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Confined to the highlands, the Rhododendron displays clumps of spectacular and attractive bell-shaped flowers, the symbol of CHiMP

30 Years 1985–2015 BENCHMARKING EXCELLENCE

HIGHLIGHTS OF THIS ISSUE

Calathea lutea, a popular ornamental plant from tropical America belongs to the same family as *P. tristachyum*

DAINTY WHITE-FLOWERED *PHRYNIUM*, EXCLUSIVELY AT FRIM

Phrynium Molek Berbunga Putih, Istimewa di FRIM

The flowers of *P. tristachyum* partly emerging from the floral bracts

The pointed inflorescence sprouts midway off the stem

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The afternoon of 30 November 1921 was when FW Foxworthy, the first forest research officer of Forest Research Institute and IH Burkill, director of the Botanic Gardens Singapore went on a collecting trip to Kanching Forest Reserve, Selangor. Several plant samples were gathered from Kanching, such as *Codonoboea platypus* (Gesneriaceae), *Munronia breviflora* (Meliaceae), *Rhodoleia championii* (Hamamelidaceae), *Vaccinium bancanum* var. *tenuinervium* (Ericaceae), *Zingiber citrinum* and *Z. gracile* (Zingiberaceae) except one collection labelled as 'Bukit Lagong, 11th mile Rawang Road from Kuala Lumpur'. The Bukit Lagong collection was initially identified as *Phrynium basiflorum* by Foxworthy but later renamed *P. tristachyum* after HN Ridley discovered the plant as novel.

Phrynium tristachyum is grouped under Marantaceae or commonly known as the prayer-plant family. The family is well distributed throughout the tropics, with tropical America being the richest region, followed by Africa and Asia. Mostly found in disturbed areas of the tropical lowland

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Cover photo anti-clockwise from top: Rhododendron wrayi, R. robinsonii, R. javanicum, R. jasminiflorum and R. longiflorum (Photo credit: Ng Seh Cheong)

Phrynium tristachyum on the dense forest floor of the Sungai Kroh valley (left). Large oblong leaves with raised lateral veins (top)

forest, the family is widely recognised through *Maranta arundinacea* (West Indies arrow root), an important crop plant from which high quality starch is produced from the rhizome. The nutritious starch is highly digestible and preferred over flour for culinary dishes and thickening purpose. Another member of the family, *Calathea lutea* is a well-known ornamental plant for home garden and urban landscape.

Marantaceae includes four genera and 14 plant species in Peninsular Malaysia. Many of the species are widespread in Peninsular Malaysia except for two endemics where *P. tristachyum* is one of them. A herbaceous perennial, *P. tristachyum* grows on the forest floor in clusters of long and thin stems reaching up to 2 m height. The large, oblong leaves lend the plant a conspicuous presence among other understory plants. The inflorescence sprouting midway off the stem is a peculiar feature of the plant. The compact inflorescence divides into two or three horn-shaped branches, each bearing small dainty white flowers which bloom lasts only for one day.

Considered rare, *P. tristachyum* was recorded in four locations: Bukit Lagong and Sungai Lalang Forest Reserves, Selangor; Ulu Bendul in Negeri Sembilan and Ulu Kahang in Johor. At Bukit Lagong, the plants were sighted at FRIM and Taman Rimba Komanwel. A large population can be found particularly at the Sungai Kroh valley of FRIM campus. The plants can be observed amongst the dense ground vegetation on the lower slopes off the Rover Track. The moist and partially shaded conditions are favoured and the plants grow in abundance under such environment.

A sanctuary for plants and animals alike, FRIM was gazetted as a Natural Heritage Site in 2009 and later obtained the National Heritage status in 2012. The campus is a living repository for many plants with 73 species recognised as threatened trees. Beside trees, many herbaceous plants including rare and endemic species such as *P. tristachyum*, find refuge in the safe haven of the Institute grounds.

The Bukit Lagong specimen collected by Foxworthy and Burkill is the type specimen for *P. tristachyum* (reproduced with permission from the Board of Trustees for the Royal Botanic Gardens, Kew)

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Dr Sam Yen Yen is a senior research officer at the Flora Biodiversity Programme, Forest Biodiversity Division, FRIM. She graduated from Universiti Malaya in plant taxonomy and her research is mainly on herbaceous plants, particularly the gingers. She has named 11 species and 1 variety of wild gingers, with many more in the pipeline.

CHiMP CONSERVES THE TREASURE OF HIGHLAND FLORA

CHiMP Memulihara Khazanah Flora Tanah Tinggi

Asmar Hassan

The entrance of Cameron Highlands Montane Park (CHiMP)

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& Noorsiha Ayop

Cameron Highlands Montane Park (CHiMP) at the Hulu Bertam Forest Reserve, Tanah Rata is a highland botanical garden which was jointly established by FRIM and the forest departments of Peninsular Malaysia (FDPM) and Pahang. CHiMP is initially an area covering 10 ha, located 1400–1500 m above sea level. The garden houses a variety of native and endemic montane flora collected from the main mountain range of Peninsular Malaysia. The winding 150 m pathway, accessible even to the handicapped is fringed by a multitude of plants creating a beautiful forest landscape. CHiMP is a component of the Cameron Highlands Dreams Programme initiated by the Natural Resources and Environment Ministry (NRE) involving various agencies to save the highland ecosystem from imminent threats. NRE—supported by FRIM and FDPM—was given mandate by the Cabinet to restore the cloud forest resort to its full glory.

