zucchini was obtained. To examine whether e73 has cross protection ability against wild type or not, we challenge inoculated the wild type of KGMMV-C1 3 or 5 days after pre-inoculation of e73 on zucchini. The zucchini plants pre-inoculated by e73 at 5 days prior to challenge inoculation showed only very mild mosaic due to cross protection whereas zucchini plants showed mosaic when challenge inoculation was conducted only 3 days after pre-inoculation. Although further selection of more stable single clone of e73 is necessary, this study showed for the first time that low temperature treatment is useful in production of attenuated KGMMV.

## INFLUENCES OF TUBE CONTAINER VOLUMES AND STORAGE DURATION PRIOR PLANTING ON GROWTH OF EUCALYPTUS LINERS AFTER TRANSPLANTING INTO THE FIELD FOR ONE YEAR

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Eucalyptus clone CT76 plantlets from tissue culture were grown in 3 different sizes of opaque plastic tube containers; small (40 cm<sup>3</sup>), medium (75 cm<sup>3</sup>) and large (120 cm<sup>3</sup>) for 75 days during nursery production. After reaching a standard size for out planting, plants were taken off from containers and packed in a 12 x 24 cm plastic bag, 30 plants per bag, according to a standard procedure of the nursery and transported to the site. Plants were transplanted into the field on the same day or stored in the same plastic bags under shade and watered daily before transplanting to simulate the conditions of long distance transport or labor shortage. Effect of different container volumes and storage duration on growth of eucalyptus liners after transplanting was monitored for 13 months under rain-fed conditions. The results showed that liners from large containers had better initial growth during the first 4 months than those from smaller containers. Liners stored for 10 days had more growth restriction after transplanting. After transplanting for 8 months, liners from large containers were still larger in sizes than those from smaller containers but the effect of different storage duration on plant growth declined. Effect of container volumes and storage duration on canopy width, dry mass of leaves, branches and main trunk and dry mass of medium roots and small roots were not statistically significant. The results suggested that liners from smaller containers can catch up with those from large containers under rain-fed conditions after transplanting into the field for 1 year and thereafter. Growth restriction can be minimized if liners are properly stored not longer than 5 days before transplanting.

## INTEGRATION OF ANTAGONISTIC BACTERIA AND SILICON TO CONTROL BACTERIAL WILT OF TOMATO UNDER GREENHOUSE CONDITION

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Control of bacterial wilt of tomato caused by *Ralstonia solanacearum* strain To-Ud3 (RS) in tomato cv. Seeda was investigated in greenhouse by using antagonistic bacteria *Bacillus subtilis* strain CH4 (BS) and silicon as salicylic acid (Si1) and sodium silicate (Si2) forms with a single or a combination with BS application. Treatment BS powder plus Si2 gave the most effective disease reduction at 8 weeks post inoculation which showed 88% tomato survival and yield by 240 gm/plant whereas the treatment BS powder alone or a combination with Si1 gave 66% tomato survival and yield by 180-200 gm/plant. All treatments were significantly different from non-treatment control. Population of RS reduced from initial inoculum of  $3.4 \times 10^8$  cfu/ml to the lowest of  $1.16 \times 10^3$  cfu/ml in treatment BS+Si2 at 8 weeks post inoculation which was significantly different from the non-treatment control. The BS population increased in all treatments at 8 weeks post inoculation. Treatment BS with sodium silicate was the most effective control providing the highest survival, yield and reduction of RS population. This is the first report of a



combined use of bacterial antagonist with silicon for effective control RS in tomato under greenhouse condition until harvesting.

### **THE MONITORING OF SPECTRUM RESPONSIVITY ON APPLES AND PEARS DECAY THROUGH VIS-NIR REFLECTANCE SPECTROSCOPY**

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Visible and Near Infra Red (VIS-NIR) spectroscopy have been widely used in agriculture industry in determining the fruits' post harvest quality. This research focused on the measurement of surface reflectance from fruits in determining the best wavelength that can be used to monitor fruits decay using red apple, green apple, yellow (snow) pear and green pear. The measurement is done through fiber optic cable using ASD spectroradiometer with range of VIS-NIR wavelength from 325nm to 1075nm. The fiber probe was allocated on top of the fruit flesh after the fruits have been cut to halve. The measurement was taken every hour for 9 hours. The experiment has shown that NIR wavelengths within range of 960nm to 980nm able to produce a good responsivity in the form of its linear correlation coefficient,  $R^2$  between reflectance and time of measurement. VIS wavelength does show deviation between 0 hour and 9 hours of measurement, but does not produce good linear correlation through 9 hours of measurement.

### **SINGLE NUCLEOTIDE POLYMORPHISM GENOTYPING OF CALPASTATIN GENE USING THE ARMS COMPARED WITH THE RFLP.**

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Calpastatin is an endogenous inhibitor of calpain which is responsible for breakdown of myofibrillar proteins. The association of single nucleotide polymorphism (SNP) in the calpastatin gene with meat tenderness is an important topic in meat production. The efficient procedure to investigate the SNP is necessary. This study sought to detect the SNP of calpastatin gene at domain L marker (G/C transversion) of the Kamphaeng Saen beef breed (KPS; n=26) by the amplification refractory mutation system (ARMS) compared with the restriction fragment length polymorphism (RFLP) methods and to determine the genotypes of KPS at that marker. Genomic DNA of calpastatin gene extracted from blood of KPS was detected using ARMS and RFLP methods. The ARMS approach has utilized two primer pairs to amplify the two different alleles of a polymorphism in single PCR reaction to detected single base mutation. In this method, the alleles-specific primers had a mismatch at 3' terminal base and a second deliberate mismatch at position-2 from 3' terminus. While the RFLP method detected a polymorphism by PCR-base technique follow by *RsaI* restriction enzyme. Amplification of the ARMS method revealed that the results were not different from the conventional method of RFLP. Analysis of genotypes revealed that the KPS cattle inherited the CC, CG and GG genotypes at domain L marker. There were reliable when verified by nucleotide sequence

analysis of PCR products. The animals were genotyped and determined tenderness phenotype for this marker that predicted variation an intronic polymorphism at domain L of the calpastatin gene. Therefore, the ARMS method was simple, efficient technique, and suitable for detecting SNP at domain L marker of the calpastatin gene.

### **CONTROL OF DIRTY PANICLE DISEASE OF RICE WITH ANTAGONIST MICROBES UNDER FIELD CONDITION**

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Dirty panicle disease caused by multiple fungus species is severe for economic loss of rice production areas in Thailand that the effective control measure is critical limitation. Biological control using microorganism may be necessary for alternative method of sustainable rice production. The two-bacterial biocontrol agents *Pseudomonas fluorescens* SP007s and *Bacillus amyloliquefaciens* KPS46 have been proven effective in controlling several diseases of various crops, but their effects on dirty panicle infection of rice are not known. Field experiment was conducted in March-July, 2008 at Anghong growing region to develop control strategies for this disease with seven treatments (T1 to T7) including 4-different antagonist formulations (T1 to T4) compared with 2-chemical programs (T5 and T6) and nontreated control (T7). They were arranged in CRD that evaluated under natural inocula. The results showed that 2-treatment program: 6-month shelf life formulation of  $1 \times 10^6$  cfu/ml SP007s (T1: seed treatment and 5-foliar spray intervals) and synthetic fungicide (T6: copper hydroxide seed treatment and 6-carbendazim foliar spray intervals) were significant greatest ( $P=0.05$ ) for reduced development of dirty panicle infection. Regarding the efficacy of pathogen inhibition, SP007s formulation was significantly higher in suppression of causal species of dirty panicle pathogens. However, all antagonist microbe treatments including SP007s and KPS46 formulations and *Trichoderma* cell culture except *Bacillus subtilis* formulation (Laminar<sup>(R)</sup>) significantly provided higher yields than chemicals T5 and T6 ( $P=0.05$ ). These antagonist microbes tested seem to enhance biocontrol activity not only with decreased disease severity but also promoted plant growth of rice clump, panicle, and kernel that result in highest yield obtained.

### **APPROPRIATE TECHNOLOGY FOR USING ETHYLENE GAS TO FLOWER INDUCING OF SMOOTH CAYENE PINEAPPLE IN ORGANIC FARMING SYSTEM**

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Thailand is the top world producer of pineapple in 2002. Prices usually go down in May-July and November-December with peak of production. This price reduction has not hit the organic market yet which is 100% higher than conventional pineapple. It therefore serves as the alternative market for farmers who want higher price. However, organic pineapple production has the important problem about natural flowering which cause serious yield losses. Ethyphon and calcium carbide are used for flower inducing but are prohibited materials in organic standards. Only ethylene gas is allowed to regulate pineapple flowering in European and Japanese organic standards. This study aimed to determine the appropriate technology for using ethylene gas as flower inducer of Smooth Cayene pineapple and to develop an ethylene gas sprayer suitable for small organic pineapple farms. The ethylene gas sprayer was developed from backpack sprayer. Ethylene gas spraying with 0.5 % activated charcoal was applied when the plant had optimum weight for forced flower induction. The

ethylene gas sprayer in this research had high efficiency. The application of ethylene gas at 800 , 1000 and 1200 g. / 6000 l. of water induced flowering 95.8, 97.8 and 96.8 % respectively which did not show significantly difference while untreated pineapple did not flower . In addition, ethylene applications did not show differences in fruit weight, yield and fruit quality.

## **QUALITY: THE CASE STUDY IN PHATTHALUNG PROVINCE**

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The problem of producing organic fertilizer so far could not meet the standard of department of agriculture. Therefore this project aimed to survey the material, methodology and quality of organic fertilizer in Phatthalung as well as give the recommendation/advice to organic fertilizer producers. The project surveyed 18 groups of organic fertilizer producers in Phatthalung. The samples of organic fertilizer before and after recommendation were taken and analyzed in laboratory. There were 3 kinds of organic fertilizer classified by texture i.e. powder, pellet and granule. Mainly they produced powder organic fertilizer followed by granule and pellet by 61.11%, 22.22% and 16.67% respectively. The base materials to produce organic fertilizer were animal manure such as cow manure, layer poultry manure and pig manure which they used as a single or mixed material together with sawdust, rice husk, rice husk charcoal, rice hull, rock phosphate, bio-extract and urea. Based on the organic fertilizer standard of department of Agriculture 2008, the over all evaluation in terms of electrical conductivity (EC), organic matter (OM), C:N ratio, moisture content, N, P and K, all groups of organic fertilizer producers did not pass. However the individual evaluation showed that C:N ratio and K were 100% satisfied followed by moisture content, P, N, EC and OM by 94%, 75%, 69%, 56% and 12% respectively. TISTR advised and recommended the ratio of material and methodology of composting to producer during mid 2006, the quality of organic fertilizer after that improved i.e. the overall evaluation was 69% passed. Meanwhile individual evaluation showed more percentage passed as well. The parameter that seldom met the standard was OM, however the percentage passing increased from 12% to 69% after advise was given. Moreover, it was found that the quality of powder organic matter was superior than pellet and granule organic fertilizer.

## **ECONOMIC AND TECHNICAL ASSESSMENT OF ORGANIC VEGETABLE FARMING IN CHIANG MAI, THAILAND**

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Government of Thailand is promoting alternative vegetable production systems such as organic, chemical pesticide free, and safe use production systems. Most of vegetable producers are not confident to transform from their conventional system to organic farming, presumably due to technical difficulties and low production efficiency. Based on a questionnaire survey of 142 farmers under different production systems in Chiang Mai province in 2008, this paper aims to clarify the common vegetable practices, cost and return of major crops, and profitability of organic farming in comparison with other production system. Over 15 kinds of vegetable were grown under different farming systems in Mae Rim district, Chiang Mai province. Kinds of vegetable grown depended on market demand and growing time. In the this district alone, vegetable production accounted to 19.6 million Baht in 2007, of which 2.6 million Baht was from organic vegetables. There were no differences in types of input used by major organic crops such as kale, pak choy, and yard long bean. Economic analysis revealed characteristics of four types of farming system; organic, chemical pesticide free, safe use, and conventional farming system. The organic farming system was

economically most feasible by high prices of produce; however, it would need further improvement in order to increase their yields and production efficiency. Both safe use and pesticide free farming systems were economically feasible. The conventional farming system was economically feasible, but faced the highest risk in the increased price of synthetic chemical inputs.

### **FARM OF THE PAST AND FUTURE: MEANS TOWARD ECOLOGICAL RECONSTRUCTION**

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The world is now facing problems which seem uncontrollable ranging from inequitable income and resource distribution and environmental degradation to social maladjustments. Due to indiscriminate collection and consumption, many species of plants and animals are slowly disappearing. Agricultural ecosystems suffer most of these ecological backlash because of the imbalances caused by loss of some important components of the food web found therein. Rural communities located within agricultural ecosystems suffer most. The unabated hunting and collection of endemic species consist most of their daily food intake and needs for survival are now depleting. The exploitation of local habitats by introduced ones caused near extinction of the important flora and fauna which once served farming communities. The Occidental Mindoro National College implemented the "Farm of the Past and Future" project. The farm envisions to bring back agricultural ecosystems to what they were in the past by retrieving and perpetuating the native species of snails that are disappearing due to introduction of agricultural chemicals and foreign species of snails. A fishpond was constructed where endemic species of fishes which were commonly found in the rice fields are being cultured and reproduced. Vacant spaces are planted with indigenous vegetables. A garden for herbal medicines was also put up to provide source of planting materials to the nearby residential lots. A native chicken production was also established inside the farm. Ultimately, the farm will be able to provide genetic material for improvement of local species of crops and animals. The future farms in the whole province will be like this once fully advocated by farmers unlike today's farms most of which are suffering ecological damage.

