2015 BIO Bulletin

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BIO Bulletin

of Cancer and Spiders

- Heroes of Cancer Research
- Understanding Cervical Cancer
- Amazing World of Spiders
- Mycotoxins in Food
- Malaysia's Disappearing Wildlife

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The School of Biological Sciences, Universiti Sains Malaysia

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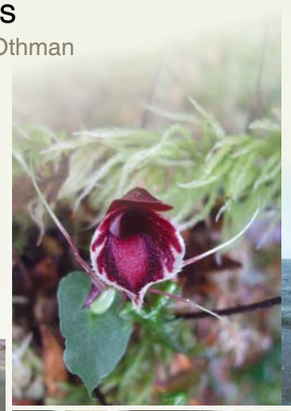

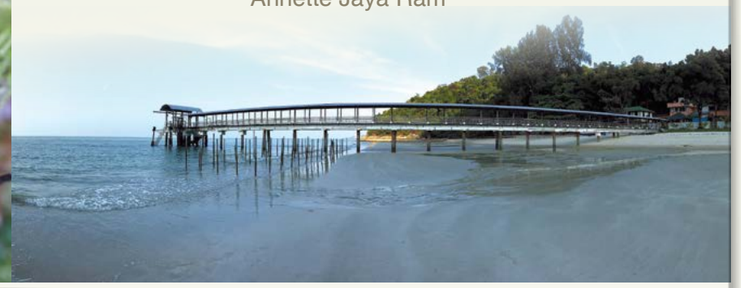

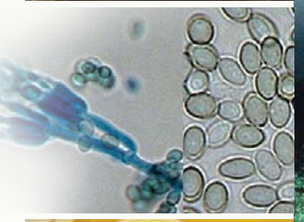

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Address all correspondence to:
Professor Ng Wing Keong
Editor-in-Chief
Bio-Bulletin
School of Biological Sciences
Universiti Sains Malaysia
11800 USM, Penang.
Fax: 604-656 5125
Tel: 604-653 4052
Email: wkng@usm.my

Bio-Bulletin December 2015

From The Dean

In this second issue of Bio-Bulletin 2015, I want to thank all the academic, administrative and technical staff of the School of Biological Sciences for their untiring efforts to sustain our Bio School's Key Performance Index (KPI) for 2015. Being rated a top KPI performing School in USM for 2014, we now have a harder task to maintain the top position. The School of Biological Sciences has obtained the largest amount of research funding in 2014 compared to all 26 Schools in USM. I am also pleased to announce that during the 52nd convocation in November 2015, a total of 12 Ph.D. and 25 M.Sc. candidates graduated from our School. Congratulations to all of them.

This year, two of our academics were promoted to Associate Professor, five were promoted to full professors and two professors were given promotions to Professor B. This goes to show that the academic contributions and achievements of our academic staffs were well recognized by the University.

Associate Professor Aileen Tan Shau Hwai has made us proud for being selected as one of the winners of the prestigious Malaysian Toray Science Foundation (MTSF) award in November. In the same month, Professor Sudesh Kumar has taken the lead in Industrial-University partnership by being the inventor for two Licensing and Commercialization Agreements signed with YS Biotechnologies. Congratulations to both of them.

This issue of Bio-Bulletin will be the last issue for the current editorial team as their two year appointment tenure will be due in December 2015. In this issue, I would like to convey my deepest gratitude to the editorial team and all the contributors.

Finally, I would like to thank all the staff at the School of Biological Sciences USM for their dedication and cooperation in ensuring our School will remain among the top academic schools in USM.

Associate Professor Ahmad Sofiman Othman

Dean, School of Biological Sciences

From Editor-In-Chief

Cancer and spiders… what do they have in common? Their very mention strikes fear in us mortal humans! With spiders, we can *fight* (kill them!) or *flight* (run away!) but with a diagnosis of cancer, it invokes a much more emotional response. Many of us who have seen family members or close friends dealing with cancer would have experienced the prolonged pain and stress cancer patients go through during and after treatment. Some of this fear of cancers and/or spiders is due to a lack of knowledge on the subject matter. This issue of Bio-Bulletin highlights some of the cancer-related research being conducted at the School of Biological Sciences. There are articles on cervical and skin cancer, and the use of cell cultures and animal models in cancer research. Research on cancer-causing compounds such as mycotoxins and potential anti-cancer protective foods such as broccoli, mushrooms and bioactive substances in fruits are also highlighted. There is an article on the "Amazing World of Spiders" which should enlighten us about these crawling creatures with eight legs and multiple pairs of eyes. Other interesting articles have an important environmental theme.

This will be my last issue of the Bio-Bulletin as Editor-in-Chief. When I agreed to helm the Editorial Board, it was one way for me to give back to Bio School but more importantly, I felt I could make a difference. With our increasingly media-savvy world, it becomes even more important for academics to be able to project our work to the public in an interesting and visually captivating manner. I went about conceptualizing a new look and focus for the magazine, set up the structure and procedures, and then imparted this new vision and mission to the editorial board. In these two short years, I hope that we had successfully contributed to increasing the profile and reputation of Bio School by highlighting the research and achievements of our students, staff and faculty members both in print and on the internet.

A more personal objective of mine was to transfer knowledge to the next generation of my peers. Having been on the Editorial Board of several international journals and magazines, I wanted to pass my experience on reviewing, editing and publishing research work. I took the time and effort to impart skills on how to review and edit articles creatively. To those that showed enthusiasm, I made it a point to include them in as much of the publishing process as possible. I was greatly encouraged when Nik Fadzly took up the challenge of Acting Editor-in-Chief during my sabbatical leave. He and the Editorial Board did a great job in coming out with the third issue of Bio-Bulletin this year. The "sweat and tears" of Shaida and Ooi in doing the layout and graphics for our very first issue is also much appreciated. We have since hired professionals to do the graphics design. Editorial work is very time consuming and often times, a thankless job. Our reward is the personal satisfaction that comes when we look at each published magazine and know that we played a role. It also gives us joy when we see Bio-Bulletin being widely read and making a difference to the lives of our readers and contributors.

Thank you for your support and all the best to the next Editorial Board.

Merry Christmas 2015 and Happy New Year 2016.

Professor Ng Wing Keong, *FASc*

Orchids
of the Cloud Forests

Farah Alia Nordin and Ahmad Sofiman Othman

Orchidaceae is one of the largest families of flowering plants. Orchids are most abundant in the humid tropics and subtropics. South East Asia is among the richest regions with more than 10,000 orchid species. Peninsular Malaysia is home to 905 species of orchids in 143 genera. About 20% of orchids found in Peninsular Malaysia are endemic species. Many more unknown species are yet to be discovered in our vast unexplored parts of our forests. Orchids are found growing from above sea level to the mountain tops with wide range of habitats.

Cloud forest at Gunung Brinchang.

A cloud forest, also called mossy upper montane forest or elfin forest, is characterized by a persistent, frequent or seasonal low level of cloud cover on the tree canopy. The environment is very wet and humid, with peaty soil. Mosses cover the ground and vegetation. This climate has contributed to the great diversity of epiphytic bryophytes, lichens, bromeliads, ferns and orchids.

Trees at the mossy forest have lower canopy, stouter, shorter (less than 10 meter tall) with gnarled limbs and thick microphyll leaves. Gunung Ulu Kali (Genting Highlands), Gunung Brinchang and Gunung Irau (Cameron Highlands) are among the cloud forests of Peninsular Malaysia. Among the most common genera of epiphytic orchids in the montane forest are *Bulbophyllum, Coelogyne, Dendrochilum, Dendrobium, Eria, Pholidota, Agrostophyllum* and *Dilochia*. Many montane orchids are highly habitat specific; for example the bizarre helmet orchids, *Corybas* species.

Corybas holttumii, a bizarre helmet orchid.

Corybas species are mostly found growing along the mountain ridge crests, among the carpeted mosses or the rock crevices. This genus is recognized by its single pale green heartshaped leaf, sometimes ornamented with silvery venations. The small hooded flower is very strange and distinct: solitary, crimsonred with long 'whiskers', sitting on the single leaf.

Corybas is always associated with the mosses, either *Acroporium* or *Spaghnum* and interestingly also with the conifers, *Dacrydium* species. Whenever the conifers are present, there is high likelihood to spot *Corybas*, as if there is a symbiotic relationship between them. These observations are true in many *Corybas* populations found in Genting Highlands, Cameron Highlands, Maxwell Hill, Gunung Besar Hantu in Negeri Sembilan and Imbak Canyon in Sabah.

Thus, we made two hypothesis (i) in their natural habitat, the mycorrhiza in *Corybas* spp. has a symbiotic association with the *Dacrydium* sp. or (ii) there is a close contact between the roots of *Corybas* spp. and the *Dacrydium* sp.; the hyphae on the surface of the root of *Dacrydium* sp. invaded the *Corybas* root. Information on this specific association is still lacking and we are pursuing further studies on this subject matter.

Cloud forests are protected areas, thus any collection of wild orchids out from the forests are strictly prohibited and illegal. Overcollection and habitat destruction are the main threats for these orchids. For example, *Corybas fornicatus* which is confined to Pine Tree Hill of Fraser's Hill can no longer be detected in the area. This rare, endemic and threatened species are now vulnerable to extinction. Therefore, they must be given conservation priority and managed systematically.

Corybas selangorensis is always found among the mosses.

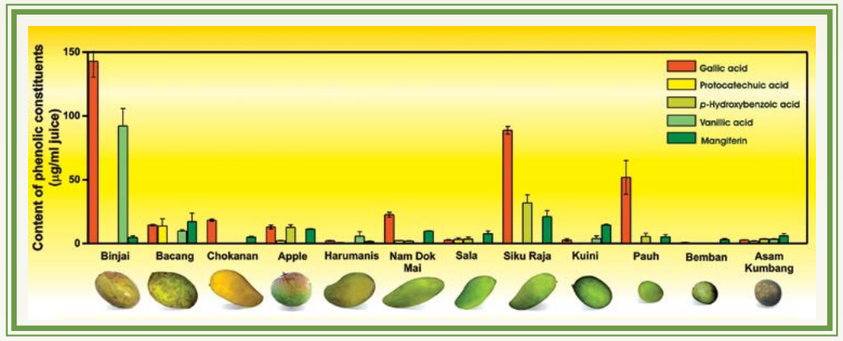
Farah Alia Nordin and Ahmad Sofiman Othman are currently working on the molecular systematic of orchids. Associate Professor Ahmad Sofiman is currently the Dean of the School of Biological Sciences.

Phenolics in pure juices of *Mangifera* sp.

Shaida Fariza Sulaiman and Ooi Kheng Leong

More than 60 species of *Mangifera* are distributed throughout tropical and subtropical Asia. *Mangifera indica* (mango) is the only species from this genus that is considered a fruit crop. Small scale plantations of *M. caesia* (Binjai), *M. foetida* (Bacang), *M. odorata* (Kuinin) and *M. petandra* (Pauh) are also found in several parts of Southeast Asia. Others are categorized as wild species. Mango is ranked fifth in global fruit production behind bananas, oranges, grapes, and apples.

Mango flesh is considered a rich source of dietary antioxidants such as ascorbic acid, carotenoids and phenolic compounds. Mangiferin, isomangiferin, gallic acid, *m*-digallic acid, ellagic acid, quercetin 3-*O*-galactoside and quercetin 3-*O*-glucoside are the major phenolics found in the flesh of mango cultivars.

