AUGUST 2022 | VOLUME NO :IV

# PLANTA

MAGAZINE

## Cover story:

***Diospyros pemadasai***

A new species, *Diospyros pemadasai* has been named in honour of Late Professor MA Pemadasa, Dept. of Botany, University of Ruhuna, Sri Lanka. (Jayasuriya, 1998)

Botanical Society

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Botanical Society,
University Of Ruhuna

When sun rays are too
harsh to bear,
Tree shade is what's
sought,
Still!!! Why nature is
devastated
Embrace Nature;
Try to harmonize with
the rhythm;
Trust me!!
Your song of "Life" will
take a different taste

-By Nimnadie De Silva-

WE WISH TO DEDICATE THIS "PLANTA" MAGAZINE; ISSUED TO COMMEMORATE THE 25TH DEATH ANNIVERSARY OF OUR FOUNDER OF THE DEPARTMENT OF BOTANY,

**PROFESSOR ALAWATHTHAGODA PEMADASA**

# Editor's Note

This PLANTA magazine has not been published since 2001. Therefore, after long taciturnity, with new committee members of the PLANTA magazine, we have been able to publish this magazine giving it a new face. As a tradition, earlier the magazine was published by collecting articles, poems or drawings, etc., mainly from students.

However, by contravention of this tradition, this time, being the senior editor of PLANTA magazine, I thought to collect articles not only from the students and staff members of the department but also from well-recognized people who have contributed particularly a lot to the field of plant science.

Moreover, I was able to get articles from our alumni members who are in good positions in their respective careers. One of the objectives of changing the tradition is to disseminate knowledge from different angles to the readers in a broader perspective. By making such a collective effort, we can identify students who have different soft skills and we will be able to guide them to improve their capabilities. I take this opportunity to thank all persons who gave the articles, poems or drawings, etc.

Finally, I greatly appreciate the committee members for your fullest support, untiring effort, devotion, and commitment to making this event a success.

Senior Prof. (Mrs.) Pushpa Damayanthi Abeysinghe
Dept. of Botany
Faculty of Science
University of Ruhuna
July 10, 2022

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# Our sincere thanks to

- Senior Professor P.D Abeysinghe for providing us tremendous support as the senior editor of Botanical Society, University of Ruhuna
- Board of officers, Botanical Society, and the University of Ruhuna for guiding us in every possible way.
- All the lecturers in the Department of Botany, the University of Ruhuna, for furnishing us with knowledge and advice
- All who contributed to the magazine by providing creative and informative content
- All the students in the Botanical Society who supported us at every stage of the process
- To all who read the magazine and gained knowledge

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# Mother of Botany Janaki Ammal

*Written by :P.H. Akshika Sewwandi*
*Sc/2018/10424*

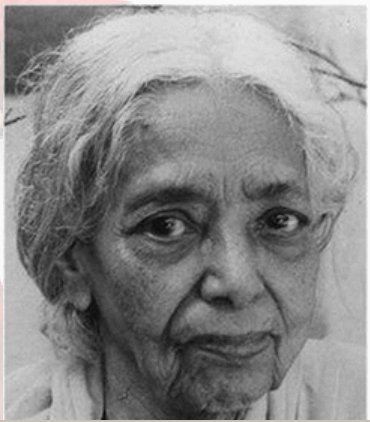
Janaki Ammal Edathil Kakkat was an Indian botanist. She was born in Thalassery, Kerala in 1897. Her Father Diwan Bahadur Edavalath Kakkat Krishan was sub-judged in the subordinate court system in Thalassery. Her mother, Devi was the illegitimate daughter of John Child Hannyogtton. Janaki had six brothers and five sisters. All girls in her family had to engage in intellectual pursuit and in the fine arts. But Janaki had another choice. She decided to study botany.

After her primary schooling at Sacred Heart Convent in Thalassery, she went to Queen Mary's College in Madras. Janaki obtained her bachelor's degree from Queen Mary's College and then an Honors degree in botany from Presidency College in 1921. Then she went to the University of Michigan, and she focused on Cytology. She specialized in breeding interspecific hybrids and intergenic hybrids. In 1925 Janaki obtained her master's degree, and in 1931 she obtained her Ph. D. from the University of Michigan. She was the first Indian woman who receives a degree in botany in the U.S. Then, she worked as a Professor in Maharaja's College of Science at Trivandrum.

In 1939 Janaki went to attend the 7th International Congress of Genetics, Edinburgh, and she had to stay there because of the second world war. There she worked for C.D. Darlington as an assistant cytologist, and they published together "Chromosome Atlas of Cultivated Plants" in 1945. She was invited to work as a cytologist at the Royal Horticultural Society. Janaki was the first salaried woman in the Royal Horticultural Society.

Magnolia Kobus 'Janaki ammal' was her investigation of magnolia shrub with flowers of bright white petals and purple stamens. She was a good researcher, and she published many articles. Janaki had created a new variety of sugarcane that give a high yield in the conditions in India. She created it working at the sugarcane breeding station. She had also worked with genera Solanum, Datura, Mentha, and some medicinal plants.

Janaki was awarded Padma Sri by the Indian government in 1977 for her service in botany in India. Sonerlia janakina is a species of plant, and Dravidogecko janakiae is a species of gecko in India named in honor of her.



Janaki Ammal

“The wilderness holds answers to questions man has not yet learned to ask." – Nancy Newhall-

Hand drawing by :S. K. H. Sandarenu
Sc/2020/11172

# Plants have feelings too

Do plants have feelings too?
Nah, they don't, bother to be not,
The central nervous system they lost,
Leave'em no touch, no taste at any cost
Yet, the big question remains unchanged,
for a plant gives life to all its breed.

Do they ever say 'Feed me Monsieur'?
or demand reasons that thee exist longer
Being busy making food instead,
keeping in mind there's a world to be fed.
The question is haunting, still unsolved,
that the plants ever rest out of lassitude?

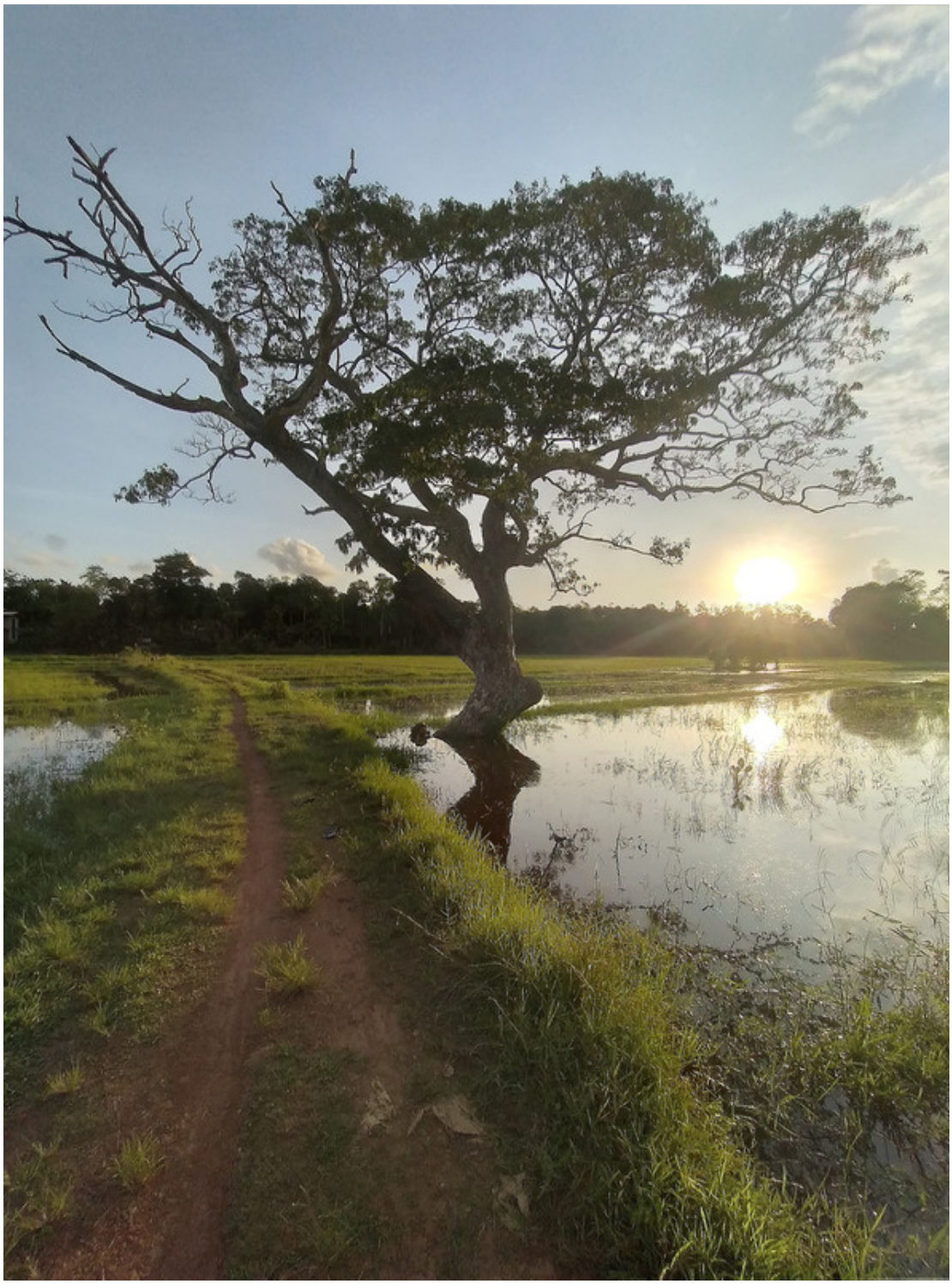
Do plants grumble and ever complain
of their offspring being destroyed?
Thousands and thousands of acres of vegetation,
dashing to the hands of fierce annihilation
Yet they do their job right,
nourish us all, and hold us tight

Do they ever fight to yearn for the right?
Instead, leisurely grow high,
seeking the sky bearing wind and rain and fire,
helping us all to grow and reach higher

Busted! Plants have feelings too
Only should be an homage to the unsung hero.

Written by: Sethmi Thisarani
Sc/2019/10980

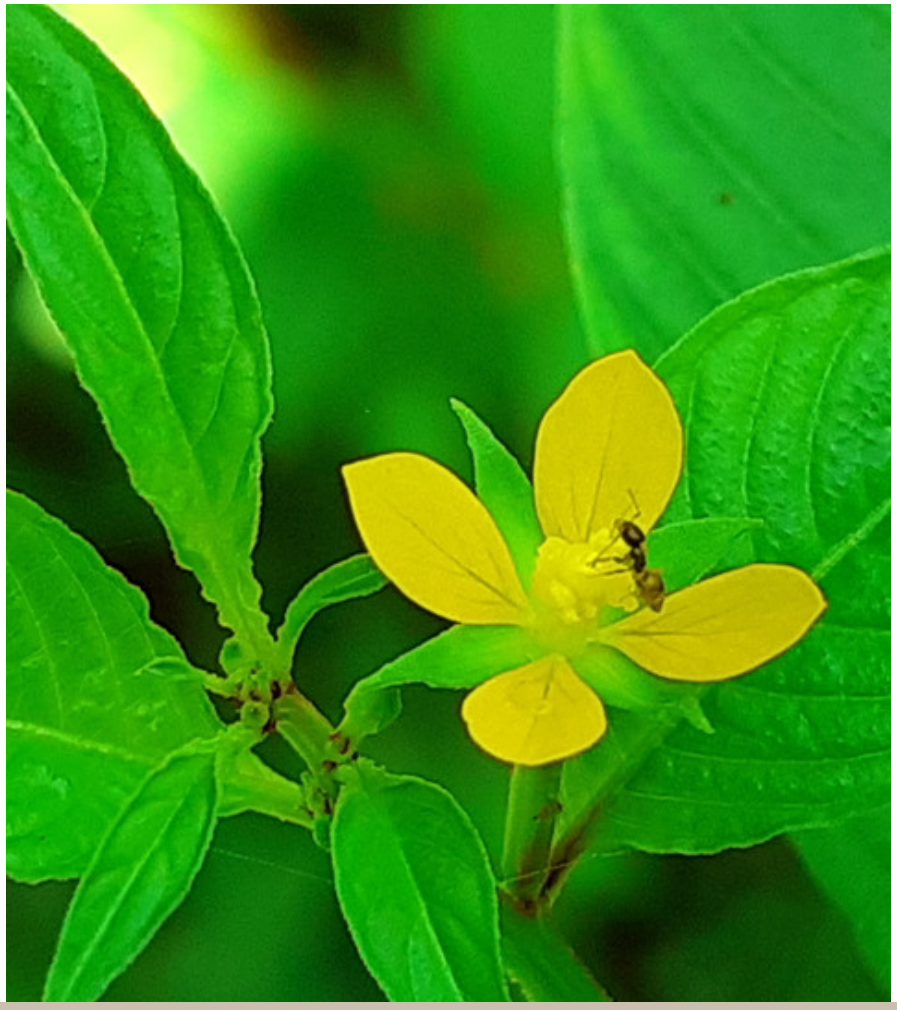
# A LOVELY EVENING AT SUNSET



Captured by : K. G. Sanoli Udara Gamage
Sc/2020/11238

-A bunch of orange Jasmine that fills the air with its sweet smell-

Captured by :
Shenolie Onela Weerasighe
Sc/2020/11195



-More to see than meets the eye-

Captured by :
W. K. K .G. Wickramarathna
Sc/2018/10346

# A new endemic Nelu (*Strobilanthes*) species discovered in Sri Lanka

A new species of *Strobilanthes*, the first record by a Sri Lankan author, was described based on morphological and molecular data from Sri Lanka in 2021. It was named "*Strobilanthes medahinnensis Nilanthi*" because it was first recorded from Medahinna, Sripadaya (Peak Wilderness) Nature Reserve in Sri Lanka.

The Genus *Strobilanthes* belongs to the family Acanthaceae, first described by Blume in 1826 from specimens collected in West Java, which is one of the largest genera in Sri Lanka and most interesting for its diversified habits, gregarious occurrence and infrequent flowering but elegant, coupled with a narrow distribution of species. The name *Strobilanthes* is derived from the Latin words "strobilus" meaning cone, and "anthos" meaning flower or shoot. While approximately 450 *Strobilanthes* species are mainly distributed throughout tropical Asia and with this new discovery, Sri Lanka consists of 33 species, and out of them, 27 species are endemic. *Strobilanthes* is known as "Nelu" in Sinhalese, and shrubs of the genus *Stroblilanthes* dominate the montane forest understory in Sri Lanka.