### **EFFECT OF SPEED AND SPREAD OF SCREW PRESS ON QUALITY OF STABILIZED AND UNSTABILIZED RICE BRAN**

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Recently, the petroleum crisis affected the whole world. Biodiesel was an alternative energy which is produced from agricultural products such as palm and cassava. The excess amount of rice bran in Thailand was high enough for producing biodiesel. The production methods of rice bran oil used in Thailand are distillation and screw press, which is suitable for biodiesel production. Therefore, screw press technique was applied into this research. However, not any report was demonstrated about the effect of speed and spread of screw press on quality of stabilization and unstabilization rice bran yet. The main objective of this study is to evaluate the effect of speed and spread of screw press on rice bran oil quality and quantity. Samples were divided into two groups; one from parboiled rice bran and another from normal rice bran. Samples were stabilized at 100°C for 5 minute. The comparison of stabilized and unstabilized samples was, then, determined. The results showed that

speed and spread of screw press were effect on rice bran oil quantity whereas it was not effect on quality. Stabilization process influenced rice bran oil quantity of normal rice bran whist it not significantly different in parboiled rice bran.

## **THE POTENTIAL OF SWEET POTATO AS AN ALTERNATIVE FEEDSTOCK FOR BIOFUELS**

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This paper discusses the learning insights in exploring livelihood options for upland farmers in a watershed area in the foothills of Sierra Madre Mountains in Tanay Rizal. Of interest and focus is the potential of sweet potato (*Ipomea batatas*) as an alternative feedstock for biofuels. The potential of sweet potato as an alternative feedstock for biofuels is seen in the perspective of farmers' acceptability to be part of their present farming systems. Apparently, sweet potato is readily accepted by farmers as it does not threaten their sense of food security. Its potential use for industrial purposes as in biofuels would simply require increasing the volume of production without necessarily depriving the farming family of its possible use for food. The idea of commercial scale production of sweet potato inspired in them some hopes of a possible increase in their farm productivity, thus, an increase in farm income and an improvement in their quality of life. Further, this paper discusses some learning insights in the initial efforts for commercial scale production of sweet potato to produce the required volume of a feedstock for an ethanol plant that was envisioned to be. The learning insights are organized into the following themes: 1) The yield performance of sweet potato as affected by climate, soil types and fertility and its cultural practices. 2) The preparedness of farmers both technically and financially in a project idea of commercial farming of this crop. 3) Possible transition strategy for farmers to shift from subsistence farming to commercial farming of sweet potato.

## **CONSUMER WILLINGNESS-TO-PAY FOR FARM-PRODUCED ETHANOL: THE VIEW FROM CANADA**

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Adequate consumer demand and willingness to pay for farm-produced bio-fuels is a necessary condition for the adoption on the supply side of environmentally friendly, employment-intensive technologies at the farm level. As taxpayers as well, consumers must be willing, through their preferences for electoral platforms, to fund public policies to ensure that farmers have stable and profitable conditions for the production of bio-fuels. These include subsidies for farm-land conversion, taxes on regular gasoline, subsidies to entrepreneurs starting up bio-fuel processing plants, and restrictions on imports of feed-stocks or finished bio-fuel from other nations, to this research, based on a survey of 1002 Canadian automobile-owning households, used Chi-squared, OLS and Logit regression analyses to measure and explain the willingness to pay for bio-fuels for each province and socio-demographic segment of the population. The average willingness to pay varies significantly by population density, age of the car most often driven, gender, age, and education; suggesting that carefully targeted public information programs could stimulate voluntary increases in ethanol purchase. The average voluntary willingness to pay remains low, however, at approximately five cents Canadian per litre. This implies that complementary tax, subsidy, and trade policies will be

necessary. Those policies most favoured by consumers as a whole are a) the restriction of ethanol imports, provided Canadian farmers are able to produce ethanol crops domestically, and b) government subsidies to start up ethanol processing plants. Here again, the level and ordering of policy receptivity differs by socioeconomic subgroup and province, suggesting that a province-by-province program to support farm production of sustainable energy crops would be more effective than a blanket national policy.

## **FEASIBILITY OF PRODUCING BIOETHANOL FROM CASSAVA IN THE PHILIPPINES**

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This paper discusses the feasibility of producing cassava for ethanol production in the Philippines under the following arrangements: 1) corporate and joint venture cassava plantation; 2) ethanol processing (primary and secondary processing), and; 3) integrated cassava plantation and ethanol processing. The results show that production under these three different arrangements will be feasible. Given the base assumptions for plantations of 10,000 has. and average yield of 20,000 kgs./ha., the corporate farming arrangement is financially more attractive with an IRR of 18%, ROI of 22.2% and payback period of 5 years compared to the joint venture arrangement with an IRR of 14.7%, ROI of 14.7% and payback period of 5.6% although the investment cost for corporate arrangement is higher. The concern under corporate farming is the prices of farm inputs and labor. The post-harvest and ethanol processing is also financially attractive with a total project cost of PhP1,411,431,529. Assuming a selling price of Php 54/liter and raw material price of Php14/kg cassava chips, the internal rate of return is 13.1%, ROI of 16% and payback period of 6.6 years. About 90.77% of income of ethanol plant comes from the sale of the anhydrous ethanol, and 6.50% from sale of carbon dioxide. About 71.39% of the total cost is for raw materials and 15.81% for processing utilities. The third case considers a corporate-run cassava plantation and ethanol processing with a total project cost of PhP1,933,538,857. Assuming dried chips cost of Php14.00 and suggested ethanol selling price of Php50/liter, the internal rate of return is 14.58%, ROI of 12.8% and payback period of about 6.8 years. The concerns here are the sustainability of feedstock supply and high utility cost.

## **PERFORMANCE EVALUATION OF SWEET SORGHUM LINES FOR BIO-ETHANOL AND GRAINS UNDER PANGASINAN CONDITION**

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This study was conducted to evaluate the performance of five sweet sorghum lines in terms of agronomic characteristics in relation to grain yield and the total fermentable sugar. Analysis of variance showed that there were significant differences among varieties observed for plant height, stalk yield, stripped stalk yield, stalk diameter, stalk juice volume, stalk juice yield, Brix, stillage

yield, grain yield and seed size. The mean agronomic characteristics of the 5 varieties evaluated showed that ICSV 700 performed better in terms of plant height. ICSV 700 and ICSV 93046 were the top performers in terms of stalk yield, stripped stalk yield, stalk diameter, stalk juice volume, stalk juice yield, and \*Brix. The varieties SPV422 and ICSR 93034 performed better in terms of stillage yield. SPV422, ICSR93034 and NTJ2 were among the top yielders, whereas, ICSR 93034, SPV422, ICSV93046 and ICSV 700 varieties were statistically similar in terms of seed size.

## **A STUDY OF SWINE RAISING UNDER CONTRACT FARMING IN THAILAND**

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This investigation sought to determine the system of production and marketing in swine raising under contract farming system, examine strengths and weaknesses, constraints, and recommendations in order to improve production aspects and marketing channels under contract farming system, and formulate swine raising development models for contract farming system. Information was gathered from in-depth interviews with stakeholders including private company, swine raising cooperative and independent farming in 6 regions of Thailand. There were 2 patterns of swine production system including subsistence farming or semi-commercial farming and commercial farming. Swine raising under contract farming system, included breeding and fattening pigs towards pattern of price guarantee, marketing guarantee, and hired feed. Breeding pigs towards price guarantee, marketing guarantee, and hired feed, were operated by companies (47%), and 53% were hired feed. All fattening pigs were operated towards price guarantee and hired feed. Appropriate price for the parties was 53.60 baht per kg. There were 2 types of swine cooperative raising under contract farming towards marketing guarantee including their own operation and member operation. Cooperatives operated breeding pigs (60%) and fattening pigs (30%) while contract farmers operated breeding pigs (40%) and fattening pigs (70%). Appropriate price guarantee was 59.60 baht per kilogram. Independent farming operated all breeding pigs and 40% of fattening pigs while contract farmers operated only fattening pigs (60-100%) towards pattern of price guarantee, marketing guarantee, and hired feed. Appropriate price guarantee was 55.60 baht/kg. Most benefit for contract farmers were less risk responsibilities in price and marketing and had more opportunity to develop raising management towards learning process. On the other hand, weak points included less autonomy in input procurement leading to face risks in higher cost and lower quality of input affecting less standard products. Most benefit for a party to the contract was accessed to expected output and cost saving. On the other hand, most weak points were dishonest and less practice in standardization of contract farmers.

## **INNOVATION ADOPTION OF BEEF CATTLE FARMING IN RURAL AREA OF INDONESIA**

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The objectives of this research were to analyze the rate of innovation adoption, to discover the farmer's characteristics factors influencing adoption of technology of cattle farming, and to describe the structure of adoption. This research was conducted by survey method in Karanganyar Regency (Central Java) and Bantul Regency (Yogyakarta Province). One hundred twenty cattle farmers as respondents were selected by purposive sampling method, quota sampling method, and convenience sampling method. The data were analyzed by using Pearson's Product Moment Correlation and Multiple Linear Regression. Experience in cattle raising and number of cattle own influence to the rate of technology adoption. The structure of adoption in cattle farming measured using communication model. Source of technology information, dominantly came from academic and government sectors, while private and non-governmental organization still a few in percent. Some recommendations were set based on the methods and mode that farmers preferred.

## **REGIONAL ECONOMIC DEVELOPMENT BY UTILIZING FOOD-INDUSTRIAL CLUSTER: A CASE OF BENI-IMO PROCESSING IN YOMITAN VILLAGE, OKINAWA**

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Sweet potato was imported to Japan approximately 400 years ago. Since then, sweet potato production and consumption have been widely extended. Recently the demand of sweet potato has declined due to the influence of diversification of consumption habits. However sweet potato is still considered as a significant crop in the upland farming in Southwest Japan. Moreover, the demand of sweet potato should be expanded to activate the production of both the development of various sweet potato products and coping with consumer needs. The purpose of this paper is to examine the development of regional economic by utilizing food industrial cluster, the case of Yomitan village, Okinawa Prefecture. In Yomitan, food industrial cluster system of 'Beni-imo' has been established. The Yomitan 'beni-imo' is a purple sweet potato that has purple flesh. Currently, purple sweet potato is widely used for primary and secondary processes. In order to promote such interaction and collaboration by crossing sectors, the flame of food industrial cluster system is required. The finding shows the importance of interactive relation towards harmonious coexistence between sectors on the promotion of commodities and services. In Yomitan village, since the beginning of 90s, local chamber of commerce and industry, agricultural cooperative and the local government have promoted 'beni-imo' production as a local revitalization project. They also requested confectionaries to conduct an experiment on 'beni-imo' products. In addition, 'beni-imo' products became popular as gifts and souvenirs of Okinawa. Furthermore, Yomitan 'beni-imo' consultant was established to certify the quality from different potato materials. The consultant certifies production records and handling by unification that gives advantages to 'beni-imo' producers. The important aspect of this experience is the establishment of certification system and the share of common values by agriculture, manufacturing and commercial sectors. Finally, the coordinator is also an important function to consider for a successful implementation systems.



**SEA URCHIN (*TRIPNEUSTES GRATILLA*) FARMING IN NALVO STA. MARIA, ILOCOS SUR, PHILIPPINES: PROSPECT FOR COOPERATIVE ENTREPRENEURSHIP**

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This descriptive research found out that sea urchin farming can uplift the socio-economic condition of the fishermen in Nalvo, Sta. Maria, Ilocos Sur, Philippines, as evidenced by the increase in their monthly income. This study, therefore, relates to the sub-theme HEI Research Capability Building for Socio-Economic Growth. Majority of the fishermen are males who belong to the age group of 20-29; most of them are married; have gone as far as high school; have been engaged in sea urchin farming from 4-20 years. The sea urchin fishermen in Nalvo can become entrepreneurs. Successful entrepreneurship, according to the Austrian School of Economics, provides an avenue of *social advancement that is particularly attractive to people who are denied opportunities elsewhere like higher education*. With in-depth, not superficial, implementation by the academe and the local government concerned, this Austrian thought coupled with Deming's Project Plan to Quality (PPQ) works for the fishermen because it focuses on embedding continuous improvement and innovation throughout the project; realistic expectations, self-auditing, self-inspection and setting goals on what specific areas of the sea urchin enterprise are targeted for improvement. This Austrian thought can make the enterprise flourish if the fishermen are made to realize government's sensitivity to the socio-economic implications of their existence as organized entrepreneurs and their impact on the rest of the society. The researchers would like to alert the Philippine government through the academe and the local officials to organize the sea urchin farmers into a cooperative enterprise because it can be a vehicle for socio-economic growth.

**AGROFORESTRY AS A STRATEGY TOWARDS SUSTAINABLE DEVELOPMENT OF AN INDIGENOUS PEOPLE COMMUNITY IN OCCIDENTAL MINDORO, PHILIPPINES**

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Occidental Mindoro National College, in partnership with Plan International conducted the Sustainable Upland Development Program in Sitio Salafay, Barangay Monte Claro, San Jose, Occidental Mindoro, site to about 50 Buhid Mangyans, one of the seven tribes in the island of Mindoro. The project was implemented to increase productivity of the community and help conserve upland resources. Community people were organized and worked collectively in the project. Thus, ownership is communal. Their interest towards establishment of the project was further aroused by carefully and clearly explaining to them its importance in improving their living conditions and their environment. Other activities conducted were the "Lakbay Turo"; showcasing 0.5 hectares on-farm soil and water conservation techniques; showcasing 1,000 m<sup>2</sup>; community nursery and showcasing community fish pond. The project contributed greatly to the continuous schooling of the minority school children because it was able to augment the food that their own farms supply which are most often insufficient. Prior to the establishment of the project, dropping out of classes was very rampant and it was found out that it was due to insufficiency of food. School children practically just drop out and either stay at home or search for food in their surroundings. The project also augmented table needs of the families by the food crops produced which are divided among the owners according to their degree of participation in the project through the guidance of the elders. Working together in the project improved social relations such as cooperation, camaraderie and belongingness. The agroforestry project will bring about increased literacy rate thereby liberating them from ignorance thus, empowering them and making them more capable of charting their own destiny. As to its long

term effect, it is envisioned that the community will truly be developed into one that is living in harmony with nature.

