REPORT

WEBINAR SERIES ON TROPICAL FRUITS

LONGAN

Prospects of Expanding Longan Production and Markets

November 2024

International Tropical Fruits Network (TFNet)

All reasonable efforts have been taken in the compilation and editing of the materials presented in this document. The views expressed herein are those of the presenters, panelists, and facilitators, and not necessarily those of the International Tropical Fruits Network (TFNet) and its members. Any companies, products from manufacturers, and technologies mentioned do not imply the endorsement or recommendation by TFNet.

eISBN: 978-983-2532-17-0

Published by:
International Tropical Fruits Network (TFNet)
Box 334, UPM Post Office,
43400 Serdang, Selangor,
Malaysia.
Tel: 603-89416589
Fax: 603-89416591
Website: www.itfnet.org
E-mail: info@itfnet.org

Prepared by:
Dorothy Chandrabalan
Yacob Ahmad

Layout by:
Christian Anthony T. Cangao

Photos:
Niddle P


Photo: Niddle P

CONTENTS

1.0. EXECUTIVE SUMMARY

Dimocarpus longan, commonly known as longan, is a tropical fruit gaining increasing popularity and holds potential for further development in global markets. Like litchi and rambutan, longan belongs to the Sapindaceae family and is believed to have originated in the tropical regions of Southeast Asia and East Asia.

Commercial longan varieties, particularly those developed in China, Thailand, and Vietnam, vary in size, pulp thickness, seed size, taste, and yield. However, challenges such as high perishability, pests, diseases, and inconsistent production remain significant hurdles.

To address these challenges and explore growth opportunities, the International Tropical Fruits Network (TFNet), in collaboration with the Fruit Tree Research Institute, Guangdong Academy of Agricultural Sciences (GDAAS), and the Southern Horticulture Research Institute (SOFRI) of Vietnam, hosted a webinar titled "Prospects of Expanding Longan Production and Markets" on the 2nd of April 2024. The webinar brought together four proficient presenters familiar with the fruit and in their respective fields, who shared their insights on best practices, challenges,

and future directions for longan production in their respective countries. The session covered various aspects, including sustainable practices, advanced research findings, and potential market opportunities. The webinar was attended by one hundred and twenty-three (123) participants from 13 countries, mostly from Malaysia, Indonesia, Vietnam, India and China. Seventy three (73) of the participants were from government research and development and extension agencies, thirty four (34) from academia, eight (8) from the private sector and six (6) from organizations or NGOs.

Dr. Tran Thi My Hanh from the Southern Horticultural Research Institute (SOFRI) provided an overview of longan production in Vietnam. With 82,000 hectares dedicated to longan cultivation, Vietnam's favourable agroclimatic conditions include optimal temperatures, full sunlight, and suitable well-drained soils. Key practices involve effective canopy management, specific nutrient applications, and Integrated Pest Management (IPM). Challenges such as climate change, market competition, and pest management were identified. The need for advanced technologies, improved fruit quality, and strategic market approaches were emphasized to enhance Vietnam's longan production and export capabilities.

Dr. Jing Wang from the Guangdong Academy of Agricultural Sciences presented her research on unilateral cross incompatibility (UCI) in longan. Key findings include the role of boron deficiency in UCI and the regulatory function of jasmonic acid (JA). Mechanized cultivation methods and fruit detection techniques were highlighted as future directions to improve production efficiency. The research's implications for breeding programs and mechanized practices promise significant advancements in longan cultivation in China.

Dr. Chaireni Martasari from the National Research and Innovation Agency discussed the status of longan cultivation in Indonesia. Despite high local demand, Indonesia still imports longan due to insufficient domestic production. Successful intercropping practices, particularly in East Java, demonstrate high productivity. Challenges include complex propagation methods, high costs, and reliance on chemical boosters for flowering. Government support focuses on expanding planting areas, developing new varieties, and improving post-harvest technologies. Agrotourism and processed longan products present additional market opportunities.