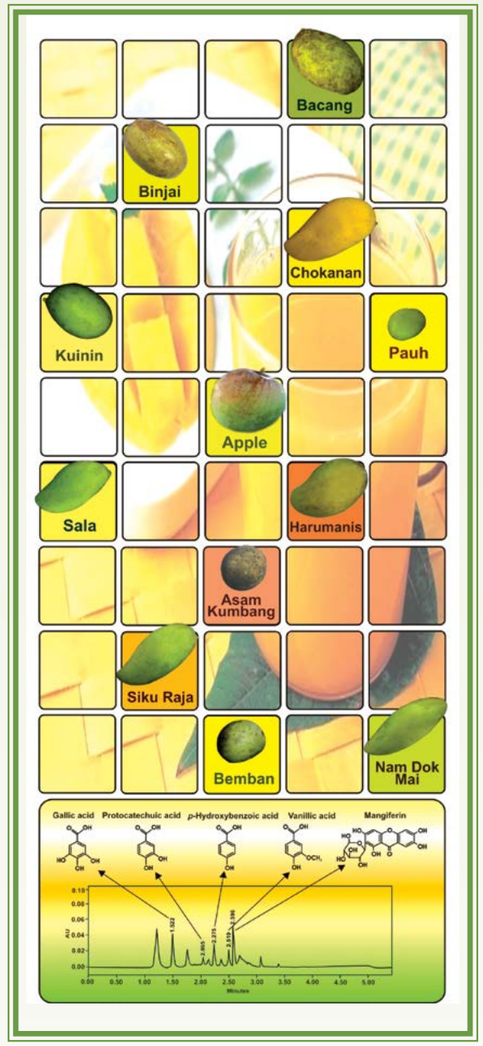


Content of phenolic compounds found in various *Mangifera* fruits.

More than a thousand mango cultivars were recorded in 25 germplasm banks worldwide. Among the cultivars, six popular cultivars from the northern part of Peninsular Malaysia were selected for our study. Among them, Harumanis is the most valuable in the local markets. It is mostly cultivated in Perlis. The aim of this study was to quantify the total phenolic content using Folin-Ciocalteu's method and phenolic compounds in the juices of the ripe fleshes from 12 Malaysian *Mangifera* using an Ultra Performance Liquid Chromatography (UPLC) system equipped with a reverse-phase Acquity UPLC BEH C_{18} column 1.7 µm and photo-diode array detector.

Here is a summary of our major findings:

1. The highest total phenolic content was measured from the juice of *M. indica* cv Siku Raja (163.30 ± 9.33 µg/mL juice).
2. Gallic acid, protocatechuic acid, *p*-hydroxybenzoic acid, vanillic acid, and mangiferin in the juices were identified using UPLC based on the retention times and UV spectra of the peaks in comparison to the standard compounds, and these were confirmed by spiking the juices with the corresponding standards.
3. All the five identified compounds were only detected in the juice of *M. quadrifida* (Asam Kumbang).
4. Gallic acid and mangiferin were found in all tested juices.
5. The juice of *M. caesia* (Binjai) had significantly produced the highest content of gallic acid (142.96 ± 21.52 µg/mL juice) and vanillic acid (92.22 ± 13.65 µg/mL juice). This result can be correlated with its high Ferric Reducing Antioxidant Potential (FRAP) activity obtained from our earlier study.



UPLC of the juice from *M. quadrifida* (Asam Kumbang)

6. The juice of *M. indica* cv Siku Raja was found having the highest content of mangiferin (21.12 ± 4.74 µg/mL juice) and *p*-hydroxybenzoic acid (31.84 ± 6.38 µg/mL juice). Our previous findings revealed the higher metal chelating activity of this juice. The activity might be attributed to the synergistic effect of mangiferin (with *ortho*-dihydroxyl or catechol group in its chemical structure) with other compounds in the juice. Metal chelating assay measures the ability of the juice to bind to ferrous [Fe(II)) ion; that catalyzes oxidation] and disrupt the formation of Fe(II)-ferrozine complex. The juice acts as secondary antioxidant due to its indirect involvement in preventing the formation of free radicals.
7. The highest content of protocatechuic acid (13.81 ± 5.57 µg/mL juice) was measured for the juice of *M. foetida* (Bacang). This compound might be responsible for the higher 1,1-diphenyl-2-picryhydrazyl (DPPH) activity of this juice. DPPH free radical scavenging and FRAP assays measured the direct involvement of the juice in enhancing the primary antioxidant activity.

As far as we know, this is the first comparative study highlighting the phenolic compounds of these juices.

For further information:

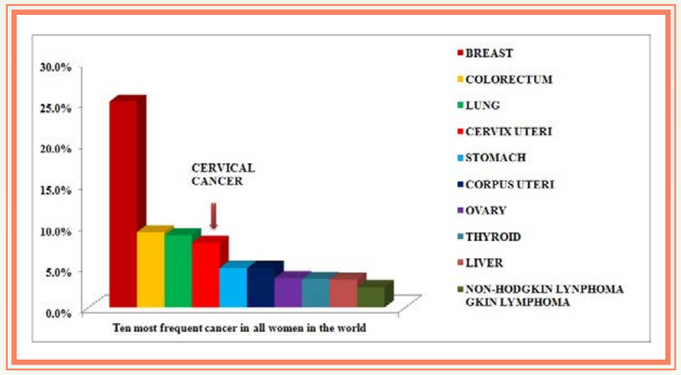
Sulaiman, S. F. and Ooi, K. L. (2012). Polyphenolic and vitamin C contents, and antioxidant activities of aqueous extracts from mature-green and ripe fruit fleshes of *Mangifera* sp. Journal of Agricultural and Food Chemistry 60 (47): 11832-11838.

Professor Shaida Fariza Sulaiman and Dr. Ooi Kheng Leong research interests lie in the identification and quantification of phenolics with bioactivities.

Understanding
Cervical Cancer

Kalaivani Muniandy and Nethia Mohana-Kumaran

Cervical cancer is a cancer which develops in the cervix.The cervix is the lower narrow part of the uterus (womb) that opens into the vagina (birth canal). The cervix is further divided into exocervix and endocervix. Exocervix is made up of thin flat cells known as squamous cells while endocervix consists of mucus producing columnar cells. In between the endocervix and the ectocervix is the transformation zone (T-zone). The T-zone is also known as the squamocolumnar junction where abnormal or pre-cancerous cells are akin to develop. There are two types of cervical cancer, namely squamous cell carcinoma and adenocarcinoma. Cervical cancer does not manifest overnight. It typically takes 10 to 30 years before an invasive cervical cancer establishes.

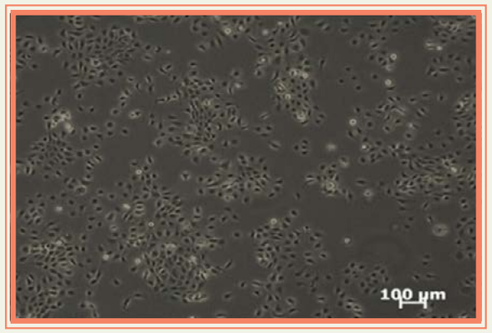


Top most frequent cancers detected in women worldwide (GLOBOCAN 2012 Cancer Incidence and Mortality Worldwide).

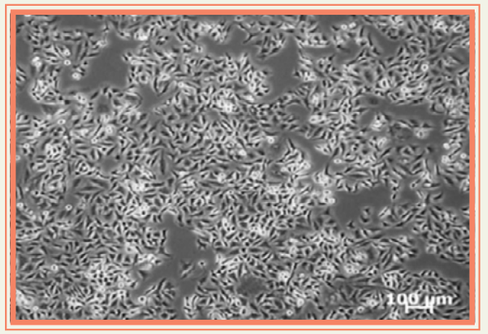
In Malaysia, cervical cancer is the third most common cancer among women after breast and colorectal cancer and the fifth most common cancer in the general population. Based on ethnic occurrences, Indian women were found to have a higher incidence rate compared to Malays and Chinese women. The incidence rate increases after 30 years old and peaks at ages between 65 to 69 years. When compared to the world estimated incidence rate, cervical cancer is the fourth most common cancer among women after breast, colorectal, lung cancers and seventh in the overall population. Cervical cancer contributes to nearly 8% of all cancers. About 84% of cervical cancer cases occurs in less developed countries. The highest incidence was recorded in Africa, Latin America and Caribbean; and the lowest incidence was in Northern America and Oceania.

The causative agent for cervical cancer is the human papillomavirus (HPV). HPV is a group of viruses that consists of more than 100 different strains or types. Studies have demonstrated that sexual activity is one of the causes that will increase the risk of HPV infection. More than 30 of these viruses are sexually transmitted, and they can infect the genital area of men and women including the skin of the penis, vulva (area outside the vagina), anus and the linings of the vagina, cervix, or rectum. HPV infection is asymptomatic and in most cases infection will clear over time.

There are two types of HPV, low risk HPV (lrHPV) and high risk HPV (hrHPV). Low-risk HPVs do not cause cancer but cause skin warts on or around the genitals, anus, mouth or throat. For example, HPV types 6 and 11 are responsible for 90% of all genital warts. High-risk HPVs, such as HPV types 16 and 18, are responsible for most HPV-caused cancers. HPV18 is highly associated with adenocarcinoma of the cervix while HPV16 is the type most frequently associated with squamous



HPV 16 infected cervical cancer cell line (CaSki) under 5x magnification.



HPV 18 infected cervical cancer cell line (HeLa) under 5x magnification.

cell carcinoma. However, HPV infection alone is not sufficient to cause cervical cancer. Other co-factors or co-carcinogens such as smoking, multiparity, oral contraceptives, chemicals, and alcohol consumption may increase the risk of cervical cancer.

HPV infects the epithelial cells of the cervix. Once HPV enters the epithelial cell, the virus begins to make the proteins that it encodes. Two of the proteins that are made by the hrHPVs are the E6 and E7 proteins. These proteins interfere with cell functions and accelerate cell growth. The infected cells are however eliminated once they are recognized by the immune system. Sometimes, these cells develop mechanisms to evade the immune system and survive and establish persistent infection. They continue to proliferate and acquire more mutations, eventually developing into an invasive cancer. Here at Universiti Sains Malaysia, we study the growth and invasion behavior of cervical cancer cells with different HPV strain infection using the 3D spheroid model.

Cervical cancer is preventable and curable if detected early. Abnormal cells of the cervix can be detected with Papanicolaou (Pap) test. Pap test is sometimes combined with DNA test to detect HPV infection (co-testing). Another preventive strategy is to immunize oneself with HPV vaccine. Gardasil and Cervarix are two HPV vaccines, which were approved by the Food and Drug Administration (FDA) in 2006 and 2009, respectively. Gardasil protects against four HPV types (6, 11, 16, and 18). It is approved for use by females and males to prevent genital warts and anal cancer. Cervarix protects against hrHPV 16 and 18. It is approved for females to help prevent cervical cancer.

Surgery, chemo- and radiotherapy are common treatment modalities for cervical cancer management. Unfortunately, surgical treatment is only restricted to early stage cervical cancer patients and patients who undergo chemo- and radiotherapy, develop resistance to the treatments. Moreover, patients also suffer from adverse side effects due to chemo- and radiotherapy. Chemoradiotherapy became a standard treatment for intermediate and locally advanced cancer after a few landmark studies performed in the 1990s. In recent years, molecularly targeted biologic agents were included into the armamentarium of cervical cancer management to improve patient outcome. One such targeted biologic agents which exhibited improved patient survival was Bevacizumab (Avastin®), a humanized monoclonal antibody against Vascular Endothelial Factor (VEGF). Other targeted therapies such as BH3-mimetics (inhibitors of anti-apoptotic proteins) and PI3K pathway inhibitors have also found their way to treating cervical cancer.