**PROCESS DEVELOPMENT FOR STANDARD OF FOOD PRODUCT AND VALUE ADDED  
IN MARKET SECTOR OF FARMER GROUP AT TAMBOL BAN PRAN, AMPHUR  
SAWAENGA, ANGTHONG PROVINCE**

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This research sought to survey background information of agricultural communities in order to evaluate their potential, improve the indigenous product into new product and achieve standard, and promote learning process, management of product, human resource and marketing to link between producers and market sector. Target farmer group for this study live in Tambol Ban Pran, Amphur Sawaengha, Angthong province. Methodology for study is documentary method and mock audit for product standard certification, knowledge transfer through group participatory process. Tool and technique for collecting data were questionnaire setting, observation form, public hearing. The qualitative data and information was transfer into quantitative figure using content analysis. It was found that 1) farmer in Tambol Ban Pran are rice grower which produce 7 crops in 2 years period according to the good irrigation system at the 1<sup>st</sup> level. After harvesting, rice will be transported to rice mill immediately. The second rank of crops is sugarcane plantation. This crop can be harvested once a year within the period 4-5 years after first planted in field. Produce from farm are sold to factory which price are not satisfied by the growers. In the past, government sector will support by transferring and training the processing technology for some products i.e., Noni juice. However, the processing and technology still lack standard and not able to purchase. This cause negative impact to the small food producer in food processing while the persons who worked with the non-food product i.e., handcrafted product, basket. In addition, villager pay attention on increasing the investment fund in community as they believe the benefits will be gained more for agriculture sector. 2) Suitable raw material for food processing are sugarcane and rice while the promoted product such as Noni juice was not in consideration neither improvement for achieving standard. Researcher attempted to show process of un-refinery sugar production and disseminate knowledge by exchanging the lessons and learns under the scope of production technology, marketing and management among producer group from Singburi province and provincial of industry from Singburi Province. By this exchanging experience, producers were gathered and form group of farmers (producers) and sale product in the local community and nearby. The packaging of products was also studied to find the most suitable for the products.

**MANAGEMENT OF COMMERCIAL CHICKEN MARKETING: OPPORTUNITIES AND  
CHALLENGES FOR MARKET ACTORS OF CHICKEN PRODUCTS**

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Poultry business in Indonesia is growing faster than other livestock commodities. This business has become the industry that has component completely from pre-production up to post-production. This development of business gave significant contribution in the agricultural development. This paper will explain the opportunity and challenges for market actors that involves in this industry especially in the small and medium levels in Yogyakarta, Indonesia. The method of this study was field research. Key informants were use to gather the data: farmers, middlemen, owner

of chicken slaughter house, and head of livestock office of Yogyakarta province. The data were analyze using descriptive statistics. Results showed that poultry business in Indonesia still concentrate in small scale, consequently, the business efficiency and profit feasibly difficult to reach. Many opportunities in this business can be taken by the market actors. Some problems also existing in this business such low quality of chicken meats and eggs, and price fluctuation. Cost fluctuation was effected by fluctuation in the production level caused to contraction in the supply level.

## **INCOME DISPARITY IN TWO RICE FARMING VILLAGES IN MALAYSIA**

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Malaysia has achieved dramatic economic growth since the late 1980s, largely due to multi national companies investing foreign capital in industrial zones on the west coast. GDP share of the manufacturing sector increased from 16.8 % in 1980 to 31.4 % in 2005. As this industrialization has been concentrated on the west coast, we may expect to see a situation of economic imbalance between the west and east coasts of the Malaysian peninsula. It is therefore necessary to study the reality of income disparity and indicate the nature of inequality in relation to the regional, household and individual levels. Also by clarifying inequality in two villages among rice farm households, we can specify the factors which have influenced inequality between the two villages and within each. Interview surveys were conducted in 2006 and 2007 in Sebrang Prai and Kelantan. A total of 42 and 39 farm households were studied respectively. This paper aims (1) to identify economic standing on the east and west coast under different geographical conditions; (2) to clarify the current situation of income distribution at the household and individual levels in both villages; and (3) to examine factors responsible for determining total income among farm households.

## **FARM PRODUCTIVITY AND FARMER EMPOWERMENT: A CASE OF SUSTAINABLE AGRICULTURAL PRACTICE IN MALAYSIA**

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Advent of Industrial agriculture, led to considerable environmental harms such as depletion of biodiversity, soil degradation, pollution and global warming. Furthermore concentration and vertical integration of corporate undermines farmer's participation in agrifood system. Farmers merely act as technology adopters and passive producers. In this system, farmers knowledge and innovations is impeded. In addition to this, heavy depended on agrochemical and fuel increases production cost, thus reducing the farmer's profit. The sustainable agriculture practices which rely more on the ecological process with exclusion of agrochemicals and high energy inputs, that can lead to healthy ecosystem and productive farm. Besides this, sustainable agriculture practices actively engage farmers themselves into agrifood system in terms of production, marketing, management, research and innovation. Objective of this case study was to explore the impact of sustainable agriculture practices among selected Malaysian farms on farm's productivity and farmers empowerment. In order to address these objective, we chose qualitative case study method, in which semi- structured interviews, participatory observation, secondary data collection and transect walks were carried out with farmers, extension officers and Non Governmental Organization workers. The study showed that in selected farms, sustainable agriculture practices such as composting, biological nitrogen fixation, crop rotations, application of biological pest control and herbal plant growth

promoter had created healthy soil, increased pest and disease resistant in crops, resulting in improved farm productivity in terms of diversified, healthy and high shelf life farm produce. Farmers earned more profit with reduction of agrochemical, machineries and direct access to local market and as well as with downstream products. Farmers become more decisive, creative, innovative and knowledgeable by involving in management, marketing, development of new products, advocating, public seminars, conferences and research. In conclusion, the sustainable agriculture practices could improve farm productivity and empower farmers to take control of their own development process.

**AN ECONOMIC STUDY OF MAJOR FARMING COMPONENTS IN MID-HILLS OF NEPAL: CASES OF NUWAKOT, KAVRE AND LALITPUR DISTRICTS**

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Nepal is ecologically divided into three regions: mountain, hill and terai. These three regions are characterized by different types of land structure, climate and temperature, resulting in varying farming systems. This paper focuses on major farming components in the hills where farming is performed on slope and terrace. It is a distinct characteristic that farming in mid hills is based on three major components: crops, livestock and forestry. Crops provide feed and fodder, while in return animals supply draught power and manure, and forests give nutrients and support lands. In the past, upland hill farmers had used sloping land for subsistence farming, but the focus has been shifted to improve productivity and sustainability of the sloping upland farming in recent years, so as to meet the increasing needs of food security and livelihoods of an expanded upland population. In order to achieve the goal, the first task is to raise the level of the farm income. This paper tries to identify the economic role of each farming components, as these three components are playing the important role in the agriculture production. Based on data obtained from a questionnaire survey, conducted in December 2007- February 2008 and another in September 2008 in three villages located in the mid-hills, this paper attempts (1) to clarify the physical degree of interactions among the three components, (2) to examine the strength and weakness of the interactions, (3) to analyze economic contribution of each component to total farm income, and (4) to suggest a sustainable system on the basis of the three components

**JOINT MARKETING OF AGRICULTURAL PRODUCTS:  
LESSONS LEARNED FROM THE IMPLEMENTATION OF RURAL AGRO-ENTERPRISE  
DEVELOPMENT IN INDONESIA**

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Agriculture is the leading sector in Indonesian economy. The production has increased but it does not accordingly always increase farmers' income. Farmers still face the lowest bargaining power in selling their produces in which they become the price taker at farm gate. Thus marketing practice that may influence the selling price and accordingly will lead to an increase in farmers' income is being important. CRS Indonesia, particularly the Agriculture Program, has implemented Rural Agro-enterprise Development (RAeD) Project (2004-2008) in collaboration with 9 local NGOs in 6 provinces in Indonesia. RAeD project put emphasis in marketing where farmers can sell their

produces and accordingly will increase their access to market and cash income. During the implementation of the project, CRS Indonesia conducted monitoring and evaluation in which questionnaire survey was conducted every year. This paper aims to (1) document the implementation of RAeD project and (2) analyze the impact of joint marketing in increasing farmers' income. Joint (collective) marketing through farmer groups and associations has been introduced. Farmers sold their agricultural products together through farmer groups or associations that conducted agreements with their business partners or buyers. The principles of the joint marketing are: (1) direct selling to final consumers or manufactures, avoiding dealing with the middlemen, (2) shortening the marketing channels, and (3) selling the products collectively, especially in the same territory (territorial approach). The selling price of the products is the same as the on-going price in the market, but farmers were able to receive higher prices compared to the conventional marketing practices due to the marketing margin by conducting direct selling and shortening the marketing channels. Farmer groups or associations protected farmers from receiving price lower than the market price, thus market survey was conducted regularly by the farmer groups or associations. Farmers have earned higher income through the joint marketing and hopefully it can be implemented in other areas.

**FACTORS AFFECTING STRENGTH DEVELOPMENT IN COMMUNITY ENTERPRISE,  
JORAKAE SAMPHAN SUB DISTRICT, U-THONG DISTRICT, SUPHAN BURI PROVINCE**

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This study sought to investigate some general background of leader farmers, status and potential of community in rice production, strength development task in community rice enterprise, relationship between some general background of leader farmers with their opinions in factors affecting strength development of rice enterprise in community, and constraints and recommendations in strength development of rice enterprise. Data collection was obtained through interview schedule from 78 leader farmers towards multistage sampling technique. Inferential statistics to testing hypothesis was Pearson product moment correlation coefficient. The findings revealed that major occupation was rice cultivation, and at least 1 minor occupation was found. Average total land was 26 rai (3.36 hectares). Average total income was 168,474 baht (USD 5,105, 1 USD = 33 bt.) per year. Rice cultivation twice a year was done by 80.8 percent of leader farmers. Major rice was cultivated in late July, 2-harvested in late Nov, 2005. Most popular variety was PATOOM THANEE No.1. Rice cultivation three times a year were done by only 16.7 percent of leader farmers. Major rice was cultivated in late July, 2005-harvested in late Nov, 2005. Most popular varieties were SUPHAN BURI No.60 and SUPHAN BURI No.1. Most popular second time for second rice was CHAINAT. More than half of leader farmers bought rice input from store in community. A few of them could use their own seed for coming crop year. Factor affecting strength development task in community rice enterprise that majority of leader farmers agreed at stronger level were type of leadership, type of group members, group atmosphere, pattern of group enterprise, and outside external support. More than half of leader farmers were needed to cooperate any times in all items of strength development management in rice enterprise. Most constraints in strength development of community rice enterprise were labor shortage and recommendation seed shortage. Most needed methods in strength development of community rice enterprise were training in vertical rice enterprise in the village and field study in rice enterprise. Testing hypothesis were found that there were non significant statistical between some general background of leader farmers with their opinions in factors affecting strength development of rice enterprise in community.

**TOWARDS AN INTEGRATIVE SOCIAL LEARNING APPROACH:  
ENHANCING COMMUNITY EMPOWERMENT FOR SUSTAINABLE AGRICULTURE  
DEVELOPMENT IN NORTHERN THAILAND**

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Enhancing community empowerment through capacity development to enable more farmers to play and active role in the decisions that affect their communities requires integrative and interactive approaches of social learning. There is also an increasing recognition that technological and social innovations are complex processes, which require knowledge domains from a variety of actors. The introduction and integration of external and local knowledge are created through a process of facilitation in various platforms of learning. Various critiques have been raised on effectiveness of facilitation in social learning particularly on its impacts on sustainable agriculture development and natural resource management, whether the process helps foster changes to maintain agro-ecological dynamics and environmental integrity. The premise to manage changes in complex environment requires systems and integrated approach to guide facilitating social learning. This paper presents different approaches in social learning that help promote technological and social innovation. It summarizes lessons learnt for achieving capacity development which resulted in different dimensions of community empowerment. A set of four case studies is presented to illustrate the critical importance of each learning approach and its impact on capacity development in practice. The paper also highlights farmers' adaptive strategies of managing changes and the roles of key actors in transforming production systems and practices. The four cases include: community rice seed development, conversion into pesticide free vegetable production, farmer-private partnership in organic rice farming and community farming enterprise development. The paper concludes which the discussion of implications for institutional arrangement and partnerships that may best enable the application of social learning in agriculture transformation for small farm holders.

**A STUDY OF FOOD CONSUMPTION PATTERNS AND CONSUMERS' RICE PURCHASE  
BEHAVIOR IN ASIA: FOR A FARMING STRATEGY REFLECTING CONSUMER NEEDS**

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The objective of this study is to reveal the relationships between food consumption patterns and consumer values as well as rice attributes that affect on rice purchasing behavior. It will give an implication to farmers to avoid risks that their products do not satisfy consumer needs and preferences. Rice is one of the most important foods for Asian farmers and consumers. In general, rice consumption increases first as the economy grows, then it decreases eventually as the economy grows further. Therefore, it is very important for rice farmer to be careful with the shift of consumer needs and to adjust their farming strategies to the shift. For the objectives, 1) food consumption patterns of several Asian nations, such as Japan, Korea, Thailand, Taiwan, and Vietnam, were clarified based on food balance sheets data (secondary). Then, 2) a comparative analysis of consumer values and rice attributes (variety, price, aroma, production method, etc.) were implemented by using CHAID analysis (Chi-squared Automatic Interaction Detector) based on the data collected by a questionnaire survey given to consumers in 2007 in above mentioned nations. The results of this analysis shows: 1) as the economies grew, food consumption patterns of Japanese and Taiwanese have shifted to the

diets that include higher percentage of fat and less rice. This shift is followed by Korean, and then Vietnamese and Thai consumers whose diets are still heavily rely on rice. 2) The results of CHAID analysis shows that Japanese, Korean and Taiwanese consumers' values are very much diversified; however, there are fewer "saving persons" on rice purchase in these nations. 3) Consumer values become more safety and health conscious as the economy grows. The values of safety and health conscious are found in multiple consumer demographics in this analysis, and the values are achieved through various attributes of rice. However, the relationship between the values and the attributes are not significant.