Dr. Shiamala Devi Ramaiyah from University Putra Malaysia analyzed the potential of crystal longan (Pometia pinnata) cultivation in Malaysia. Despite being underutilized, crystal longan offers significant opportunities due to its fast growth and high nutritional value. Challenges include identifying suitable varieties, lack of comprehensive research, and limited consumer awareness. Promoting crystal longan as an intercrop and enhancing market linkage through innovative products and awareness campaigns were suggested as key strategies to boost domestic cultivation and reduce imports.

The panel discussion addressed several key topics concerning longan cultivation and its prospects. The panel explored the origins of longan, suggesting that East Asia and Southeast Asia to be potential centres of origin. Looking to the future, the panellists provided insights into advancing longan cultivation and research. Overall, the discussion underscored the significant potential for expanding longan cultivation through enhanced research, mechanized methods, better pest and disease management, and improved market development. The importance of international collaboration and innovative approaches was highlighted as essential for advancing the longan industry regionally.

2. INTRODUCTION

Dimocarpus longan, commonly known as longan, is a tropical fruit gaining increasing popularity and holds potential for further development in global markets. Like litchi and rambutan, longan belongs to the Sapindaceae family and is believed to have originated in the tropical regions of Southeast Asia and East Asia.

Commercial longan varieties, particularly those developed in China, Thailand, and Vietnam, vary in size, pulp thickness, seed size, taste, and yield. However, challenges such as high perishability, pests, diseases, and inconsistent production remain significant hurdles.

Adding to the list of minor tropical fruits that have the potential to be globally developed, a webinar with the theme 'Prospects of expanding Longan production and markets' held on 5 April 2024. The webinar workshop organized by International Tropical Fruits Network (TFNet), Guangdong Academy of Agricultural Sciences (GDAAS) and Southern Horticultural Research Institute (SOFRI), Vietnam spotlighted on speakers from China, Malaysia, Indonesia and Vietnam who shared the status and development of the fruit in their countries. One hundred and twenty three (123) participants from 13 countries attended the webinar, mainly from Malaysia (69), Indonesia (20), Vietnam (10), India (9) and China (5), Korea (3), Thailand (2), and one each from USA, Philippines, Oman, Fiji, Australia and Bangladesh. Seventy three (73) of the participants were from government research and development and extension agencies, thirty four (36) from academia, eight (8) from the private sector and six (6) from organizations and NGO's.

The objectives of the webinar were:

a. To share information on the common varieties, production status, processing options, market, challenges and opportunities in developing the fruit.
b. To share information on research and development focus, including varietal development, best farm practices, postharvest management, pests and diseases management and impact of the weather on longan production.
c. To discuss initiatives to enhance the visibility of longan in global markets.
d. To establish networking among longan and other tropical fruits stakeholders.

The speakers for the webinar were Dr. Tran Thi My Hanh from Southern Horticultural Research Institute, Vietnam who shared Vietnam's longan development through her paper 'The status of longan production in Vietnam – best practices , challenges and sustainability'.

Dr. Wang Jing from the Fruit Tree Research Institute, Guangdong Academy of Agricultural Sciences, China who presented on 'Investigating the Mechanisms of Unilateral Cross-Incompatibility (UCI) in Longan', followed by Dr. Chaireni Martasari, from the Indonesian National Research and Innovation Agency, who presented on 'The status of longan cultivation and market prospects in Indonesia'. Dr. Shiamala D. Ramaiyah from Universiti Putra Malaysia described another species of longan and its commercial potential in her presentation on 'Current status and prospects of crystal longan in Malaysia'.

3. WEBINAR PRESENTATIONS

Moderator: Yacob Ahmad, Advisor, International Tropical Fruits

3.1. The Status of Longan Production in Vietnam – Best Practices, Challenges and Sustainability

Dr. Tran Thi My Hanh, Deputy Head of Plant Protection and Senior Researcher, Southern Horticultural Research Institute (SOFRI), Vietnam

Vietnam's total fruit production area is approximately 1.2 million hectares, generating an export value of $5.6 billion USD in 2023. Key fruits include banana, mango, durian, pomelo, orange, longan, jackfruit, lychee, dragon fruit, pineapple, and rambutan. Among these, longan is a significant crop, occupying 82,000 hectares, which is 6.7% of the total fruit planting area. The main production areas are in the Central Highlands (36%), Mekong Delta (31%) and the South Easter region (9%)

The optimal conditions for longan production include a temperature range of 21-27°C for growth, with the flowering season requiring slightly higher temperatures of 25-31°C. Longan trees thrive in full sunlight, which promotes better fruit yield and quality. The ideal annual rainfall for longan is between 1,400 and 2,200 mm. The best soil types for longan cultivation are sandy, acrisols, alluvial, and bazan (red basaltic soils) soils with good drainage and a pH range of 5.6-6.7.