There are 14 *Strobilanthes* species included in Fauna and Flora Protection Ordinance (FFPO). According to the Red List of 2020, S. caudata is listed as Extinct, while S. *hypericoides* is listed as Critically Endangered 'Possibly Extinct.' Eight are listed as Critically Endangered, while eight each are listed as Endangered and Vulnerable, respectively.

The life cycle of *Strobilanthes* is very interesting. Most plants take about 8-12 years to grow from a seedling to a mature flowering stage. It flowers only once in its lifetime, sets seeds, and then dies. Since *Strobilanthes* dominates the understory, the forest takes on a spectacular appearance of bluish mauve when it is in gregarious bloom. *Strobilanthes* fruits rupture with a loud noise at the time they shed their seeds. Very soon, these seeds germinated, and seedlings of the next generation of Nelu were seen on the forest floor. These seedlings grow very close to each other, and for a few years, the forest floor takes on the appearance of a green carpet, but when the seedlings become treelets, the forest interior is very difficult to penetrate. It has established thick undergrowth while becoming the dominant member of it.

Finally, after some years the mature *Strobilenthes* will flower and then set seed, and this cycle of changes will be repeated.

After the blooming, the old *Strobilanthes* trees die by disseminating the seeds over the plain, and dried Nelu branches fall on the forest ground. Meantime, other plants species such as Coleus spp. and Impatiens spp. grow in the undergrowth and complete their lifespan. Since *Strobilanthes* flowers bloom only once in their lifespan these trees die subsequently, thereby making opportunities for the young plants of "Damba" (*Syzygium rotundifolium*), "Keena" (*Calophyllum walkeri*) and "Mihiriya" (*Polyspora ceylanica*) which constitute the undergrowth of the forests to grow high, due to the disturbance caused to the permanent undergrowth with the sudden baring of the forest lands without undergrowth vegetation.

*Strobilanthes* species were recorded in a very wide range of different habitats such as dense aggregations along steep rocky slopes, along margins of grasslands, dense aggregations along slopes at lower altitudes, in plains, thick rainforest undergrowth, shaded places in ravines, open rocky cliffs, on the exposed rocks, along stream banks, evergreen forest margins, primary forests, scrambling shrub growing through other plants, moist rocks along streams. Nelu species grow from 100 m up to 2800 m.

Lowland wet zone, Dry zone, Intermediate zone, Montane and submontane zones but the collection localities for the new Nelu species is restricted to an undisturbed evergreen rain forest at a high altitude below 1500 m in a wet zone.

Most Nelu species have anti-inflammatory, antimicrobial, antidiabetic, and anticancer and wound healing properties. Extract of some species of *Strobilanthes* has been commonly used to treat infections by a respiratory virus, such as influenza viruses, hepatitis B virus, mumps virus, and severe acute respiratory syndrome (SARS), coronavirus and are used in spider poisoning, snake bites, cerebrospinal meningitis, viral pneumonia etc. Leaf extraction of these species is generally used for the production of indigo dyes.

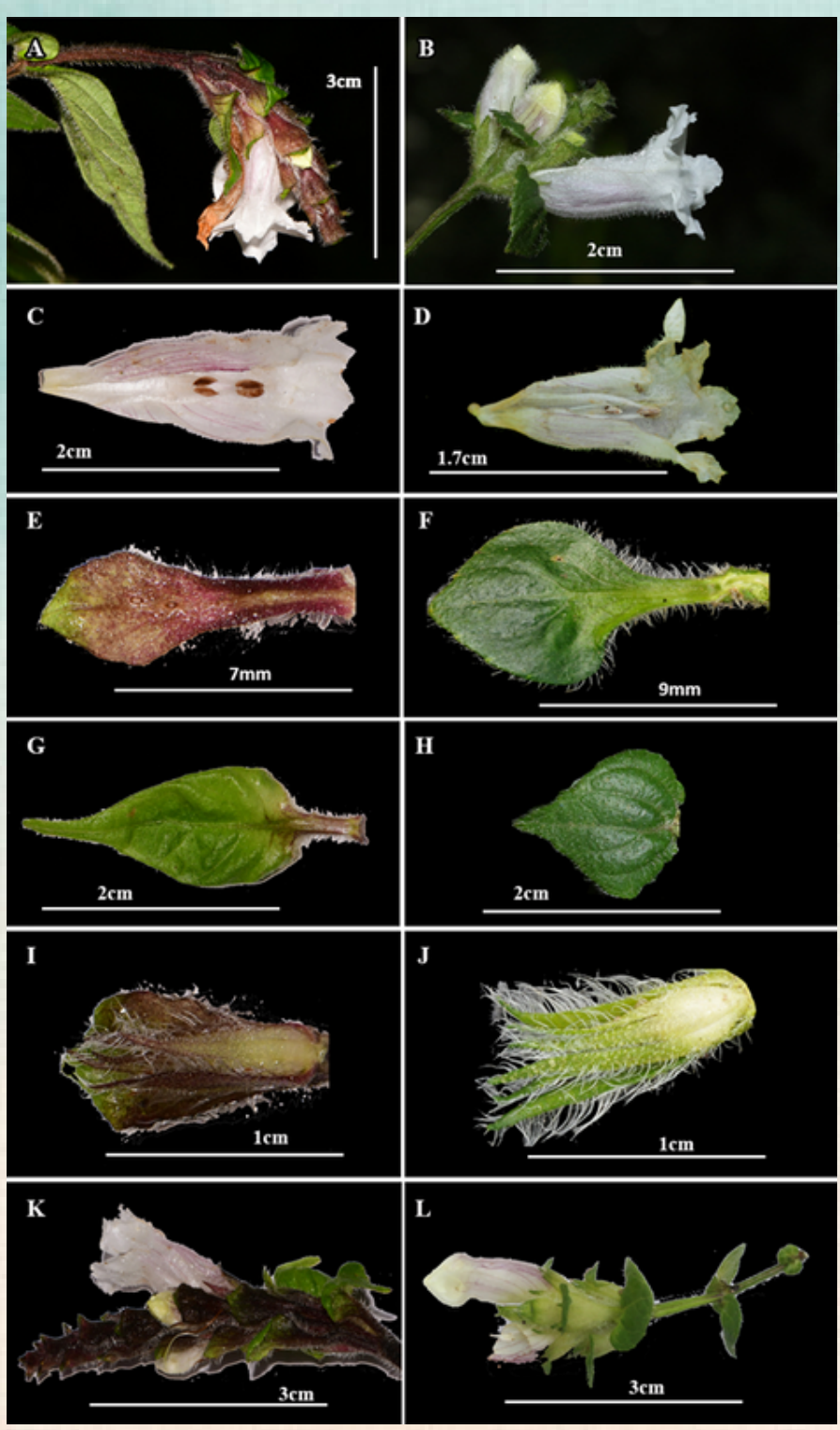
During the plant explorations at Peak Wilderness Nature Reserve, on the 1st of September 2015, we found an interesting *Strobilanthes* population at Medahinna at 1430 m elevation, consisting of about 25 individuals, growing in the shade and along the nature trail. Although the population was not flowering at that time, this appeared distinct in leaf characters of its morphologically closest ally *S. anceps Nees*. The Research Group includes Nilanthi Rajapakse, Nuwan Jayawardena from the Department of Wildlife Conservation, Prof. Siril Wijesundara from the National Institute of Fundamental Studies,

and Prof. Pradeepa Bandaranayake and Hiruna Samarakoon from the University of Peradeniya. We conducted extensive plant explorations across the entire distribution range of *Strobilanthes* in Sri Lanka covering 21 administrative districts from January 2012 to September 2020.

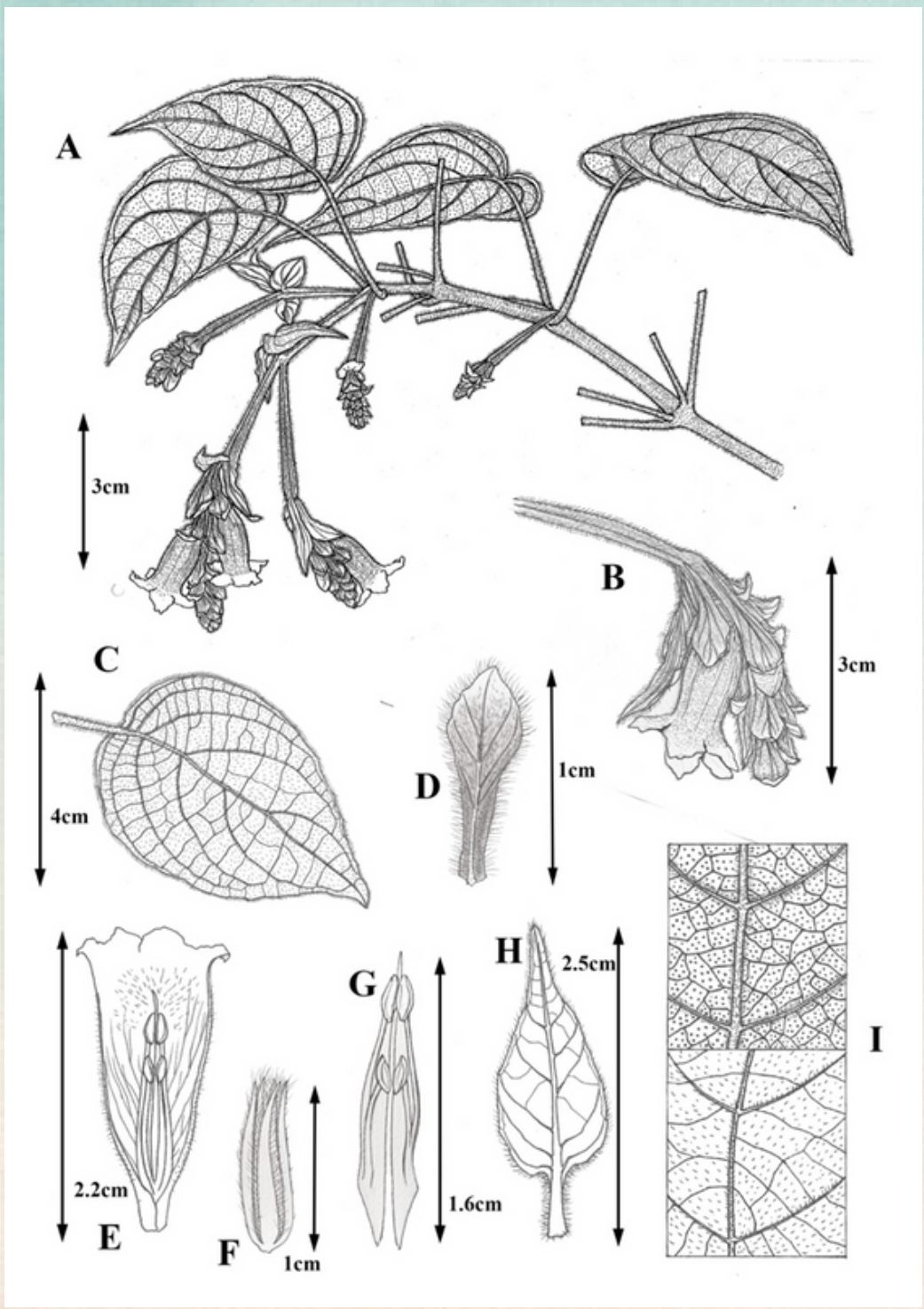
However, this new plant was not found in any other location except Medahinna and we visited Medahinna several times to study this population since 2015. Finally, on 29th June 2020, we could observe flowers in the population at Medahinna. After a closer examination of the specimens and critical study of the literature, comparison of the specimens at National Herbarium, Royal Botanic Gardens, Peradeniya (PDA), and online herbaria, we found that it is different from all known species of *Strobilanthes* in the world. In addition to the preparations of a distribution map, superlative photographs, and meticulously illustrated line drawings, the complete chloroplast genomes of this interesting material and *S. anceps* were also analyzed. According to morphological and molecular evidence, it could not be assigned to any previously published species; hence it is described as a new species.

The new species is somewhat similar to S. anceps but differs by shrubs with less branched (not much branched), rounded stem (not quadrangular), leaves with acuminate apex (not long acuminate or caudate), elongated spikes (not short spikes), lanceolate outermost bracts (not ovate), outermost bract with long acuminate apex (not acute), outermost bract with a long purplish-brown stalk (not short green stalk), inner bract with the purplish-brown outer surface (not green outer surface), androecium with glabrous filaments (not pubescent filaments), dark brown anther thecae (not white anther thecae), glabrous style (not hairy style), glabrous ovary (not hairy ovary).

*Strobilanthes medahinnensis* Nilanthi




Diagnostic morphological characters of *S. medahinnensis* from *S. anceps*. *S. medahinnensis*—A. side of the corolla, C. half flower, e. inner bract, g. outermost bract I. calyx, K. inflorescence. S. anceps—B. side of the corolla, D. half flower, F. inner bract, H. outermost bract. J. calyx, L. inflorescence




*Strobilanthes medahinnensis*. A. Flowering branch; B. Inflorescence; C. Leaf D. Inner bract; E: Half flower; F. Calyx; G. Stamens; H. Outermost bract; I. Close up of the leaf surfaces adaxial and abaxial (Drawn by Rukmal Ratnayake).

Here complete chloroplasts were sequenced for both new species and closely related species. The chloroplast region, atpB-rbcL could be a DNA barcode for the differentiation of *S. medahinnensis* from its close relative *S. anceps*. The divergence time of *S. medahninnensis* and S. anceps was determined by using a fossil evidence-based speciation event between Arabidopsis thaliana and *A. lyrata*. Based on the divergence time, the speciation between *S. medahinnensis* and *S. anceps* happened about 0.33 million years ago (Mya). This is the first record from Sri Lanka when describing new plant species by the use of a complete chloroplast sequence and divergent time analysis.

Urbanization, cultivation, tourism activities, fire, overgrazing, pollution, road, and dam constructions are major threats to Nelu. Therefore, we must protect these economically important and valuable Nelu plants for tomorrow.

Written by:
R. M. R. Nilanthi Rajapakse
(98/99 Batch (UoR)
Research Officer/Chief Editor of WILDLANKA
Department of Wildlife Conservation, Sri Lanka


Designed by : K. K. Pramudi Amanda
Sc/2020/11284

# Hidden NANO In Flowers

Nature is full of miracles. Sometimes scientific eyes either cannot observe such mystery hidden among them. Flowers; are one of the most eye-catching creations in nature. Have you ever thought that there are hidden mysteries in these amazing creations which are not sensitive to naked eyes?

Have you ever wondered why some flowers can shine with metallic, iridescent colors- but there is no paint that lets them depict these dynamic colors directly?