#### **EXTRACTION OF CHITOSAN-GLUCAN COMPLEX FROM FUNGUS AND YEAST FOR IN-VITRO STUDY ON THEIR CHEMOTHERAPEUTIC POTENTIALS**

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$\beta$ -glucan is a common component of yeast and fungal cell walls, and it is known as biological response modifiers, which stimulate the immune system of the host and exert an amazing range of immunopharmacological activities. In the cell wall of yeast and fungus,  $\beta$ -glucan is covalently associated with chitin and these two biologically active polysaccharides in the complex may enhance its pharmacological effect. The chitosan-glucan complex was isolated from the cell wall of baker's yeast (*Saccharomyces cerevisiae*) and fungus (*Aspergillus niger*) which was grown on sweet potato pieces supplemented with mineral solution. Mycelia were harvested after 7 days of cultivation. The extracted water-insoluble complexes were solubilized in water by means of carboxymethylation. The isolated complexes were characterized by UV, IR and NMR spectroscopy. Mineral contents of the complex were also determined. Chitosan which were obtained from chitosan-glucan complex treated with 2% Acetic acid solution have antimicrobial activities against two gram-negative (*Escherichia coli*, *Salmonella typhimurium*) and gram-positive bacteria (*Staphylococcus aureus*). The resulting carboxymethylated complex were detected their anticancer activities with human fibroblast cell lines in comparison.

#### **ISOLATION OF SESQUITERPENE SYNTHASE FROM PEPPERMINT THAT CATALYZES THE PRODUCTION OF APHID ALARM PHEROMONE B-FARNESENE AND ITS EXPRESSION IN *E. COLI***

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The trans- $\beta$  farnesene in peppermint was synthesized by sesquiterpene synthase which encoded by *tspa11* locus that mimics the aphid alarm pheromone. The specific primers were designed by alignment the three accessions of *tspa11* retrieved from the GenBank named *Lumi Far5* forward [5' CACCTCTAGAATGGCTACAA ACGGCGTCGTA3'] and *Far 2B* reverse [5' GGATCCTCAAAG ACTATGGCATCAACAAAGAG3'] which included the *Xba* I and *Bam*HI recognition sequences to the 5' ends, respectively. The total RNAs were extracted from peppermint leaf and subjected to cDNA synthesis and PCR in the coupled one step RT-PCR reaction. The PCR fragment was cloned into PCR<sup>®</sup>8/GW/TOPO<sup>®</sup> and selected the clone harboring the insert fragment of this gene for sequencing. The 1662 base pair of DNA sequence and 552 deduced amino acid were obtained from the inserted clone. Subsequently, the *tspa11* fragment was re-amplify from the cloning vector using

the proof reading DNA polymerase *Deep Vent* and ligated into Campion™ pET160 Directional TOPO® expression vector. The positive clone was further introduced into *E. coli* BL21Star™ (DS3) for protein expression. The optimum time for protein production was 6 hours after induction that produced discrete band of approximately 55KD. The purification protocol may apply the Ni<sup>+</sup>NTA affinity column to obtain the purified protein for immunization and for further detection the level of sesquiterpene synthase in transgenic papaya after introducing of this gene by means of genetic transformation.

**INSECTICIDAL ACTIVITY AND CHEMICAL COMPOSITIONS OF *STEMONA BURKILLI* AGAINST *SPODOPTERA EXIGUA* AND *SPODOPTERA LITURA***

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The increasing awareness about the environmental and health impact of pesticide use including the increasing demand for food safety and quality led to a higher degree of interest in integrated pest management utilizing biopesticides as one of the tools. *Stemona* sp.(Stemonaceae), a potential plant, have been widely used for vegetable crops pests control in Thailand especially crucifers. Initial investigations on *Stemona burkilli* root extracts were shown to possess insecticidal activity<sup>1,2</sup>. In this research, *Stemona burkilli* roots were sequentially extracted with hexane, dichloromethane and methanol and bioassayed. The result showed that dichloromethane crude extract (DCE) exhibited the highest toxicity against *Spodoptera exigua* and *Spodoptera litura* by leaf dipping method. with LC<sub>50</sub> values of 6,204 and 9,589 ppm at 24 hr, respectively. The DCE was further isolated on silica gel column chromatography and successively purified by preparative HPLC with 100% EtOH elution to give two active fractions. Among the two, fraction 2 showed stronger influence on antifeedant activity in no-choice leaf dip test by giving 80.0 ± 1.07 and 87.9 ± 2.05 % feeding reduction against *Spodoptera exigua* at 17.70 and 44.25 µg/cm<sup>2</sup>, respectively. Against *Spodoptera litura*, at 15.00 and 30.00 µg/cm<sup>2</sup>, fraction 2 could reduce feeding activity by 80.14 and 83.12 %, respectively. Results informed that *Spodoptera exigua* was more susceptible to the active compound than *Spodoptera litura*. On the basis of IR, GC-MS, <sup>1</sup>H NMR and <sup>13</sup>C NMR spectral data, the active compound responsible for the insect activity was identified as stemofoline. In addition, we found that the purified fraction 1, which was effective in causing larvae mortality even less toxicity than compound stemofoline, had EI- mass spectrum identical with stemofoline. Consequently, fraction 1 was suggested to be an isomer of stemofoline. These findings indicated that *Stemona burkilli* root extract could be applicable as an alternative agent for controlling larvae of *Spodoptera exigua*, as well as larvae of *Spodoptera litura*.

**INSECTICIDAL EFFECTIVENESS OF *PIPER RETROFRACTUM* AND *TEPHROSIA VOGELII* EXTRACTS AGAINST *CROCIDOLOMIA PAVONANA* AND *PLUTELLA XYLOSTELLA* AND THE SAFETY OF THE EXTRACTS TO *DIADEGMA SEMICLAUSUM***

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Most farmers rely heavily on the use of synthetic insecticides to control crucifer pests. Excessive use of insecticides may lead to some undesirable side effects to the environment and human



health. In order to alleviate this problem, botanical insecticides could be used as alternative to conventional insecticides. The active fractions of ethyl acetate extract of *Piper retrofractum* (*Pr*) fruits and hexane extract of *Tephrosia vogelii* (*Tv*) leaves and their mixtures were evaluated for their insecticidal activity on second-instar larvae of *Crocidolomia pavonana* and *Plutella xylostella* as well as for their safety to the adults of *Diadegma semiclausum* parasitoid. Fraction (fr) 2 of *Pr* from vacuum liquid chromatography (VLC) and fr 2-4 of *Tv* from column chromatography (CC) had strong insecticidal activity on *C. pavonana* and *P. xylostella*. In the test with *C. pavonana*, the two fractions were more active by feeding than by contact. Based on  $LC_{50}$  at 72 hours since treatment (HST), fr 2 VLC *Pr* was 3.8 times more toxic than fr 6 VLC *Pr* to *C. pavonana*. Besides, fr 2 VLC *Pr* was 2.4 times more toxic to *C. pavonana* than to *P. xylostella*. On the contrary, fr 2-4 CC *Tv* was 1.8 times more toxic to *P. xylostella* than to *C. pavonana*. The mixture of fr 2 VLC *Pr* and fr 2-4 CC *Tv* at concentration ratios of 8:5 and 5:1 was antagonistic to *C. pavonana* and *P. xylostella*, respectively. The mixture of fr 6 VLC *Pr* and fr 2-4 CC *Tv*, however, had additive to weak synergistic joint action against *C. pavonana*. At equal test concentrations, the treatment with fr 2-4 CC *Tv* and its mixture with fr. 2 KVC *Pr* caused much lower mortality in *D. semiclausum* parasitoid adults than in its host larvae, *P. xylostella*. This suggests the selectivity of the test extracts in favour of the parasitoid. In contrast, an organophosphate profenofos, included in this study as a positive control, was much more detrimental to *D. semiclausum* than to *P. xylostella*. In a semifield experiment, fr 2-4 CC *Tv* had comparable effect to profenofos and bioinsecticide *Bacillus thuringiensis* in reducing the population of *C. pavonana* larvae on broccoli plants. Thus, *T. vogelii* extract preparation and, to a limited extent, its mixture with *P. retrofractum* extract hold the potential as alternatives to conventional insecticides for the control of crucifer pests.

**INSECTICIDAL ACTIVITY OF *AGLAIA ODORATA* (MELIACEAE) COLLECTED FROM SEVERAL LOCATIONS AGAINST *CROCIDOLOMIA PAVONANA* (LEPIDOPTERA: PYRALIDAE) LARVAE**

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Extract of *Aglaia odorata* (Meliaceae) has been known to possess insecticidal activity to several insect pests. As an insect pest control agents for field application, the preparation of mass extract product is necessary, therefore a large number of plant raw material sources is needed. On the other hand, content of plant active compound is greatly influenced by climate condition and location where those plants are growing. So, the objective of this study is to evaluate the insecticidal activity of *A. odorata* taken from several locations against *Crocidolomia pavonana* (Lepidoptera: Pyralidae) larvae. Plant materials were collected from Bogor (Cimanggu, Ciapus, and Bogor Botanical Garden), Bekasi, both are located in West Java, and Tegal of Central Java. Plant materials were extracted with methanol and then extracts were bioassayed by using leaf residual method. Based on the  $LC_{50}$  and  $LC_{95}$  values, the results showed that there were differences on  $LC_{50}$  and  $LC_{95}$  values of each extract. This result suggests that difference locations of plant growth may cause the differences in insecticidal activity of plant extracts.

**INSECTICIDAL ACTIVITY OF *PIPER CUBEBA* FRUIT AND *TEPHROSIA VOGELII* LEAF EXTRACTS ON THE CABBAGE HEAD CATERPILLAR, *CROCIDOLOMIA PAVONANA***

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Most farmers rely heavily on the use of synthetic insecticides to control crucifer pests. Excessive use of insecticides may lead to some undesirable side effects to the environment and human health (Stenersen 2004). In order to alleviate this problem, botanical insecticides could be used as alternatives to conventional insecticides (Prakash & Rao 1997; Isman 2006). This study was conducted to evaluate the insecticidal activity of hexane extract of *Piper cubeba* fruits and *Tephrosia vogelii* leaves and their mixture on the cabbage head caterpillar, *Crocidolomia pavonana*, in the laboratory and greenhouse. Commercial insecticide formulations containing *Bacillus thuringiensis* (Bt) and profenofos were included in this study as positive controls. *P. cubeba* extract consisted of oily and solid phase, in which only the solid phase was active. Hereafter, for the sake of brevity, the solid phase of *P. cubeba* extract is shortened to *P. cubeba* extract. In the treatment with *P. cubeba* and *T. vogelii* extracts as well as with Bt, the mortality of the test larvae was still low at 24 hours since the beginning of the treatment (HBT) and increased after 48 HBT. Based on LC<sub>50</sub> at 72 HBT, the order of toxicity of the test materials against *C. pavonana* larvae was as follows (in a decreasing order): *B. thuringiensis* = profenofos > *P. cubeba* + *T. vogelii* extract mixture ≥ *T. vogelii* extract > *P. cubeba* extract, with LC<sub>50</sub> of 0.010%, 0.013%, 0.112%, 0.14%, and 0.341%, respectively. The mixture of *P. cubeba* and *T. vogelii* extract had weak synergistic joint action at the LC<sub>50</sub> level for the assessment time at 48 and 72 HBT, whereas at the LC<sub>95</sub> level, the mixture was additive at 48 HBT and weak synergistic at 72 HBT. In the a persistence study in the greenhouse, the treatment with Bt residue caused fairly high mortality of *C. pavonana* larvae (>85%) until 7 days after application (DAA), whereas *T. vogelii* extract had relatively good persistence (larval mortality >70% at 7 DAA) and *P. cubeba* + *T. vogelii* extract mixture had moderate persistence (larval mortality >50% at 7 DAA). In general, the residual activity of the test materials started decreasing at 3 DAA. The residual activity of profenofos decreased sharply from 3 DAA to 5 DAA and 7 DAA, i.e. larval mortality decreased from about 70% to 18% and 0%, respectively. Thus, *T. vogelii* extract and its mixture with *P. cubeba* extract hold the potential as alternatives to conventional insecticides for the control of crucifer pests.

**EFFECT OF *DENDRANTHEMA* ON *COTESIA PLUTELLAE* PARASITISM IN BRASSICACEOUS CROPS: CONTROL OF DIAMONDBACK MOTH, *PLUTELLA XYLOSTELLA***

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In Myanmar, the infestation of the diamond backmoth (DBM) was considered as one of the major constraints to cruciferous vegetable production. DBM becomes resistance to many pesticides and uses of pesticides cause damages not only to the environment but also to the farmers. It is safer and cheaper than pesticides to plant selected flowers into brassicaceous crops in the control of diamond backmoth. Two commercial fields of each of cabbage, cauliflower, and kale, with active spraying programmes, were used and all were under same treatment. The larval population was examined before the treatment and repetition was carried out after 14 days. Parasitism rate of diamond backmoth larvae by *Cotesia plutellae* was significantly higher in the fields adjacent to *Dendranthema* than away. *C. plutellae* parasitism rate occurred highest in cabbage plants (61.11%) and lowest in kale

plants (25%) when planted adjacent to *Dendranthema* flowering plot but DBM larval population was not significant. Serious elimination of adult parasitoids was occurred by the pesticides at their recommended doses. DBM population was 0.71, 0.6, and 0.2 larva /plant in kale, cauliflower, and cabbage respectively, but small white butterfly population was significantly higher in adjacent plots as the result of *Dendranthema* plant.