In North Vietnam, popular longan varieties include Long Hung Yen, Cui, Chin Muon Ha Tay, and Huong Chi. The Long Hung Yen variety is noted for its small size, yellow colour, pleasant aroma, and crispy flesh. In South Vietnam, varieties such as Tieu Da Bo, Edor, Xuong Com Vang, Thanh Nhan, and hybrids like LD11 and LD19 are prevalent. Typically, harvesting in the south occurs from June to July and July to August in the north.

From 2018 to 2021, longan production in Vietnam has seen stable expansion and increased productivity. Cultivation practices include varying planting distances from 5m x 5m to 6m x 6m, resulting in tree densities of 280-400 trees per hectare. Effective canopy management, such as pruning undesirable branches after harvesting, helps reduce pests and diseases and improves ventilation and fruit quality.

Research indicates specific nutrient requirements for longan trees, including nitrogen (0.8-1.5 kg per tree per year), phosphorus (0.4-0.7 kg per tree per year), and potassium (0.8-1.5 kg per tree per year), with an application of 10-30 kg of organic matter per tree per year. Foliar applications of soluble borax and plant growth regulators such as NAA and GA3's are recommended for improved fruit set and yield. With different irrigation requirements at the different development stages, economic factors have to be considered. Climate change poses irrigation challenges, necessitating studies on water requirements at different growth stages. Potassium Chlorate (KClO3) is commonly used as a soil drench to induce flowering, sometimes together with the practice of branch girdling.

Key pests affecting longan include mites, mealybugs, fruit borers and fruit flies, with the last two listed as very important pests. For fruit borers, using mesh netted bags, light traps, and balanced fertilizer application are recommended. For fruit flies, methods include protecting natural predators, using sticky traps, using protein baits such as SOFRI-Protein as adult fly attractant, and SOFRI-Paeccilomyces organic matter mix to control pupae, and rearing and releasing black earwigs (*Chelisoches morio*) and parasitoid wasp (*Diachasmimorpha longicaudata*) to manage fruit fly population. Debilitating diseases such as longan witches' broom are managed through pruning infected branches and shoots, doubling use of K2O and organic matter, rearing and releasing predatory mite *Amblyseius longispinosus* to control eriophyid mites, and, additionally sulphur or neem sprays to control the same mites. For fruit rot caused by *Phytophthora spp*, control measures include soil lime application to increase pH, application of a mixture of SOFRI-Trichoderma and OM or soil fungal and soil moisture control by restricting irrigation. All the practices to control pests and diseases described above have been incorporated into Integrated Pest Management (IPM) for longan and adopted in some orchards. Farms which practices IPM tend to have higher economic efficiency, reduced pesticide use, increased food safety, and better market prices compared to non IPM ones.

Harvesting season typically stretches from May to November, with the peak period in June and July. Harvesting is also carried out in the morning when cool and dry weather, are preferred. Effective post-harvest handling within four hours involves sorting, trimming, washing, coding, irradiation (when required), packing in mesh bags, put into cartons and cold chain transportation at 5 degree C with 85-90 percent relative humidity. Estimated postharvest losses in longan ranges from 11 to 35 percent, most of which occurs at the retailer/consumer level (5-10 percent). Besides being sold fresh, longan is also processed into dried longan, longan pollen, syrup, sugar added canned products, wine and juice.

Vietnam exports longan primarily to China, with smaller amounts to the US, Europe, Canada, New Zealand, Australia, Japan, and Korea. However, exports have declined since 2019 due to the aftermath of the COVID-19 pandemic. The challenges in longan production include small landholders, market competition, impact on production due to climate change, emerging pests and diseases, and farmers' lack of IPM knowledge. Market challenges include lack of market information, postharvest losses, lack in product branding, strict quarantine regulations for export markets and exporters' preference for a more lucrative fruit, such as durian.