The highland botanical garden was planned in three phases namely the establishment and infrastructure development (Phase I: 2002–2010); main development for hardscape, softscape, forest trail and showcase garden (Phase II: 2011–2015); and development of conservation, recreational and educational zones (Phase III: 2016–2020). Plants were collected from seven states and 14 forest reserves. The *ex situ* plant collection which began in Phase II now records 4361 accession (ID number) and 7802 individuals representing 491 taxa or 14% of the montane species in Peninsular Malaysia.

There are presently 14 showcase lawns at CHiMP housing native and unique plants from selected floristic groups. The garden although small, is an effective and comprehensive showcase of highland flora which portrays the healing forest and the first of its kind in Peninsular


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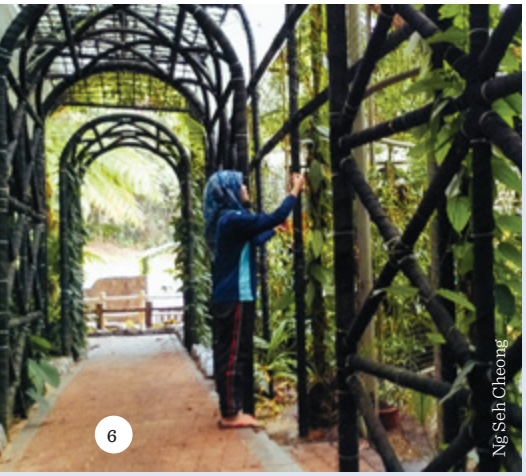
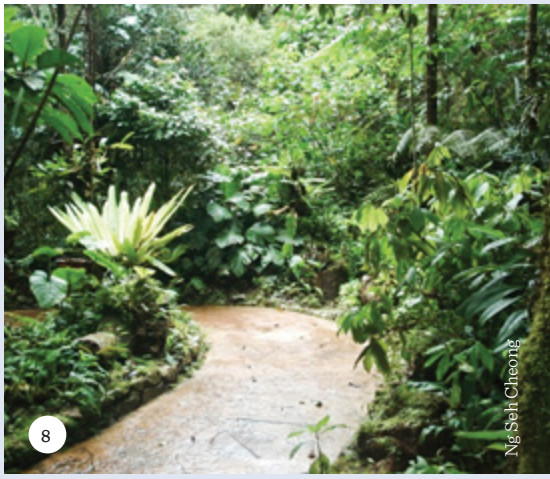
Malaysia. Visitors can systematically view lawns established for ginger, aroid/ yam, begonia, rhododendron, highland ornamental plants, wild terrestrial, and epiphytic orchids, montane herbs, bamboo, fern, palm, pitcher plant, rare and endemic orchid (house), and a welcoming lawn. Each lawn has its own star attraction awaiting discovery.

The ginger or Laman Halia features a number of interesting plants that thrive amidst the cool misty environment of the mountain. The main attraction of montane ginger is the *Geostachys*, a genus which is only found in highlands. The endemic *Geostachys* which was relocated from the original sites include *Geostachys megaphylla* from Gunung Brinchang, *G. rupestris* from Gunung Jerai and *G. penangensis* from Penang Hill. The splendid orange flower inflorescence of torch ginger, *Zingiber spectabile* never fails to attract attention. The inflorescence is often collected and sold by Orang Asli at the road shoulders from Ringlet downwards. The mountain ginger or *Hornstedtia* sp., is noticeable by the network of reddish stilt roots which prop up individual clumps. The aroid or Laman Keladi includes *Colocasia gigantea* or lambuk which stem is

1. **The garden trail began by showing the wild gigantic ginger *Etlingera coccinea***
2. **The magnificent ladies slipper orchid or *Paphiopedilum callosum*, native species to Gunung Jerai, Kedah**
3. **Buluh perindu or *Holttumochloa magica*, a native bamboo found at summit of Gunung Brinchang, the highest mountain in Cameron Highlands, Pahang**
4. **Lambuk or *Colocasia gigantea*, an edible gigantic yam**
5. **The rare wild orchid collection at CHiMP orchid house**
6. **Pergola structure with climbing orchid, *Vanilla kinabaluensis***
7. **Various begonia collection displayed at Laman Asam Batu**
8. **The 150 m pathway winding through the garden; user-friendly even to the disable**
9. **A new species of *Thrixspermum taianum* at CHiMP**





eaten raw by the Malays. Aroids can be differentiated among similar forest floor plants by the winged leaf stalk. Kelemoyang or *Homalomena* is another type of keladi used by Malay women in post-natal treatment.