### **EFFECTS OF THE CONSORTIUM OF ENDOPHYTIC BACTERIA, CHITINOLYTIC BACTERIA, AND PLANT GROWTH-PROMOTING RHIZOBACTERIA ON THE GROWTH OF BANANA AND THE ACCUMULATION OF BANANA BUNCHY TOP VIRUS**

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Banana Bunchy Top is one of the most important diseases of banana in Indonesia. Nurhayati (2003), in West Java (Bogor, Cianjur, Pandeglang, Subang dan Sumedang) the virus has been spread widely with the disease incidence was about 7.2-38.6%. As an alternative control of the disease, each isolate of endophytic bacteria (*Pseudomonas* PK5), chitinolytic bacteria (*Aeromonas caveae*), and Plant Growth-Promoting Rhizobacteria (*Bacillus cereus* L32) were investigated individually and/or in combination. The effects of treatments were also investigated to the abundance of fluorescent *Pseudomonads* and heat tolerance bacteria using plate-count method. Based on the green house experiment data, at 60 days after inoculation of Banana Bunchy Top Virus (BBTV) the height of the plant treated with bacteria were significantly higher than control plants. The height of the plants treated with bacteria was at range of 82.7 to 88.2 cm while control was up to 71.6 cm. The accumulation of BBTV on the plants treated with endophytic or chitinolytic bacteria individually were not significantly different compared with control but for the other treatment the accumulation of BBTV was higher than control. In the field, 120 days after transplanting, the diameters of stem of plants treated with *Bacillus* and/or *A. caveae*, individually or in combination among them, were relatively lower compared with control. Application of *Pseudomonas* individually or in combination with *Bacillus* or *A. caveae* caused the diameter of stem were relatively higher than control. The highest diameter of stem on 120 days after treatment was up to 17.27 cm on the plants treated with *Pseudomonas* combined with *A. caveae*. The highest population of heat tolerant bacteria, i.e  $1.8 \times 10^4$  cfu/g soil, was found in the soil both treated with combination of *Bacillus*+*A. caveae* and *Bacillus*+*Pseudomonas*+*A. caveae*, while the lowest was found in the soil treated with *A. caveae*, i.e  $1 \times 10^3$  cfu/g soil. Population of fluorescent *Pseudomonads* in the soil treated with *Bacillus* and *Bacillus* + *Pseudomonas* was similar with Control, while in the other treatments the population of fluorescent *Pseudomonads* were relatively higher than those in control.

### **PRODUCTION OF ANTAGONISTIC ACTINOMYCETES AGAINST *FUSARIUM OXYSPORUM* BY SOLID STATE FERMENTATION**

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The *Streptomyces* sp. isolate 22.2 was isolated from Termite mound and proved to have antagonistic effect against *Fusarium oxysporum* that caused Fusarium Wilt in solanaceous crops (tomato, potato, pepper, and egg- plant). The antagonist isolate 22.2 had chitinolytic activity, therefore, chitin could be used as their carbon source in culture medium. The biomass production of

antagonistic actinomycetes for using as a plant pathogen fungal control agent could be possible by the utilization of shellfish processing wastes. Shrimp shell powder prepared from dried shrimp processing waste was used as a major carbon source in culture medium. For optimization of solid-state fermentation of the antagonist, response surface methodology based on central composite design (CCD) was used. The design was employed by selecting ratios of shrimp shell powder-to-rice bran for being carbon sources in solid medium that having soy bean meal as nitrogen source at the ratio of carbon and nitrogen source 10:1, moisture content, and incubation time as model factors. The maximum yield of the antagonistic actinomycetes biomass derived from the optimized solid state fermentation using shrimp shell powder-to-rice bran ratio, 1; moisture level, 60%; and incubation time, 5 day was  $7.5-8.0 \log \text{ cfu.g}^{-1}$  dry matter.

### **METABOLIC FINGERPRINTING OF *ERWINIA CAROTOVORA* ISOLATED FROM JACKFRUIT, CHUMPHADA AND VEGETABLE**

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Bacteria were isolated from jackfruit and chumphada which shown gummy from tree branch and die back symptom which identified the causal agent as *Erwinia carotovora* group by *pel* gene. Moreover, the bacteria can infect either tree or vegetable where as EC isolated from vegetable can not (Sudjasin, *et.al.* 2005). The objective of this study was use metabolic profile to study phenotypic variability of EC isolated from tree and vegetable. Bacteria were grown on nutrient agar at 30°C for 16 hr. Bacterial suspension were prepared by scrubbing bacteria and diluting in inoculation fluid at 63% transmittance. The bacterial suspension of each strain was inoculated 150  $\mu\text{l}$ /well into Biolog GN2® microplate. Plates were incubated at 30°C for 16 hr and measured carbon source utilization by Microlog™ System. Bacterial carbon source utilization profiles were translated into binary numeral system. Phylogenetic dendrogram based on carbon used as substrate characteristic was generated by simple matching coefficient and clustered by unweighted pair-group method, arithmetic average (UPGMA). The *Erwinia carotovora* (EC) grouped in the same branch at 86% similarity coefficient while *Erwinia chrysanthemi* (ECH) separated at 77%. The EC which isolated from vegetable and tree were separated at similarity coefficient of 89.5%. The EC isolated from tree divided into two branches while the EC isolated from vegetable mostly in the same branch. From the result, the bacteria isolated from tree emphasis in EC member that metabolic profile similarity more than 80%. However, they may be a different sub-species group which 93% similarity of sub-species level had been shown in *Pantoea stewartii* subsp. *stewartii* (Willson, *et al.*, 1999).

### **SOYBEAN INDUCE ITURIN A PRODUCTIVITY OF *BACILLUS SUBTILIS* NB22**

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Iturin A is a lipopolypeptide which shows antifungal activity for several kinds of plant pathogenic fungi. *Bacillus subtilis* Nb22 is one of the Iturin A producing bacteria. Previously, we showed that the suppressive effect of the solid state culture of *B. subtilis* NB22 for *Fusarium* yellow of Taasai by combination with organic matters as media, and soybean cake was the most effective treatment for suppression and for Iturin A producing by *B. subtilis* Nb22. Hence, it is deduced that IturinA production is one of the critical matters for suppression of plant diseases by *B. subtilis* Nb22. In this study, we compared commercial polypeptons which were derived from different raw materials

and digested by different enzymes for Iturin A production in liquid medium. Number 3 medium (polypepton 1%, glucose 0.5%,  $\text{KH}_2\text{PO}_4$  0.1%,  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  0.05%) was used as basal medium for Iturin A production (Phae and Shoda, 1991). All of 7 kinds of polypeptons were purchased from Nihon Pharmaceutical (Tokyo, Japan). Raw materials of polypeptons were soybean cake, purified soybean protein, fish meat, and milk casein, respectively. After 5 days incubation at 25°C by shaking, there were no differences among 7 kinds of polypeptons for cell numbers in culture. By using 3 kinds of polypeptons which were derived from soybean cake with digested by different enzymes, *B. subtilis* Nb22 produced Iturin A, whereas by using of polypeptons which were derived from purified soybean protein, fish meat, and milk casein, Iturin A was not detectable in liquid culture. Our results showed that soybean contained inducer(s) for Iturin A productivity of *B. subtilis* Nb22 and the inducer(s) were not available by purification of protein from soybean.

### **STUDY ON NATURAL ENEMIES OF INSECT PESTS ATTACKING VEGETABLES, BEANS, ORANGE FRUIT TREES IN HA NOI, VIETNAM.**

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Natural enemies of key insect pests play a big role in reducing their population. This study concentrated only on the key insect pests in vegetables, beans, orange fruit trees and their natural enemies found in Hanoi, where these crops are heavily cultivated. We found 7 species of predatory fly belong to Chamaemyidae and Syrphidae family of Diptera. They are natural enemies of aphids attacking on cucumber fields in Hanoi region. We found 14 species of indigenous natural enemies of *Thrips palmi*, belong to 4 orders (*Hemiptera*, *Thysanoptera*, *coleoptera* and *Hymenoptera*). Among 14 species, 13 species are predator and only one species is parasitoid. The relationship of population dynamic between *Thrips palmi* and *Orius sauteri* are closely, between *Thrips palmi* and *Orthotylus* sp. are more closely. We found 13 species of predatory bug which belong to 5 families on leguminous crop at Dang Xa-Gia Lam, Hanoi. There were 4 species of whitefly belong to Aleyrodidae: Homoptera attacking on citrus trees and 3 parasitoids species, 3 predator species in Gia Lam, Hanoi. The life cycle of the predatory bug *Orius sauteri* Poppius, predatory fly *Syrphus ribesii* Linne, *Eocanthecona furcellata*, and *Coranus fuscipennis*. The predatory bug *Orius sauteri* Poppius was successfully mass-reared on *Corcyra cephalonica* egg and *T. palmi* larvae for release to the field. Yield of cucumber in every three treatments (chemical control treatment, chemical control + biological treatment and biological control treatment) were significant different if compared to the control treatment. In the biocontrol treatment and in the chemical treatment, the cucumber yield was not significant different at 5 % level, this demonstrated that the effect of predacious bug is equal to insecticide control.

### **SURVEY OF COCONUT CADANG-CADANG VIROID SEQUENCE IN OIL PALM WITH ORANGE SPOTTING DISORDER USING MOLECULAR DIAGNOSTIC TOOLS**

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The lethal cadang-cadang disease of coconut palms (*Cocos nucifera* L.) in the Philippines is caused by *Coconut cadang-cadang viroid* (*Pospiviroidae: Cocadviroid*). It has caused extensive losses to coconut production in the Philippines. . Several species of palm and other monocotyledons in Oceania and South-East Asia have been shown by molecular hybridization assay to contain CCCVd-related sequences. In African oil palm (*Elaies guineensis*) plantations in South East Asia and the

South Pacific, CCCVd-related molecules were frequently associated with an orange leaf spotting disorder previously described as “genetic” orange spotting (GOS). In this study, variants of CCCVd have been identified in plantation oil palms with orange spotting disorder growing in Malaysia. These variants were detected by molecular hybridization of dot blots and Northern blots of two-dimensional polyacrylamide gels (2D-PAGE) with a <sup>32</sup>P-labelled 246 nt form of CCCVd (CCCVd<sub>246</sub>) cRNA probe. In addition, a ribonuclease protection assay (RPA) has been developed for detecting the 246 nt sequence of CCCVd. It has been widely used as a powerful sensitive method to detect and quantify specific RNAs and its variations in nucleotide sequence of a RNA population. A small scale survey in three commercial plantations in Malaysia showed OS incidence ranging from 13-16 %. Thirty palms were screened for CCCVd sequences using methods described above and 17 out of 30 commercial oil palms sampled contained CCCVd sequences. Cloning and sequencing of RT-PCR products from the oil palm showed over 90 % sequence similarity to the 296 nt form of CCCVd (CCCVd<sub>296</sub>) from the Philippines. Three size classes are described comprising 297, 293 and 270 nt. Mutations and deletions accounted for the different sizes. At present, OS is not considered to be economically important, hence, no major research effort has been carried out to investigate this problem, especially the etiology and epidemiology of the disorder. However, with this evidence, serious consideration is needed to study the threat of CCCVd to the oil palm industry.

### INTEGRATED PEST MANAGEMENT USING BIOPRODUCT FOR CHINESE KALE PRODUCTION

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Field experiment was set up in Suphanburi chinese kale production area using RCBD of 12 treatments or technologies during 29 Feb to 19 Apr, 2008. The size of the plots depending on the commercial field 5x7 m. The 9 treatments investigated were KU-Technology package of integrated management system of disease and insect pest. Evaluation of the results was based on pest control efficacy and yield obtained. The result revealed that all KU-Technology packages (T4 to T12) provided the better yield increased (P=0.05) and reduction of disease severity (*Alternaria* leaf spot) and number of insect pest incidence (*Plutella xylostella*, *Spodoptera litura*, and *Phyllotreta flexuosa*) compared to those of sole chemical treatment (T2 copper hydroxide seed treatment+6-copper hydroxide+mancozeb fungicide+6-abamectin insecticide spray intervals) and untreated control (T3). The KU-Technology of T5 (seed treatment and 3-foliar spray intervals with *Pseudomonas fluorescens* SP007s), T10 [SP007s seed treatment and 3-foliar sprays+4-botanical spray of Non-taai-yaak (*Stemona collinsea*) +1-natural enemy release of stink bug (*Eocanthecona furcellata*) and earwigs (*Proreus similans stallen*)], and T11 (SP007s seed treatment+3-foliar plus algae extract sprays+4-botanical sprays+1-natural enemy release) exhibited the best result in terms of increasing yield (with 10.3 t/ha obtained from either T5 or T10) that were significantly different (P=0.05) from T1 of conventional grower plots (alachlor+8-swine placenta extract plus EM+6-abamectin+8-copper hydroxide sprays). Furthermore, the lower epidemic of *Alternaria* leaf spot and insect incidence of *P. xylostella*, *S. litura*, and *P. flexuosa* correlating with the higher yield increase obtained from those KU-Technology packages was observed. The SP007s formula enhanced more plant growth and yield increased than SP007s cell culture suspension. The result also showed that insect monitoring and decision based on action threshold (T10, T11) were able to reduce the number of insecticide application and total cost of chemical control. These technologies should be an important integral part of Chinese kale pest management system. The KU-IPM Technology package of microbial antagonists (*P. fluorescens* SP007s, *T. harzianum* plus sodium silicate)+botanical pesticide+natural enemy in T10, T11, and T12 was the most promising to enhance plant growth and yield increase of Chinese kale

production. These studies demonstrated that a combination of KU-biological technology resulted in a reduction of all pest development and increased yield better than higher application rates of pesticides.