To sustain fruit production and markets, including longan, Vietnam has embarked on the use of production and packaging facilities area codes, establish farmers' groups and cooperative that have been GAP certified and introducing low carbon models by using less chemical fertilizer, IPM and 'green technology'.

Dr. My Hanh continued by sharing the Ministry of Agriculture and Rural Development (MARD) future development plans for 14 key tropical fruits until 2023, including longan which includes maintaining current production areas, enhancing research to develop new longan varieties, continue to improve fruit quality and standards, develop certified code systems for production areas, conducting supply and value chain analysis, value addition initiatives, as well as market studies and building brands for Vietnamese longan.

In conclusion, Dr. Tran Thi My Hanh's presentation highlighted the status and future directions

for longan production in Vietnam. She emphasized the need for sustainable practices, advanced technologies, and strategic market approaches to enhance production and export capabilities.

3.2. Investigating the Mechanisms of Unilateral Cross-incompatibility (UCI) in Longan

Dr. Jing Wang, Institute of Fruit Tree Research, Guangdong Academy of Agricultural Sciences

Dr. Jing Wang presented her research on the mechanisms of unilateral cross incompatibility (UCI) in longan. The speaker's work began in 2018 in Guangzhou, Guangdong Province, an area known for having the largest longan planting area in China, approximately 126,000 hectares. This region is home to a longan germplasm resource nursery founded in 1978, covering around two hectares and containing more than 150 longan accessions. The presentation was divided into four parts: Longan Genome and Population Genetic Diversity, Boron Deficiency's Contribution to Longan UCI, JA-DISPHS Regulation of Longan UCI, and additional projects on longan.

In 2023, the research team successfully assembled a high-quality, chromosome-level longan genome. The genome size was 455.5 Mb, with 98.7% of sequences anchored onto 15 chromosomes. To explore the genetic diversity of longan germplasms worldwide, the team performed genome sequencing on 87 longan accessions, primarily from Guangdong and Fujian provinces in China, as well as from Thailand, Vietnam, and Australia. The data revealed that the biogeography of longan significantly contributes to its genetic diversity. For example, Thai populations, where the main cultivar Yiduo is known for its excellent taste, were found to be genetically distant from Chinese populations, which mainly grow the Shixia cultivar, known for its good taste but smaller fruit size. The team hypothesized that crossing Yiduo with Shixia could produce heterozygous offspring with superior fruit quality.

Since 2018, the researcher has been crossing Yiduo and Shixia varieties annually. However, unilateral cross incompatibility (UCI) occurred when using Yiduo as the female parent and Shixia as the male parent. The researchers speculated that this incompatibility might be due to boron deficiency, as soil in Guangdong orchards contained only 0.17 mg/kg of boron, compared to up to 5 mg/kg in Thailand. To investigate, they conducted a boron application experiment, which successfully restored cross compatibility, allowing Yiduo to bear fruit. This confirmed that boron deficiency contributed to UCI in Yiduo. Further investigations revealed that despite Yiduo's high demand for boron, its leaves and flowers had higher boron levels than Shixia. Molecular analysis showed that specific boron transporters, such as NIP-19 and NIP1, played crucial roles in boron levels. NIP1, expressed in Shixia flowers, functioned as an importer under high boron conditions, while NIP-19, expressed in Yiduo's vegetative organs, acted as an exporter.

During the boron application experiment, the team observed down-regulation of jasmonic acid (JA) in Yiduo's female flowers. This led to further investigation into JA's role in UCI. Macroscopic observations and comparisons of pollen tube growth rates indicated that Yiduo inhibited pollen tube growth when used as the female parent. The team found that JA and its active form, JA-ILE, were consistently higher in Yiduo compared to Shixia. By preventing JA biosynthesis using chemicals like ibuprofen, they could break the UCI phenomenon, confirming JA's regulatory role. Transcriptomic analysis identified SPH5 as a self-incompatibility protein regulated by JA,

with higher expression levels in Yiduo than in Shixia. SPH5, a small peptide secreted into the extracellular space, interacted with pollen-expressed kinase MIKI, inhibiting pollen tube growth. The final part of the presentation covered additional projects focused on improving longan cultivation. As longan trees grow taller over time, management becomes labour-intensive. The team is exploring mechanized cultivation methods, including mechanized pruning and new techniques for fruit detection. For fruit detection, they are using FT NIR analyzers that rely on near-infrared spectroscopy and exact cameras to detect fruit phenotypes, hoping to find correlations between these methods.