Another not to be missed spot is the begonia or Laman Asam Batu. Attractive patterns and various shades of leaves adorn begonia which make the plant popular among horticulturists. The magnificent bluish green *Begonia pavonina* outshines other members with its unmistakable iridescent upper leaves that glow when shone with light at a certain angle. *Begonia decora* is a popular ornamental potted plant, while some other begonias have sour leaves which are eaten as salad by the Malay and Chinese. Several different begonia species hybridise easily and are expected to produce many hybrids from cross-breedings.

Rhododendrons are characteristic highland plants that prefer open areas. Several individuals planted at CHiMP are still under observation and need further horticultural intervention. The conspicuous *Cyathea contaminans* is a huge tree fern that grows naturally at CHiMP, while *Cibotium barometz* is a handsome tall fern with medicinal claims associated to its young shoot, which is locally known as 'ayam emas' due to its dense cover of light brown hair. It is sold at many places along the roadside leading to Cameron Highlands.

Amidst the foliage are splashes of colourful flowers, fruits and even pitchers that break the often green monotonous background of the garden. Colourful flora at CHiMP include the white-flowered senduduk gunung (*Medinilla pauciflora*), the striking purple flowers of *Ridleyandra morganii*, the bright yellow wild balsam (*Impatiens*), the pinkish and available all-year-round flowers of *Coelogyne xyrekes*, the reddish magenta coloured pitcher plant (*Nepenthes*) and the indigo fruits of siak-siak (*Dianella javanica*).

Orchids with their unique and attractive features remained as the garden highlight. The ladies slipper orchids (*Paphiopedilum callosum* and *P. barbatum*) are named for its pouch-like magenta coloured petals while *Corybas geminigibus* is a tiny rare orchid from Gunung Jerai, sized like a five sen coin. On rare occasions during its flowering season, the *Crytosia javanica* (a saprophyte orchid that obtains food from rotten wood) emerges from the ground. The jewel orchid, *Anoectochilus* sp., is sought after for its beautiful dark leaves with striking red veins. A new orchid species, *Thrixspermum taianum* was found in Cameron Highlands and now thriving at CHiMP orchid house.

The complete development of the garden will highlight CHiMP as a one-stop centre for montane ecosystem and biodiversity reference, to fulfil requirements for highland research and conservation; environmental education and awareness; and destination for recreation and ecotourism; particularly for Cameron Highlands and Peninsular Malaysia, in general.

ABOUT THE MAIN AUTHOR

Ida Suraini Abd Shukor began her career as an science editor in 1996 and became the *FRIM in Focus* editor and writer in 2007. She has written 49 full articles and overseen the publication of 35 issues of the Institute official newsletter. Several of her articles were reproduced in the Yellow Pages *Corporate Agriculture Directory* and *Buletin Rimbawan*. She holds a BSc in botany from Universiti Malaya and MBA in general management from International Islamic University Malaysia.

NYATUH TABAN MERAH (*PALAQUIUM GUTTA*)–

Is the Tree Adequately Known?
Apakah Pokok ini Dikenali Sepenuhnya?

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Existing stands at FRIM (left) and young saplings of *Palaquium gutta* at Skudai (right)

Nyatuh taban merah (*Palaquium gutta*) is a medium-sized timber tree, grouped under the Sapotaceae family and naturally found in the lowland mixed tropical forest. Its timber falls under the non-durable and light heavy hardwood category and when dried, is suitable for furniture manufacturing and decorative interior finishing such as panelling and partitioning.

Sap or latex is produced when nyatuh taban merah tree is tapped or cut. The natural whitish sap is a well-known source of gutta percha latex or *getah perca* in Malay. During the second half of the 20th century, gutta percha was used in domestic, industrial and dentistry purposes. It was used for insulation in underwater telegraph cables which performed better than rubber as insulator of heat and electricity. Gutta percha is an almost non-elastic material at room temperature that softens into a viscous fluid when heated exceeding 65°C. Since late 1800's, the latex is most common and widely-used material in dentistry for root canal filling.

As a main canopy tree, nyatuh taban merah grows naturally up to 40 m in height. The bark is reddish brown while the evergreen leaves are glossy green on the above, and yellow or glaucous underneath. It is widely distributed in Sumatra, Peninsular Malaysia, Java and Borneo. Considering the potential use of the latex, the species was planted rigorously beginning September 1927 at various locations within the Forest Research Institute (FRI). Field records showed the seedlings were originally prepared in bamboo pots at the nursery and field-planted in alternate rows alongside rain trees (*Samanea saman*) and in lalang (*Imperata cylindrica*) infested areas. The rain trees interfering with *P. gutta* trees were later felled and removed in 1933 and the vacant spaces were replanted with durian (*Durio zibethinus*). The planting site is now an uneven mixture of planted and newly regenerated trees which is kept as a long-term research site. An *ex situ* conservation effort to avoid further species loss is currently undertaken. A long-term reforestation programme between FRIM and Universiti Teknologi Malaysia (UTM), Skudai, Johor involves the selection and planting of nyatuh taban merah saplings.

Seedlings

White sap

Bole

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Dr Ahmad Zuhaidi Yahya is the Director of the Forestry Biotechnology Division, FRIM. He studied plantation forestry (growth and yield modelling) in Scotland, United Kingdom. His specialisation is in forest plantation silviculture, majoring in growth and yield modelling of selected tropical forest species. He has written several articles on silviculture of forest plantation, financial viability, tree growth and modelling, and afforestation.