## **RISK IDENTIFICATION AND MITIGATION FOR INSECTICIDE USE IN VEGETABLES**

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Farmers resort to relying heavily on chemical control when insect pest pressure in vegetable production is very intense. Vegetable production offers a difficult situation for compliance to good agricultural practice, pre-harvest intervals in particular, when the financial situation is tight or when weather conditions require an early harvest. Some farmers spray every 2-3 days or even worse spray in the late afternoon and harvest early the next day. A nation-wide monitoring of vegetables in 2006 showed that about 30% of the samples contained detectable residues, which were generally below MRLs. There is therefore, a compelling need to identify risk and risk mitigation measures in this situation. Vegetables were sprayed at the recommended rate with insecticides late in the afternoon, harvested early in the morning of the next day and analyzed for residues. Home processing of vegetables, such as washing and boiling were done, while fresh fruits were also stored under ambient conditions to simulate wet market conditions to determine residues at this point in the supply chain. Dietary risk assessment for insecticides is made. Examples are discussed where insecticide residues, at one day after spraying, were within and above ASEAN MRLs; another discusses a situation without ASEAN MRL. Home processing reduces pesticide residues which may be present in vegetables. Substantial reduction under ambient temperature and indoor sunlight was also noted. Malathion registered the greatest reduction of residues. In countries where harvesting of vegetables do not conform to registered good agricultural practice, a re-assessment can be made and use patterns re-registered after satisfying a dietary risk assessment. Supervised pesticide residue trials (SPRTs) on insecticide use in minor crops like okra, kangkong and pechay need to be done. ASEAN countries should continue to work together in collaborative research to produce SPRT data that can protect consumers as well as for CODEX MRLs to protect our exports.

## **GERMPLASM EVALUATION OF PATHOGEN-TESTED POTATO ACCESSIONS GROWN FROM APICAL CUTTINGS IN THE PHILIPPINE HIGHLANDS**

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Sets of germplasm with wide range of genotypic characteristics were evaluated in the low mountain zone in the Philippine highlands. The trial was conducted to determine the growth and yield of 32 accessions grown from apical cuttings and to select promising accessions for further evaluation in different agro-ecological zones in the Philippine highlands. Tuber yield of selected accessions and check varieties Ganza, Igorota and Granola ranged from 1.25 to 23.29 t/ha and were significantly different among accessions. A total of 14 accessions were selected both by the researchers and farmers for their good yield, desirable tuber shape, skin color, and shallow eyes. Most of these selected accessions were resistant to late blight. It is recommended that these selected accessions be screened further for their adaptability in different agro-ecological zones in the Philippine highlands. Selected accessions will be included in the National Testing Center for final evaluation. Outstanding accessions will be recommended to the Philippine Seed Board for variety release.

## **FOOD SAFETY AND AGRO-PRODUCTION OF PLANT AND ANIMAL ORIGIN**

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Food safety has become more and more important and sometimes reaching to the crisis of risk in term of contaminants and consumer awareness. These situations have threatened and made food production system instability where stakeholder has to minimize as fast as possible. One of the visible pictures is the emerging of food safety risk that always appears one by one. However, the unavoidable factor such as global warming is also played an important role for these incidences without any reliable prediction. During 2000-2007, the development of food safety systems in Thailand is increasing and also regulatory support. Several quality standards have been issued and implemented such as National GAP within the Ministry of Agriculture and Cooperatives, ThaiGAP, GlobalGAP, GMP, HACCP, ISO 22000 and also Agricultural Standard Act B.E. 2551. These regulatory, both in voluntary and mandatory basis aim to reduce risks of any causes of food safety by management of the prerequisite factors, certified processes and also try to early identify any emerging hazards as preventive approaches. These indicators reviewed from many incident countries comprise of three different environment issues; the environment surrounding the food production, the food production chain from farm to table/fork and consumers. However, this can not be excluded the contamination by intention as had happened recently in case of melamine in feed and baby powder. In this paper, the various indicators for emerging hazards have been identified and will be presented in detail as predictive devices for the country in the future.

### **‘CLEAN AND SAFE’ AGRICULTURE IN NORTHERN THAILAND: ACHIEVEMENTS, CHALLENGES AND PRIORITIES**

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Concern about health and environmental hazards has led 'clean and safe' agricultural products to be an important issue among consumers, farmers and governments worldwide. This has been reflected in the increasing supply of and demand for organic and eco-labelled products. While developed countries' interests are focused on certified organic production, developing countries such as China and Thailand develop their produce along various levels of 'clean'. The clean continuum ranges from production practices including high chemical, safe-use chemical, chemical-free and no chemical to environmentally friendly practices (organic). The ideal clean produce system is perceived to be one that utilizes organic practices that allow the use of alternative fertilizers and bio-pesticides rather than chemicals. Safe-use and chemical-free practices are between organic and conventional practices and are a possible step before converting conventional farms directly to organic farms. Organic farming in Thailand was initially developed by farmers and non government organisations (NGOs) in the 1980s, and was subsequently implemented by the Thai government through a series of policies on clean produce to meet international standards. The progress began in 2004, where, in order to meet the requirement to export and improved domestic food quality, the policy on agricultural chemical-use reduction had established and extended the Good Agriculture Practice (GAP) program for major economic crops including vegetables. The government also declared 2004 as the year of 'Health for All' and highlighted clean and healthy food in a public campaign to raise



consumer awareness. In 2005, the government promoted organic agriculture as a national agenda. In 2007, the government restated the advanced policy for 2007-2008 on 'food safety' which takes into account the food chain or 'from farm to table'. There are various 'clean and safe' agricultural systems being developed in Thailand, although there is some confusion about what they actually mean and how they operate. This paper aims to review the initiatives on 'clean and safe' agriculture with emphasis on vegetables in 'clean and safe' farming systems in northern Thailand. The background of 'clean and safe' agriculture such as definitions, aims and principles will be briefly described. Then the discussion will focus on some important components of 'clean and safe' vegetable production systems in northern Thailand including research and development, certification systems, and market.

### **GOOD AGRICULTURAL PRACTICE IN TRANSITION OF DURIAN GROWERS TOWARDS PARTICIPATORY APPROACH IN CHANTHABURI PROVINCE, EASTERN THAILAND**

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The specific objectives of this study were to 1) determine GAP of durian growers towards farmers-participation approach, 2) examine existing condition and constraints in durian cultivation, and 3) initiate durian GAP innovation. Information on durian GAP was gathered from relevant agencies and in-depth interview with stakeholders and durian growers in Chanthaburi province. They also have been certified on durian GAP by Department of Agriculture, Ministry of Agriculture and Cooperatives, Thailand. There were several advantages on GAP durian production such as suitable physical factors for cultivation, local wisdom and skillfulness on cultivation technique that came from their long experiences, capability input used and also abundant recommendation technology to attain both quantity and quality towards market standardization. In addition, there were more market channels that access surrounding the areas. Weak points included exaggeration input used, higher cost, and market risk. However, because of GAP promotion, there were significantly lower chemical input used particularly fertilizer and pesticides used among certified growers. There were also increasing diversified crops that reduced risk instead of durian mono crops. Furthermore, cultivators have more opportunity to access R&D program from Office of Agricultural Research and Development (OARD), and Horticulture Research Centre (HRC), respectively. Currently, over existing oil crisis, the respondents faced a lot of constraints in particular high cost of transportation while compare with the other resource product, Rayong province. Recommendations for GAP promotion from concerned agencies were: 1) local wisdom harmonized with recommendation technology should be promoted, 2) durian central wholesale market center for GAP durian products only should be urgently provided, 3) image and brand name promotion should be continuously promoted both domestic and abroad through various media channels, and 4) appropriate and efficient vertical durian promotion data should be easily accessible.

**CAPACITATION OF LOCAL COMMUNITIES OF GEN. NAKAR AND INFANTA QUEZON ON GOOD MANAGEMENT PRACTICES IN BANANA PRODUCTION THROUGH FARMER-MANAGED TRIALS**

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The municipalities of Infanta and General Nakar in Quezon, Philippines are predominantly agriculture-based. These municipalities were badly affected by the November 2004 flashfloods due to overflowing of the Agos river that runs between these 2 municipalities, following successive typhoons and days of torrential rains. Illegal logging in the Sierra Madre mountain ranges was blamed for exacerbating the disaster. Close to 1,000 died and millions of pesos worth of properties were destroyed. The towns were inundated with mud and water. Resource-poor farmers were among the most badly affected, with their farmlands destroyed, covered by layers of mud and debris. Farmers were able to use the land again only after a year. Heeding the call to assist in the rehabilitation of the affected areas, the Project established farmer-managed trials on local banana cultivars in 22 trial sites involving 14 farmer-cooperators and a total of 2-ha. area (144m<sup>2</sup>-2400m<sup>2</sup> per site). A package of technologies (POT) for local banana cultivars was introduced by the Project which provided free tissue-cultured planting materials, fertilizers and technical support in exchange for farmers' participation in trials that included fertilizer treatments as per POT and biofertilizers. Farmer provided land, labor and security for the trials and gave free access to the Project team for monitoring and sampling. Further, the Project actively sought the involvement of the Local Government Units of Infanta and General Nakar who, are mandated to pursue and fund agricultural development of their constituent areas. This paper discusses the preliminary outcome of the farmer-managed trials and the other activities on assisting in the local capacitation of the local community in pursuing an expanded and sustainable banana production program before Project phase-out in June 2009.

**NUTRIENT DIGESTIBILITY COEFFICIENT OF WEANER PIGS FED DIETS SUPPLEMENTED WITH ESSENTIAL OIL MIXTURES AS FEED ADDITIVE**

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This experiment was conducted at Naresuan University, Phitsanuloke, Thailand to evaluate the potential of using 5 mixtures of essential oil extracted from clove, peppermint and orange peel in weaner pig diets for nutrient digestibility evaluation using 35 days old crossbred Duroc X (Landrace X Large White). Twenty four pigs consisting of 12 males and females were housed in individual cages and randomly distributed into 6 groups of 4 pigs each in a Completely Randomized Design. The pigs in each group were randomly fed with one of 6 diets as follows: diet 1 was a basal diet (control diet) containing corn-soybean meal. Diet 2, 3, 4, 5 and 6 was a basal diet supplemented with a mixture of clove oil : peppermint oil : orange peel oil at the ratios 1:1:1, 1:2:1, 1:2:2, 2:1:1, 1:2:2, and 2:2:1, respectively at 5 ml/kg diet. Experimental period consisted of 3 days for diet adjustment followed by 3 days of total feces collection for nutrient analysis. The results showed that digestibility coefficient of dry matter, crude protein, gross energy, crude fiber, ether extract and ash of the pigs fed diets 1, 3,

4, 5 and 6 were not significant different among treatments. However, the pigs fed diet supplemented with 5 ml/kg diet of mixture of clove oil : peppermint oil : orange peel oil at the ratio 1:2:1 had the highest nutrient digestibility coefficient. A mixture of essential oil extracted from clove, peppermint and orange peel at the ratio 1:2:1 has a potential for use as feed additive in weaner pig diets.

#### **SOIL CONSERVATION AND WEED MANAGEMENT THROUGH REDUCED TILLAGE AND HERBICIDE APPLICATION IN VARIOUS PRODUCTION SYSTEMS**

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This study being conducted in five Philippine provinces is a proponent of the Gramoxone technology (GSL) which stresses that through effective weed management and reduced tillage, the risk of soil erosion in farms will be minimized, if not reduced to zero, coupled with providing cost-saving benefits and increased yields to farmers. This technology involves pre-plant application and inter-row spraying of Gramoxone 20SL to control weeds. This is being compared to the farmer's practice (FP) of cultivation and clean culture. It aims to prove that Gramoxone technology is safe to users, cost-effective and practical to use in light of sustainable agriculture. It is also expected to explore different means of weed management as a way to combat soil erosion in farms and crop plantations in the Philippines. Three-year results of the study in four of the sites show that soil erosion was reduced in GSL over FP by 76.17, 61.33, 32.6 and 69.4% in Sites 1, 2, 3 and 4, respectively. Soil erosion in GSL treatments in these sites are below the allowable limit set by FAO which is 10 tons/hectare/year. Applying GSL reduced cost over FP by 38.6% in Site 1(corn), 20.0% (upland rice) and 28.0% (corn) in Site 2, 65.3% (cabbage) and 67.3% (potato) in Site 3, 33.6% (corn) in Site 4 and 44.5% (lowland rice) in Site 5. Yields in GSL treatments also showed significant increases over FP in most of the cropping seasons in the various sites. For weed management, applying Gramoxone as pre-plant and as inter-row is effective in suppressing the growth of all kinds of weeds and when applied at least one week before planting, the herbicide has no side effects on the crop. In Site 1, however, there was a shift to *Imperata cylindrical* in the corn field, hence, other methods of weed control should be included once the condition continues.