Kalaivani Muniandy is a PhD student under the supervision of Dr. Venugopal Balakrishnan (INFORMM, USM) and **Dr. Nethia Mohana Kumaran. Dr. Nethia** is a cancer biologist and her research focuses on utilizing the 3-dimensional spheroid model to study the growth, invasion and drug sensitivity of cancer cells. She also utilizes a genetically modified mouse model of melanoma to study the contribution of the apoptosis pathway for melanomagenesis and melanoma drug resistance.

Broccoli:
Flowers for Food and Health

Chew Bee Lynn and Lim Ying Houng

Broccoli may have anti-cancer properties.

Broccoli is an edible green plant species derived from the family Brassicaceae. The name "Broccoli" is derived from the Latin word "*brachium*", which refers to the arm or branch. Generally, broccoli is classified into two distinct forms, the "sprouting broccoli" and the "cauliflower broccoli". Sprouting broccoli consist of clusters of green colour flower buds on top of a thick flower stalk, while cauliflower broccoli consist of a dense white curd on top of the flower stalk.

Broccoli provides us with a high content of protein, fibers, vitamin A and vitamin C. Hence, pairing up broccoli with other food, will make a healthy contribution to our daily nutrient requirements. Epidemiologic studies had found that broccoli consists of high levels of glucoraphanin, which is the precursor of sulforaphane. Sulforaphane was identified as one of the most crucial natural occuring dietary phytochemical compound in cruciferous vegetables that benefits human health. Upon chewing, glucosinolate of broccoli "glucorophanin" will be hydrolyzed by broccoli's enzyme myrosinase, releasing sulforaphane as its final product. Sulforaphane exhibits low toxicity and it is well-tolerated when administered into the human body.

Many studies have focused on verifying the health benefits of broccoli's sulforaphane in treating various diseases such as diabetes, esteoarthritis, artheroscelrosis, ocular disorders, neurodegenerative disease, ocular diseases and most importantly, cancer. Plant tissues and cell suspension cultures allow the generation of *in vitro* plant cells in the form of callus to proliferate and produce various secondary metabolites that are beneficial for the pharmaceutical industry. This tool poses as an alternative in the effective production and accumulation of medicinal bioactive compounds.

Callus of broccoli cultured *in vitro* at the School of Biological Sciences, USM.

Sulforaphane from *ex vitro* plants may be present at lower levels but can be elevated *in vitro* through cell suspension culture. Currently we are establishing callus and cell suspension cultures from the seedling ex-plants of brocolli with the aim of obtaining higher levels of sulforaphane *in vitro*. In our investigation, the induction of callus biomass using plant growth regulators at optimal levels may result in the formation of friable callus suitable to be used for cell suspensions in the enhancement of secondary metabolites. In the near future, we hope that this study will be able to produce sulforaphane at sufficient levels and enable the evaluation of the potential human health benefits.

Dr. Chew Bee Lynn is a Senior Lecturer and researches on the establishment of callus cells from brocolli seedlings for the isolation of sulforaphane. **Lim Ying Houng** is her intern student performing studies on callus induction from brocolli seedlings.

The Amazing World of Spiders

Nik Ahmad Irwan Izzauddin Nik Him

Spider Diversity and Morphology

The latest number of spider species that had been identified reaches more than 45,719 species worldwide, belonging to 114 different families under the Class of Arachnida, Order Araneae. Spiders can be found everywhere in the world. However, in Malaysia, very little information and study on spiders is available. Studies conducted by our local researchers showed that there are about 425 species of spiders belonging to 42 families. The current constraint to determine the actual diversity of spiders in Malaysia is challenging due to the fact that the study of spiders in Malaysia is not a popular subject matter. This problem is exacerbated by the limited references and literature for spider taxonomy and systematic.

Spiders and other arachnids have two major body parts rather than three as seen in insects. The anterior body segment is known as the cephalothorax or prosoma. The dorsal (upper) part of the cephalothorax is known as the carapace. The ventral (lower) part is the sternum. The posterior body part is termed the abdomen, or opisthosoma. They have four pairs of legs that are attached to the cephalothorax and are numbered as I, II, III and IV from anterior to posterior. The most common feature of spiders is the presence of four pairs of eyes at the cephalothorax which are one pair, respectively, of posterior lateral eyes, anterior lateral eye, posterior median eyes and anterior median eyes. However, for certain species, there are only three pairs of eyes present. The placement of the eyes can also be used to differentiate the families of spiders. Females can be distinguished based on the observation of the structure called epigyne at the underside of the abdomen. While for males, the palps are normally swollen at the terminal segments like a pair of boxing gloves. They also have chelicerae with fangs that inject venom which relate to their ability to hunt for prey and liquify prey for food.

Lynx Spider, Family Oxyopidae.

Spider Web

One of the familiar characteristics of the spider is their ability to produce spider web. The web or the spider silk is made up of proteins which are produced in glands inside the abdomen. Most of the time the silk web are use for catching preys. In females, they produce certain silks that are used for the purpose of creating their egg sacs. In addition, based on the web design, we can also differentiate the families of spiders. For example, the vertical orb decorated with silken zig-zag bands normally belong to Araneidae family members and the horizontal orb with an open hub belongs to the Tetragnathidae family. For certain families of spiders, they can produce structured three dimensional webs (e.g.

Jumping Spider, Family Salticidae.

Uloboridae) or unstructured three dimensional webs (e.g. Pisauridae). In some families, they do not produce silks at all e.g. Salticidae (Jumping Spiders) and Oxyopidae (Lynx Spiders). Both of these spider families normally can be found on tree trunks and often on foliage.

Behaviour of Spiders

Interestingly, all spiders are carnivorous. They prey on other animals, especially insects. There is even a spider that preys on birds, frogs and snakes for food known as Goliath bird- eating tarantula. This spider can reach up to 28 cm in size and due to their big size, they are able to hunt and prey on large animals. The tarantula spider would use their venom to strike and kill the prey before consuming them. However, this type of behaviour is uncommon and most of the time spiders prey on other insects.

Because spiders are one of the most diverse animals on earth, it is not surprising to see a variety of morphologies and shapes. For example, there is a genus of spiders that mimic the ant such as *Myrmarachne* sp. This genus is known as the ant-mimicking jumper. For this genus, they have a long waist and elongated cephalothorax which give a simulation of a three part body as seen in ants. Some of these spider species copy the physical appearance and behaviour of ants so that this might give them some advantages. Normally this spider-predator species try to avoid ants due to the fact that ants may secrete corrosive formic acid when attacked. This genus normally can be found on foliage in secondary forests with different colours even though they are from the same species, for example, the curved long-spined spider *(Macracantha arcuata)*. The colour of this spider ranges from white to red. They are easily spotted because they have a curved long spin on both sides of the abdomen. The appearance of the long curve spins makes this genus very easy to distinguish from other spider families.

Arachnophobia

Spiders are one of most fearful crawling creatures on the earth. These little creatures are usually described by terms like “poisonous”, “venomous”, disgusting”, “despicable” or “horrible” but in fact, the bad reputation is entirely undeserved. Perhaps one of the most fearful is the tarantula spiders even though not a single fatality case from a tarantula’s bite has been reported. Most of the time, people are scared of spiders due to the way they move and how they look. Arachnophobia is the term used to describe humans who are scared of spiders and other arachnids. Most spiders are not dangerous to humans at all. In fact they are harmless and do not attack humans as long as they are not feeling threatened.

However, there are a few species of spiders that can cause harm to humans. The most dangerous spider in the world is the Brazilian Wandering Spider *(Phoneutria fera)*. The bite of this spider injects a powerful neurotoxin which is nearly 20 times more deadly than that of a Black Widow spider. Once the neurotoxin gets into the blood stream, it can result in complete respiratory paralysis and eventually asphyxiation. If you happen to be a male, the consequences can worsen because it can cause an erection that can lasts for several hours, unfortunately it is also painful. This spider normally hides in unexpected places around humans such as in boots, piles of clothes, cars and bananas. One of the most fearful and venomous spider is the Black Widow Spider *(Latrodectus hesperus)*. In fact, 5% of

Female curved long-spined spider,
Macracantha arcuata

Ant-mimicking jumper spider, *Myrmarachne* sp

the reported bites from this spider were fatal. This spider can be distinguished based on the colour and the hourglass shape of the abdomen. They are normally found in temperate regions of the world. The Black Widow can inject a toxic venom that can cause general pain and swelling spreading from the affected area, abdominal cramps, nausea and sweating. In addition, it also can cause burning pain leading to a systemic condition known as latrodectism which can cause death.

Needed Research on Spiders

In contrast to the bad reputation of spiders, spiders are very important animals. Some studies have demonstrated that spiders can play important roles in stabilizing or regulating the insect population because insects are their main prey. A study in India reported the effectiveness of spiders in regulating adult mosquitoes’ and mosquito larvae in controlled conditions. This suggested that spiders might have the potential to control mosquitoes and play a part in minimizing mosquito-borne diseases. Spiders have also provided valuable information on how they construct their webs. This information is important to engineers. Scientists at Massachusetts Institute of Technology reported that the spider web is stronger than steel (on a pound to pound basis). The combination of computer modelling and experiments on spider webs have opened an opportunity for new designs in engineering.

Spiders are mysterious creatures. The myths and terrible stories about them make them one of the hated animals on earth. Their presence is not well understood because of the ignorance of the human public. Spiders have also become the victims of deforestation, agriculture, grazing, and urbanization. In agro-ecosystems, the use of pesticides indirectly kill spiders. By reducing the spider population in an agro-ecosystem, this will affect the ability of spiders to control pests. More focussed research on spiders are needed. Fears of spiders can be reduced through education and exposure.

Dr. Nik Ahmad Irwan Izzauddin Bin Nik Him specialises in the area of veterinary parasitology. This article is based on his interest in the diversity of spiders and to share the beauty of macrophotography.

From Waste to Wealth: The Mushroom Industry

Tao Hung and Rosnida Tajuddin

Agricultural waste, which includes both natural (organic) and non-natural wastes, is a general term used to describe waste produced on a farm through various farming activities and it includes manure and wastes from poultry and slaughter house, harvest waste, fertilizer run-off from fields, pesticides that enter into water, air or soils, and salt and silt drained from the field. Agricultural wastes are important biological resources as they contain nutrient and energy. Currently, the vast majority of agricultural wastes are not utilized. They are either thrown away or burned, and these have caused pollution to the environment. Therefore, it is very important to change the agricultural "waste" to "wealth", which can help to reduce environmental pollution and also help to increase the farmers' income. The mushroom industry is one of the suitable solutions to deal with agricultural waste problem while creating wealth.

China is one of the biggest agricultural producers and also the largest agricultural waste producers. China produces nearly 200 million metric tons (MMT) of rice straw, 200 MMT of corn stover, 100 MMT of wheat straw, 100 MMT of crop stalks, legumes and grains, 100 MMT of peanuts, potatoes and sugar beet vines per annum. It also produces nearly 2.6 billion MT of manure, 0.5 MMT of forestry waste (excluding firewood or charcoal) and about 0.5 MMT of other types of organic waste per annum. As the largest agricultural country dealing with huge quantities of agricultural wastes, China is also facing serious challenges to increase the farmers' income and to overcome national food security issues.

Black fungus *(Auricularia auricula)* cultivated with sawdust.