POLYURETHANE FROM BIOMASS: A SUSTAINABLE ALTERNATIVE TO PETROLEUM

Poliuretana daripada Biojisim: Pilihan Mampan Menggantikan Petroleum

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Wan Sarah Samiun, Mohd Faizul Mohd Shukari, Siti Rafidah Mahmud & Rosnasuha Mohd Nasir

Wood liquefaction is widely-used to convert renewable resources such as wood and residual biomass into useful liquid substances such as bio-oil and polyol. A typical liquefaction process from biomass to polyol can be accomplished by using a suitable solvent system with acidic catalyst at temperatures ranging from 120–180°C. Polyol is further treated chemically to form the multiple usage polyurethane polymer.

Polyurethane is a highly useful and versatile product for polymer industries. The three main applications of polyurethane include usage as resin, coating and foam. Polyurethane resin is used to produce a multiple range of materials from ink to plastic. By processing into liquid and pouring into suitable moulds, polyurethane can be transformed into various products.

Petroleum or oil is the main source of raw material for polyurethane manufacturing. The instability of crude oil prices and limited production capacity have spurred high oil global demand. Since petroleum is a non-renewable resource, exhaustion of global resources has created a demand for alternative renewable resources which are both environmental-friendly and sustainable. Plant-based biomass or lignocellulosic resources were identified as alternatives for polymer industries due to the abundant and renewable nature, and ease of converting wood or plant parts to liquid.

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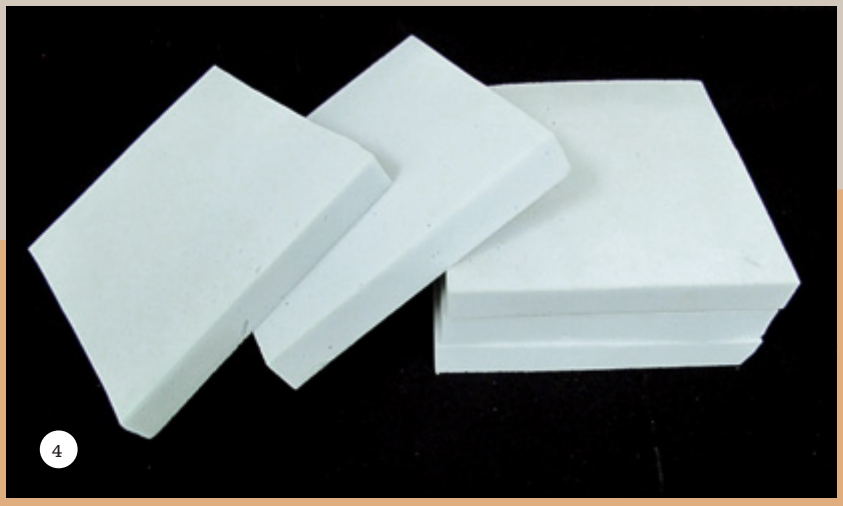

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Polyurethane coating which is commonly applied in various industries including wood (for furniture and flooring) has advantages including high gloss finish, abrasion resistance, anti-scratch and stable towards chemical exposure. Polyurethane coating cures faster at ambient temperature and has exceptional weathering performance characteristics, for example exposure to normal light, intense ultra-violet radiation and humidity.

Another value-added product from polyurethane is foam which is important in mattress and cushion manufacturing. As packaging material, polyurethane foam absorbs shock and protects fragile items during transportation and storage. Polyurethane foam is highly versatile, can be cut and easily moulded into end products of countless shapes and sizes.

With the availability of biomass-derived alternative materials, manufacturers no longer need to depend on non-renewable resources as their primary resource. Research initiatives by FRIM and university partners have produced renewable and environmental-friendly alternatives as opposed to conventional materials, as in the case of the polyurethane.

1. Plant-based biomass or lignocellulosic resource
2. Polyurethane as wood coating on sample (right) and finished product (left)
3. Polyurethane resin
4. Polyurethane foam slabs

ABOUT THE MAIN AUTHOR

Dr Mohd Khairun Anwar Uyup from FRIM Forest Products Division led the wood liquefaction research with students Wan Sarah Samiun from the Science Faculty, Universiti Putra Malaysia and Rosnasuha Mohd Nasir from Universiti Teknologi MARA Perlis. The team also includes Mohd Faizul Mohd Shukari and Siti Rafidah Mahmud from FRIM.

STANDARDISED EXTRACTS: EXPLOITING THE HERBAL CHEMICAL BLUEPRINT

Ekstrak Piawai: Mengeksploitasi Kandungan Kimia Herba

Asmar Hassan

Le Natura biscuits incorporating mengkudu or noni (*Morinda citrifolia*) extract

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Commercial herbal products are available in different forms such as bulk herbs, teas, tinctures, liquid and powder extracts, tablets and capsules. The herbal constituents of a particular product are mostly available in standardised strength or the guaranteed ingredient quantity as shown on the product label. The consumer usually assumes the standardised constituents are the active herb ingredients and getting more of the particular component is naturally preferred. To what extent is the concept correctly understood?