In conclusion, the speaker emphasized the significant progress made in understanding and improving longan cultivation through genetic and molecular research. The findings on UCI and the role of boron and JA in longan cross-compatibility are particularly promising for future breeding programs. The ongoing projects on mechanized cultivation and fruit detection are expected to further enhance longan production efficiency and quality.

3.3. The Status of Longan Cultivation in Indonesia – best practices, challenges and market

Dr. Chaireni Martasari, National Research and Innovation Agency, Malang, Indonesia

Dr. Chaireni Martasari presented the report on the status of longan cultivation in Indonesia. Longan, known locally as Lengkeng, is not native to Indonesia and is believed to have been introduced in the 18th century. Traditionally grown in yards by farmers across the archipelago, longan is highly favored by Indonesians for its sweet taste. While currently enjoyed primarily as a table fruit, longan was initially consumed for its medicinal properties. It is believed to reduce stress and insomnia, strengthen bones due to its vitamins and minerals, and contribute to heart health and kidney stone prevention. Despite the popularity of longan, Indonesia still imports the fruit predominantly from Thailand, Vietnam, and China. However, local cultivation has been increasing, with longan grown both in lowland and highland areas up to 900 meters above sea level.

The production of longan in Indonesia, as illustrated in a graphic, ranks as one of the lowest compared to other fruits. East Java stands out as a major production center, witnessing a 25% increase in longan production from 2021 to 2022. Interest in longan cultivation began in 2000 with the introduction of lowland mainly Thai varieties such as Diamond River, Pingpong and Itoh. Lowland production areas include Demak, Semarang and Kendal in Central Java. Longan are also grown in higher elevations (500 – 900 above sea level) in Magelang, Temanggung, Ambarawa, Saltiga in Central Java and Tumpang/Poncokusuma, Batu in East Java. Factors which lead to this includes earlier bearing from grafted plants and appealing fruit appearance and taste. A case study from Sugihan Village, Tuban District, East Java, showcased the successful cultivation of 3,800 trees over 25 hectares between 2000 and 2020. The growers practiced mixed cropping with chili and rice, and with some of them rearing bees. With this system, higher productivity was achieved, with yields around 40 kg per tree, resulting in approximately 152,000 kg of fruit per season, which is considered high under Indonesian conditions.

Indonesia grows both local and introduced varieties of longan. Local varieties thrive in medium

to high altitudes, with examples including Kopyor, Batu, Selarong, Pringsurat, and Mutiara Poncokusumo. These varieties are known for their sweet taste and brown to dark brown skin. Introduced varieties, such as Ping Pong, Diamond River, and Itoh, are often grown in low to medium altitudes, and requires mechanical and chemical treatments for flowering. Popular varieties among farmers include Diamond River, Ping Pong, and Itoh, which are early maturing, high yielding, very sweet and easy to maintain.

Longan cultivation in Indonesia depends on several factors, including climate, altitude (0-900m above sea level), desired rainfall (2,500-3,000 mm/year), optimum temperatures (20-33°C with 65-90% relative humidity), and good soil conditions (pH 5.5-6.5). Propagation is typically done through vegetative methods, such as grafting, cuttings and marcotting, with seeds from generative propagation used only as rootstocks due to high segregation in cross-pollinated flowers. Challenges in propagation include high seedling demand, limited rootstock availability due to seasonal seed availability, which also impacts seedling prices. Seedling production through in vitro culture techniques needs to be developed.

Flower stimulation in higher elevations is less problematic due to the cooler temperatures, however, trees grown in lowland areas need application of chemicals such as potassium chlorate (KClO3), of which availability is limited and expensive, for floral induction. The chemical is normally applied normally soil drenching.