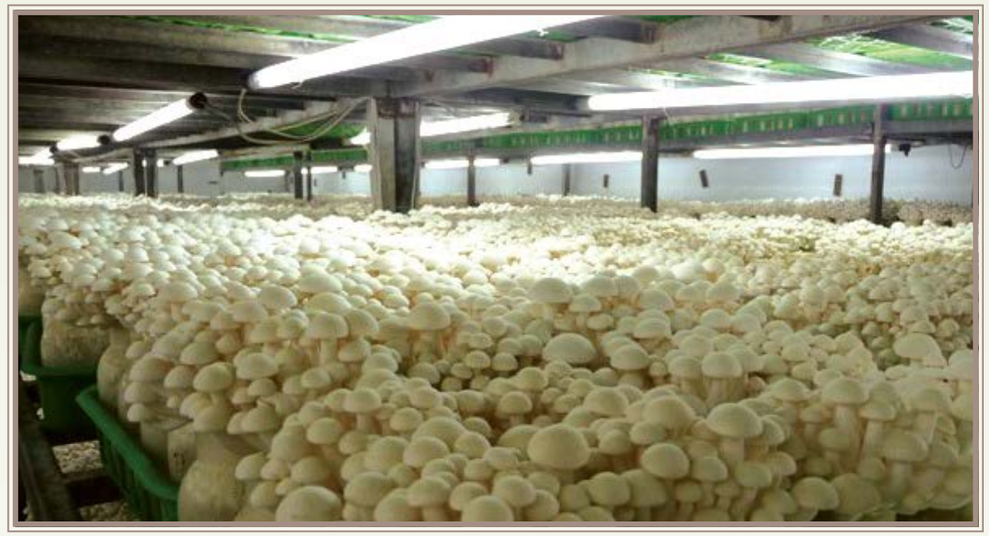
Agricultural waste is the main raw material for edible mushroom cultivation

Wood was previously used as the main substrate to cultivate edible mushroom. However, wood is expensive and could easily lead to other environmental problems such as deforestation, if it is not properly managed. China carried out the first successful trial of wood substitute cultivation of edible fungi in the 1950s by using agricultural wastes. The successful use of agricultural wastes as edible mushroom cultivation substrates has helped to reduce environmental pollution as the mushrooms are efficient in degrading the macromolecules such as cellulose, hemicellulose, lignins, proteins and polysaccharides in the agricultural wastes.

The cultivation of edible mushroom produces its own waste and this waste is reusable as secondary raw material to cultivate new mushroom and also as organic fertilizer. For example, by adding potassium and phosphorus bacteria, the mushroom cultivation waste can further develop into a high quality fertilizer. The waste is reported to assist in improving the physical and chemical properties of soil, and indirectly help to improve fruit quality and increase yield. It was also found that the use of fermented mushroom waste as organic fertilizer can help to control weeds. Mushroom wastes contain high nutrients that make it suitable to be used as vegetable growing media.

Casing soil pattern of *Lentinus edodes* (shiitake mushroom) cultivation bags.

Mushrooms mostly contain large amounts of lactase, polyphenol oxidase and peroxidase enzymes and a variety of degrading enzymes that degrade lignin, polycyclic aromatic hydrocarbon (PAH) compounds (for example phenanthrene), naphthalene and pyridine. This allows mushroom waste to be used as remediation inoculum to treat contaminated fields. Approximately 82% of naphthalene in 100 mg PAH soil was reported to be degraded when treated with 1% of mushroom waste. The utilization of mushroom waste is in line with the agricultural circular economic concept; the concept of sustainable development used in agricultural production and management system.



The industrial cultivation of enoki mushroom *(Flammulina velutipes)*.

Cultivation of edible mushrooms in Malaysia

Malaysia is known to be amongst the biggest producer of palm oil and rubber. The palm and rubber tree wastes (for example, tree trunk) are known to be appropriate substrates for edible mushroom cultivation. We at the School of Biological Sciences have developed a working collaboration with the Mushroom Innovation Team from the University of Anhui Agricultural in China to conduct research in exploring the potential of profitable edible mushroom cultivation that can be set up and grown in Malaysia.

China has vast experience in the mushroom industry and has been growing many types of mushrooms such as oyster mushroom, black fungus, enoki and shiitake mushrooms. Mushrooms are not only consumed as vegetables, but they are also resources for health care products that help to improve the human immune system. The Chinese Edible Fungi Association of China reported the rapid growth and development of edible mushroom industry. In 1978, China produced 5.8 MMT of mushrooms. In 2000, the production of edible mushrooms has increased to about 6.6 MMT and reached 10.39 MMT in 2003. The production kept increasing and in 2006, production was 14.74 MMT and increased to 22.01 MMT in 2010. China has become the world's largest producer of edible mushrooms with total trade volume accounting for 75% of world production, equivalent to more than USD 2.05 billion. China currently has more than 1,000 professional mushroom villages and more than 2,000 mushroom production enterprises.

It is hoped that our active collaboration with researchers from China will contribute to turning Malaysian agricultural wastes into mushroom wealth.

Dr. Rosnida Tajuddin research interests are concerned with the identification of mycorrhizal fungi, understanding ectomycorrhizal fungi community and their distribution in Malaysia rainforest and nutrient transportation in ectomycorrhizal and arbuscular mycorrhizal symbioses. **Professor Tao Hung** is with the University of Anhui Agricultural - Mushroom Innovation Team.

The Unsung Animal

Heroes of Cancer Research

Phang Su Ling and Nethia Mohana-Kumaran

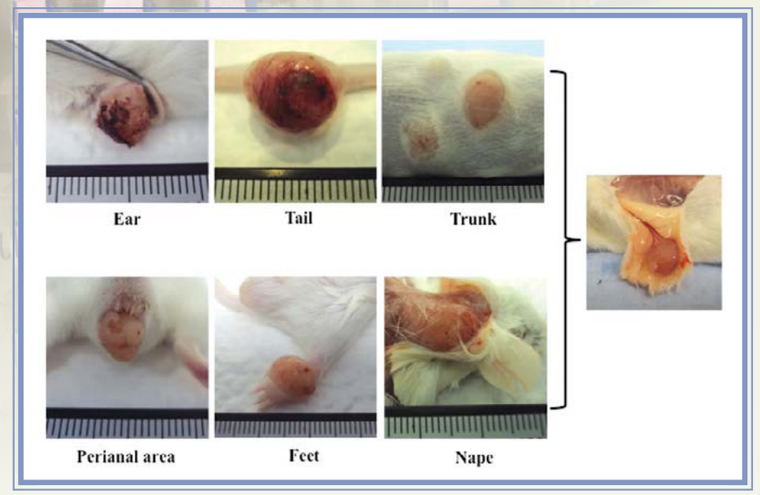
On the outside, they may look like your typical furballs but these mice are actually our unsung heroes. Laboratory mice used for cancer research has their genetic materials altered to model those in human.

Research mice are housed in Individually Ventilated Cages (IVC) to protect them from the outside environment.

Scientifically known as *Mus Muculus*, the laboratory mouse has been widely used in biomedical research since they were first created in 1974 by Professor Rudolph Jaenisch. Genetically Engineered Mouse Model (GEMM) has helped us understand the developmental progress of diseases and allow for research of therapeutic strategies to study the efficacy of unfamiliar treatments prior to the conduct of costly and time-consuming human clinical trials. The laboratory mouse are preferred animals in most research due to their small size, short reproductive cycle, known genetic information, our ability to introduce precise genetic alterations into stable mouse lines and, most importantly, mouse and man share about 97.5 % of our working DNA.

The sacrifices these mouse models made into contributing towards the improvement of our understanding of human diseases without putting humans at risk is notable in many areas of medical research. An excellent example is the *Cdkn2a -/-,* Tyr-*HRAS* mouse model which are ideally used for research on melanoma (skin cancer). With some clever genetic tweaking, these mice mimic lesions common in human melanoma; meaning, the normal cells are now turned into cancer cells. The cells of these mice grow at an overly active rate, which then develop into visible tumours on their skin and occasionally on other parts of their internal organs. Despite the growing tumours, the mice are immune-competent and they will survive in the same environment humans live in.

The understanding of the mechanisms involved in the emergence and evolution of the disease at the cellular level has resulted in the development of GEMM with the ability to develop spontaneous melanoma such as those of the *Cdkn2a -/-,* Tyr-*HRAS* mouse model. While the *Cdkn2a -/-,* Tyr-*HRAS* mouse model is good for the study of familial history of cancer,



Development of spontaneous melanoma at different anatomical locations in the *Cdkn2a -/-,* Tyr-*HRAS* mouse melanoma model. All melanomas were well vascularized.

some of the other mouse melanoma models have been extensively used to study the role of somatic (meaning not genetically transferred from one generation to another) mutations in the development of melanoma in adult mice. This approach is very powerful as it has been utilized for drug screening.

Direct testing of new preliminary therapies, in a context that is more biologically relevant than cell lines is also allowed with the usage of the melanoma model systems. Ideally, molecular data from the model system are compatible with, and can be pooled with, those from the human disease. Such compilation of data can contribute to developing a better understanding of the underlying mechanisms of cancer growth, allowing for development of targeted therapy in cancer patients.

Numerous different transgenic mouse lines have been developed over the last two decades with the aim to gain a better understanding in treating melanoma and other diseases, such as the *GLUT 4* mouse for research on diabetes, *Lox-1* Mouse for cardiovascular studies and the *NSE-p25* Mouse for Alzheimer's disease, just to name a few.

Major advances in the diagnosis and treatment of human diseases have been achieved in the last decade with the help of several mouse models. As much as we appreciate sacrifices made by these mice in the battle of mankind against cancer and other diseases, it should be kept in mind that mice are not men and mouse melanoma models can only serve as an approximation of this disease in humans. Nevertheless, the use of mouse models is indispensable in our quest for better cancer treatments in humans and we owe much of our medical advances to the laboratory mouse. They are truly our unsung heroes.

Phang Su Ling is a Msc student. She utilizes the *Cdkn2a -/-*, Tyr-*HRAS* mouse melanoma model to study the involvement of the intrinsic apoptosis pathway for melanomagenesis and melanoma drug resistance.

Dr. Nethia Mohana Kumaran is a cancer biologist and her research focuses on utilizing the 3-dimensional spheroid model to study the growth, invasion and drug sensitivity of cancer cells. She also utilizes a genetically modified mouse model of melanoma to study the contribution of the apoptosis pathway for melanomagenesis and melanoma drug resistance.

Phosphorus

Management in Malaysian Paddy Fields

Muhammad Izzuddin Yusoff and Hasnuri Mat Hassan

Phosphorus and its importance

Phosphorus and nitrogen are two limiting nutrients for plants. Phosphorus is important for various plant processes such as growth, reproduction, maturity and photosynthesis. Plant roots obtain phosphorus from soil in inorganic form. The deficiency of phosphorus can be observed by symptoms such as growth retardation, changing older leaf and stem color to reddish or purple, and formation of spindled leaf and thinned stem. These symptoms are usually exhibited earlier by older leaves due to the translocation of phosphorus from the old part to the new parts of the plant. Phosphorus deficiency will ultimately reduce crop yield and quality.

Phosphorus is easily immobilized in soil in comparison to other nutrients and can be converted from soluble form into insoluble form within a few hours of fertilizer application. Phosphorus in soil is divided into two groups; inorganic and organic phosphorus. Plant usually takes up inorganic phosphorus in the form of phosphate ions. This form of phosphorus is usually derived from fertilizer or chemical substances and occurs in several combinations with other elements. Although inorganic phosphorus is known as 'available phosphorus' for plant uptake, it is also can become unavailable to plants when it is fixed. The fixation of phosphorus is influenced by soil pH. In acidic soil, phosphorus is fixed with aluminum and iron while in alkaline soil, it is fixed with calcium. Phosphorus uptake can be maximized by mychorriza, a type of mutualism between fungi and plant root that can be found ubiquitously in most soils.