Tobius Wenzel & Silvia Vignolini reveal an ingenious strategy that flowers use to become colored & attract pollinators.

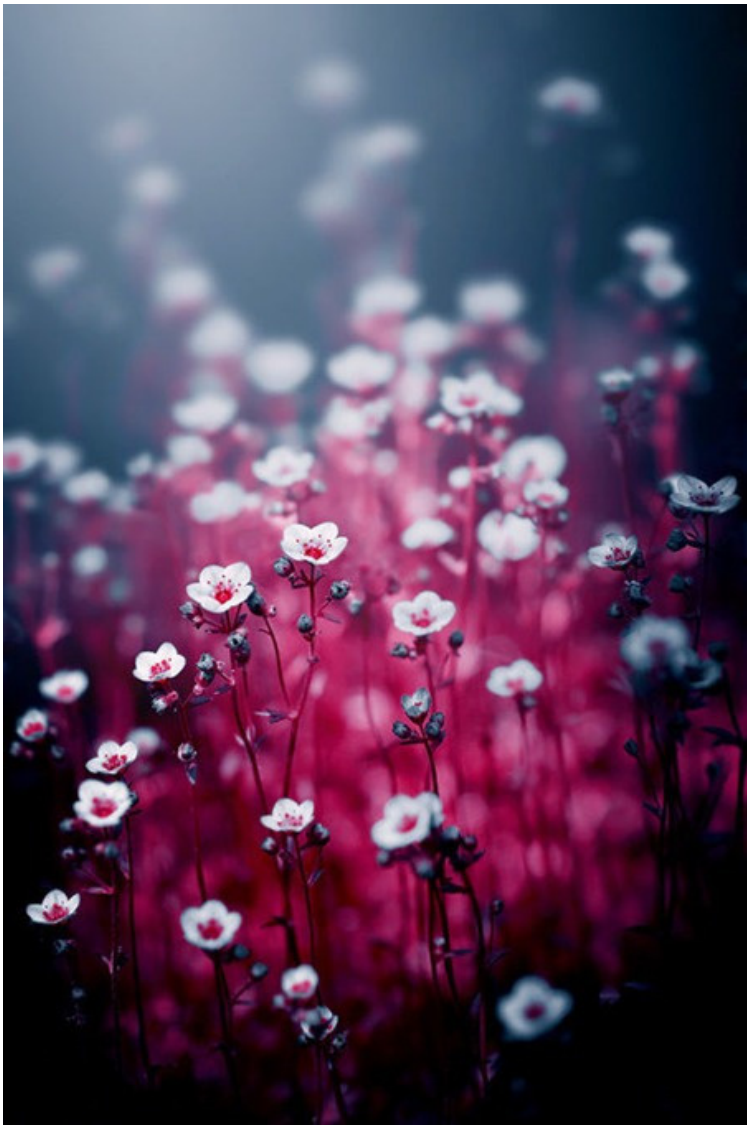
A team from the University of Cambridge operated a project to find an answer to this question. Floral striations; they observed in their flower specimens with surface striations.

# FLORAL STRIATIONS

Some flower petals have nanostructures that generate colors. They are some kinds of wrinkles in the petals' cuticle parallelly. When directional growth of the underlying plant cells happens, it causes the petals' surface to wrinkle physically. These striations are really small. If I say how much, they are 100 times smaller than the diameter of human hair. The length of these structures is similar in size to the wavelength of visible light. This causes interference. This interaction is a partial reflection of light at the material interface; because light traveling at different speeds when propagating through materials with different optical densities.

They found the flowers with structural colors, which they did by looking large number of flowers optically first. Then they did scanning electron microscopy for viewing angle dependent coloration. These selected flowers were from different flower families.

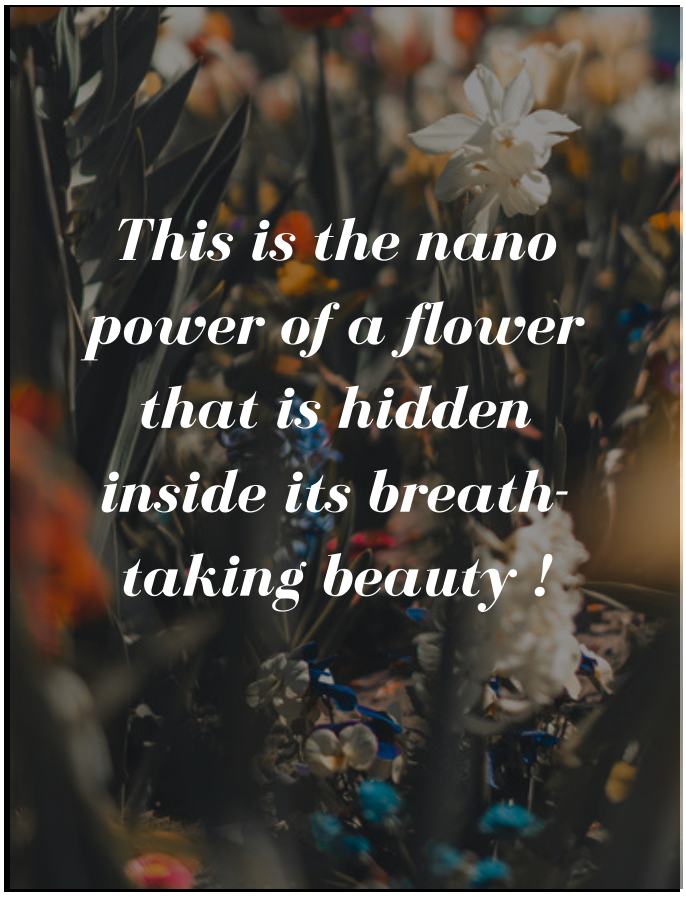
While they were conducting those experiments, unexpectedly they gave rise to a new optical effect; **BLUE HALO**.



## WHAT IS BLUE HALO?

**While common diffraction gratings reflect all colors relatively equal, but at different wavelengths such as Ultraviolet region & Blue light it reflect in a much wider & more consistent range of directions.**

They examined furthermore by analysis of different plants. Interestingly, they have observed a very similar optical effect. Despite the height, width & spacing of the striations varies about a quarter of their size within a flower & by more than a factor of 2 between species. The strength of the optical effect makes semi-ordered striations particularly useful to achieve a reliable coloration since biological materials organization is variable. It also suggests that the amount of disorder in flowers is not random but optimized to some degree. The disorder in floral striations is, therefore, a functional feature, not a limiting legacy of the structure.




## MYSTERIOUS HIDDEN BEAUTY

When flowers display a blue halo on a dark pigmented region, the disordered Nano-structure looks blue to the human eye because we cannot see Ultraviolet light. So many flowers have striations, and they all display this blue halo effect. The structural color of many of these flowers is hidden for a long time because the effect is in the Ultraviolet region. That is because we cannot see & underlying pigment does not provide a good contrast to structural colors. Also, in most flowers, bright yellow& red pigments make it more difficult to observe the blue at all.

This blue halo effect is important for most bees to attract to the flowers because they pollinate the flowers. Thus securing the reproduction & evolution of plants.

The Ultraviolet blue reflectance from striations could therefore be an important evolutionary contribution to the appearance of flowers, especially considering that the plant leaves in the background of the flowers are already green& that blue tends to be a color that is very difficult to synthesize for most plants.

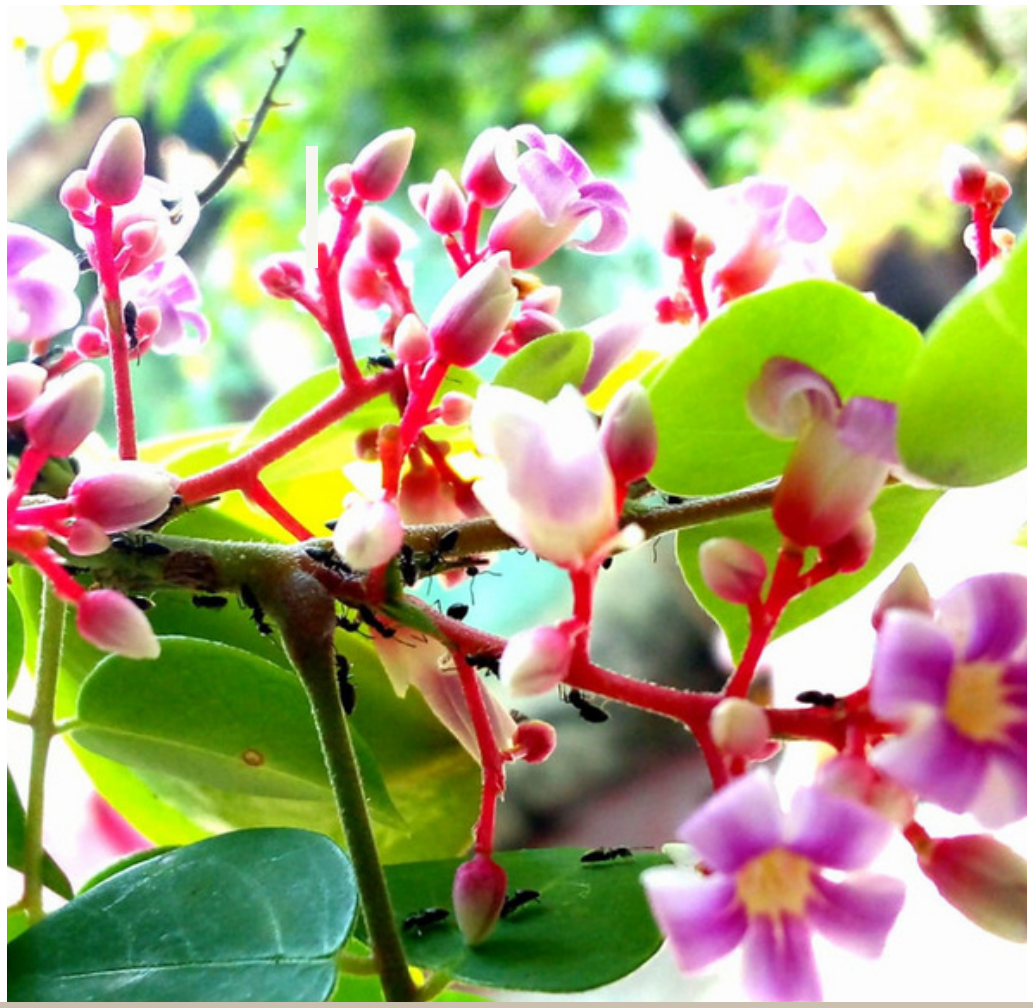
Written by: Bhagya Bandarigoda
Sc/2019/10928


-Make space in your life for what matters-

Captured by :
Udara Rathnayake
Sc/2018/10377

-Every flower is a soul blossoming in nature.-

Captured by :
J. A .Rishadhi Lavanya
Sc/2020/11311



# ALLOW NATURE TO RESTORE DEGRADED ECOSYSTEMS: A PLEA FOR ASSISTED NATURAL REGENERATION

Forests play a vital role in many ecological processes. In addition to harboring diverse flora and fauna, forests provide numerous ecosystem services, and the benefits of the forests to man are well known. However, due to various factors, the global forest cover has been declining significantly in recent times. According to Global Forest Watch (GFW), Sri Lanka lost 10,500 ha of humid primary forests from 2002 to 2021 period. Therefore, the forest cover in our country must be increased.

We have many ways to address the problem of deforestation. The most common method used to increase forest cover is to plant trees in selected areas. However, this method has some drawbacks. First, the sites selected for planting trees may not be suitable for the purpose. Secondly, the trees selected for planting are not suitable for the ecological conditions of the selected site. The most commonly used plants for these planting projects are those that are commonly available at the time in the nursery. It has been observed that trees suitable for lowland areas, such as Mee (*Madhuca langifola*) and Kumbuk (*Terminalia arjuna*), have been planted in mountainous areas. It is advisable to select native, early, or mid-successional tree species for afforestation.

It is observed that when selecting native trees for afforestation, the tendency is to use late-successional or climax tree species which are not adapted to the sites. When they fail, the whole exercise is abandoned claiming that our native species are not suitable for afforestation. Consequently, in many instances, non-native plants are used for this purpose.

The Department of Forest Conservation has been cultivating exotic plants for the plantation industry since 1870. These plantations at present cover nearly 93,000 ha and consist mainly of teak (*Tectona grandis*), *Eucalyptus* species, *Pinus* species, and mahogany (*Swietenia macrophylla*). Such monocultures do not have the biodiversity or functional diversity found in normal, natural forests. However, it should not be forgotten that such plantations also provide numerous environmental services. It was also observed that some tree planting programs are conducted in grasslands. Some people think of grasslands as degraded ecosystems; therefore, they plant forest trees to 'rehabilitate' those sites. Sadly, they are not aware that these grasslands are also unique ecosystems.

Planting trees in the gaps in degraded forests to restore them is another common practice. These enrichment plantings are often extremely useful, but even their success depends on choosing the right plants. Nature knows exactly what trees are suitable for the site. The plants we choose may not be suitable for the location. Restoring the degraded lands to their natural conditions with primary forest species is a challenge and a difficult task. One other way is to allow the forest to restore naturally. This system also has various obstacles. The soil seed bank is generally rich in native seeds but light-demanding and fast-growing early pioneer species and alien invasive plants suppress the regeneration of native, late-successional tree species. Therefore, the restoration of degraded forests using established common methods, including natural regeneration, is very challenging.

Promoting the growth of natural tree species, in sites regenerated naturally, can be done by selectively removing the aggressive weedy species that compete with the natural tree seedlings. The seedlings that appear in the naturally regenerating sites are those that come mostly from the soil seed bank.

In other words, those seedlings are selected by nature and not by man. If the survival of those seedlings is assured by removing the competitive species it will be possible to get a collection of trees ideally suited for the site

Assisting the natural regeneration of forest trees in that way is called Assisted Natural Regeneration (ANR). ANR is a successful method to re-establish forest cover in deforested lands. This method allows natural seedlings to establish and mature. It overcomes obstacles that are generated by natural regeneration and artificial regeneration.

The NIFS- Popham Arboretum in Dambulla is one such woodland developed by ANR. This Arboretum is situated about two and a half kilometers away from Dambulla by the Kandalama Road. It was owned by an Englishman, Mr. F. H. (Sam) Popham, who gifted it to NIFS (then IFS) in 1989 to carry out research and educational activities. When Popham bought this land in 1963, it was a seven and half acre-scrub jungle. Popham allowed the indigenous tree saplings in the site to emerge and establish themselves by removing the 'weedy' shrubs around them. Consequently, the original scrub jungle was turned into a tall woodland with a closed canopy. After taking over the land in 1989, IFS bought and added another 27 acres of adjoining scrubland and expanded the arboretum. Popham's "Assisted Natural Regeneration (ANR)" method was practiced.

