2013 International Award for Young Agricultural Researchers

Timber tracking system of an important Malaysian timber species, *Neobalanocarpus heimii* (Dipterocarpaceae) using DNA approach

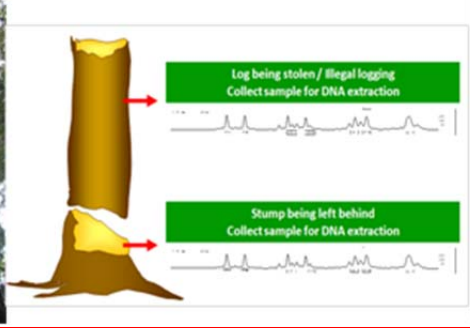
Dr. Lee Hong TNAH
Research Officer, Forest Research Institute Malaysia (FRIM)

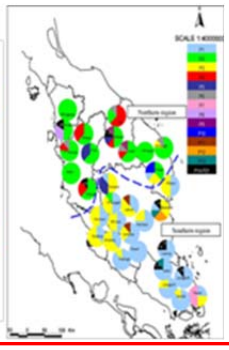
Reason for the Award

It is crucial to prevent illegal logging in order to conserve forest resources and facilitate their sustainable use. Timber tracking systems that depend on the certificate of origin or the conventional practice of physical tagging could hinder the confirmation of legality because of forgery. The award winner was engaged in the development of a timber tracking system using DNA markers and contributed to the world's first establishment of a system applicable to one tree species of Dipterocarpus, an important wood resource in the Southeast Asian region. This system has already been used as a research model for other important tree species in Malaysia, and it is expected that similar systems will be employed for other main tree species, which would contribute to conservation of forest resources in regions including the Southeast Asian region, facilitation of their sustainable use, and local environmental conservation.

Outline of Research Achievements

New methods to match a timber log into its population and stump of origin would signify an important forensic component in the context of stolen log traceability for the control of illegal logging and also the approach in chain of custody developed for the certification of timber from sustainably managed forests. In Malaysia, foresters at the moment have to depend on wood anatomy evidence to link the suspected timber thefts to the source trees. But this is inadequate as identification could only be done on the group of trees and not to the species and individual levels. Therefore, the use of inbuilt unique properties of DNA within a timber could serve as an important technical element in forensic forestry to support the determination of identity and provenance. By using *Neobalanocarpus heimii* (chengal) as an example, we have developed a timber tracking system, which comprises of population and individual identification databases, using chloroplast DNA (cpDNA) and nuclear short tandem repeat (nSTR) markers. These databases could be applied for timber tracking in two different circumstances (1) to verify the provenance of wood lot in the context of forest certification and chain of custody certification, and (2) to identify the potential population of origin and its original stump for the suspected illegal harvested wood lot.





Main Publications:

(1) **Tnah LH**, Lee SL, Ng KKS, Subha B, Rofina YO. 2012. DNA extraction from dry wood of *Neobalanocarpus heimii* (Dipterocarpaceae) for forensic DNA profiling and timber tracking. Wood Science and Technology. 46: 813-825.
(2) **Tnah LH**, Lee SL, Ng KKS, Faridah QZ, Faridah-Hanum I. 2010. Forensic DNA-profiling of tropical timber species in Peninsular Malaysia. Forest Ecology and Management 259: 1436-1446.
(3) **Tnah LH**, Lee SL, Ng KKS, Tani N, Subha B, Rofina YO. 2009. Geographical traceability of an important tropical timber *(Neobalanocarpus heimii)* inferred from chloroplast DNA. Forest Ecology and Management 258: 1918-1923.

2013 International Award for Young Agricultural Researchers

High-throughput phenotyping and selection for drought tolerance in cowpea (*Vigna unguiculata* L. (Walp.))

Dr. Nouhoun BELKO
Research Fellow, Senegalese Agricultural Research Institute (ISRA)

Reason for the Award

Cowpea, an annual leguminous crop, is a main crop in the sub-Saharan region of West Africa and an important traditional food, being a local source of protein. Since the semi-arid zone spreads over this region, which could be strongly affected by climate change, it is important to enhance drought tolerance in crops. The award winner identified and characterized the traits related to the drought adaptation of the crop, and selected cultivars of cowpea with high-yielding and drought-tolerant characteristics. By introducing such technologies as infrared thermal imagery in the selection, the winner improved the efficiency of the selection process, and quantified and standardized the selection criteria, which helped accelerate the development of related research. Through further research in the development of crops using the technology developed by the winner, it is expected that high yield and stable production of cowpea will be possible, which would contribute to local food security, poverty reduction, and the improvement of the value chain.