The organic phosphorus portion in soil usually consists of 20% to 80% at surface soil. It is usually derived from manures, dead organisms and other organic substances. Generally, the organic phosphorus is in inositol phosphate (phosphate esters), nucleic acid and phospholipids groups. Plant uptake of this form of phosphorus is generally lower than inorganic phosphorus. Organic phosphorus undergoes mineralization from soil organic matter with the help of microorganisms to be converted into available inorganic form. The microorganisms secrete enzymes such as phosphatase to mineralize organic matter into available phosphorus.

Paddy soil

The paddy field is the largest managed wetland ecosystem in the world. The area under paddy cultivation is estimated to be about 155 million ha. Paddy is the third main crop in Malaysia after oil palm and rubber. In Malaysia, the land area for paddy cultivation is about 243,043 ha and yields up to 9.4 million metric tons of rice. However, rice is still imported from other countries (especially Thailand) due to the insufficient production to meet local demand.

A number of land management methods are used to minimize phosphorus leaching in paddy soils. However, the leaching of phosphorus remains a problem in paddy fields. This is partly because paddy takes up only 20 to 40 % of the applied phosphorus fertilizer while the remaining phosphorus will rapidly undergo fixation. This process will reduce available phosphorus concentration for plant use and contributes to the over-fertilization of paddy fields by farmers. In the past, excessive application of phosphorus fertilizer had resulted in the build-up of less labile inorganic and residual phosphorus, which are not available for plant uptake. When leached, the main problem caused by phosphorus pollution in water bodies is eutrophication. Excessive amounts of phosphorus from fertilizers leached into nearby water canals can induce algal blooms that are harmful to aquatic organisms.

Paddy field at Kota Sarang Semut

Project on phosphorus in paddy soil

The aim of this project is to discover an effective strategy to minimize phosphorus leaching by determining the phosphorus concentration in different paddy soils and plants. The results from this analysis will allow us to elucidate the quality of the crop growth and yield resulting from the conventional soil management, which can then be used to establish benchmark data for the application of phosphorus fertilizer into paddy soil leading to a more efficient soil management programme.

Muda Agricultural Development Authority (MADA) is the largest granary area for paddy cultivation and is known as the paddy/rice bowl of Malaysia. MADA areas are located in Kedah (81%) and Perlis (19%). In our study, four sampling sites in the Kota Sarang Semut region were randomly chosen ranging from locations near the beach site to the hill site and from the east to the west. The soil samples were taken before the paddy was planted for the second season.

Based on our observation, available phosphorus concentration (as indicated by resin P, see Figure) in paddy soil is strongly influenced by the soil pH (see Table). Plot 1 with slightly alkaline pH has the highest concentration of resin P. The pH values of other soil plots are acidic. This could be due to the fact that acidic soils might induce the fixation of available phosphorus. In addition, the clay content of the three plots (P2, P3 and P4) was also higher than that of P1 soil. Soil from P4 plot has the greatest microbial P probably due to the conversion of organic phosphorus into available phosphorus by microorganisms as a result of the lowest total organic carbon in the soil. More laboratory analyses are being conducted in order to elucidate the dynamic of another phosphorus pools such as organic phosphorus (labile and non-labile), inorganic phosphorus (labile and non-labile) as well as residual P pool.

It is hoped that this project will provide a better insight on the phosphorus status of paddy soils together with phosphorus uptake by paddy plants in order to better strategize phosphorus fertilization. We hope that it will contribute towards increasing Malaysia's rice production.

Sampling site	Coordinate	Soil Texture	pH (H_2O) (soil:water, 1:5)
P1	Latitude 5°56'35.47"N Longitude 100°21'16.24"E	Loam	7.25
P2	Latitude 5°56'33.72"N Longitude 100°21'22.69"E	sandy loam	5.01
P3	Latitude 5°54'40.08"N Longitude 100°26'58.04"E	clay loam	4.53
P4	Latitude 6°1'13.39"N Longitude 100°28'3.62"E	sandy clay loam	4.80

Table: Sampling locations, soil texture and pH value of soil samples collected from Kota Sarang Semut Region, MADA Kedah.

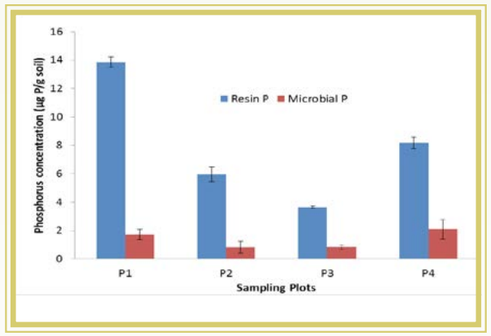


Figure: Resin P and Microbial P in soil samples of collected from various plots of paddy soil in MADA, Kedah.

Dr. Hasnuri Mat Hassan specializes in soil fertility focusing on phosphorus dynamics in cropping systems.

Muhammad Izzuddin Yusoff is her MSc student performing research on phosphorus dynamics in paddy soils.

A New Biofertilizer

for Leguminous Cover Crop

Amir Hamzah Ahmad Ghazali, Flory Keyeo, Salwani Shaffie, Ahmad Ramli Mohd Yahya and Hasmaliza Mohamad

Components of a biofertilizer

Biofertilizers are important components of any integrated nutrient management. These potential fertilizers play key roles in productivity and sustainability of soils. Biofertilizers are considered eco-friendly and cost effective inputs for the planters. The success of microbial inoculants as biofertilizers to promote the growth of plant is vastly influenced by the number of viable cells, which is introduced into the soil. To be commercially viable, there is a need to develop high biomass of effective microbial strains in a short amount of time. A high number of bacteria that are present and their capability to sustain their viability for a long period of time will ensure that the biofertilizer is in good condition and can be readily applied to the soil.

Inoculants can be applied to plants by using several techniques:

1. By direct liquid inoculation whereby the medium culture of the inoculant is directly inoculated to the host plant upon the end of fermentation process.

2. Incorporate the inoculant into a solid medium called carrier. Carrier is the bulky component of a biofertilizer and preserves living microorganisms until they are applied. Selection of an efficient carrier is important for successful inoculation and to ensure the survivability and sufficient contact of inoculant with the crop.

A carrier must have special properties such as high water-retaining capability, easily adjusted pH, easy to sterilize, non-toxic, and have the ability to maintain inoculant viability during storage. Traditionally, rice husks (or hull) were used as a carrier. Rice husks are agricultural wastes and are usually discarded. However, its usage as a carrier is no longer preferable because of its low water retention capability. This makes it difficult to support bacterial growth. Nevertheless, this problem can be solved by mixing phyllosilicate minerals (such as kaolin) with the rice husk. Kaolin is a soft clay material composed primarily of kaolinite, a layered clay silicate mineral with a low shrink-swell capacity and cation exchange capacity. Kaolin is now a component of media formulations and is mined in Malaysia and many other regions of the world for its numerous industrial applications. Kaolin is well-suited as a carrier medium due to its unique physical and chemical properties, which facilitate its combination or binding with other materials (such as rice husk) and its application to the target plants. The platy structure of kaolin also aids in the retention of moisture. Nevertheless, the combination of rice husk and kaolin as a carrier has not been thoroughly studied. The determination of an optimal ratio of rice husk and kaolin is critical in order to sustain a high amount of inoculant for a longer period of time.

Novelty and commercialization of new biofertilizer

Through many years of research at the School of Biological Sciences, we were able to develop an effective prototype biofertilizer. This new biofertilizer (containing locally isolated Plant Growth Promoter; *Burkholderia* sp. USMB20) can be used for application on a leguminous cover crop *(Mucuna bracteata).* It utilizes rice husk and kaolin as the carrier. This biofertilizer *(mb biofert)* enhances the growth and nodulation of the cover crop. This will in turn minimize the need for high chemical N fertilizer inputs. The estimated shelf life of this novel product is six months. This biofertilizer is safe, toxin-free and eco-friendly. It contains bacteria ($1.0x10^{12}$ cfu/mL) that were locally isolated from the nodules of *M. bracteata*. It is an ideal biofertilizer to be used in sustainable agriculture practices.

mb biofert: Effective biofertilizer for *Mucuna bracteata*

Mucuna bracteata fertilized with *mb biofert*

The latest report by the Malaysian Palm Oil Board (MPOB) showed that since 1960, the total planted areas of oil palm have increased at a rapid pace. In 1985, a total of 1.5 million ha of land were planted with the oil palm, and it had increased to 4.3 million ha in 2007. As of 2011, the total planted area was recorded at 4.9 million ha. Based on these facts and the annual rates of oil palm replanting at 2.41% (1995-1999), it is forecasted that more areas will be planted with *M. bracteata* as the cover crop. Therefore, the commercialization potential of *mb biofert* is very encouraging. This novel biofertilizer *(mb biofert)* had won a Gold Medal during the 25th International Invention, Innovation and Technology Exhibition (ITEX 2014) held at the Kuala Lumpur Convention Centre.

Team members of *mb biofert;* from right, Amir Hamzah, Flory Keyeo and Salwani Shaffie.

Mucuna bracteata is the cover crop in this oil palm plantation.

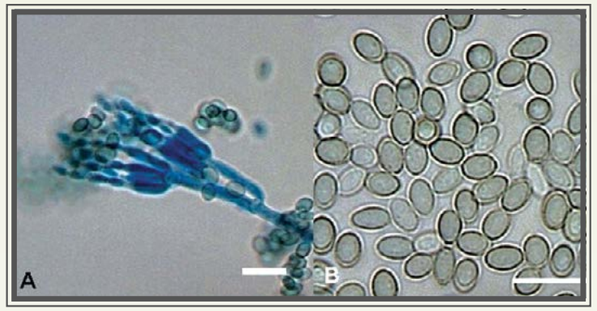
Assoc. Prof Dr. Amir Hamzah Ahmad Ghazali research interest is mainly focused on understanding the biological nitrogen fixation process and plant growth enhancement by diazotrophic microorganisms in association with legumes and non-leguminous plants.

Mycotoxins in

Food and Feed

Latiffah Zakaria

Macroconidia and microconidia of *Fusarium*



Conidial heads and conidia of *Penicillium*

Source of mycotoxins

Mycotoxins are secondary metabolites which are toxic compounds produced mainly by mold or microfungi from the genera *Aspergillus, Penicillium* and *Fusarium*. Other toxigenic fungal genera include *Alternaria, Cladosporium, Stachybotrys, Acremonium* and *Clavicep.* Under favourable temperature and moisture conditions, these toxigenic fungi proliferate and may produce mycotoxins. These mycotoxins may have developed to provide a defense mechanism against other microorganisms, insects, nematodes, animals and humans.

Mycotoxins commonly enter the food chain in the field, through contaminated crops and during storage. Mycotoxin contamination can be severed during shipping, handling and storage if the conditions are conducive for growth of toxigenic fungi. The mycotoxins that commonly occur in agricultural produce are not completely destroyed during most food processing operations which may lead to contamination of the food and feed products. In general, mycotoxins can survive food processing as the compound is chemically stable.

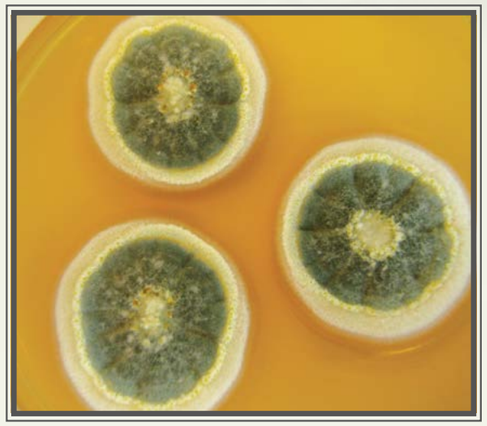
The toxigenic fungi can be classified as field or storage fungi. *Aspergillus* and *Penicillium* species are known as storage fungi as these genera either grow in crops without obvious signs of infestation, or invade crops after harvest and produce mycotoxins during drying and storage. Commonly, *Fusarium* species infect crops before harvest and are called field fungi.