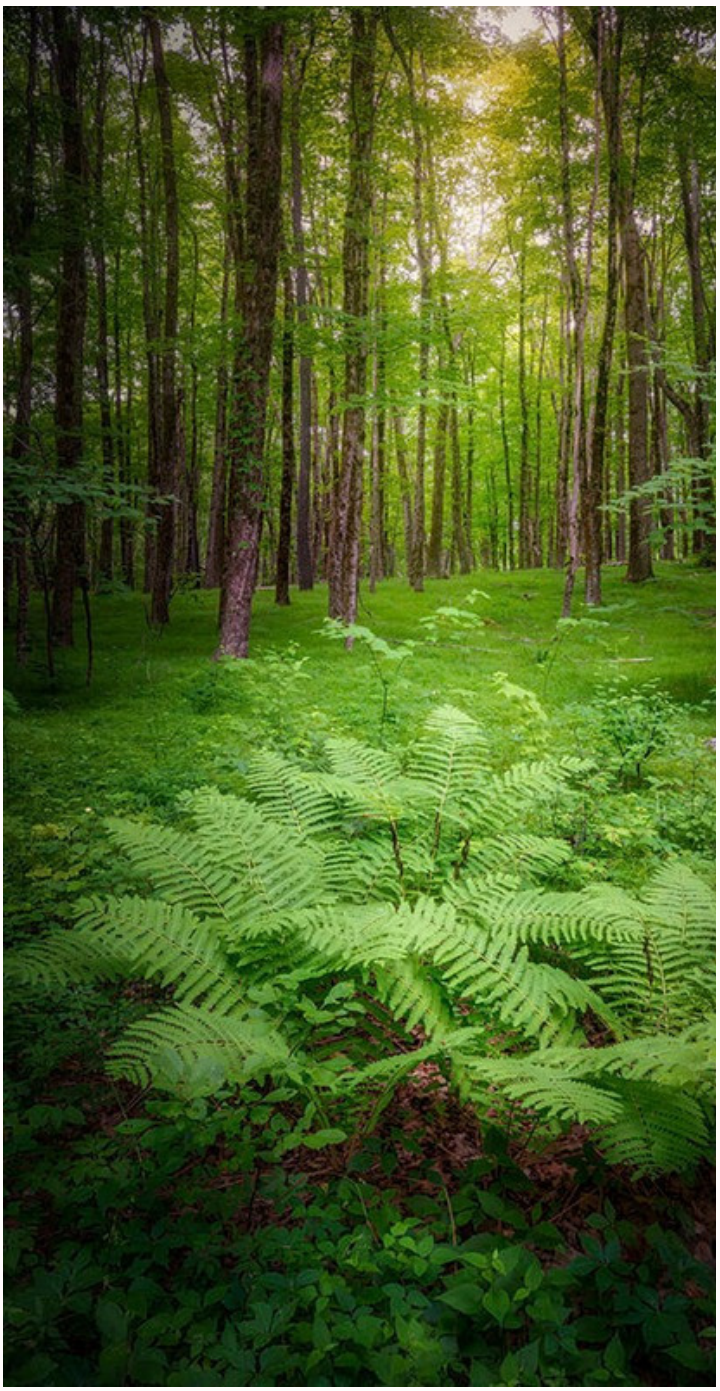
About 36 acres of degraded land now have been converted into dense woodland over a period of about 20 years. Interestingly this land is now occupied by over 350 plant species belonging to 89 families, and this forest is now a habitat for many species of mammals, birds (with migrants), and butterfly species. This Arboretum is now a refuge for unique animals such as the slender Loris and pangolin. It is interesting to note that when ANR is practiced, the wildlife in the restored site is improved gradually.

The presence of wildlife implies that the conditions are suitable for the sustenance of those indigenous species on the site.Forest is a complex system with many biotic components having numerous functional diversities. A site restored by ANR is very similar to natural vegetation with high biodiversity providing many ecosystem services. NIFS Popham Arboretum is a very good example of such a site.

After a long period of restoration

**Prof. Siril Wijesundara**
**National Institute for Fundamental Studies, Hantane Road, Kandy**
**(Former Director-General, National Botanic Gardens Departments)**

# PLEASE KEEP ME ALIVE



*I'm a gift of God···*
*Born for your good*
*I give you food····.*
*Breath, shelter, and wood*

*Stand tall and proud····.*
*For many years with grants*
*Birds and babies*
*dancing around*
*Let me stay with my dudes...*

*We are never mean like Man We never mean like a man?*

*So, give your hands to thrive*
*Don't you feel grief to harm?*
*Please keep me alive!!*

Written by:
R. M. Dinelka Neshani Bandara
Sc/2020/11255

# SPIRIT OF LIFE WITH NATURE

WHAT HAVE WE DONE TO THE WORLD? LOOK WHAT WE'VE DONE
WHAT ABOUT ALL THE PEACE
THAT YOU PLEDGE YOUR ONLY SON?"

"THE EARTH – MICHEL JACKSON"

Written by :
R. M. Dinelka Nishani Bandara
Sc/2020/11255

"What have we done to the world?" This is a question that needs to be asked of the selfish people living today. The present world is perishing day by day. It has simply been proven that the root cause of this catastrophe is the distance between nature and mankind, which is the most powerful factor in the way our ancestral lifestyle.

In the past, our people lived in a unique way, maintaining a deep connection with the environment. Almost all of their special moments in life happened with the environment. Most of the food, clothing and accommodation were a legacy donated by nature.

But today,
Have we ever wondered how close we are to a tree, a bird, or to an animal? It's pretty sure that the answer is "No". Because today people only chase after money. They think that everything can be bought, and everyone is a slave in front of money.

Red men leader, Chief Seattle had told one day,

"*How can you buy or sell the sky, the warmth of the land? If we do not own the freshness of the air and the sparkle of the water, how can you buy them?* "

This is the point all of us have forgotten. Every part of this Earth is connected. All the things we share; belong to the goddess, nature. Mankind, Rabbit, Tree, Pony, Parrot, we all share the same breath, same land. We all have the same feeling; the will to live. We must remember this. If not, we will suffocate in our own waste.

Today, people have no time to think about how delightful the chirps of birdies are, the meaning of the song of crickets, the simplicity of a mossy stone, mourn of a graveyard, the whisper of the sea, the murmuring of water lapping in a lake, the narration of the blue sky. No one wants to listen to them. People always trumpeted their arrogance. They shed tears only to their sadness.

They become dumb in front of the grief of a tree, to the loud sobs of a mother animal or a baby animal. Unfortunately, they had said goodbye to nature.

But what is a man without trees and animals? It may turn out to be a desert. Surely, man would die out of spiritual loneliness.

However, we have come a long way. There is no point in sobbing over the past, whereas steps should be
taken forward in support of nature. Give your compassion to Mother Nature, TODAY ITSELF!. Live in harmony with nature and give all your effort to preserve our mother, Nature, for the sake of the unborn. Then at the moment of death, no regrets will be left!!!

# NATURE, THE MOTHER!

*Rays of the sun called me out*
*Dews on daisies made me smile*
*Mist has left the greening plain*

*The drizzle of the sky reminded me of her*
*Gloomy face glowed*
*When she saw blooming roses*
*A dazzling smile on her*
*When they say 'Good Morning'*

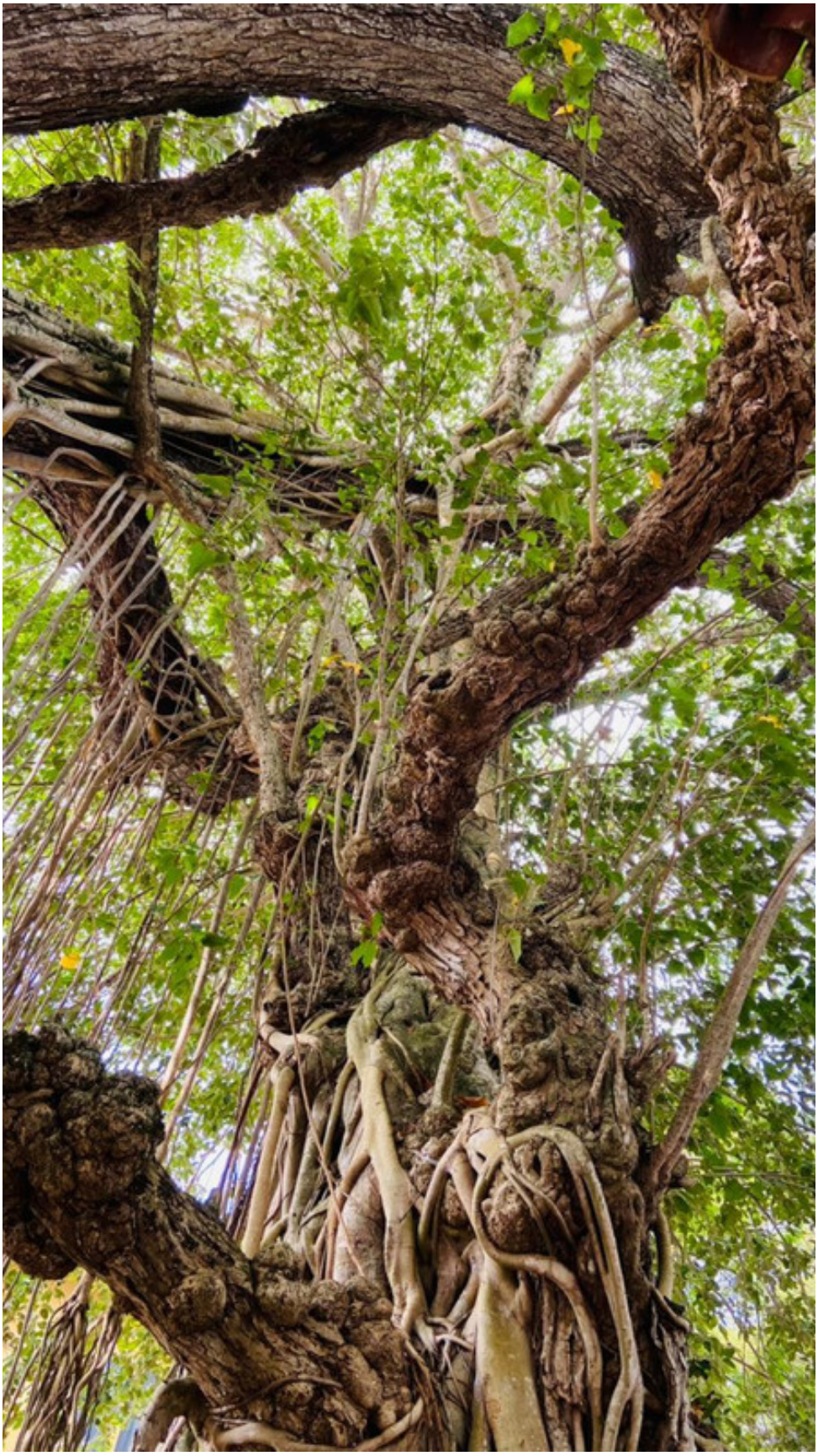
*She gets scar*
*When they mar*
*I see her in the shrub club*
*I see her in green leaves*

*I weep deeply*
*When she bleeps*
*We seek her*
*When she's sleep*

*She is my mother! She is mother nature!!*

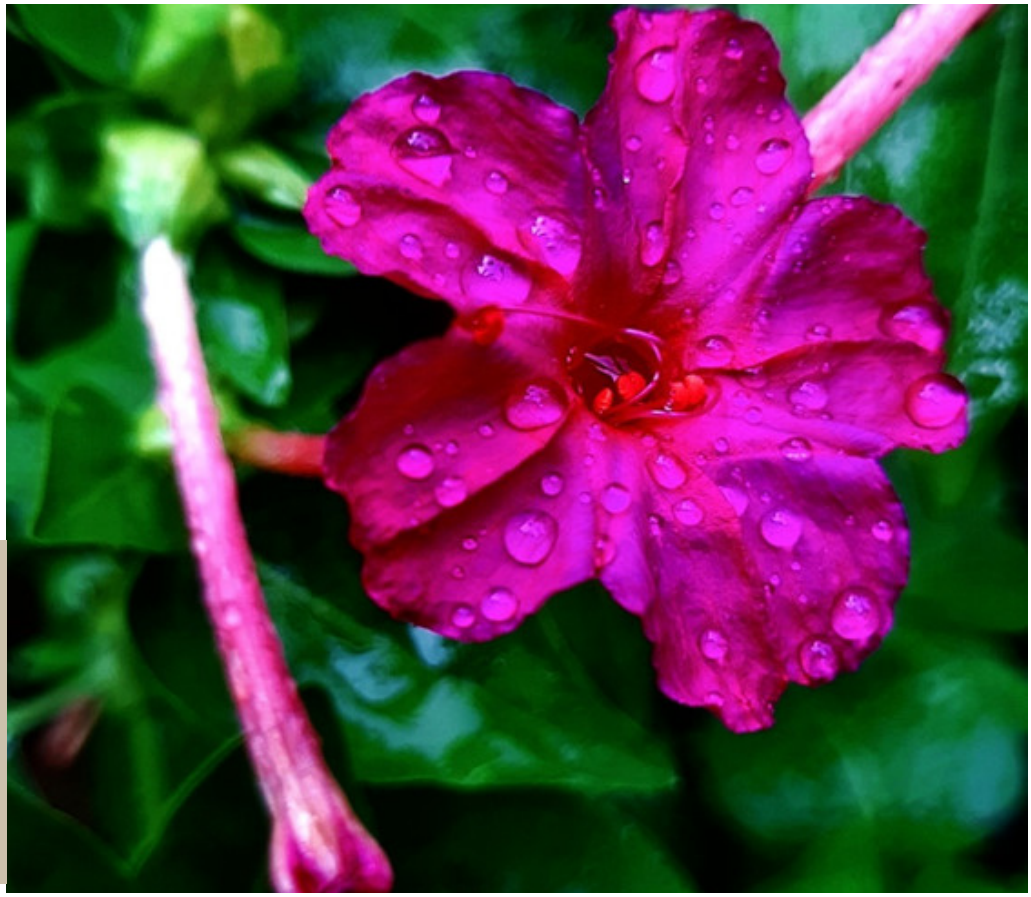
*Written by ;*
*Salma M.F.*
*SC/2019/10979*

# THE UNIQUENESS OF THE NATURE



Captured by :
L. U. Piyumi Saumya
SC/2019/11014

"A flower does not think of competing with the flower next to it. It just blooms." - Zen Shin



Captured by :
Thilini Malshanee Dayarathne
SC/2020/11340

**A little heaven on earth**

Captured by : A. Achini Dabare
Sc/2019/10955

# EXOTIC ORNAMENTAL AQUATIC PLANTS: A THREAT TO THE AQUATIC BIODIVERSITY IN SRI LANKA

Sri Lanka is consecrated with rich biological diversity. Sri Lanka's location, geological isolation from the continental landmass, topographic and climatic heterogeneity as well as its coastal influence have contributed to this biodiversity richness of the island as well as the high endemism. However, the extensive loss and degradation of natural ecosystems owing to anthropogenic activities and the rich endemism, Sri Lanka, together with the Western Ghats of India, has been identified as one of the 36 biodiversity hotspots of the world.