Whole herbs contain the entire plant constituents used for hundreds of years by many cultures. The chemical composition may vary depending on a variety of factors such as geography, climate, plant parts and species, agronomy, primary processing, post-harvest handling, extraction procedure, analytical methods and the manufacturing process for obtaining the final product. The term "standardised" herbal extracts (usually expressed in percentage) refers to the delivery of a consistent and measurable concentration of a single or several specific plant-based constituents. Standardisation of herbal extracts guarantees that chemical constituents (including the unknowns) are consistent in all batches. Standardisation requires the control of variables affecting the final quality of extract. The chemical constituents of the extract comprise active principles, natural vehicles or inert substances.

The standardised extract in normal practices is optimised according to two major considerations: the extract contains the major or preferably the entire active components of the original herb, and the efficacy reflects the original herb. Chemical analysis and bioassay are required to establish the chemical identity and quantify the bioactivity of the active component, rendering it unsuitable for herbs with unknown beneficial constituents. Chemical fingerprinting analysis is needed to uncover the multiple components and target nature of the herb to establish the authenticity and quality of the extract.

Standardised flavonoid extract (right) from *Chromolaena odorata* (left)

Standardisation may concentrate on a single component at the expense of other potentially important herbal constituents thus changing their natural balance. Nevertheless the efficacy of some concentrated extracts for specific biological actions was proven though they do not function exactly like the whole herbs.

Plants contain a complete blend of chemicals with the unique ability to address a multiplicity of problems simultaneously. The complete medicinal value of herbs on human is most likely due to interactions of different components rather than a specific component. Many constituents and chemical interactions in many herbs remain poorly understood. A second form of standardised herbal extract was developed using the main chemical components as markers of identity or consistency. The entire phytochemical content of the extract is concentrated to maintain the full spectrum components of the whole herb. The resulting standardised extracts guarantee a minimum level of potency without sacrificing other components and maintain the natural ratio of the constituents. The desired effects from a full spectrum extract may likely be attributed to the interaction between various chemical constituents.

Sxanct gold, premium standardised extract of *Ocimum sanctum*

Due to the complex standardisation process, a group of researchers from the Natural Products Division contributed a decade of research and development on more than 35 standardised extracts, focusing on primary and secondary metabolites. The first plant species attempted for primary metabolite was mengkudu or noni (*Morinda citrifolia*). The standardised polysaccharides from noni fruit has potential to reduce after meal blood sugar level. Research continued with the development of standardised polysaccharide from star fruit (*Averrhoa carambola*) that could potentially reduce blood cholesterol level. A nano-sized drug carrier was later developed from mature seeds of petai belalang (*Leucaena leucocephala*). An ergogenic polysaccharide extract was derived from the roots of tongkat ali (*Eurycoma longifolia*).

A significant output on secondary metabolites was the standardised extract of patawali (*Tinospora crispa*) with an antihypercholesterolemic claim verified by an international testing laboratory which complies with the OECD principles of good laboratory practice. Pokok kapal terbang (*Chromolaena odorata*), a roadside remedy plant contributed a standardised flavonoid content of 15% quercetin equivalent, showed anti-MRSA and wound healing activities. Another 12 standardised antioxidant extracts exceeding 70% antioxidant activity level were established and licensed to commercial entities for product development.

Standardised extracts are needed for modern herbal preparations although herbs in other forms contribute some of their best usages. Thousands of medicinal herbs are grown worldwide and most may never be standardised due to the unknown complex chemical compositions and synergistic relationship. The choice between whole herbs and standardised extracts finally lies on the individual preference and requirement.

ABOUT THE MAIN AUTHOR

Dr Ling Sui Kiong is a senior research officer at the Phytochemistry Programme, Natural Products Division, FRIM. She holds a PhD in pharmaceutical sciences from Nagasaki University. Her research specialisation is natural products chemistry mainly on isolation, identification and fingerprinting.

IS KELEMPAYAN SUITABLE FOR COMMERCIAL FOREST PLANTATION?

Sesuaikah kelempayan sebagai pokok hutan ladang komersial?

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Nine year-old stands at Sandakan (above) and four year-old stands at Bukit Lagong, FRIM (below)

Kelempayan (*Neolamarckia cadamba*) is listed as a plantation species and commercially planted mainly in Sabah and Sarawak including some trial plantings in Peninsular Malaysia under the Forest Plantation Development Programme. Kelempayan plantations cover a total area of 21,762 ha since the programme was implemented in 2007. Sarawak has the largest planted area in addition to trial plantings in Sandakan and some small areas in Setul, Negeri Sembilan and Bukit Lagong Forest Reserve, Selangor. Field performance of the tree is under question for reasons including its domestication from the natural forest and sustainability of plantings according to sizes and ages.