Types of mycotoxins

The study of mycotoxins began in 1960 when over 100,000 young turkeys on a poultry farm in England died from 'Turkey-X disease' after eating a peanut meal that was contaminated with aflatoxins, a group of mycotoxins produced by *Aspergillus* species. Ducklings and young pheasants were also affected in the fatality. After this massive fatality and discovery of aflatoxin, other important mycotoxins were discovered.

There are as many as 400 types of mycotoxins reported, but aflatoxins, fumonisins, trichothecenes and ochratoxins are of great interests and concern because of their prevalence in agricultural produce and the harmful effects to humans and animal. Mycotoxin contamination of agricultural produce raised a lot of concern for food safety. Mycotoxins can occur in feed grains and a wide range of foods including cereal-based and soy-based products such as soy milk, tofu, bread, breakfast cereals, pasta, pastries as well as in biscuits, groundnuts, dried fruits, spices, coffee, milk, apple juice and wine.

Aflatoxins are primarily produced by *Aspergillus* species, especially *A. flavus* and *A. paraciticus*. These toxigenic fungi are present in soil and decaying plant material, causing decay of stored grain, and invade corn and peanuts in the field. Although aflatoxins are detected on a wide variety of foods, it has been most commonly associated with peanuts, corn, pistachio, dried fruit, nuts, spices, figs, vegetable oils, cocoa beans, corn, rice and grains used as animal feeds.



Colonies of *Penicillium* sp.

Conidial heads and conidia of *Aspergillus*

Ochratoxins are produced by several species of *Aspergillus* and *Penicillium.* Ochratoxin contamination is economically important in cereal grains, grapes, nuts and coffee bean. *Penicillium verrucosum* is the main cause of ochratoxin contamination of cereal grains. A number of *Aspergillus* species cause ochratoxin contamination in green and processed coffee and nuts.

Fumonisins are a group of mycotoxins produced primarily by *Fusarium verticillioides* and *F. proliferatum,* which are common contaminant of corn-based food and feed as well as rice and sorghum. Fumonisins found in food are produced mainly in the field in which suitable temperature and moisture conditions are important factors that affect *Fusarium* infection and fumonisins synthesis. Insect damage of corn ears and kernels might also contribute to *Fusarium* infection.

Trichothecenes are the largest group of mycotoxins comprising more than 150 chemically-related toxic compounds. Tricothecenes are produced mainly by *Fusarium* species and several other fungal genera including *Stachybotrys* and *Trichoderma.* The most important form of trichothecene is deoxynivalenol, a common contaminant of wheat, barley, corn and oats. Trichothecenes have also been detected in other food commodities including sorghum, potatoes, bananas, mustard seed, groundnuts, mangoes, sunflower seed and cassava. *Fusarium graminearum* is the most important deoxynivalenol producer and this species is the main causal pathogen of head-blight of wheat and barley.

Zearalenone is also produced by numerous *Fusarium* species. This mycotoxin has been found in almost every agricultural products especially cereal crops and has been detected in corn and corn products, breakfast cereals, wheat flour, bread and walnuts and in animal feed products.

Exposure to mycotoxins is always accidental and in most cases, resulted from eating contaminated food and feed. Mycotoxins usually enter the body via ingestion of contaminated foods, inhalation of toxigenic spores and direct dermal contact. Mycotoxin exposure can lead to adverse health effects such as cancer induction, kidney disorders and immune suppression.

Controlling the production of mycotoxins by toxigenic fungi is largely through preventive method which include sufficient drying of agricultural crops after harvest and adopting good agricultural practices. Another method is cultural practices which can reduce survival or spread of toxigenic fungi in the field. Mycotoxin contamination of crop can also be minimized through timing of planting and harvest.

Latiffah Zakaria is a Professor of plant pathology and mycology. Her research focuses on the diversity, systematics and phylogenetics of microfungi from various genera.

Aquatic Insects
in Recreational Rivers

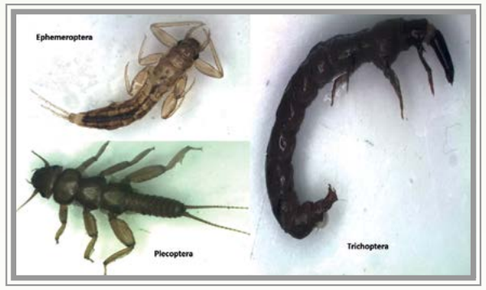
Norshamiera Normi and Suhaila Ab Hamid

Mayflies are found only in clean rivers.

Aquatic invertebrates especially aquatic insects have long been recognized as useful indicators in biological monitoring. These insects spend most of their life in water, especially members from the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). They display varying sensitivity and tolerance towards pollution. Their availability and sessile nature makes them susceptible to changes including physical and chemical fluctuations *in situ*. Hence, their relative abundance has been used to make interpretations about pollution loads. Numerous research on their ability to tolerate pollution has resulted in the derivation of important biological indices such as Biological Monitoring Working Party (BMWP), Family Biotic Index (FBI), Average Score Per-Taxon (ASPT) and even the EPT taxa itself became an index known as EPT index. Aquatic insects are excellent bio-indicators of water quality.

Aquatic insects are generally one of the major living components in freshwater ecosystems. They are well adapted to various freshwater environments ranging from lakes to pools and streams. Aquatic insects also play an important role in the aquatic food web due to its various functional feeding groups (FFG) from collector-gatherer or filterer to shredder, scraper and predator. They are also food for other aquatic organisms which includes fish. Their various FFG make them a crucial component in freshwater ecosystems by allowing them to live in various microhabitats such as in the leaf-litter, between the cervices and on surfaces of rocks.

Each aquatic insect has different tolerance value towards changes in water quality or anthropogenic disturbances. Certain species from the order Ephemeroptera, Plecoptera and Trichoptera are generally sensitive towards pollution and changes in water quality.



Larvae of Ephemeroptera, Plecoptera and Trichoptera (EPT).

Titi Hayun River, a hot spot recreational river in Yan, Kedah.

Generally, ephemeropteran, also known as mayflies have flat body surface allowing them to crawl on the surfaces of rocks. In order to maintain life in water, they developed leave-like gills on their abdomen. Another example is the stonefly which is scientifically known as Plecoptera. Similar to ephemeropteran, stoneflies have a flat body surface that allows them to crawl on surfaces of the rocks. They have a sturdy body with gills along the abdomen. In situations of low oxygen availability, the stonefly will jerk its body up and down to ventilate more oxygen to its gills. This plecopteran can be found mostly in upstream river and abundantly in cold medium to fast flowing rivers.

Meanwhile, Trichoptera or caddisflies is well known as underwater architects. Some caddisflies are case-maker while others are net spinners. Different taxa will construct different casing that allows them to attach themselves to surfaces of rocks using silk excreted from salivary gland. These cases are made from different types of medium such as different types of sands, aquatic vegetation and leaf-litter. Hence, this variation allows the identification of the different taxa.

Diptera is pollutant tolerant and can survive in most conditions. Order Diptera comprised of mosquitoes and fly larvae. The most tolerant group is red non-biting midge larvae (Chironomidae) and rat tailed maggots (Syrphidae). The chironomids can survive in harsh conditions because of their oxygen-absorbing 'blood' while the rat tailed maggots breathe air through long extending siphon or tube. However, they can also be found in clear running water on the surfaces of rocks, leaf-litters and even on the surfaces of the tiniest substrate on the river bed such as sand. For example, aquatic insects from the Simuliidae family attached themselves by creating silken pad to the surface of any substrate, especially sand, and embed its hooked posterior onto the silken pad.

Norshamiera Normi is currently pursuing her MSc. in Applied Entomology, conducting research on the effects of recreational activities on aquatic insects.

Dr. Suhaila Ab Hamid is an aquatic entomologist and her research emphasizes on taxonomy, biology and ecology of aquatic insects in freshwater ecosystems.

Malaysia's Disappearing Wildlife:

A Case Study at the Segari Melintang Forest Reserve

Nadine Ruppert

A marked tree separating the Virgin Jungle Forest Reserve from the encroaching oil palm plantations.

The Segari Melintang Forest Reserve in Perak has long been known to national and international botanists for its endemic, rare and critically endangered Dipterocarp species, *Shorea lumutensis* (balau putih), that can only be found here and in nearby forests of the Lumut area. This Forest Reserve is a green treasure chest at the Western coastline of Perak, and with 2270 ha coverage, it is one of the last coastal primary rainforests in Peninsular Malaysia. This unique ecosystem, rich in commercially valuable *Shorea glauca* trees and countless plant and animal species, had to endure heavy losses since it was first declared a forest reserve in the 1960s, when it still comprised 4000 ha of Permanent and 470 ha of Virgin Jungle Reserve. Heavy encroachment from oil palm plantations, mining, and urbanization projects have diminished this Forest Reserve to half of its original size.

The Segari Melintang Forest Reserve is situated at Perak's last sea turtle nesting beach, Pasir Panjang Segari, where the Malaysian Fisheries Department operates a sea turtle hatchery and conservation centre. Green turtles *(Chelonia mydas)* visit the 7 km long beach to lay their eggs, which are then transferred to the enclosed hatchery for safe-keeping. Hatchlings are reared at the centre and released after several months, once they are strong enough to survive the challenging ocean waters. Surrounded by lush green jungle, this place is a tourist attraction and a favorite of nature lovers.

The jungle might be less open to the public as its "reserve" status strictly forbids anyone to enter without permission from the Forestry Department. Nevertheless, people do not always stick to the rules and illegal hunting for valuable forest commodities, such as agarwood (gaharu), timber, rattan (12 species alone can be found in the southern part of the forest reserve) or endangered and sought-after animals, like pangolin *(Manis javanica),* white-rumped shama *(Copsychus*

A mining and wasteland fill within the Forest Reserve.

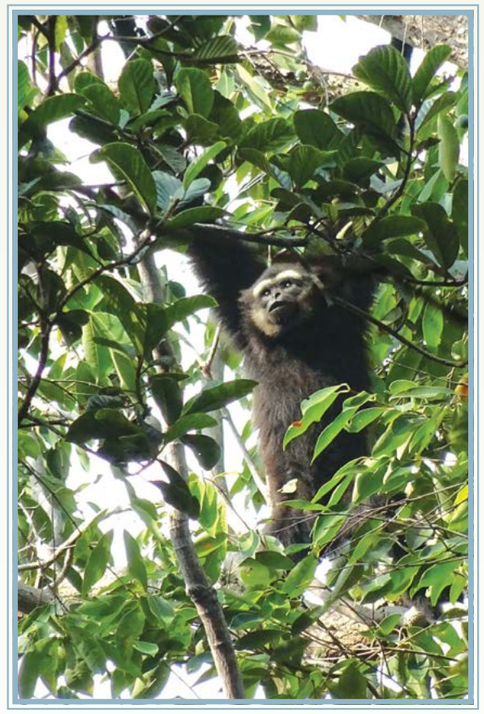
malabaricus), muntjak deer *(Muntiacus muntjak)* and others, is common practice amongst many locals. More scientific expeditions are needed to fully assess the fauna and flora biodiversity of this beautiful forest.