Among the different diverse ecosystems of the island, the aquatic ecosystems could be considered as threatened and more vulnerable to destruction. Considering the aquatic flora, Sri Lanka is blessed with over 370 native aquatic or wetland plant species, of which 12% are endemic to the country. According to the most recent Biodiversity Profile of the country, 51 freshwater crab species and 128 freshwater fish species are recorded from the island. In addition, many bird species find their shelter and associate the wetland habitats.

The aquatic ecosystems have been affected throughout history by various anthropogenic threats, habitat deterioration/degradation, over-exploitation of species, and alien invasions. Alien invasions are directly related to human activities and could mostly be attributed to the aquatic ornamental plant industry.

Even though Sri Lanka harbors a larger number of naturally occurring aquatic plants, there is a high demand for certain exotic aquatics in the export market, which has resulted in the importation of these exotic plants into the country for propagation and re-exported for the foreign market. These plants are also popular in local aquatic landscapes and aquaria. Once escaped from these controlled environments, some of these exotic plants are capable of surviving and establishing in the new environment and end up as invaders in the natural ecosystem.

Many Invasive Alien Species (IAS) have been encountered in the country's water bodies in the past, where 'Japan Jabara' or Water hyacinth (*Eichhornia crassipes*) is one of the classic examples which has become a menace to aquatic ecosystems. *Salvinia molesta*, a free-floating water fern, has also established its name in the invasive alien species list, being only second to *E. crassipes*. *Pistia* stratiotes, even though it has not set records, is another alien invasive species that has got established in local water bodies drawing considerable attention.

In the past years, a few other exotic aquatic ornamental species, *Ludwigia sedioides*, *Mayaca fluviatilis* and *Echinodorus* spp. have been recorded as potential invasive alien species in local water bodies in the Western Province of Sri Lanka. Of these *L. sedioides* and *Echinodorus* spp. are popular aquatics in aquariums and in landscaping. *M. fluviatilis* is a popular aquarium plant.

The most recent addition to the list of potential invasives alien species of the country is of great interest as it opened up a new chapter in invasive alien plant research in Sri Lanka while highlighting the importance of Plant Taxonomy and proper identification of organisms.

The flawed identification of a violet flowered water-lily ['Dam-manel'] as Nymphaea nouchali [synonym: *N. stellata*] and subsequent recognition of it as the National flower of Sri Lanka ['Nil manel'] in 1986 have overlooked its threat to the local biota and invasiveness. Introduced to the island as an ornamental plant, 'Dam-manel' has been silently invading the local freshwater bodies where it has gone unnoticed due to the erroneous identification as a native and its popularity as an ornamental plant. The plant did not have a botanical identity until it was named recently as a new hybrid, *Nymphaea* × *erangae* Yakandawala, Guruge & Yakandawala. Studies have further revealed hybrid populations between the native *N. nouchali* and *Nymphaea* × *erangae* with intermediate characters in natural water bodies, which also pose a threat to the genetic integrity of the native populations.

The story does not end with a species that keep being added to the list. Information gathered from state institutes/authorities, and private sector growers of the country in 2013 has revealed that 389 aquatic plant species are currently on trade. Of which, exotic represents 62%, while natives and endemics represent 9% and 4%, respectively. Further, 3% were cultivated species, while the remaining 22% included hybrids /cultivars, plants referred to only by their genus or illegitimate names. The list contained plants identified as IAS and potential invasions in the country. Further 124 species are listed in the Global Compendium of Weeds.

Meanwhile, many exotic water lilies, different 'Manel,' 'Nelum' and 'Olu' species are being traded at several ornamental plant stores. There is a growing demand for aquatic plants in society. Even though an immediate threat is not foreseen, with time, there is a high possibility for these aquatics to spread into local water bodies. In addition to the ornamental aquatic plant industry, unregulated e-commerce is partly accountable for the spread of exotics into new environments.

As an island nation, we are in a better position to control biological invasions. Early detection and rapid response to invasive species is the widely accepted approach to controlling the invasive. Therefore, reporting the detection of exotic in the natural environment is important. At the same time, being responsible for discarding propagules while using exotic plants in landscaping is the most effective way that an individual could contribute to reducing this menace. The ornamental aquatic plant industry is a booming industry with the potential to establish itself as an industry, bringing in foreign revenue to the country, and at the same time, the industry is responsible for the intentional or unintentional release of plants into the environment. From a conservation point of view, this is a topic open for debate.

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# Intelligence of plants

Plants have electrical and chemical signaling systems, may possess memory, and exhibit intelligent behavior in the absence of brains.

## Plant Intelligence

The adaptively variable growth and development during the lifetime of the individual. Through rigorous research and experimentation, the following behavioural characteristics have now been established and could be attributed to plants:

- Communication
- Learning
- Problem solving
- Memory and memory recall

## Plant memory

A study published in 2014 has determined that plants could indeed create memories and consequently exhibit their memory recall through learned response. It has been observed that they were able to quickly learn, in fact, as little as within a day.

Regardless of the lack of a nervous system, the Mimosa pudica or “sensitive plant” started exhibiting the learned responses within a 24-hour time period.

## Plant Communication

There is a growing evidences that suggests that plants, trees in particular, could communicate with one another.This communication occurs through underground Mycorrhizal networks or cobweb-like networks of mushroom mycelial growth that grow around the root structures of trees. These mycorrhizal networks have affectionately been dubbed the “Wood Wide Web” and scientists hypothesize that they could be used for anything from nutrient transportation to signaling that of a potential threat such as a nearby caterpillar. Essentially, these Mycorrhizal networks could create a communication network between trees similar to the internet. These networks may even enable an entire forest to communicate

## Learning ability of plants

Although plants may lack brains and neural tissues, they possess sophisticated calcium-based communication network in their cells similar to that of in an animal's memory.

## Importance of Plant Intelligence

Plants have to find the energy, reproduce and stave off predators. To do these things, plants have developed smarts and sentience.

## Do plant seeds have brains?

Special groups of cells in the seed may communicate with each other to decide when conditions are right for germination.

## Plant cognition

Plant cognition is the study of the mental capacities of plants.

## Problem Solving

The new Botany research suggests that, although the plants are sensitive and possess the ability to problem-solving, they bypass the need for self– consciousness and cerebral activity which we assume is a necessity for intelligence. People who possess this notion are often criticized as anthropocentric

Written by;
J. M. N. D. Jayakody
SC/2018/10411

Captured by : M. D. Sadun Prasad Subasighe
Sc/2020/1133

## EVENING AT WEWATHANNA

## A HEARTFELT VIEW

Captured by :
W. K. K. G.Wickramarathna

# HAKGALA BOTANICAL GARDEN

The Botanical Gardens in Sri Lanka hold a major significance. Moreover,out of five major botanical gardens in Sri Lanka, Hakgala Botanical Garden happens to be the second-largest botanical garden. And why not? The allure surroundings of the Hakgala Botanical Gardens have made this place one of the best reasons to visit Sri Lanka. Thus, we thought of sharing with you the delight of this magical paradise!

Hakgala Botanical Gardens is situated 16km from Nuwara Eliya on the main road of NuwaraEliya to Badulla.In addition, it is close to the Hakgala Strict Nature Reserve. And of course, you can get there from Nuwara Eliya. Simply, ride along the Peradeniya – Badulla – Chenkaladi highway,through Katumana and Seetha Eliya, to Hakgala,to reach the Hakgala BotanicalGardens.

## THE SECOND LARGEST BOTANICAL GARDEN IN SRI LANKA

The route to Hakgala Botanical Gardens on Badulla Road is a wonderful downhill mainly through pine forests. Similarly, the pleasant cold weather that prevails all year round complements the tropical flora and fauna, making it a real paradise.

The garden has a cool temperature climate due to its altitude of 1620 meters above sea level. From December to February, the temperature is cool, although the climate ismild from April to August.

However, Hakgala Botanical Garden's mean annual temperature is typically between16°C and 30°C.

Dr. G. H. W. Thawaites founded the Hakgala Gardens in the year of 1861 as observational cultivation of Cinchona, a commercial crop that grew in Nuwara Eliya at the time. Once the tea was replaced by the Cinchona, it was converted into observational tea cultivation in Nuwara Eliya. And since then, many subtropical and temperate plants have been grown in the gardens.

The Sri Lankan Lord Ravanais said to have abducte dSita, kept her concealed in this area, and offered it to Sita as a pleasure garden. Hence, the Ramayana describes this place as 'Ashok Vatika'. Later, the place which is called “Sita Eliya” and “Sita Amman Temple” was built on this site.

Hakgala is a tropical hill-country garden. The way the lovely Low-Country Lotus and Water Lilies bloom there, mingle in their serene beauty with sophisticated classical flowers is simply delightful. The way they blend with the similarties with endemic Orchids are more fantastic. Moreover, the arduous rock of Hakgalaoffers an impressive background to the garden.

## *Safe heaven for over 10,000 plant species*

The Hakgala gardens flowers, shrubs, ferns and mountain trees are marvelously set in a safe setting. The small streams that flow, wooden bridges constructed over them, and the birds soaring around; further enhance the delight of this garden. Also, the charm of this garden, the cool and shady climate, and the enchanting landscape help your mind in soothing your anxieties.

The gardens stretch up the steep hillside, from the anodyne ornamental areas around the entry to the much larger and more interesting wood up the slopes. However, the best views are from the stairs. Moreover, the walk to the right directly after the entrance gate leads through the azalea garden to a small pavilion.

Further, below are some of the most significant garden flora species that can be found on this wonderful land.

Old Tea Trials
Eucalyptus,Pinus
Casuarina,Cupressus
Rhododendron zeylandicum
Streptosolenjamesonii
Santolinachamaecyparissus

In addition, the impressive Rose Garden, Conifers, Cedars, Cypresses, Pine Trees and English Oaks make their home in the garden

Hakgala Botanical Garden consists of main sections.

· The Spice Garden

· The Rose Garden

· The Orchid House

· House with Small Plants

· The Cactus House and the Herb Garden

· The Fernery

· The Rock Garden

· The Bulb Garden

· The Arboretum

· Forested Areas

Indeed, their splendours are worth exploring! So, let us get to know about each of them

The pleasant Spice Garden on the right at the main entrance bears a good array of cinnamon, cardamom and nutmeg. A few of the oldest nutmeg trees are already available in excellent form since the year 1840.

The Rose Garden, a twin cottages block of land, is home to over 100 varieties of Roses. Further, the British colonial emperors of Ceylon planted some of the other varieties of the Roses here. Also, glass house, indoor garden shows flowering species & varieties of Begonia, Peperomia, Saintpaulia, Primula, Gloxinia, Steptocarpus & Pelargonium.

The Orchid House displays the captivating tropical flowers of Cattleya, Dendrobium, Arachnis, Oncidium, Phalaenopsis, Vanda, and their hybrids. Similarly, around the Orchid House, you have the ability to see numerous hardy orchids, including the

argest orchid in the world (Grammatophyllum speciosum), which grow a flower spike up to 2.5 m long and a green orchid (Coelogyne mayeriana).

Next to the Orchid House is a small plant house with a number of green indoor plants, such as ferns, begonias, African violets, Episcia dieffenbachia, Philodendronbromelia and Anthurium.

The Cactus House exhibits over 800 species, such as Agaves, Opuntia, Kalanchoe, ereus, Rebutia, Rhipsalis. Similarly, the Flower Garden showcases various annualflowers organised according to the height and colour of the plants.

It offers a shaded environment. Wood Fern is one of the kinds of ferns (Cyathea crinita). Many species of natural ferns grow in the shadow of tall trees. This section also houses old tea bushes (Camellia sinensis) which have been used to experiment with the cultivation of tea in the hill country.

Moreover, this collection forms the very appearance of the Assam Tee Hybrid brought to Ceylon in 1967.

The major rock garden, founded in 1921, provides an area for several kinds of herbaceous plants. However, these plants survive well in the beds of rock and boulders. Similarly, the reservoir underneath the sloppy grass is home to the water lily (*Nymphaea mexicana*).

The history of Bulb Garden runs back to the year 1924. Besides, it comprises a good selection of subtropical bulbous plants and some of them are as follows.

- Lillum
- Watsonia
- Agapanthus
- Gladiolus

The arboretum is one of the most significant aspects of the garden. This segment includes a wide area in the rock garden. Various native species as well as species imported from subtropical countries occur here.

The wooded areas of the gardens contain several magnificent Monterey Cypresses from California

Hakgala Botanical Garden has become one of the best destinations on the island to spot endangered mountain bird species and migrating birds during the North East monsoon.

We have the ability to find a good number of native birds in the garden premises.
Some of them are as follows.