Kelempayan is a pioneer tree with a wide geographical and ecological range of between latitudes 27°N and 9°S, from India and Nepal, through Myanmar, Thailand and Indo-China, and eastwards towards Peninsular Malaysia, and the islands of Borneo, Java and Papua New Guinea. It is known as kelempayan in Peninsular Malaysia, laran in Sabah, jabon in Kalimantan and kadam in India. The tree grows naturally in moist and warm deciduous and evergreen forests types in areas below 1300 m altitude with annual rainfall of 1500–3000 mm. Kelempayan is a light demanding tree that grows on a variety of soils and performs best on deep, moist alluvial ground, along rivers and swampy areas. The trial plantings in Sandakan and Bukit Lagong (Field 48, FRIM) show potential where results are based on the principle of species-site matching.

Kelempayan stands showed encouraging growth results after nine and four years of planting. The average diameter at breast height (DBH) was 26.6 and 14.0 cm with an annual growth of 2.9 and 3.5 cm. Both plantations were established along an alluvial plain in a low and high density regime of 324 and 1600 stems ha^{-1} with an average stand volume of 115.37 (86.40–131.62) and 110.35 m^3 ha^{-1}. The stand achieved the desired growth rate of 95% survival rate and justified management for saw or peeler logs with an average annual production of 12.81 and 27.58 m^3 ha^{-1} after nine and four years respectively. The stands in

Stand and stock table of the nine- and four-year-old kelempayan in Sandakan and Bukit Lagong Forest Reserve

Site	Age (years)	N	Av. DBH	Ht (m)	V (m^3 ha^{-1})	MAIv (m^3 ha^{-1} y^{-1})	MAIdbh (cm y^{-1})	Ele. (m)	Sur. %
Sandakan	9	324	26.6	20.23	115.37	12.81	2.9	25-40	95
Bukit Lagong	4	1600	14.0	9.76	110.35	27.58	3.5	105-123	95

Stands of *N. cadamba* at two locations of Setul Forest Reserve experiencing seasonal water stress

Stand and stock table for five-year-old kelempayan in Setul Forest Reserve

Site	Age (years)	N	Av. DBH	MAIdbh (cm)	Ht (m)	V (m^3 ha^{-1})	MAIv (m^3 ha^{-1} y^{-1})	Ele. (m)	Sur. %
Setul	5	800	11.0	2.2	8.75	46.67	9.33	145-183	78.8

Bukit Lagong provide comparison for high planting density regime.

The stands at Bukit Lagong Forest Reserve achieved 14.0 cm in DBH with a yearly growth rate of 3.5 cm after four years of planting. Although planted on elevated grounds, the stands are located along alluvial plain of a river which is suited for tree growth. The average stand volume after four years was 110.35 m^3 ha^{-1} and equivalent to an annual yield of 27.58 m^3 ha^{-1}.

The trial plantings at Setul Forest Reserve, Negeri Sembilan were established on varying topographical sites thus showed variable results.

Subsequently, the stands at Setul Forest Reserve achieved a diameter growth from 9.2–13.5 cm with an average annual diameter increment of 2.2 cm. The stands showed the lowest growth rate due to unfavourable conditions such as topographical and constant water or moisture stress, particularly for trees at higher elevations of 145–183 m above sea level. The stands were established along gentle slopes and far from available water sources or alluvial plain. After five years, the average stand volume was 46.67 (26.05–80.49) m^3 ha^{-1} or 9.33 m^3 ha^{-1} annually. The survival rate after five years was 78.8 percent.

Commercial kelempayan planting initiated in 2006 at Kanowit, Sarawak failed to meet target growth after four years due to high elevation. The stands were subsequently phased out and replaced by other species such as *Paraserianthes falcataria* and *Acacia* sp. However, some trees at Bukit Lagong faced the opposite situation where continuous and excess water led to physical growth disadvantage and uprooted trees, due to poorly developed root system. It is crucial that prior to the decision to invest on large scale planting, proposed sites are evaluated for its suitability and balance between high moisture regime and availability of water.

Uprooted tree (above) due to poorly developed root system in excess water-logged areas (below)

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Dr Ahmad Zuhaidi Yahya is the Director of the Forestry Biotechnology Division, FRIM. He studied plantation forestry (growth and yield modelling) in Scotland, United Kingdom. His specialisation is in forest plantation silviculture, majoring in growth and yield modelling of selected tropical forest species. He has written several articles on silviculture of forest plantation, financial viability, tree growth and modelling, and afforestation.