#### **THE UTILIZATION OF KAKAWATE (*GLIRICIDIA SEPIUM*) JACQ. KUNTH EX WALPH. WOOD ASH FOR CONCRETE ADMIXTURE**

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The search for raw materials in the innovation of technologies is now undertaken in many countries. Kakawate (*Gliricidia sepium*) is a multipurpose tree and its distribution in the Philippines is endemic. This study sought to determine the other uses of its waste, as the disposal of ash and sludge is a growing problem. A related problem is the recycling of other waste materials. Because of the high volume of kakawate trees in the area and that ash of kakawate wood is considered waste taken from dirty kitchens of every household, recycling the ash is made possible in the formulation of construction material for low-cost housing. It is a good admixture in the formulation. A methodology for the determination of the compressive strength of concrete cylinder mixed with kakawate (*G. sepium*) Jacq. Kunth ex Walph. using the proportion 20% ash and 80% cement for the

mixture 1:2:3. Information about the wood material's physical properties and related environmental and waste management issues are discussed as bases for the acceptability and practicability of wastes and recycled material (WRMs) and developed design to be recommended for construction of low-cost housing projects without sacrificing the strength of the structure.

### **ADOPTION OF VERMICOMPOST TECHNOLOGY: A KEY TOWARD SUSTAINABLE FOOD PRODUCTION**

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Kalinga is a consistent top hybrid rice producing province in the Philippines but the profit margin of the farmers is minimal due to the exorbitant prices of chemical fertilizer. Vermicomposting is an appropriate undertaking due to the presence of abundant rice straw which is a good substrate to produce quality organic fertilizer but farmers are not doing it. Thus, a study was conducted to identify the different factors affecting the adoption of vermicompost and test the difference of the net income of adopters before and after using vermicompost as fertilizer. There were 50 respondents, each were given with 200 pcs earthworm breeders and 10 kg vermicompost. Descriptive statistics were used to analyzed the data. Findings showed that the average annual income is far below the poverty line. There were only five respondents who used commercial organic fertilizer before using vermicompost. Statistics revealed that net income is greatly increased with the incorporation of vermicompost in their farming activities. The dominant reasons impeding the use of vermicompost in the farm are expensive cost of earthworm breeder, lack of information, and insufficient extension support in the community. To address these problems, subsidy from external sources must be established. Appropriate reading materials and support of extension offices coupled with frequent personal monitoring is needed to match the growing demand of the farmers.

### **DIGESTIBILITY AND FEEDING VALUE OF CATTLE RUMEN CONTENTS IN SWINE DIETS**

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The shortage and high cost of feed ingredients for livestock and poultry has forced raisers to identify raw materials, that are not used as food for man, for animal feeding and this includes cattle rumen content (CRC). This study was conducted to determine the digestibility, nutritive and feeding value, and economics of CRC as a component of plant protein-based swine diets. Five treatments were evaluated: Diet I (No CRC), Control), Diet II (10%), Diet III (12%) and Diet IV (14%) using Completely Randomized Design with three replications. Percentage dry matter recovery of cattle rumen contents was 25.02%. Proximate analysis revealed that CRC contains: crude fiber (24.8%), nitrogen free extract (53.99%) and crude protein (15.41%). Gross energy was 0.72 kcal/kg with an ether extract digestion coefficient of 82.48%. Crude protein and nitrogen free extract were moderately digestible, 65.17% and 46.57%, respectively. Crude fiber digestibility was 38.68%. Average initial and final weights, cumulative feed consumption and average daily gain of pigs were statistically similar in all treatments. Feed conversion ratio did not significantly vary during the starting and finishing stages, but varied significantly during the growing stage. Significant variations on protein efficiency ratio were noted only during the growing stage. Pigs fed with Diet V had the highest dressing percentage of 65.12 while Diet IV fed pigs had the lowest backfat reading of 1.66

cm. Pigs fed with Diet IV had the lowest cost of feed per unit gain in weight during the growing and finishing stages. Cattle rumen contents could be nutritionally and economically incorporated in swine diets at 10 to 14 percent levels.

### COCCINELLID FAUNA IN RICE AND VEGETABLE AGROECOSYSTEMS IN NORTHERN PART OF THAILAND

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Field survey of coccinellid fauna was carried out in the rice and vegetable agroecosystems in the northern part of Thailand in Chiang Mai area from October 2007 until September 2008 to determine their role and efficiency as natural enemies for biological control. Specimens were collected and identified using Natural Enemies Reference Depository (NERD) of the National Biological Control Research Center (NBCRC) at Kasetsart University in Bangkok. This investigation revealed more than 20 species of coccinellids which are generalist predators of insect pests of rice and vegetable. Few coccinellid species were found to be phytophagous and were not of biological control importance. Among these predatory coccinellids, *Curinus coeruleus* (Coleoptera: Coccinellidae) was an exotic species, introduced to Thailand by the National Biological Control Research Center since 1989 for successful biological control of leucaena psyllid, *Heteropsylla cubana* (Homoptera: Psyllidae). These coccinellids are considered naturally-occurring and could be attributed as partial but effective biological control agents for regulating the populations of certain insect pests in the rice and vegetable agroecosystems. Their conservation and augmentation programs are highly advocated.

### DEVELOPMENT OF A REDUCED USE PESTICIDE PROGRAM FOR THE SUSTAINABLE MANAGEMENT OF DISEASE, INSECT AND WEED ON CHINESE KALE PRODUCTION

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Epidemiology of pest complexes is one of the most serious problem affecting Chinese kale production in Thailand. Pest management in this vegetable crop traditionally has been accomplished through pesticide application that pose the risk of developing resistance and environmental concerns. Field trial was conducted during March-May, 2008 at Suphanburi production area to determine the effects of biocontrol agents and products in combination with cultural practices on the incidence of Alternaria leaf spot (caused by *A. brassicae*) and insect pest and weed population. Reduced pesticide programs comprising combinations of *Pseudomonas fluorescens* SP007s powder formulation (for disease control); *Bacillus thuringiensis*, Non-taai-yaak extract; *Stemona collinsea*, and natural enemy including stink bug: *Eocanthecona furcellata* and earwigs: *Proreus similans stallen* (for control of insect pest); and hoe weeding and straw mulching (for weed control) were investigated. Additional programs with alachlor herbicide, all alone pesticides (alachlor, copper hydroxide, abamectin, mancozeb), conventional practices (mentioned pesticides and swine placenta extract plus EM), and nontreated control were included in the experiment. Reduced pesticide programs provided adequate levels of disease, insect and weed management compared with nontreated control. Although the

programs did not clearly affect the abundance of weed populations, there were program differences in the incidence of disease and insect pests. When one of reduced pesticide program (5-Non-taai-yaak and 3- *P. fluorescens* SP007s foliar spray intervals) combined with alachlor herbicide, it significantly reduced Alternaria leaf spot, insect pests (*Phyllotreta flexuosa* and *Spodoptera litura* except *Plutella xylostella*), and weed population (broad leaf and early season grass) and increased yield compared to all alone pesticide and conventional programs. In this study, reduced pesticide programs comprised of stink bug and earwigs; and hoe weeding clearly reduced *P. xylostella*; and grass weed respectively. These reduced pesticide programs appear to be a promising strategy for pest management of Chinese kale production and could minimize grower reliance a conventional pesticide application.

### **GROWING MALAPAPAYA, *POLYSCIAS NODOSA* (BLUME) SEEMAN, AN ENVIRONMENTALLY, ECONOMICALLY AND FRIENDLY SOURCE OF LIVELIHOOD**

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Malapapaya is a soft wood tree *Polyscias nodosa* from the family ARALIACEAE. It is one of the most economically useful and promising lesser-used specie. It is a tall tree reaching a height of about 25 m and 50 cm diameter. It is harvestable 6 to 7 years after planting. It is one of the best sources of wood in the manufacture, among others, of plywood and veneer, wooden shoes, handicrafts/woodworks. Its most significant contribution to environment is its usefulness for the reforestation of denuded forest areas and best replacement for non biodegradable food containers. To be able to give not only the farmers, the community, but the Indigenous People a source of livelihood, help the country recover from disastrous killer flash floods due to denudation of forest and do away with the non biodegradable food containers. A seedling nursery for growing malapapaya was established in Rizal, Philippines. Plants are ready for sale and field planting or transplanting when they reach the height of 10-20 cm or 8-10 months old from sowing. The cost to produce a seedling ready for field planting is PhP10 and can be sold for PhP25 each with a return of investment of 40%. It is worth growing and producing malapapaya seedlings to supply the demand for planting materials here and abroad.

### **THE ECONOMIC EFFECTS OF RAINMAKING IN LAMTAKHONG RIVER BASIN, NAKHON RATCHASIMA PROVINCE**

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This research sought to analyze cost and return of rainmaking (weather modification activities) at Lamtakong River Basin, Amphoe Seekue and to reduce rainmaking expenditure. The research collected cost and return of rice, maize, cassava and sugarcane farms data of 2006/2007 crop year and interviewed 60 farmers of each crop. Regression analysis, ratio and descriptive method were used. To reduce rainmaking expenditure, rainmaking could operate only during May until October. Numbers of raining date were statistically affected on maize and rice yield. Rice farms at irrigation area obtained higher yield than rain fed area. There were 737.04 kilogram per rai and 433.00 kilogram per rai. Some scenarios showed statistically indifferent yield between rain fed area and non-rain fed area however statistically

different numbers of raining date. We might conclude that the rain might not directly increase yield but some indirect benefit were excluded or uncounted.

**SUSTAINABILITY ANALYSIS ON RESOURCES MANAGEMENT PLAN OF  
AGRICULTURAL COMMUNITIES AT KLONG MUANG WATERSHED, RAROENG SUB  
DISTRICT, WANG NAM KHIEO DISTRICT, NAKHON RATCHASIMA PROVINCE,  
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The sustainability analysis on resources management plan of agricultural communities aimed to analyze the existing natural resources potential and environmental status as well as the socioeconomic conditions at Klong Muang Watershed, Raroeng Sub District, Wang Nam Khieo District, Nakhon Ratchasima Province then assessed the sustainability of community after applied the suitable resources management plan. The results revealed that the rainfall potential was in the moderate level where as the climatic conditions were in the warning stage. The potential of water resources was in the moderate level, but water quantity and quality were in the warning status. The potential of soil fertility was in the moderate level, but risky level for soil erosion conditions. Socioeconomic conditions were in the risky level. Land use and natural resource management plans were introduced to the community of Klong Muang Watershed. The study area was classified into Conservation Zone and Utilization Zone. Check dams construction and reforest remediation will be conducted to the Conservation Zone as well as water storage area, soil and water conservation practices for erosion control and organic fertilizer strategy will be applied in the Utilization Zone. The community co-operative shop will be opened in order to combine agricultural product and increase negotiative power. The minor job should be trained for higher income and decrease migration of the communities. The result on sustainable analysis showed that the status was changed from risky conditions to natural conditions.

**MAKING AID WORK FOR SUSTAINABLE COASTAL GOVERNANCE THROUGH  
CONSERVATION PARTNERSHIP AGREEMENTS (CPAS):  
THE EXPERIENCE OF THE SAGIP LINGAYEN GULF PROJECT (SLGP) IN  
MAINSTREAMING ACADEMIC KNOWLEDGE AND TECHNOLOGIES FOR COASTAL  
COMMUNITY DEVELOPMENT**

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The Philippines is one of the largest island-groups in the world. However, despite its vast and rich coastal resources, about 80% of the municipal fishing families still live below the poverty line. Overexploitation of resources, environmental damage both from marine and terrestrial origins, and increasing population contribute to a declining economic status of coastal fisherfolks. Sustainable and balanced development of coastal communities remain a challenge to most foreign-aid projects such as the Sagip Lingayen Gulf Project (SLGP) which is an Integrated Conservation and Development/Coastal Resources' Management (ICD/CRM) project funded by the Netherlands. SLGP developed models for co-management of the coastal environment leading to sustainable coastal resources, water quality and livelihoods. Its interventions include marine protected areas (MPAs) and

mangroves management, high value invertebrates' restocking, mariculture and water quality management, coastal law enforcement and direct legal assistance, resource-linked livelihood development and institution-building for local coastal governance. These are operationalised through a pioneering management and budgetary framework called the Conservation Partnership Agreement (CPA). The CPA internalises a set of working principles and strategies in making aid utilization for resource conservation and rural development more relevant, effective and efficient. Further, the CPA represents an important paradigm shift towards output-orientation, contractual accountability and rationalised cooperation. With CPAs, the SLGP partners who are permanently mandated institutions to undertake coastal resources management (CRM) buy into the implementation of CRM strategies developed jointly with and advocated by the SLGP, to further their own CRM programmes. The SLGP and its partners, Alaminos, Bani, Bolinao and Anda, San Fernando City and the Province of Pangasinan, Philippines and a number of people's organizations shared 15 months of experience in joint CPA implementation. This experience is shared in this paper for its instructive value to future ICD/CRM programming; it emerges a very specific set of insights from the field about "what CRM intervention strategies work, how, why and under what specific set of conditions".

**UNDERUTILIZED CROPS: THEIR IMPORTANCE IN THE SUSTAINABLE  
MANAGEMENT OF THE AGRICULTURAL LANDSCAPE OF THE LAGUNA PROVINCE,  
PHILIPPINES**

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The Philippines is among the countries in the tropics endowed with rich natural biodiversity. Despite this, only a few plant species are being fully utilized today for food, income and even for environmental conservation and enhancement. Laguna is one of the provinces in the country that is characterized by diverse agricultural landscape which often consists of mixed cropping systems where underutilized crops are a major component. Underutilized crops are plant and tree species that many communities traditionally use for food, fiber and animal fodder, oil or medicine but have further underdeveloped potential uses including diversifying cropping systems, developing value-added products, protecting the environment and restoring degraded lands. This study was conducted to show the importance of underutilized crops in enhancing agrobiodiversity of Laguna through a measure of its contribution to vegetation cover and implications on environmental protection; illustrate the economic importance of underutilized crops in Laguna through an estimation of their potential contribution in household occasional income hence their contribution to community/ local income; and provide recommendations on how these underutilized crops might be integrated into the farmers' decision-making on land use management and how the neglect of these biological resource may be overcome. At least 83 underutilized plant species were identified, mostly tropical fruit trees shrubs that serve as vegetables; medicinal herbs and rootcrops that are locally consumed. Underutilized tree species alone, contribute up to 40% of the total tree population in mixed cropping system. Occasional income from these crops benefits various sectors in the rural communities.. A review of the nutritive value of these plant species revealed valuable sources of minerals and vitamins, often lacking in the daily diet of the rural poor. To maximize potential contribution to environmental enhancement, food security and economic productivity, proper integration of these underutilized crops in different agroecosystems is necessary. Integration may include domestication or inclusion in the production system or conservation of species outside the production system.