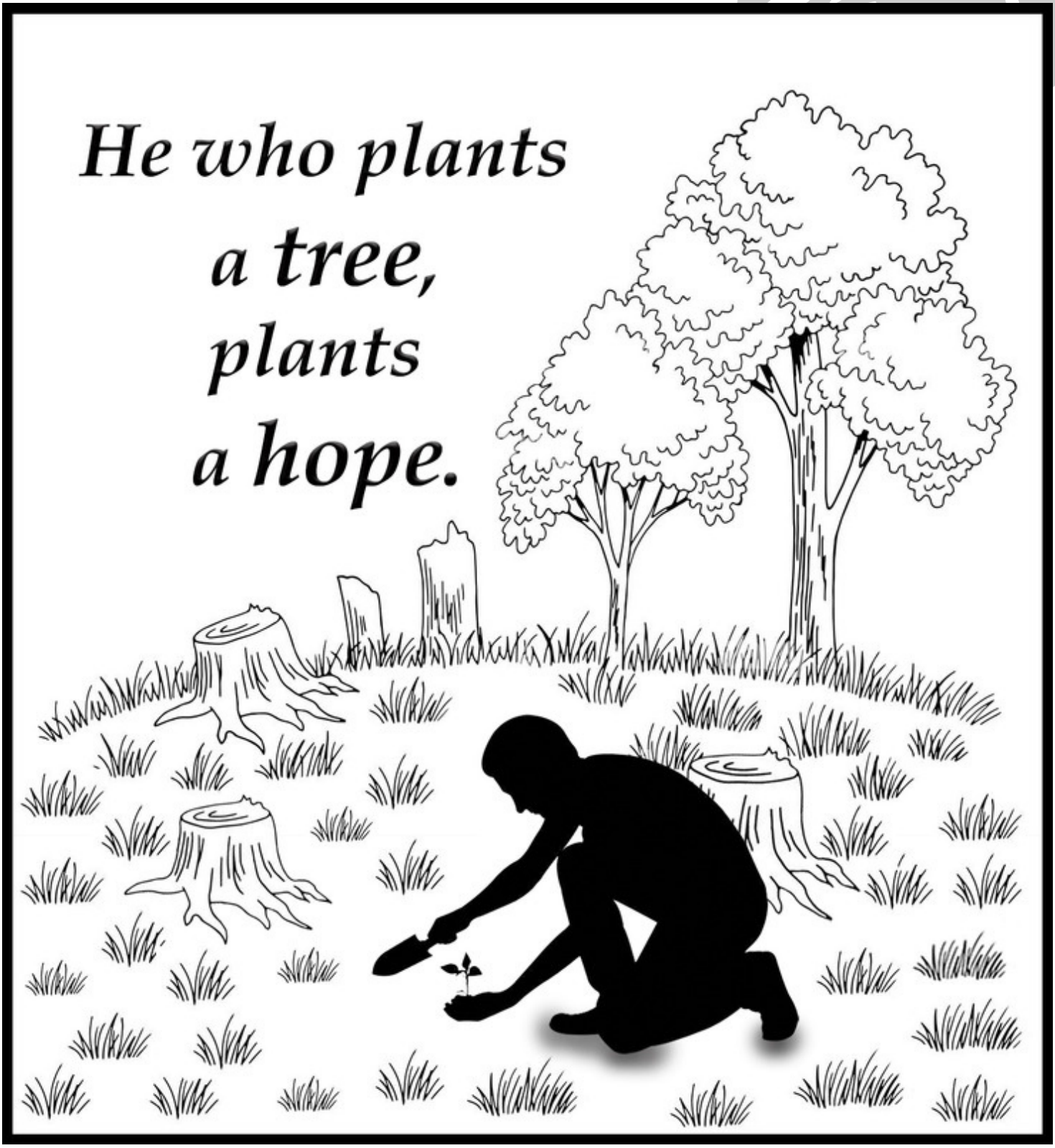
- Sri Lankan Wood Pigeon
- Southern Crow Pheasant
- Layard Woodpecker
- Powerful Fan Tailed Warbler
- Black Heaven

Besides, the most visible migratory birds out there are as follows.

- Gray wagtail
- Pied field thrush
- Pied & brown shrike

Hakgala Botanical Garden is world famous for the number of species of orchids and roses that it houses. Also, it is home for an extensive range of massive trees, plants and fauna. All these together, makes it one of the ideal places to observe the biodiversity of nature at its best.

Written by :
Kumuditha Jayasekara
SC/2018/10310




Designed by :

T. G. Yasith De Silva
SC/2020/11373

# *Mimosa pudica*

A.K.A SENSITIVE PLANT/ HUMBLE PLANT/ SLEEPY PLANT/SHAME PLANT

This plant is herbaceous to woody plants, often spread on the ground but sometimes erect. It has compound leaves and small globular pink or mauve flower puffs. The first leaves are alternate and composed. The flower consists of tiny calyx and a campanulate corolla, pink with white anthers. The fruit has a sessile pod, linear-oblong and flattened. There are generally four articles per pod containing a single seed. The inflorescence consists of 1-4 axillary and terminal glomerulus. The stem is cylindrical. It is rapidly lignified at the base, loosely arranged hairs, and it is well-branched. The plant has a deep, robust taproot.

## SPECIAL ADAPTATIONS

**Chemical adaptations –**
*M. pudica* does contain toxic chemicals and as a weed, does not let other surrounding plants reproduce due to the chemicals secreted from the roots. However, the *M. pudica* has also adapted to provide medicinal uses from the toxins inside the plant itself, that which can neutralize enom as well.

**Nyctinastic movements –**
The leaflets of these plants are light and touch-sensitive.has been noted to fold inwardly
when the sun has set and remains folded in this way until sunrise.

This plant has adapted throughout generations to better survive against herbivore animals.

General adaptations include Anatomical adaptations - This plant has sharp thorns that can cause a painful wounds.
Response to stimulus - respond to touch and other stimulation by rapidly closing its leaves and drooping. This rapid movement provides the plant better survival chance.

In the evening, the leaflets fold together, and the whole leaf droops downward until down.

Seismonastic movements - any contact with the leaves, such as tapping or shaking, will cause the folding of the leaves to occur, reopening a few minutes later. And the cause of this response to stimulus is all about the release of water in the cell. The cells of this plant are normally filled with water, and a single touch can generate the transmission of electrical signals that releases Ca2+ K+Cl- leading to a further release of water from the vacuoles.This reduction causes the deflation of cells as they collapse and appear wilted. One wilted. One single touch triggers the collapse of cells throughout the entire leaf.

## Health benefits

- For treating asthma, diabetes, snake bites, insect bites, stomachache and intestinal worms
- To cure gum problems and toothache
- For joint pain or arthritis
- To cure itching
- To uplift sagging breast.

Written by ;
M. G. N .N. Piyumantha
SC/2019/11061

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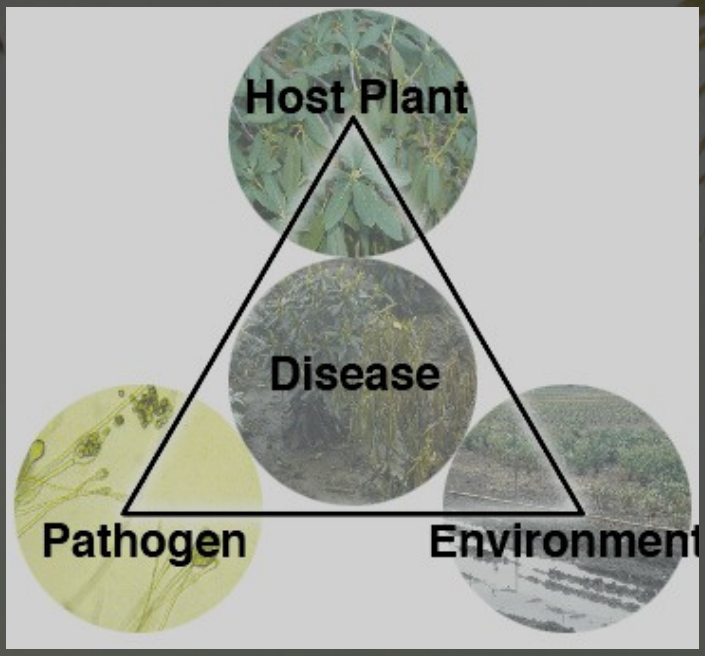
Composed by :
W. A. Prabuddika Sandamali
SC/2020/11390

# Plant Disease Triangle

Plant disease is any abnormal condition that damages a plant and alters its appearance or function or reduces its productivity.

A disease occurs when a disease-causing agent or pathogen meets the right host organism under environmental conditions favorable for disease development.

These three elements, pathogen, host, and environmental conditions, make up the disease triangle. The disease triangle is a concept that illustrates the importance of all three elements – just as there are three sides to a triangle, there any three critical factors necessary for the disease to develop. This concept was formalized in the 1960s by George McNew, a scientist at the Boyce Thompson Institute for plant research.




Pathogen factors

- Level of virulence
- Quantity inoculum near hosts
- Type of reproduction of the pathogen
- Ecology of the pathogen
- Mode of the spread of the pathogen

Environmental Factors

- Moisture
- Temperature

Host Factors

- Levels of genetic resistance or susceptibility of the host
- Degree of genetic uniformity of host in a particular field
- Type of crops
- Age of host plants

Importance of disease triangle

The disease triangle can be used to predict the epidemiological outcomes in plant health. It is an important tool for understanding the dynamics of infectious diseases in plants.

Management of disease is effectively carried out by manipulating at least one side of the triangle to reduce the infection.

Written by :
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SC/2018/10419

# Timber Industry of Teak in the World .

Teak (Tectona grandis) is a species of significant ecological and socio-economic importance throughout the tropics and one of the most favored timbers all over the world since it has been used for many centuries for a range of products and services. It is known for its strength, durability, and ability to maintain an attractive appearance and is one of the most sought-after hardwoods in the international market. The ever-increasing need for teak timber has resulted in large-scale plantations, both within and outside its range of natural distribution.

Teak grows well in regions having deep, flat, and well-drained alluvial soils rich in calcium, a mean annual temperature of 22-27°C and annual precipitation of 1,200-2,500 mm, with a marked dry season of three to five months and a maximum of 50 mm of rain during the period. Dry site conditions are usually associated with stunted growth. Highly moist conditions may be conducive to faster growth, but with more sapwood, lower average density, yellowish color, poor texture, and inadequate strength. Teak trees grown in plantations in good soils may reach an average of 60 cm diameter at breast height (dbh) and 30 m in height in about 50 years.

The earliest yield table in teak was prepared by von Wulfing (1932) for plantations in Java (Indonesia). Teak yield tables indicate the early peak of mean annual volume increments between 6 and 20 years.

High mean annual increments of above 20 m3 ha-1 year-1 are reported from Indonesia, Trinidad, and Tobago. In Indonesia, the average actual MAI at harvest age, with rotation varying between 40 and 90 years, was 2.91 m3 per hectare per year. Konni forest in Kerala, India, averaged 172 m3 ha-1 with a 70- year rotation, giving a MAI of about 2.46 m3 ha-1 year-l. The mean annual increment of Teak plantations in rotation of 40 to 50 years in Benin and Ivory Coast was between 8 and 11 m3 ha-1 year1. Teak occurs in natural forests between 9° to 26° N latitude and 73° to 104° E longitude, which includes southern and central India, Myanmar, and northern Thailand.

Teak has been introduced to South-East Asia, Indonesia, Sri Lanka, Vietnam, Malaysia, and the Soloman Islands, as well as to Africa and Latin America. It was introduced to Sri Lanka in 1680. Teak planting in India began during the 1840s. In 1902, teak was firstly introduced to Nigeria (outside Asia). Teak introductions in other countries of Africa included Ivory Coast and Ghana. Teak plantations in tropical America were first established in Trinidad and Tobago in 1913. It was also introduced in Costa Rica and Brazil. About 4.5 percent of Teak plantations are in tropical Africa (Ivory Coast, Nigeria, Sierra Leone, Tanzania, and Togo).

The rest are located in tropical America. They are known to exhibit a wide range of origin-related variations in growth and wood characteristics. Breeding programs continue to improve the timber quality of teak-planted forests. Most of them have been established seeds of uncertain origin and quality, and more recently, clones have been produced in countries such as Brazil, Costa Rica, India, Indonesia, Malaysia, Tanzania, and Thailand.

Natural teak forests are declining, and the sustained production of teak logs from natural forests is decreasing due to over-exploitation of existing stands, deforestation, conversion to other land uses, and growing demand for environmental services from forests. But, the demand for high-quality wood will continue to grow, despite gains made in engineering timber and other low-cost substitutes, thus making it increasingly difficult to supply teak wood on a sustainable basis, either from natural forests or from plantations.
o meet the global timber requirements i in the context of reduced output from natural forests due to the practice of sustainable forest management, the establishment of large areas of quality tropical hardwood plantations is essential.

For many countries, teak represents the best opportunity to produce quality timber. And is a major asset in the forest economy and attracts large investment from the private sector. Myanmar and Ivory Coast dominate the export trade in teak logs, while China and Thailand are the largest importers. China's imports of teak logs and sawn timber are increasing (US$41 million in 2012). Teak is mostly used for manufacturing wooden furniture for export in China. The largest manufacturers of teak products are Indonesia, Thailand, and India. Most of the sawn timber produced in India consume in the domestic market. India also imports teak wood. The worldwide demand for teak is much greater than the available resources. Thailand plays a significant role across the whole teak value chain.

The wood-based manufacturing sector in Sri Lanka depends almost entirely on the local wood supply for raw materials. Treated Teak wood has become the main source of raw materials for the wooden produce industry. Teak growing in dry and intermediate lowland climatic regions in Sri Lanka covers 25,000 ha, which is the largest share of the total forest plantation area. The annual average Teak log production of STC is about 30,000 m3 (It is approximately 23 % of total log production). Moratuwa area claims to be the heart of Sri Lanka's woodworking industry.

83% of the production in the Moratuwa area is manufactured using Teak wood, and (Sri Lanka Timber cooperation) STC is their main supplier of raw materials such as logs and sawn timber.

There are about 1631 woodworking industries in the Moratuwa area; the majority of them represent carpentry workshops. As they are facing intense competition when purchasing raw materials for the furniture industry, most of them compete to purchase low-priced, defects-free, high-quality raw materials from suppliers. Although both small-scale and large-scale furniture manufacturers request their required volumes of teak logs, STC is unable to supply the teak logs according to the specifications that they demand at a lower cost.

Therefore, as a country, Sri Lankan wood-based industries should go for optional timber species as well apart from Teak due to the scarcity of teak timber.

Teak price indices have been developed from publicly available long-term time series published in ITTO's Tropical Timber Market Reports since 1998. These indices measured in US $ per cubic meter indicate the superior status of natural teak timber as compared to plantation-grown Teak. In the Indian market, the average cubic meter-related value of plantation-grown Teak is about half the value of natural Teak from Myanmar. However, in recent years the market appears to have recognized a higher value for plantation-grown Teak, the price index of which has grown more rapidly than that of the natural Teak.

Teak trees mature in about 16 years, and if kept longer, the value increases. A cubic meter of teak costs around Rs.30, 000 in Sri Lanka, and the value of a 20 years teak tree are around Rs. 15,000 – 20,000. The global demand for teak is expected to grow due to its exceptional qualities of teak wood, such as mellow color, appearance, fine grain, durability, and hardness. In the global market, the current price of teak is about US$600–US$1000 per m3 for high-quality logs and US$350–US$500 per m3 for low dimension plantation logs.

The major challenge for teak growers is to produce internationally recognized quality wood. Despite the considerable international debate over many years, the global teak trade is hampered by a lack of international standards and the lack of consistency in measuring and establishing volumes and qualities for teak logs, which results in widespread uncertainty and confusion around teak investments. Investments in teak plantations growing under suitable site conditions with genetically superior planting material and good management practices yield attractive and robust financial returns.