SISTEM RANGKAIAN MENGHUBUNGKAN WARGA FRIM

Network System Connects FRIM Staff

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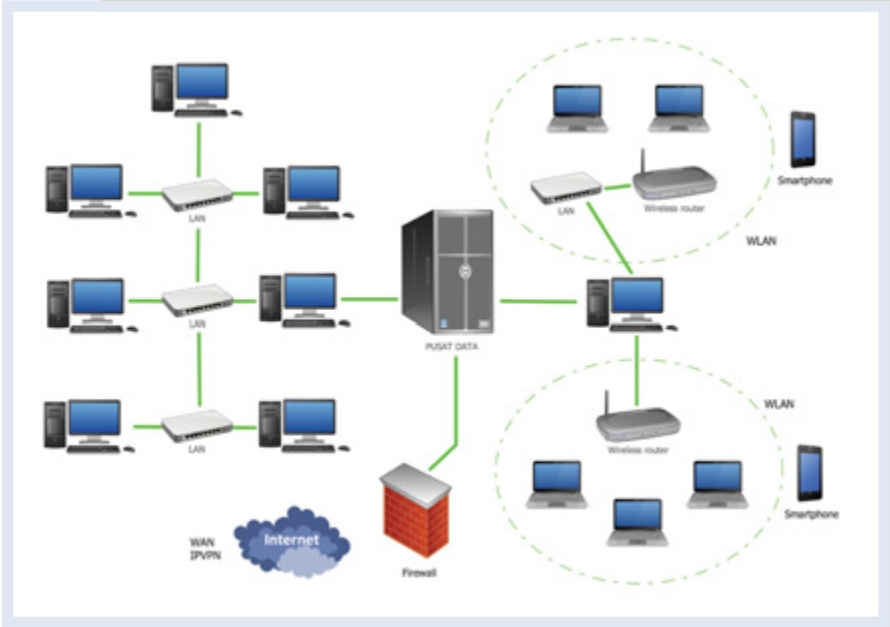
Berada dalam era digital menyaksikan faktor jarak dan masa tidak lagi menjadi penghalang kepada capaian maklumat. Perkongsian maklumat yang pantas direalisasi melalui sistem rangkaian komputer dengan adanya pelbagai alat komunikasi yang saling berhubung secara rangkaian setempat (LAN) atau menggunakan rangkaian antarabangsa (internet). Internet atau singkatan kepada *international network* ialah sistem rangkaian komputer terbesar yang menghubungkan seluruh dunia. Saluran komunikasi ini disambung menggunakan pelbagai medium penghantaran elektronik yang berbeza keupayaannya iaitu kabel wayar tembaga, kabel gentian optik, gelombang radio dan infra merah. Sistem rangkaian komputer memudahkan perkongsian, penyebaran serta pencarian maklumat; membenarkan perkongsian perkakasan dan perisian; dan menyediakan pelbagai saluran komunikasi seperti e-mel, Facebook dan Skype dan sebilangan aplikasi lain yang berkaitan.

Peningkatan kelajuan sistem rangkaian FRIM mengikut tahun dan pembekal perkhidmatan internet (ISP)

Kadar kelajuan	Tahun ditingkatkan	ISP
64 Kbps	1994	Jaring/Telekom
128 Kbps	1997	Jaring/Telekom
1 Mbps	2001	Jaring/Telekom
2 Mbps	2003	Jaring/Telekom
(2 Mbps x 2) 4 Mbps	2007	GITN (1Gov*Net)
(4 Mbps x 2) 8 Mbps	16/12/2010	GITN (1Gov*Net)
16 Mbps	31/11/2012	GITN (1Gov*Net)
20 Mbps	14/12/2012	GITN (1Gov*Net)
30 Mbps	29/12/2014	GITN (1Gov*Net)

Sistem rangkaian komputer terbina daripada sebilangan komputer, pencetak, pelayan dan peranti yang dihubungkan oleh saluran komunikasi berwayar atau tanpa wayar. Setiap peranti yang disambungkan kepada rangkaian dikenali sebagai nod, di mana bilangannya boleh mencapai sehingga berjuta-juta. Sistem rangkaian mampu menghubungkan pengguna dalam sesebuah bangunan atau di sebilangan lokasi yang berlainan. Internet ialah perkongsian sumber rangkaian dengan sokongan pengkalan data yang terdapat di seluruh dunia dan merupakan matlamat utama penubuhan sistem rangkaian komputer.

Sistem rangkaian komputer FRIM dibangunkan pada tahun 1994 dan terus berkembang sehingga kini. Perkembangan ini dibantu oleh perubahan teknologi dari segi kepantasan capaian talian internet secara talian khusus (dedicated line). Sistem rangkaian kawasan luas atau WAN (wide area network) di Malaysia bermula pada 1992 dan diterajui oleh MIMOS. Kewujudan sistem internet memberi peluang perniagaan kepada syarikat pembekal perkhidmatan telekomunikasi contohnya Telekom Malaysia, Celcom, Digi dan Maxis. Pada peringkat awal kewujudan sistem rangkaian FRIM, talian internet yang dibekalkan berkelajuan 64Kbps. Sehingga 2014, sebanyak lapan kali peningkatan talian internet FRIM telah dilaksana bagi menyokong pertambahan bilangan kakitangan, komputer dan aplikasi sesawang. Internet yang dinaik taraf telah mempercepatkan aktiviti memuat naik, memuat turun dan mencari bahan rujukan daripada laman sesawang.



Infrastruktur sistem rangkaian

Kecekapan internet bergantung kepada unit kelajuan pemindahan data iaitu bit per saat. Sistem rangkaian FRIM telah melalui beberapa fasa peningkatan kelajuan mengikut tahun dan perubahan pembekal perkhidmatan internet (ISP).