Many villagers who are living nearby the forest edge still remember the days when they could hear the deer barking or the Great Argus pheasant *(Argusianus argus)* giving his mating calls in the mornings, or encounter the foot prints of large felids *(*probably *Panthera pardus)* a few decades ago. Although still rich in its biodiversity, many of the iconic species have since become diminished or even extinct in the area. Elephants, tigers or tapirs are long gone. What is still left is worth protecting at all costs.

Only recently, plans on the industrial development of the area including heavy industry factories and highways that would cut through the forest reserve were opened to the public for comments. Protests from villagers, NGOs and unfavourable EIAs have since put the plans on halt but the creation of more public awareness towards this unique coastal ecosystem should proceed until the plans are fully dropped, or better, until the area has reached a higher protection status, such as State Park.

We have been doing field work at the Segari Melintang Forest Reserve since I first came to Malaysia 10 years ago. I was introduced to this forest by a German researcher who had undertaken his studies on the slow loris here since 1990. We have looked into various aspects of Segari's unique wildlife biodiversity.

The forest is home to a diverse array of small mammals, including 9 different murid species, of which many, such as the grey tree rat *(Lenothrix canus)* are not only rare but completely unstudied. Another unique small mammal, the feather-tailed tree shrew *(Ptilocercus lowii)* became famous in



Agile gibbon swinging through the tree canopy.

Jungle siesta by a group of pigtailed macaques.

this forest as it was found to consume vast amounts of natural alcohol, produced by the fermented nectar of the Bertam palm *(Eugeissona tristis)*. We observed not only the tree shrew visiting this jungle toddy bar, but also the grey tree rat and many more, amongst them the Sunda slow loris *(Nycticebus coucang)*, a nocturnal primate. The forest is home to four more primate species, which are longtailed macaque *(Macaca fascicularis)*, pigtailed macaque *(Macaca nemestrina)*, dusky leaf monkey *(Trachypithecus obscurus)* and the iconic agile gibbon *(Hylobates agilis)*, an ape, not a monkey.

Sunda colugo *(Galeopterus variegatus)*, sun bear *(Helarctos malayanus)* and Asian golden cat *(Catopuma temminckii)* have been reported but seldom encountered. The smaller leopard cat *(Prionailurus bengalensis)* and at least three species of civets (Viverridae) are still abundant in the forest and its fringing oil palm plantations. The list of mammals also comprises many colourful squirrels, such as three species of *Ratufa* spp., two species of *Callosciurus* spp., and one species each of *Sundasciurus* spp. and *Larsicus* spp. Many more are probably hidden in the upper layers of the canopy. They might be wise to stay there, hidden from the human eye and only the future will tell if this biodiversity treasure chest can be saved from the encroaching human exploitation.

Dr. Nadine Ruppert is a senior lecturer for zoology. Her current research focus is on primates, especially pigtailed macaques.

A Centre for Marine Science Research

Annette Jaya Ram

The island of Penang is well known not only for its melting pot of cultures and delicious food, but also for its beaches. If you are an islander, it is not easy to avoid the sun, sea and sand. One of life's pleasures (for some) is to sit on the beach, listen to the sound of crashing waves and watch the edge of the sea blend into the horizon - it is definitely a sight to behold. Now imagine that you are working at a location as such - that's got to be a great motivation to kick start your day and get to work daily. The staff of the Centre of Marine and Coastal Studies (CEMACS) are indeed fortunate to work at such an idyllic place. This beach-front facility is located within the Penang National Park, which is on the North-Western coast of the island. Each morning the staff and students assemble at the Teluk Bahang Jetty and are transported to the centre by boat ride which takes about five minutes; talk about getting to work in style!

CEMACS is located at Teluk Aling and takes up about 3.75 acres of land. It started out as Muka Head Marine Field Station in 1978. It was only known as CEMACS in 1991, and was established to provide an institutional mechanism for mobilizing and integrating the marine science expertise and resources in the university. The main purpose of CEMACS formation was to enhance the capability of conducting integrated inter- and multi-disciplinary studies leading towards solving problems related to marine and coastal ecosystems. To date, this centre has seen to the training and supervision of numerous undergraduates who choose to spend their industrial training here. It also has produced postgraduates who conducted research in fields of marine and coastal sciences. CEMACS is also a place where local and international post-doctoral candidates spend their time to conduct their research and field studies.

The peaceful environment in CEMACS is usually peppered with the voices and laughter from first year Biology undergraduate students. The research and teaching activities remain closely tied between CEMACS and the School of Biological Sciences. A compulsory course for all Biology major (degree) students, Biodiversity and Ecology Practical is conducted over the span of several days within the facility. The course covers different terrains such as coastal, riverine and forest ecosystems. Students are introduced to techniques in data collection, correct usage of equipment involved and also to scrutinize the various organisms inhabiting the different locations. There is also a teaching laboratory and wet laboratories for research to take place. CEMACS is equipped with culture labs for phytoplankton studies and basic microbiology. Within its walls there also lies an extensive Marine Reference Collection and Museum which houses specimens of molluscs, corals, echinoderms, crustaceans, gorgonians, fishes and herbarium

The jetty leading to the Centre of Marine and Coastal Studies at USM (photo courtesy, Sim Yee Kwang).

Muka Head Marine Field Station in March 1976
(photo courtesy, the late Mr. Ganesh).

of flora from around the region. The centre has capacity for accommodation, whereby there are 5 dormitory units (60 pax capacity) and also 12 flatlet units (34 pax capacity).

The research areas encompass several dynamics which are offered to postgraduate students and collaborators alike. Studies on coral reef and mangrove ecosystems provide vast knowledge in further understanding these complex habitats. These fragile ecosystems are facing various threats, especially due to human activities. What is to become of the inhabitants when the dangers we pose to them are far greater than the efforts to protect? Research is also conducted on marine pollution and toxicology with focus on their effect on marine organisms. Besides this, there is also the area of research on integrated coastal zone management which includes geographical and political boundaries. Mariculture is an important field, be it the culture of fish, seaweed, molluscs or crustacean. In this discipline, the research conducted is to improve the output of the cultured organisms not only in the sense of filling the human food basket, but to provide a sustainable way to obtain seafood. Many a species are facing pressures from over-fishing and extinction threats due to irresponsible harvesting from the seas. Research in CEMACS is widely related to many aspects of marine sciences and also biodiversity conservation. Studies on marine mammals such as dolphins and dugongs are also currently being conducted. To the student or researcher who wishes to bring about improvement to the coastal and marine ecosystem, or just to understand and appreciate the marine environment, CEMACS would be an ideal place to consider beginning their studies. Collaborative work with local and also international universities not only enhances the ties amongst the institutions, but propels this centre towards improvement in the research arena.

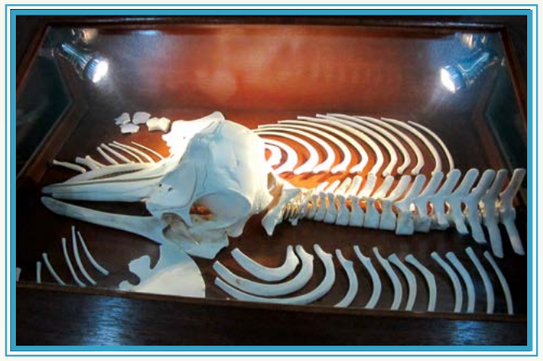
School of Biological Sciences students identifying field samples during their practical course at CEMACS (photo courtesy, Ng WK).

CEMACS' international collaborators originate from various countries including Indonesia, Singapore, Vietnam, Cambodia, India, Japan, China, Iran, Australia, USA, Canada, Denmark and the United Kingdom. Research collaboration is also conducted with staff from within USM

Some of the teaching and research facilities at CEMACS (photo courtesy, Ng WK).

as well. Efforts from association with the School of Biological Sciences have yielded many journal publications throughout the years. The strong ties between these two facilities prove beneficial not only to the students but in the research area too. Many of the research staff and council members of CEMACS have direct links to the School of Biological Sciences. Besides this, CEMACS has been actively involved in conservation and community-based projects to create appreciation towards scientific research and its application in the local community.

Although CEMACS is known to possess several boats for transportation and research purposes, the centre is also accessible via jungle trekking route which is a 25 to 30 minutes' walk. The stretch of beach outside the facility (about 350 m) sees avid hikers taking a rest stop, revelling in nature, or even a dip in the inviting sea (do keep a lookout for jellyfish). It has also been noticed that there are two main types of primates inhabiting the area, the long tailed macaques and the dusky leaf monkey. The lush green forest in the surrounding area also houses many species of reptiles, insects, small mammals, amphibians and birds. By looking up into the cerulean sky, you may spot several white bellied sea eagles or Brahminy kites gliding majestically in the vicinity. This centre has been standing proud in its spectacular location for many years. The doors of this centre will continue to welcome students and researchers to delve deep into the vast ocean of knowledge for many more years to come.



An exhibit in the Marine Reference Collection and Museum.

Dr. Annette Jaya Ram was a former PhD student at the School of Biological Sciences and is now a Senior Lecturer at CEMACS. She is involved in mariculture research focussing on mud crab culture in captivity and to cease reliance of seed stock from the wild. She also conducts research related to the culture of other marine crustaceans.

Trip to West Kalimantan, *Indonesia*

Onrizal, Muzzalifah Abd Hamid, Siti Norasikin Ismail, Wan Nur Fasihah Zarifah Wan Rozali and Mashhor Mansor

Aerial view of Danau Sentarum National Park during the dry season in September 2015.

A field survey in West Kalimantan was conducted by a team from the School of Biological Sciences in September 2015. West Kalimantan is located on the island of Borneo and its provincial capital city is Pontianak. The total area of West Kalimantan Province is 146,807 km² (7.53% of Indonesia). This field survey was part of the cooperation between the School of Biological Sciences (USM) and the Limnology Research Center of Indonesia (LIPI). The main objective was to record terrestrial and aquatic diversity of the flora and fauna in Sentarum Lake and Kapuas River. Vegetation along roads and established sampling sites were the main focus.

Our journey begins on the 5th of September from Semitau to Danau Sentarum National Park (DSNP). DSNP lies in the upstream of Kapuas River, about 700 km from the delta. It is a Ramsar Site since 1994 and decreed as a national park in 1999. The basin is a vast floodplain, consisting of about 20 seasonal small lakes, freshwater swamp forests and peat swamp forests. The basin of Sentarum Lake acts like a reservoir. During the rainy season which usually lasts about 9-10 months, the basin will be flooded to 6 – 14 meters in depth. During the dry seasons, the area is without much water.

The team with the local people at Banua Tengah, Putussibau Province.

In Sentarum Lake, the majority of the people live along the river and they rely on boats as their main mode of transportation. Most of the local communities build their houses along the river banks and some of them build floating houses to escape from flood during rainy seasons. Residential areas, small shops, mosques, and fish pens are characteristics of the area. We also visited a special long house in Putussibau.

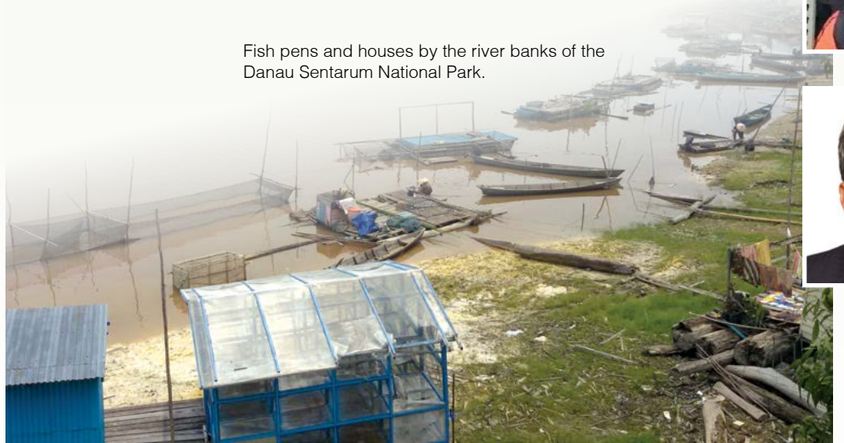
West Kalimantan experience a wet tropical climate with rich flora biodiversity that supports various species of fauna. The forest of West Kalimantan is also a suitable habitat for some endangered species such as the Bornean orangutan *(Pongo pygmaeus)*, proboscis monkey *(Nasalis larvatus)*, Binturung *(Arctictis binturong)*, vampire squirrel *(Rheithrosciurus macrotis)* and the Bornean flat-headed frog *(Barbourula kalimantanensis)*.