Large-scale private teak plantation developers in Ghana achieve return rates of more than 10% (IRR). This is mainly due to substantial economies of scale and cost-reducing management interventions such as intercropping with food crops by nearby farming communities, which reduces maintenance costs. Additionally, most investors raise their seedlings, which, apart from giving them control over the quality of planting material, also leads to lower unit costs.

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# Secrets of Hydrangeas


## Written By :

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Hydrangeas (a.k.a. Hortensia) are classical garden plants beloved for their immense flower- heads and old-fashioned charm. There are about 75 known species and 600 named
cultivars in genus *Hydrangea*. One of the most popular species is *Hydrangea* macrophylla. The name hydrangea comes from the Greek words “Hydor” which means water, and “angos” which means vessel in reference to the shape of its seed capsule, which looks like a small water jug.

The Hydrangea is a perennial shrub that ranges from 1 foot to 15 feet. Blooming is started in March and often last until July. Flowerheads are arranged as corymbs or panicles at the end of the stem. The sepals of the blooms can be pink, blue, red, white, purple, or green

But hydrangea colors are not a result of different pigments as in roses. The color of many hydrangea blooms is a result of soil pH. Therefore, these blooms act as a natural pH indicator as their bloom develops a blue color in acidic soil and pink or red in neutral to basic soil. This phenomenon is widely used in the horticulture industry by chemically manipulating the bloom color by using soil additives. We can have different color blooms on the same bush by changing the soil environment.

However, the underlying chemical mechanism of this colour-changing behavior is not soil acidity. The only pigment present in hydrangea is delphinidin-3-glucoside which is an anthocyanin and naturally red or pink in color. It can bind with aluminum sequestering it in flower and thereby protecting the plant from aluminum’s toxic effects. In acidic pH, aluminum becomes mobile as Aluminium ions and is absorbed by the roots of the plant.

# SECRETS OF HYDRANGEAS

In horticulture, if someone wishes to have blue color blooms, both Al3+ and H+ should be added to the soil. There are many commercially available additives, and most of them consist of Al2(SO4)3, which can add both ions at the same time. To have red color blooms additional lime (Ca(OH)2) should be added to the soil to be resulted a basic soil.

Then it binds with delphinidin-3-glucoside and resulted blue colour in sepals. In neutral or basic soil aluminum remains as Al(OH)3, which is immobile. Therefore, the red colour delphinidin-3- glucoside remains as it is and shows its original red or pink colour. At a threshold value about 40 pg of Al3+ per 1 g of fresh sepals, the sepals show blue colour. At a lower level than this threshold value, hydrangea sepals show purple colour, and the absence of Al3+ sepals shows red colour.

*"The Hydrangeas bushes*
*I see from my window*
*are a vivid blue color*
*Hot and humid today*
*so they do stand out*
*By the way*
*some Hydrangeas*
*are pink*
*The colors seem to come*
*from different soil*
*conditions"*

*-Keith Wilson-*

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**Composed by :**
**Ishara Lakshan**
**SC/2019/11022**

# Overcoming the challenges in life

# BE LIKE MANGROVE

Life is full of challenges. Everyone has to face their own set of challenges. So do not compare your life with others. Though you have a daily plan, you cannot predict what will happen in the next moment. That is the nature of our life. If there is a problem in front of you, there are two options; accept or escape. Instead of accepting, most people escape from the challenge and suffer throughout their life. And also, people always complain and do not satisfy with the things that they already have. No matter how serious the situation is, we must learn how to overcome the challenge and become successful. Let me give an excellent example of how it is possible.

Have you ever heard about Mangroves? Mangroves are shrubs or trees that grow in coastal saline or brackish water.

Mangroves live in extreme environmental conditions like changing tides, high salinity in the water, low oxygen availability in waterlogged soils, strong winds, etc. How pathetic they are carrying inborn challenges. But they have unique adaptations to face these challenges and to survive. There are many more adaptations; here, I'm mentioning very few. The cell sap of plant roots in most mangroves is hypertonic. It helps to extract the water from the saline soil solution. Having a thick cuticle, fleshy shiny leaves, and sunken stomata are some of the mechanisms used to conserve the absorbed water. This is how they face freshwater challenges. Mangroves possess a unique type of roots called pneumatophores that grow against gravity to make direct contact with the atmospheric air. They have found a very fruitful solution for anoxic conditions.

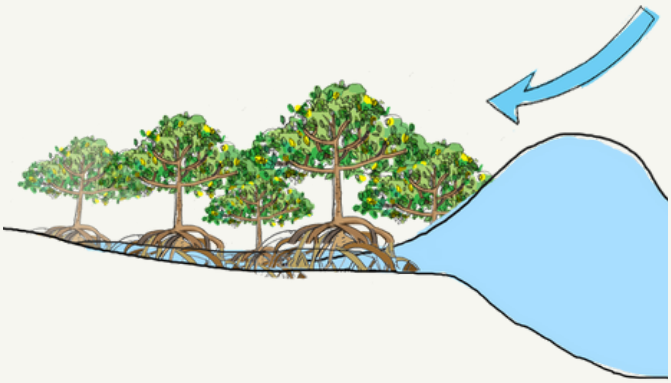
pneumatophores of mangrove

**Vivipary** is the wonderful adaptation shown by mangroves. The seeds germinate while they are attaching to the parent tree as the prevailing conditions are not suitable for seed germination. Other than that, it is difficult to anchor in water-logged muddy soil. Therefore, many mangrove species possess adventitious roots (drop roots and prop roots), which grow into the soil and provide additional anchorage. It is amazing how they face their challenges. They have found so many gimmicks to overcome their obstacles creatively. So be like a mangrove in your life. Think creatively and find solutions. Then you will find most challenges are not challenges at all.

vivipary in mangrove

The 2004 Indian ocean earthquake and tsunami were one of the deadliest natural disasters in recorded history. Kapuhenwala in Sri Lanka, surrounded by 200 hectares of dense mangroves and scrub forest, the tsunami killed only two people. Mangrove acted as a green barrier against tsunami. Tsunami waves dissipated their energy when they pass through the porous medium. They reduce the height and velocity of waves. Like mangroves, we must have the capacity to manage the situation.

Prop roots of mangrove



Protection of the coastline by mangroves

Written by :
W. K. K. G. Wickramarathna
SC/2018/10346

# Lay in peace

No more drives
to the candy stall by the riverbed
I can feel your presence fading,
fading away on your deathbed

They say life is too short to waste
But I'm still 22. I haven't even taken a taste
Grandpa,isn't there another way,
you were my hero,you don't deserve to pay
They say I'm all grown up now

but I don't understand why, when, how
a lot of things I fail even to try
for I might be grown up now, but I'm still your
"Kiri kai."

As the school bell rang, I came running
knowing I'd be at yours the rest of the day
playing
They say it's all fun to grow up that way
But I feel sad and gloomy now that you have
gone away.

What is love, pa? Is it a gift?
Does it help hearts and souls to lift?
And if it does, why does it hurt so much?
when those are leaving, whom you loved so
much

I will listen to the poem you used to sing.
I will learn every word you asked me to search
I will carry all the books which you asked me
to bring.
I will sit with you on the garden bench.

Everyone around me is talking about karma now
they are saying everyone passes away somehow
It's not fair
Shouldn't you have more time to spare?
for I could give you my soul, we could share

Know that you were a good person
You lighted my days with proper reason
if I could give life to only the people I love
Wouldn't this world be filled with dove

Goodbye grandpa I hope you lay in peace
My heart will forever be creased
But it doesn't matter for everything seems so brief
So will this pain and all the grief

Written by :
Dananjana Navaratne
SC/2020/11357

# Little Tree Plant

## SCIENTIFIC NAME: *Biophytum sensitivum*

- The plant is also a common weed in tropical greenhouses.
- Investigations have been undertaken into the plant's chemistry, biological
- activities, and medicinal uses.
- Similar to Mimosa pudica, the leaflets of *Biophytum sensitivum* can move rapidly in response to mechanical stimulation such as touch.

### HABITAT :

- Commonly found in wetlands of Nepal, tropical India,
- Sri Lanka and other Southeast Asian countries.
- Grows up to a maximum of 20 cm and possesses an unbranched woody erect stem.

### USES:

- Chemical analyses have shown that the plant parts are rich in compounds such as amentoflavone, cupressuflavone, and isoorientin.
- Its extracts are traditionally believed to be antibacterial, anti-inflammatory, antioxidant, antitumor, radioprotective, chemoprotective, antiangiogenetic, wound-healing, immunomodulatory, anti-diabetic, and cardioprotective in nature.

Written By :
A.Achini Dabare
SC/2019/10955

# Cyanotoxins;

## a hidden threat in your drinking water

Access to safe drinking water is a basic human right. Everyone has the right to have safe, adequate, continuous, and physically accessible water sup40ply for drinking, domestic use, irrigation, recreation, and various other purposes. According to the World Health Organization (WHO 2022), globally, over 2 billion people use drinking water contaminated either with feces or chemicals such as arsenic, fluoride, nitrate, pesticides, pharmaceuticals, and microplastics. Fecal-contaminated drinking water can transmit diseases such as diarrhea, cholera, dysentery, typhoid, and polio and is estimated to cause 485 000 diarrhoeal deaths each year.

In Sri Lanka, the National Water Supplies and Drainage Board (NSWDB) is the key player in supplying drinking water to the country. Presently, pipe-born water is available for over 55% of the population. This water is supplied through 348 water supply schemes distributed across the country while the rest of the population fulfills their drinking water requirement either directly from natural water resources such as rivers and reservoirs or private-owned dug wells and rainwater harvesting systems. The pipe-born water is generated after undergoing general treatment procedures of raw water taken from rivers and reservoirs, including ancient irrigation reservoirs and recently constructed multi-purpose reservoirs. In dry and intermediate zones, more than 70% of raw water for treatment plants is obtained from ancient irrigation reservoirs.

The main objectives of raw water treatment for drinking in Sri Lanka are to protect consumers' health by ensuring bacteriological safety, to reach acceptable quality standards for consumers based on taste, odor, and color, and to prevent scaling and corrosion in water distribution pipelines. These objectives are in line with the general drinking water treatment objectives of other countries. However, in countries like Sri Lanka, it is difficult to comprehend that the water quality of finished water has no obvious impact on human health based on bacteriological safety alone when raw water is obtained from static water bodies like lakes and irrigation reservoirs.

Other than fecal contaminants, static water bodies may contain additional toxic contaminants that originated from harmful cyanobacteria in the water body, known as cyanotoxin. Therefore, paying attention to potent cyanotoxin contaminations in water is particularly important for water treatment plants located in dry and intermediate zones in Sri Lanka, which obtain raw water from static ancient irrigation reservoirs. This article focuses on the nature and health impact of cyanotoxins, analytical methods for the detection of cyanotoxins, and management strategies.

## • Nature and health impacts of cyanotoxins

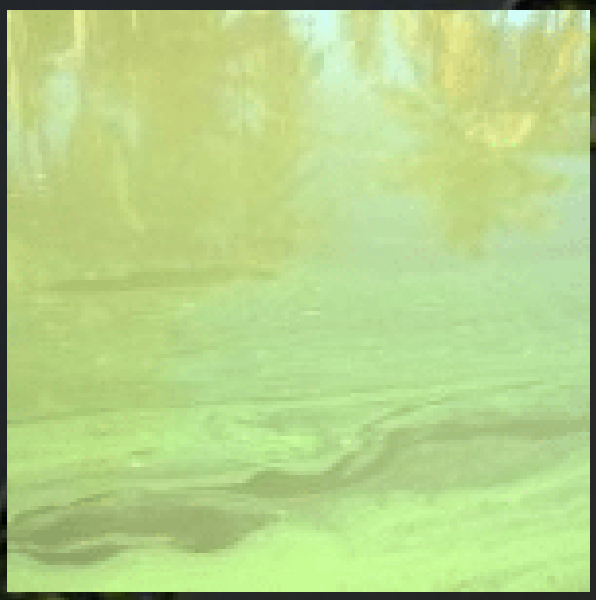
Cyanobacteria and green algae are the major primary producers in freshwater aquatic ecosystems. Cyanobacteria produce toxic secondary metabolites known as cyanotoxins. Considering the chemical structure, cyanotoxins are mainly classified into alkaloids, cyclic peptides, lipoglycans, lipopeptides, and non-protein amino acids. Microcystin (MC) is a cyclic peptide known to have more than 250 different chemical variants. The most common and toxicologically most studied MC is the MC-LR variant. MCs are produced by a wide range of species in the major orders of cyanobacteria, *viz.* Chroococcales, Oscillatoriales and Nostocales. Those species include *Anabaena*, *Anabaenopsis Microcystis*, *Nostoc*, *Oscillatoria*, *and Planktothrix*. MC-producing cyanobacteria have been reported from freshwaters in wide geographic locations.

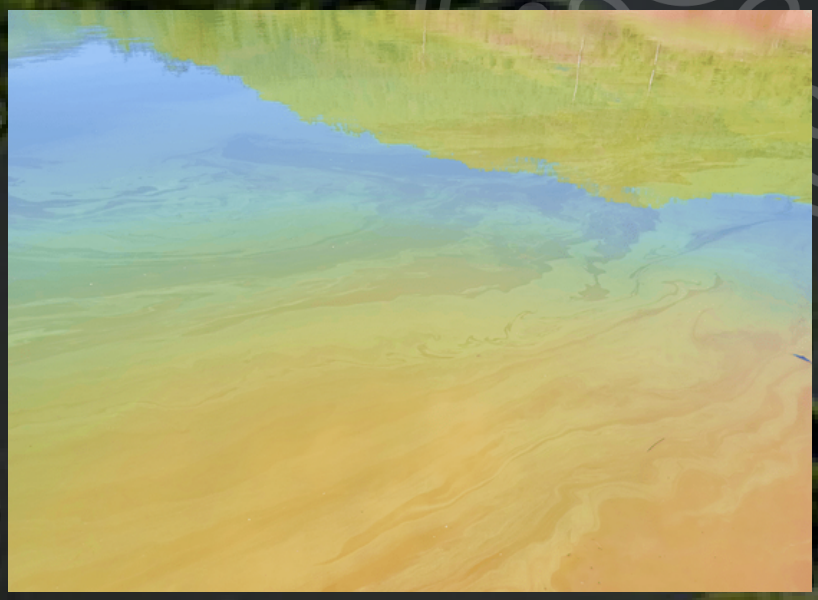
As a result, MCs are the most frequently reported cyanobacterial toxins. The second most frequently found cyanotoxin in freshwaters is cylindrospermopsin (CYN). The CYN is an alkaloid, and unlike MC, only a few natural variants are found. The CYN-producing cyanobacteria genera are primarily in the order Nostocales, such as *Anabaena*, *Aphanizomenon*, *Cylindrospermopsis*, *Raphidiopsis*, *Umezakia*, and *Lyngbya* and the genus *Oscillatoria* in the order Oscillatoriales.