Penggunaan sistem rangkaian menghasilkan implikasi terhadap warga FRIM. Sistem rangkaian komputer membantu penyelidik FRIM menghasilkan penulisan penyelidikan dengan menyediakan bahan rujukan dengan pantas daripada sumber dalaman mahupun luar negara. Jaringan antarabangsa menyediakan platform bagi aplikasi carian internet seperti Google, Google Scholar, Science Direct dan Mendeley. Pelbagai sistem dalaman juga diwujudkan untuk kemudahan urusan menerusi talian bagi penjawat awam FRIM seperti sistem pentadbiran, kewangan dan sumber manusia. Sistem berkenaan boleh dilayari secara setempat, menerusi paparan utama intranet iaitu di laman Infocenter FRIM. Sistem popular yang sering dilayari oleh penjawat awam FRIM ialah sistem tuntutan perjalanan (TNT), tuntutan lebih masa (OT), sistem cuti, Adunet, MyProcurement, latihan, MyMesyuarat dan prestasi. Beberapa sistem aplikasi penyelidikan seperti RIMS, MyERNET dan e-compendium turut dibangunkan bagi menyokong aktiviti penyelidikan. Portal FRIM di www.frim.gov.my diwujudkan untuk memberi dan menyebar maklumat tentang aktiviti yang dijalankan di FRIM secara lebih meluas. Penyampaian maklumat ini memberikan impak khususnya dari segi menonjolkan FRIM sebagai institusi penyelidikan perhutanan tropika ke seluruh dunia. Capaian maklumat, seperti berada di hujung jari, menjadikan sistem rangkaian komputer sangat diperlukan khususnya oleh warga FRIM dan amnya oleh semua lapisan masyarakat.

TENTANG PENULIS

Nurul Hilal Ahmad Tarmidzi mula berkhidmat di FRIM pada 1991 sebagai juruteknik elektronik dan kini bertugas sebagai pegawai penyelidik sejak 2008. Beliau terlibat dalam permulaan sistem rangkaian komputer di FRIM pada tahun 1994. Beliau memperoleh ijazah sarjana muda dalam bidang sains teknologi maklumat pada tahun 2006 daripada UniSel dan sarjana dalam bidang kejuruteraan komunikasi dan komputer daripada UKM pada tahun 2014.

PENYELIDIK RAIH DUA PINGAT GANGSA DI PHARMA+BIO ASIA 2015

Scientists Acquire Two Bronze Medals at Pharma+Bio Asia 2015

Rosdi Mohamad

Pemenang anugerah bio-inovasi daripada FRIM

4 September 2015— FRIM meraih anugerah gangsa bagi dua penyertaan anugerah bio-inovasi sempena pameran Pharma+Bio Asia 2015 yang berlangsung di Pusat Konvensyen Kuala Lumpur pada 2–4 September 2015. Dua penyertaan ialah "Ekstrak kaya antioksidan daripada bahan buangan pertanian: *Sandoricum koetjape* (buah sentul) bagi penghasilan produk makanan berfungsi" oleh Shalini Markandan dan Siti Humeirah Abd Ghani dan "Penyambung kekuda modular pada galang bagi rasuk-I jambatan kayu" oleh Rizuwan Mamat.

Yusni Idris

Ketua Setiausaha NRE (tengah) menyampaikan sijil kepada Ketua Pengarah FRIM (kiri)

Sijil dan piala AKRAB Inovatif NRE

FRIM TERIMA ANUGERAH AKRAB INOVATIF

FRIM Receives AKRAB Innovative Award

2 September 2015— FRIM menerima anugerah rakan pembimbing perkhidmatan awam (AKRAB) kategori organisasi iaitu AKRAB Inovatif NRE yang disampaikan oleh Dato' Azizan Ahmad, Ketua Setiausaha NRE kepada Dato' Dr Abd Latif Mohmod, Ketua Pengarah FRIM. AKRAB berperanan sebagai agen transformasi perkhidmatan awam yang memberi motivasi serta menjadi pembimbing kehidupan berkerjaya bagi penjawat awam.

MAKMAL FARMAKOGNOSI TERIMA ANUGERAH CEMERLANG RAKAN BIONEXUS

Pharmacognosy Lab Receives BioNexus Partners Excellence Award

18 Ogos 2015—Makmal Farmakognosi FRIM memenangi anugerah cemerlang rakan BioNexus (BNP) bagi kategori kolaborasi paling tinggi. Anugerah disampaikan oleh Datuk Madius Tangau, Menteri MOSTI kepada Dr Nik Musaadah Mustapha, pegawai penyelidik kanan dari Bahagian Hasilan Semula Jadi ketika Malam Penghargaan Bio 2015. Majlis dianjurkan oleh Perbadanan Bioteknologi Malaysia (MBC) bagi mengiktiraf para pereka cipta. Makmal Farmakognosi yang mendapat status BNP pada 2011 menggabungkan perkhidmatan teknikal antara Makmal Biologi dan Program Fitokimia.

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1. Barisan penerima anugerah
2. Dr Nik Musaadah Mustapha (kiri), pegawai penyelidik kanan dan Dr Rasadah Mat Ali (kanan), Pengarah Bahagian Hasilan Semula Jadi