The island of Borneo also has great potential for woody and non-woody forest products. Non-woody forest products in the area are dominated by rattans of various types with very high economic value such as rotan Sega, rotan Cincin and rotan Dahan. Throughout our trip, we have observed several different types of rattan which comprised of the genera *Calamus, Daemonorops, Korthalsia,* and *Plectocomia*.

Unfortunately, we noticed that much of the forest ecosystem was converted to oil palm plantations and agriculture lands. Therefore, the threats to endangered species have gradually increased. We observed forests being burnt along the main roads from Pontianak to Kapuas Hulu as part of land preparation for agricultural and plantation purposes during the dry season. Based on the field survey, we estimated approximately 5 ha of land burning occurred at every 5 km. Developers and farmers here applied the 'slash and burn' technique for land clearing. They believe the usage of chemicals could lead to serious environmental health as the chemicals can leach into agriculture area and end up in rivers and lakes. The 'slash and burn' technique involves cutting and burning and has been practiced by the local communities for many years.

Biologically, forest burning can destroy many species. Fire causes the breakdown of organic material into nutrients that are returned to the soil. Those nutrients can be recycled and used for new plant growths. Fire also aids in recycling nutrients. Mineral-rich ash nourishes the soil and provides an ideal environment for the germination of many seeds and the regeneration of certain plants.

However, burning of large areas of oil palm plantations can negatively impact the social and economic aspects of the country. Burning of peat swamps causes smoke to spread underneath the soil even when the visible fire on the land surface has been extinguished. This phenomenon can contribute to haze due to incomplete combustion. Illegal burning of peatland has continued despite stringent laws forbidding such practices. Greater enforcement needs to be implemented. Haze has affected residential areas and resulted in the closure of airports and schools not just in Indonesia but also to neighboring countries such as Malaysia and Singapore. This year's haze was so bad that it even reached the southern part of Thailand, severely affecting their tourism industry. Knowledge of peat swamp ecosystem is crucial, and the burning activities of oil palm plantations and other agricultural land should stop immediately.



Fish pens and houses by the river banks of the Danau Sentarum National Park.

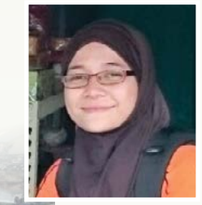
Authors' note:

We would like to thank Lembaga Ilmu Pengetahuan Indonesia (LIPI) for inviting us to join in their field survey in Danau Sentarum. This trip was funded by USM APEX Incentive Grant.

Onrizal is currently a lecturer at the Forestry Sciences Department, Universitas Sumatera Utara (USU). He obtained his PhD in Environmental Biology at USM with specialization on tropical forest ecology.

Muzzalifah Abdul Hamid is a PhD student in Environmental Biology focusing on aquaculture and its impacts on Lake Ecosystem.

Siti Norasikin Ismail is a PhD candidate in Environmental Biology focusing on aquatic vegetation and tropical lake ecology.



Wan Nur Fasihah Zarifah Wan Rozali is a Ph.D student in Botany focusing on Rattan ecology and phylogenetics in Peninsular Malaysia and Borneo.

Mashhor Mansor is an Ecology Professor at the School of Biological Sciences. He has focused interests with research related to ecology and botany.

Artificial Islands Project *in Penang*

Chee Su Yin

Dr. Chee (USM) and Dr. Firth (Plymouth University) on the rock revetments in Straits Quay, one of the three pilot implementation sites where rock pools are drilled to encourage habitation of coastal organisms in Penang.

Penang Island is one of the fastest growing and most densely populated regions in Malaysia. To accommodate the burgeoning population, the local council is planning to construct two artificial islands and reclaim a large tract of land off the iconic Gurney Drive, Georgetown. These islands will be connected by bridge and will be housing 12,000 people with opportunities for retail and recreational sectors development. The islands have attracted much negative criticisms from locals and environmental groups due to the potential negative impacts on the environment.

Researchers from Universiti Sains Malaysia are set to play a key role in Malaysia's first marine ecological engineering project. This project entitled "Eco-Engineering: design with nature" will be led by Dr. Chee Su Yin (Centre for Marine and Coastal Studies, Universiti Sains Malaysia) and Dr. Louise Firth (School of Geography, Earth & Environmental Science, Plymouth University) with funding from The British Ecological Society & Rufford Small Grants. The main objective is to assess how small-scale novel engineering interventions on artificial coastal structures can provide important habitats for marine organisms and enhance local biodiversity and ecosystem services. This 18-month project is a collaboration between Universiti Sains Malaysia, Plymouth University, Aberystwyth University and the University of Southampton.

Discussions on environmental challenges with the former Chairman of Chew Jetty (far right). The Jetty is an UNESCO World Heritage site.

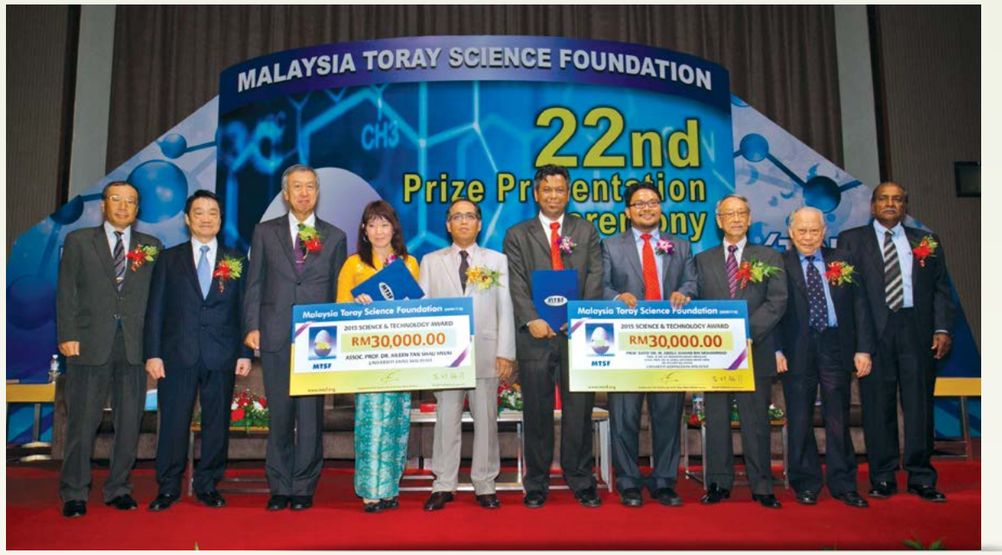
Dr. Chee and her collaborators, including Assoc. Prof. Aileen Tan from the School of Biological Sciences, will conduct several trials of small-scale ecological engineering experiments on existing artificial structures to investigate the efficacy of these techniques in the region. In September 2015, Chee facilitated Firth's visit to Penang to oversee the drilling of artificial rock pools. If results are positive, the goal is to scale up and team up with a range of scientists and engineers to consider large-scale approaches for the artificial islands planned for Penang.

The drilling of artificial rock pools on the newly constructed rock revetment at Karpal Singh Drive, Penang.

Dr. Chee Su Yin is a Senior Lecturer at the Centre for Marine and Coastal Studies, USM. Her interests are in ecological engineering, coastal conservation and mangrove ecology. She also has research interests in mangrove habitats in Malaysia.

A Prestigious Congratulations

Science and Technology Award



Associate Professor Aileen Tan Shau Hwai was conferred the prestigious Science and Technology Award from the Malaysia Toray Science Foundation (MTSF) for the year 2015. Due to her extensive experience in the field of marine ecology and conservation of marine biodiversity, she made significant contributions to this research area both nationally and internationally. She received the award in conjunction with the 22nd MTSF Prize Presentation Ceremony recently.

The award comes with a cash prize of RM30,000 and a certificate of special recognition. When interviewed, Aileen said she was overwhelmed and excited to be selected as one of the country's best scientists and said that *"this achievement is an acknowledgment of the efforts that have been undertaken, particularly in advancing the field of marine biodiversity research that has great potential to be tapped." "USM and Malaysia continues to be the focus of molluscs research and we are among the pioneers who are working to develop this area until it was recognized at the global level"* she said.

Vice-Chancellor, Professor Dato' Dr. Omar Osman who was also celebrating the success of USM said that this recognition demonstrates the excellence of USM researchers in various fields for the benefit of science and society. He expects the award to be an inspiration and motivation for other young researchers to seek grants from other agencies in strengthening their research. He added that the recognition by external agencies also help to provide greater impact for research excellence of the researchers.

MTSF Awards, now in its 22nd year, was established to promote science and technology by recognizing the contributions and efforts carried out by students, scientists and academicians. The award involves three main categories: Science & Technology Award, Science & Technology Research Grant Award and Science Education Award. Also present at the ceremony were the Deputy Secretary General of MOSTI as the representative for the Minister of Science, Technology and Innovation, the Japanese Ambassador to Malaysia (Dr. Makio Miyagawa), MTSF Chairman (Professor Emeritus Tan Sri Dr. Omar Abdul Rahman), and Senior Director Toray Industries Inc. Japan (Hiroshi Murakami).

Dr Aileen is passionate about her research and has devoted the past 25 years in conducting in-depth work on the mariculture and conservation of molluscs. She made history by becoming the first woman scientist to be elected as the President of

Bio Bulletin

Congratulates

Dr. Aileen Tan

for being conferred the
Science and Technology Award 2015.

Syabas!

Dr Aileen and a giant clam.

Dr Aileen Tan receiving her award from the Malaysia Toray Science Foundation.

UNITAS Malacologica, a leading worldwide organization based in Belgium that was established since 1962. UNITAS Malacologica has global recognition especially in molluscs research. One of its roles is to increase public awareness on issues related to the conservation and management of marine species biodiversity in the world. She is tasked to organize the 19th World Congress of Malacology in the year 2016, the second time to be held in Asia. Her vast body of work on oysters, as featured in the website of World Oyster Society (www.worldoyster.org), has gained recognition, not only in Malaysia but also internationally.

Through her guidance and support in setting up a commercial hatchery, a private company was bestowed "The First Commercial Oyster Hatchery in Malaysia" by the Malaysia Book of Records in year 2014. Currently she is involved in projects to transfer knowledge to rural coastal communities in the culture of molluscs so as to allow these communities to generate extra household incomes. Dr Aileen was recently appointed as the Executive Director of Asia-Pacific University Community Engagement Network (APUCEN) and is responsible for linking countries in Asia-Pacific and beyond in university-community engagement programmes. She is also transferring knowledge through supervising her students and educating the public.

Aileen Tan has been the resource person for the aquaculture of molluscs both nationally and internationally, where she has continued to be involved in setting up hatcheries not only in Malaysia but also in Thailand, Vietnam and China. Among her many achievements is a grant from the United Nations Development Programme to work with womenfolk in the isolated islands of Johor Darul Takzim on giant clam conservation programme.