Outline of Research Achievements

Cowpea is an important food legume widely cultivated in the semi-arid tropics where drought is a major limitation of crops productivity. However, the creation of improved cultivars is hampered by the lack of effective screening techniques and selection criteria. Therefore, an integrated and innovative approach is needed to revitalize the development of drought-adapted and high-yielding cultivars. In this regard, Dr. Belko conducted significant research in various environments such as field station, rain-out shelter, glasshouse, and growth chamber in Senegal and India with the objective to (i) develop high-throughput plant phenotyping methodologies, (ii) identify morpho-physiological drought-related traits, and (iii) select post-flowering drought tolerant and high-yielding cowpea cultivars. From his extensive work, Dr Belko made significant achievement including (i) selection of several cultivars with higher yields and post-flowering drought tolerance, (ii) identification of key agro-physiological traits that are correlated with drought tolerance, and (iii) publication of several high impact research papers. The technologies developed from his work are now used in the breeding programs in Africa and the US. Currently, Dr. Belko is working to parameterize and test the robustness of a legume crop model to predict the effects of specific plant traits or traits combinations on the crop yields and to determine their probability of success in improving crop growth and yields across drought scenarios and environments in Africa.

Main Publications:

(1) **Belko** *et al*. 2012. Lower soil moisture threshold for transpiration decline under water deficit correlates with lower canopy conductance and higher transpiration efficiency in drought-tolerant cowpea. Functional Plant Biology 39: 306-322.
(2) **Belko** *et al*. 2013. Restriction of leaf conductance under high vapor pressure deficit and non-limiting water conditions is important for the terminal drought tolerance of cowpea (*Vigna unguiculata* (L.). Walp.). Plant Biology 15: 304-316.
(3) **Belko** *et al*. 2014. Selection for post-flowering drought resistance in short and medium duration cowpeas (*Vigna unguiculata* (L.). Walp.) using stress tolerance indices. Crop Science - Doi: 10.2135/cropsci2012.12.0685.

2013 International Award for Young Agricultural Researchers

Honey bee pathology and development of beekeeping in Asia

Dr. Panuwan CHANTAWANNAKUL
Associate Professor, Chiang Mai University, Kingdom of Thailand

Reason for the Award

Honey bees have a long history of relation with humans such as through the utilization of products including honey or as facilitators of crop pollination. However, the history of bee pathology research in Asia is short, and the award winner was a pioneer who played a leading role in this field. The winner played an active role not only in pathology, but also in the research of bee pests, behavior, and products, and published various research papers. The work has been set as Thai national guidelines for honey standard and also the disease diagnosis guideline according to the OIE (World Organization for Animal Health).The award winner also contributed to the advancement of materials science of bee products, including the development of nanofibers using propolis. The winner also developed a method for quick detection of viruses utilizing real-time PCR. The findings obtained are expected to contribute to agriculture and other related industries such as materials science, health care, and medicine.

Outline of Research Achievements

Dr. Chantawannakul started her work with American foulbrood, the most fatal disease in honey bees. Her research revealed that the proteases from American foulbrood-infected cadaver of honey bee were metalloproteases and her experiments showed three patterns. These patterns of protease banding in different isolates can provide a means for distinguishing strains and will be of epizoological value in following the outbreak of American foulbrood disease. Later, she surveyed bee diseases pest and parasites in Thailand and found that the bee industry has been affected by a fungal pathogen as well as Varroa and Tropilaelaps mites. Through observations, she discovered the relationship between virus, Varroa mite and bee. The discovery was made on the grounds that genetic materials of viruses were found in Varroa mites, which parasitized in bee. Therefore, Varroa mites could be a biological vector for viral transmission and it could cause the collapse of bee colonies due to the so-called "bee parasitic mite syndrome." Moreover, this study provides the first evidence for the co-existence of several bee viruses in a single mite and also the first report of bee virus in Thailand. This will help beekeepers to make an attempt to reduce mite population in their apiaries to contain viral transmission. Recently, concerns have been raised about chemical residue left in honey and antibiotics resistance of microbial pathogen. Her research has an orientation to use natural product to combat the bee diseases and pests. Her research has also focused on honey bee genomic analysis. Apart from European honey bee, which has been introduced to South East Asia for economic reasons, the study of ecological roles of other native bees in SEA also has been of interest. In recent years she has studied the bee diseases affecting native bees in both Thailand and Japan, and also the resistance mechanisms of Asian honey bees against bee diseases and parasitic mites.

Main Publications:

(1) Disayathanoowat, T., Young, J.P.W., Helgason, T., and **Chantawannakul, P.** (2011): TRFLP of bacterial communities in the midguts of *Apis mellifera* and *Apis cerana* honey bees in Thailand. FEMS Microbial Ecology 79 , 273–281

(2) **Chantawannakul, P.**, Ward, L., Boonham, N., Brown, M. (2006): A scientific note on the detection of honeybee viruses using real-time PCR(TaqMan) in varroa mites collected from a Thai Honeybee (*Apis mellifera*) apiary. Journal of Invertebrate Pathology 91, 69-73.

(3) Promnuan, Y., Kudo, T., Ohkuma, M. and **Chantawannakul, P.** (2011): *Actinomadura apis* sp. nov. isolated from a honey bee (*Apis mellifera*) hive in Thailand and the reclassification of *Actinomadura cremae* subsp. *rifamycini* Gauze et al., 1987 as *Actinomadura rifamycini* (Gauze et al., 1987) sp. nov., comb. nov. International Journal of Systematic Evolutionary Microbiology 61, 2271–2277.