Nodularin (NOD) toxin is also a cyclic peptide with only a few natural variants. It has been characterized only in the genus Nodularin so far. Anatoxin-a (presently known as guanitoxin) is a low molecular weight alkaloid and is produced by *Anabaena flos-aquae*, *Anabaena* spp., *Aphanizomenon*, *Cylindrospermum*, *Oscillatoria*, and *Plantothrix*.

Saxitoxins are also alkaloids. They are originally isolated from shellfish from marine dinoflagellates (so-called "red tide" algae) that caused deaths in humans. Saxitoxins are also produced by cyanobacteria *Aphanizomenon flos-aquae*, *Anabaena circinalis*, *Lyngbya wollei*, and *Cylindrospermopsis raciborskii*.

The lyngbyatoxin is produced by the members in the genus *Lyngbya*, and aplysiatoxin is produced by Lyngbya, Schizothrix, and Planktothrix. Both lyngbyatoxin and aplysiatoxins are alkaloids. From Sri Lankan freshwater, MCs and CYN are the most commonly and frequently reported cyanotoxins as they are the most widely studied cyanotoxins in Sri Lanka. Other types of cyanotoxins are not reported from Sri Lanka not because they are absent but because they are not specifically tested for. Hence, there is a high probability of the prevalence of cyanotoxins other than MCs and CYN as cyanobacterial species that are known to produce other types of cyanotoxins that are also present in Sri Lankan freshwaters.





*Aphanizomenon* bloom observed in Ridiyagam reservoir, Ambalantota in August 2021 (left) and *Microcystis* bloom in Castlereagh reservoir in Maskeliya observed in April 2022 (right).

Cyanotoxins are classified according to their toxic effect on humans. Microcystin, NOD, and CYN are hepatotoxins. Anatoxin-a and saxitoxin are neurotoxins, while lyngbyatoxin and aplysiatoxin lead to dermatotoxicity. Hepatotoxins can cause acute liver and kidney failure. Neurotoxins affect the central nervous system and can cause seizures, paralysis, respiratory failure, or cardiac arrest. Anantoxin-a is the most dangerous of all as it can cause death within minutes or hours. Anatoxin-a degrades quickly, within less than 24 hours in most natural blooms. Therefore, rapid degradation creates problems for determining toxin levels after exposure. Dermatotoxins affect the skin and mucous membranes. Their symptoms include skin rashes, allergic-like reactions such as a runny nose, sore throat, nausea, and vomiting. Exposure to high doses of cyanotoxins can lead to the death of a human, pets like dogs, birds, and fish. The sudden death of fish is an indication of potent cyanotoxin contamination in water.

Many species of cyanobacteria can produce more than one type of cyanotoxin. For instance, *Aphanizomenon* produces MC, CYN, anatoxin-a, and saxitoxin. Therefore, exposure to water containing a dense population of such cyanobacteria may lead to multiple toxic effects.

Cyanotoxins such as MCs are intracellular toxins that accumulate in viable cells. Lysis of cells due to natural senescence of blooms or induced by cyanophage activity, unfavorable conditions, or algicidal treatment release a large concentration of toxin to the surface water. Hydrophilic cyanotoxins such as CYN are released from cells to their extracellular environment and are readily dissolved in water. In addition, cyanotoxins can also accumulate in deep sediments. Recent evidence showed that cyanotoxins could bioaccumulate in the tissues of fish and plants such as rice that are fed with cyanotoxin-contaminated irrigation water.

Cyanotoxins accumulate in high concentrations in surface waters when toxic cyanobacterial blooms are formed. Cyanobacterial blooms are frequently formed in warm, static, and eutrophic waters. Our studies during the last three years, from 2019-2022, and previous studies by other researchers showed that the majority of reservoirs that supply water for water treatment plants, fisheries, and irrigation in the dry and intermediate zone in Sri Lanka are eutrophic, which make them ideal places for cyanobacterial bloom formation and accumulation of cyanotoxins.

Some of the major reservoirs where toxic cyanobacterial blooms were found include, Basawakkulama, Nachchaduwa, Mahakanadarawa, Kala *wewa*, and Tissa *wewa* in Anuradhapura district, Parakrama Samudraya Padaviya, Giritale and Kaudulla in Polonnaruwa district, Iranamaduwa reservoir in Kilinochchi district, Senanayake Samudraya and Maduru Oya in Ampara district, Lunugamvehera, Chandrika wewa and Ridiyagama reservoirs in Hambantota district. Their toxin levels were mostly above the maximum permissible limit for drinking water (1.0 µg/L for MC and 0.7 µg/L for CYN) defined by WHO and Sri Lanka Standard Institute. Our studies also found that fish death and symptoms like skin irritation often coincide with cyanobacterial blooms and high concentrations of cyanotoxins in surface waters.

## • Analytical methods

Ingestion of cyanotoxin-contaminated water is the most direct route of exposure. Bathing, consumption of toxin-contaminated food items such as fish, irrigation, and recreational activities are the other possible routes of exposure. Cyanotoxins are highly stable in water and moderately resistant to chemical and microbial breakdown. Cyanotoxin-contaminated water could not be identified by its color, odor, or taste. Toxins can remain in the water for a long time after the senescence of bloom. Therefore, unless analytically detected, it is impossible to trace cyanotoxin contaminations in water.

Cyanotoxins are analytically tested by enzyme-linked immunosorbent assay (ELISA) and liquid chromatography coupled with mass spectrometry (LC-MS). Commercially available ELISA kits are one of the popularly used testing methods, as they are relatively low cost and do not require extensive training to run. ELISA gives accurate quantitative measurements of cyanotoxins. Presently, more precise and accurate test kits are available for MC-LR, NOD, CYN, and saxitoxin. In addition, semi-quantitative field screening ELISA test kits are also available for the detection of their presence or absence.

However, ELISA kits are unavailable for anatoxin-a, instead, a rapid receptor-binging kit is available. ELISA kits have some limitations in specificity as some are not congener specific and some have cross-reactivity. For example, both MC and NOD kits are based on ADDA structure within the MC molecule which is shared by all chemical variants of MCs. As a result, ELISA cannot distinguish between congeners of MC. On the other hand, ADDA structure is also present in NOD molecules with little structural changes. Therefore, ELISA kits for MC cross-react with NOD in the test sample. In contrast, LC-MS can precisely and accurately identify cyanotoxins with high specificity if analytical standards are available.

## • Management strategies

When cyanotoxins and their toxins are detected in surface waters of reservoirs that supply water for treatment plants, they should be carefully managed by understanding the growth pattern and dominant species of the bloom, nature of their toxins, and appropriate treatment processes. Some management options are effective for some cyanotoxins but not for others. For intracellular cyanotoxins, treatment options should be designed to prevent cell lysis in order to avoid the release of toxins into the water.

Coagulation and sedimentation used in general treatment procedures effectively remove cyanobacterial cell biomass present in raw water. Dissolved air floatation (DAF) also effectively removes intracellular toxins from water since many toxin-producing cyanobacteria are buoyant. In Sri Lanka, coagulation and sedimentation are the processes used to remove suspended solids, including cell biomass, from water. However, cyanotoxins that are dissolved (extracellular) in water are not removed by coagulation and sedimentation.

Filtration and treatments of chemicals, ozone, and radiation, are some of the presently unitizing methods to remove dissolved cyanotoxins in water. Ozonation, which is not included in the Sri Lankan general water treatment procedures, effectively removes anatoxin-a, CYN, and MC. The effectiveness of chemical and radiation treatments depends on the type of cyanotoxin being treated and the pH of the water.

For instance, activated carbon is effective for MC but not for anatoxin-a, CYN, and saxitoxin. In Sri Lanka, activated carbon is not an essential component in the filtration systems in treatment plants. Disinfection by chlorination oxidizes dissolved cyanotoxins from finished water. It is effective only when the pH of water is below 8.0. Chlorination appears to be a promising option to remove dissolved cyanotoxins from water in Sri Lanka since it is the widely utilized disinfection method, and both MC and CYN are effectively removed by chlorination.

However, pH is an issue in freshwaters in some areas where raw water pH is above 8.0. Chlorination is ineffective for anatoxin-a. UV radiation is another option used by other countries to treat cyanotoxin-contaminated water, which effectively degrades both MC and CYN. However, its application is impractical at high doses and is not cost-effective for countries like Sri Lanka.

Hence, coagulation, sedimentation, and chlorination in the general drinking water procedure in Sri Lanka contribute to removing cyanotoxins from water to some extent. Therefore, unless successfully treated, cyanotoxin-contaminated water can reach the consumer. Cyanotoxins are not destroyed in boiling and cooking. Also, can pass through domestic drinking water filtration systems. Therefore, if raw water is contaminated with cyanotoxins, there is a high possibility of consuming contaminated water unknowingly.

Hence, careful monitoring of water resources for bloom formation and analytical detection of raw water before entering the treatment plant are the most effective safety persuasions to prevent potential health hazards.

However, unfortunately in Sri Lanka, we do not have mechanisms for surveillance of toxic cyanobacterial blooms or their toxins. Freshwater reservoirs are not monitored for the presence of cyanobacterial bloom.

Although research conducted by universities and other institutes has identified toxic bloom-forming reservoirs, that information is not effectively transferred to the ground level. Also, cyanotoxins are not routinely tested in raw water, especially in regional water treatment plants. The major constraints appear to be a lack of knowledge on cyanotoxins and their hazardous health impact, lack of technical knowledge to conduct analytical tests, and high operational cost for routing detection. Further in Sri Lanka, reports on clinical diagnosis of cyanotoxic effects on humans are not available.

Therefore, Sri Lanka requires a cost-effective monitoring system for toxic cyanobacterial blooms and their toxins to minimize potential health hazards. Most other countries are now moving toward remote sensing for monitoring and forecasting harmful cyanobacterial blooms as an effective mechanism of surveillance. Thereby aims to prevent cyanotoxin-contaminated raw water from entering into treatment plants. At the same time, remote sensing can provide early warning to the public for potent harmful cyanobacterial blooms and their toxins.

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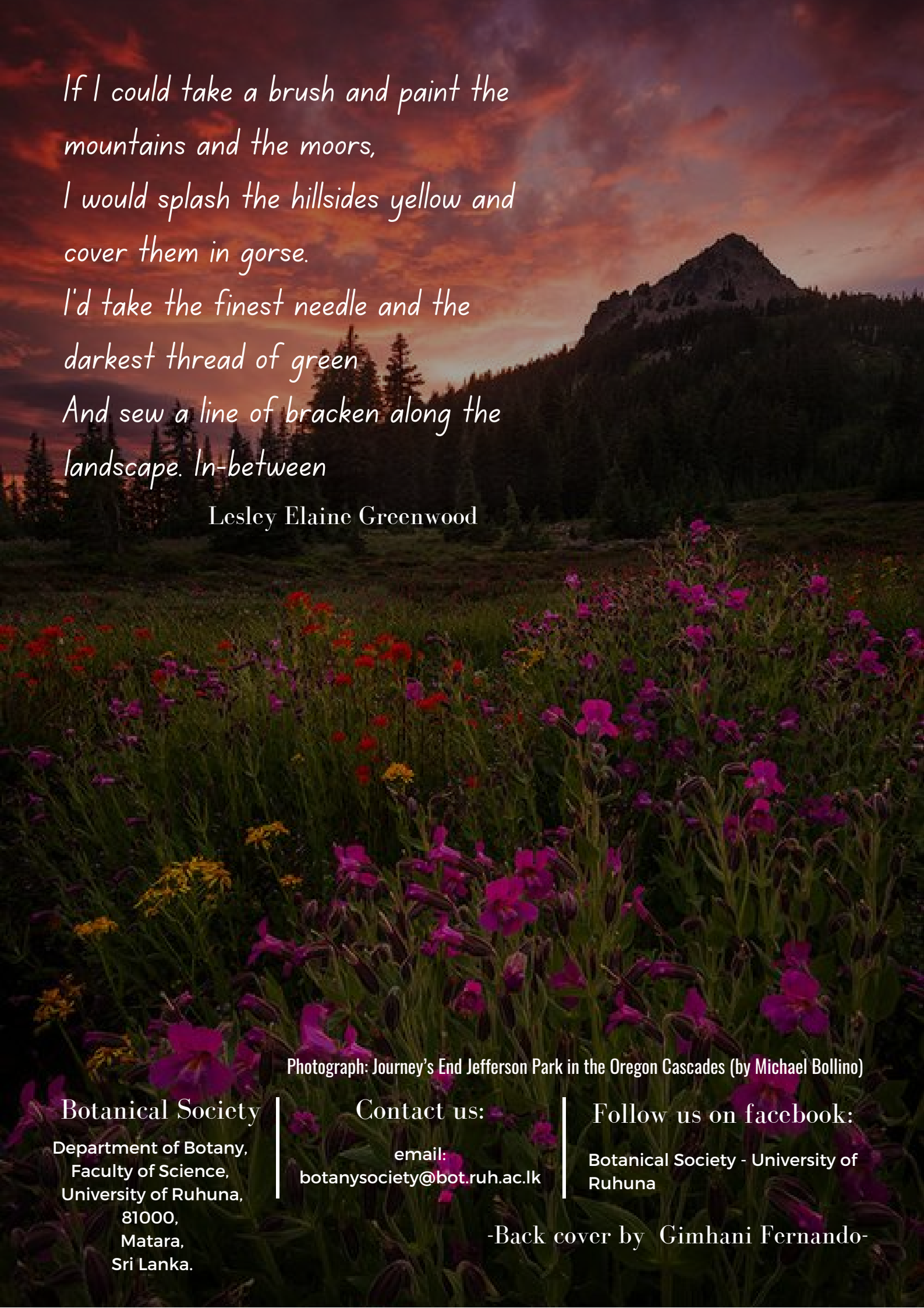

If I could take a brush and paint the
mountains and the moors,
I would splash the hillsides yellow and
cover them in gorse.
I'd take the finest needle and the
darkest thread of green
And sew a line of bracken along the
landscape. In-between

Lesley Elaine Greenwood

Photograph: Journey's End Jefferson Park in the Oregon Cascades (by Michael Bollino)


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