**PRESENT STATUS AND SOME PROBLEMS OF SOYBEAN PRODUCTION  
UNDER RICE POLICY REFORM IN JAPAN: CASE STUDY IN SAGA PREFECTURE**

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In Japan, in order to uplift the extremely lower ratio of food self-sufficiency (40%; 2007), an increase of crops converted from paddy rice has been conducted with the emphasized intention along the context of rice policy reform based on the higher multi-utilization of paddy field in the recent years. However, the production of converted crops such as wheat & barley, feed grain (maize) and soybean has not necessarily been going upward due to the combination of some complicated factors like technological problem on growing, lower profitability in comparison with rice and vulnerability of labor force and farmers' group. On the other hand, there are also some production areas with good performance, overcoming the difficulty on crop growing, farm management and farmers' organization. Therefore it is considered that the research topics concerned with pulling out the successfully experienced lessons from the good examples will be beneficial from the viewpoint of practice. A case of Shiroishi-town in Saga prefecture provides the excellent examples in increasing the production of soybean. One of the greatest reasons in the increased soybean is attributed to the effective use of crop converted policy accompanied with adjustment of rice production. In this case, farmers' group plays an important role on materializing this use effectively. This presentation aims to clarify effective roles played by farmers' group in accordance with the crop converted policy, taking an example to rural area focused on soybean production in Saga-prefecture of Japan while explaining the national policy for the increase of soybean comprehensively.

**ASSASSIN BUGS (INSECTA, HETEROPTERA, REDUVIIDAE)  
COLLECTED BY THE AFRP EXPEDITION TO SOUTHEAST ASIA FOR 10 YEARS**

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Assassin bugs, or the Reduviidae, form the second largest family in number in the insect order Heteroptera, comprising approximately 7,000 species worldwide. All of them show predatory habits, feeding on small arthropods such as insect and millipedes, with a certain group having vertebrate-blood sucking habits. As the family includes many members attacking such pest insects as beetles and larvae of moths, some species have been investigated for use in biological control against agricultural pests (e.g. *Pristhesancus plagipennis* against pests of cotton and soybean crops in Australia). By the middle of 20th century, a number of reduviids had been described or recorded from various areas of Southeast Asia such as Sumatra, Java, Borneo (Kalimantan), Sulawesi and New Guinea (Irian Jaya) by old heteropterists such as Distant, Miller and Wygodzinsky. Since that time, little has been published on the Reduviidae in Southeast Asia for about forty years. Within the past ten years, several species of the Reduviidae have been newly described and recorded from Southeast Asia such as Vietnam, Thailand and Indonesia (East Java, Bali and Flores) by the members of AFRP. These facts indicate that these regions are still poorly investigated even though there are several historical studies on the Reduviidae. In the course of extensive faunal studies of the Southeast Asian Reduviidae conducted with AFRP for about ten years in undersampled countries such as Vietnam, Thailand and Indonesia (East Java, Bali and Flores), we collected a number of specimens of the Reduviidae. The collection indicates that high species diversity of the Reduviidae may be also kept in Southeast Asia. Moreover, many of the species collected were recognized not only to be unrecorded in respective countries or areas but also to be undescribed (new to science). This presentation highlights the

assassin bugs from the faunistic viewpoint listing the species collected by our surveys from Southeast Asia for ten years and providing information available for considering the predators as biocontrol agents as well.

### **LOCAL KNOWLEDGE ON THE SUSTAINABLE USE AND MANAGEMENT OF INDIGENOUS PLANT RESOURCES IN THE CORDILLERAS, PHILIPPINES**

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The Cordilleras is home to a rich diversity of indigenous plants that is widely used in various purposes. The sustainable use and management of these resources is commonly entwined with the rich cultural practices and beliefs of the local people. This study aims to elucidate the application of local knowledge on sustainable management of indigenous plant resources in the Cordilleras, Philippines. Documentation activities such as Key Informant (KI) interview, field visit, desk literature search and literature survey was conducted in two case study sites: Benguet and Kalinga. The information gathered serve as the baseline in the conceptualization of the information system. Open source tools were used in the development of the Database Information System (DIS). The DIS consists of project homepage and database of lesser-known indigenous plants used in various purposes in the Cordilleras. Out of the 449 total plant species recorded in the DIS, about 67.04% or 301 were identified as indigenous. The 301 documented indigenous plants species were used for: organic farming system (1.34%); sustainable indigenous farming system (3.34%); community health care (28.09%); food and food supplements (30.77%); cultural practices (10.03%); construction and livelihood (20.74%) and ornamental, landscaping and gardening (5.69%). In terms of growth habit of the indigenous plants, herbs accounted for 29.03%, shrubs (26.88%) and trees (26.88%). Most of the indigenous plants species belongs to Moraceae (9.68%), Rosaceae (8.60%) and Palmae (7.53%). In the study area, local people perceive indigenous plants as valuable resources and God's creatures. They employ conservation practices for its sustainable use and management such as *gen-gen* system (soil and organic matter conservation), *sul-ulan* (control pest attacking grains and cereals), sound farming system (e.g. fallowing) and *muyong* or *pinugo* commonly practiced by Ifugaos (indigenous forest management). The local knowledge on sustainable use and management of indigenous plants plays a vital role in the lives of the local people in the Cordilleras. It is also an important knowledge base in the sustainable use and management of bio-resources in the upland communities in the country.

### **THE MULTIFUNCTIONALITY OF AGROFORESTRY: ARE THEY REAL OR JUST IMAGINATIONS?**

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Agroforestry is an age-old land use practice of integrating trees on farms. It is claimed to have various functions like the conservation of biodiversity, rehabilitation of degraded lands, creation of sustainable rural communities and most recently, mitigation of climate change. Despite its claimed multifunctionality, it is still being questioned as to how this land use approach fare with other land

uses like mining, monoculture agriculture and even forestry. The main reason for this questioning was that despite the many programs of government and non-governmental organizations about its promotion, its practitioners seem not to have gained substantially from its conceived potentials. It is along these contexts that this paper is hereby developed. This paper examines the socioeconomic and environmental feasibility of the different agroforestry systems/models in the Philippines. Specifically, this study seeks to 1) document/characterize the different agroforestry systems that are being practiced in the selected areas in the Philippines with emphasis on the economic, environmental and social functions; 2) analyze the economic and financial viability of the different agroforestry systems/models; 3) assess the impact of agroforestry on the biophysical, socioeconomic and environmental conditions within the farmers' farm (in particular) and farming community (in general).

### **SUSTAINABLE AGRICULTURE IN PADDY FARMING SYSTEM**

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The agricultural sector has multiple roles in developing country. It provides resources for the live hood and adequate incomes of a majority of people without destroying the environmental base. In Malaysia, Agriculture and Agro-Industries Ministry targets to push the national rice production from the current 72 per cent to 90 per cent by the year 2010 (Azhari, 2008). However, this is not an easy task because there are several problems that the farmers will face. As a solution, introducing sustainable management is a best alternative to increase paddy production and increase socio-economy of the farmer. Furthermore, it can promote a sustainable living environment. Therefore, the main objective of this paper is to discuss and identify the sustainable agriculture system of paddy farming in Malaysia. This research employed a qualitative research design using observation and case study approach. The respondents are farmer, researcher and agriculture officer. The location of case study is paddy farming area at Sabak Bernam, Selangor and Muda Agricultural Development Authority (MADA) at Northern Malaysia. Sabak Bernam location was chosen because it has the most productive paddy fields and MADA has the largest size of paddy planted area (hectare) in Malaysia. This paper also provides examples of successful adaption of sustainable agriculture at others countries. As a conclusion, the result shows that paddy farming in two locations in Malaysia have used sustainable agriculture system in certain phase of management paddy farming.

### **STRATEGIES FOR THE INSTITUTIONALIZATION OF THE SOLID WASTE MANAGEMENT PROGRAM IN AN ACADEMIC COMMUNITY: TOWARDS SUSTAINABLE MANAGEMENT OF RESOURCES**

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The program of the Philippine government on solid wastes provides for the systematic, comprehensive and ecological management of waste materials from various sources. The participation of various sectors includes the academe, it is not just a seat of learning, it also opens avenue for research and development undertakings. In this research, the strategies that can strengthen the institutionalization of the solid waste identified and how such strategies can support proper management of resources were determined. The relation of the program to sustainable resource

management was looked into. Simple random sampling method was employed in the selection of respondents composed of the stakeholders such as the faculty, staff, parents, households and students. The respondents are willing to support the program and there are various strategies that could be adopted which include production of information education campaign materials, crafting of policies related to the program coupled with strict enforcement of such whenever necessary, involvement of stakeholders in the composting, recycling, segregation and proper disposal activities, periodic monitoring of the activities, construction and operationalization of the Material Recovery Facility, improvement of the existing dumpsite, inclusion of the solid waste management program in the research priorities of the University and generation of appropriate technologies in handling solid wastes. The stakeholders find the implementation of the program essential and worthy of support, the strategies are significant to properly manage the resources.

### **SUSTAINABLE AGRICULTURAL TECHNOLOGIES AND PRACTICES DEVELOPMENT PROGRAM: POVERTY REDUCTION TOOL**

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The “Sustainable Agricultural Technologies and Practices Development Program (SATPDP)” primarily aims to generate and verify agricultural technologies and practices for the benefit of the farmers of Occidental Mindoro, responding to the province’s poverty reduction programs while addressing agricultural sustainability. The program consist several projects that include both basic and applied researches such as: 1) Inoculated Organic Fertilizer Production Project; 2) Vermicomposting Project; 3) OMNC Improved Banana Production Project; 4) Farm of the Past and Future Project; and 5) Technology Generation and Verification Project. The program disseminated the generated and verified agricultural technologies, specifically to the farmers to improve their farming practices and income. The program accomplished 1) researches and verification studies; 2) establishment of organic fertilizer plant – increasing demand for organic fertilizer; 3) showcased agroforestry technologies – serve as blue print in upland management; 4) increasing adoption rate of organic fertilizer production and utilization by the community an indicator of the massive advocacy promotion – resulted to reduced production cost and enhance the fertility of the soil; and 5) financial assistance to student labor in the implementation of the projects. The program changed the institution’s latest Annual Performance Rating (APR) of “very satisfactory” as overall rating”; served as income generating projects and related learning experiences in the teaching-learning process.

### **EFFECTS OF HUMAN-INDUCED ENVIRONMENTAL CHANGE IN MANGROVE FORESTS ON ARMORED SCALE (COCCOIDEA: DIASPIDIDAE) COMMUNITIES IN SOUTHERN THAILAND**

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Mangroves provide for the livelihood of millions of people in the coastal area of the tropics and subtropics. They also minimize damage to property and losses of life from tsunamis and storms. Rehabilitation and conservation of mangroves have been implemented, however, influence of those human activities on mangrove ecosystem is difficult to assess and not clearly understood. Therefore, it would be useful if an ecological indicator that reflects the influence of human activities on mangroves is available. Several species of scale insects (Insecta: Coccoidea) are known to occur frequently in

urban environment or artificially disturbed conditions. In earlier studies, they have been used as indicators for urbanization. Armored scales (Diaspididae), in particular, would be environmental indicators for mangroves due to their specific morphology and sedentary lifestyle. In the present study, the distribution and population constitution of three genera of armored scales, *Aulacaspis*, *Fiorinia*, *Lepidosaphes* on mangroves were assessed in three experimental sites, which differ in human-induced environmental factors, in southern Thailand. A highly infested zone (HIZ) was defined as a series of same mangrove species with less than 10m intervals, including any trees infested by any one of three armored scale genera with an average population more than 5 individuals in a 50 cm piece from a sampled branch. No HIZ of *Auracaspis* were found in Site I, which was a natural forest with few human's visits, while they were found in Site II, which was a natural forest with frequent human's visit and in Site III, which was an artificial forest. On the other hand, HIZs of *Fiorinia* and *Lepidosaphes* were found only in Site I and II, but not in Site III. Such difference in the distribution pattern between three armored scale genera seems to be useful as an indicator for human-induced environmental change in mangrove forests.

### **EVALUATION OF Cu COATED UREA ON SELECTED SOIL SERIES OF MALAYSIA**

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Urea is useful fertilizer because it is immediately available to plants and have an immediate response. Urea as a fast release fertilizer however is subjected to rapid depletion from the soil due to ammonia loss and leaching. If fast release fertilizers are applied too heavily, the plant can be damaged usually by burning. As well as it caused ground water pollution by leaching. The application of urea normally resulted in high losses more than 30- 50% due to different environmental and biological factors. There is need to produce an efficient slow release fertilizer which is more efficient, environmental friendly and economically beneficial. For this purpose a study was conducted in order to find out an environmental friendly controlled release fertilizer. In this laboratory experiment, the effects of cu coated urea on release of Total nitrogen in selected soil series were observed. An incubation experiment was carried out for 6 weeks from 2<sup>nd</sup> June to 15 July2008 in laboratory. Three soil series: Rengom, Holy rood and Serdang were sampled and used as fresh soil. The release of urea N, ammonium and nitrate was analyzed every week for each sample and it's 3replications, by spectrophotometer and distillation method respectively. The results of experiment showed that the cooper coatings significantly reduce the fast release of urea by inhibiting the urease activity.