Besides leaf eating caterpillars, borers, fruit flies and bug, bats are also very important pests of longan. Bat control includes wrapping the fruit inflorescence with bags or woven bamboo or to cons yjtruct 'preventive' nets around the farm, which can be expensive. Common longan diseases in Indonesia include 'upas' fungus, white root, black root, leaf spot and root rot.

Traditional markets are the primary venues for selling fresh longan fruit, but online marketplaces are also emerging. Agrotourism, particularly fruit-picking activities, is gaining popularity and proving profitable for plantations, especially in East Java. Processed longan products, such as dried fruits and seeds used as 'coffee beans' branded as "Koleng," are also available. Longan fruits are even processed into chips.

The Indonesian government actively supports the longan industry through research and development of new varieties, pest and disease management, expansion of planting areas, and branding new regions as 'Kampung Lengkeng.' There is also a focus on producing and distributing high-quality seedlings, moving production centres towards commercial scale, implementing Good Agricultural Practices (GAP), improving post-harvest technologies, and developing marketing networks, and encourage production in the lowland areas. These initiatives aim to enhance the sustainability and profitability of longan cultivation in Indonesia.

3.4. An Assessment of the Potential of Crystal Longan Cultivation in Malaysia

Dr. Shiamala Devi Ramaiyah, Senior Lecturer, Faculty of Agriculture and Plantation, University Putra Malaysia (Bintulu Campus)

Dr. Shiamala Devi Ramaiyah presented an in-depth analysis of the status and prospects of crystal longan (*Pometia pinnata*) cultivation in East Malaysia, particularly in the Borneo Highlands. This report outlines the unique species and genotypes of longan found in East Malaysia, with a

specific focus on the crystal longan, its potential for commercial cultivation, and the challenges faced.

The Sapindaceae family, also known as the soapberry family, includes approximately 1,900 species across 140 genera. Among these, lychee, longan, and rambutan are prominent due to their translucent, sweet flesh. These fruits are popular worldwide and are often used in products like juice, jelly, and ice cream. In Malaysia, rambutan is a major crop, producing about 159,000 metric tonnes annually. Longan, while popular, is considered a minor fruit with only about 35.6 hectares under cultivation and an annual production of 714 metric tonnes. Due to high demand, Malaysia imports longan from Thailand.

East Malaysia is home to three genotypes of indigenous longan, a subspecies of the common longan (*Dimocarpus longan*) known as malesianus. These genotypes are locally known as Kakus, Isau, and Sau. Isau and Sau trees grow along riverbanks in Sarawak, and their fruits remain green when ripe. Kakus, popular in Sarawak, turns yellow when ripe. These genotypes share similar characteristics with the common longan in terms of texture and aroma.

Crystal longan, also known as Island Lychee, Crystal Lychee, Fijian Longan, Matoa, Kasai, and Tawa, belongs to the Sapindaceae family due to its single large seed and thick white or translucent yellow flesh. However, it is classified under genus *Pometia* and species *pinnata*, unlike the popular and easily available longan species which belongs to the genus *Dimorcarpus*. The fruit combines flavors of rambutan, durian, and lychee. The skin is hard, requiring a special method to open. Dr. Shiamala reported that according to Jacobs (1962), in Sarawak, Malaysia, based on morphological characteristics such as inflorescence, leaflet midrib and nerves, there are eight forms belonging to the crystal longan genotypes under *Pometia pinnata*. Most of the underutilized fruits of crystal longan genotypes are edible such as *Formae glabra, ainifolia* and *cuspidata*, while others like *Forma pinnata*, also known as Kasai is inedible. *Forma glabra* is sold in various colours like green, rainbow, red, and purple, while *Forma alnifolia* is yellow Specifically, the formae are distinguished by characteristics such as fruit skin hardness, floral morphology, leaf size and shininess and ovary color.

Despite its potential, *Pometia pinnata* is underutilized in Malaysia. It was introduced from Papua New Guinea, where it was initially planted for timber and later for edible uses. The species is well distributed across South China, Southeast Asia, and South Asia.

Crystal longan is cultivated on a small scale in Malaysia, often intercropped with cocoa and other fruit farms. It is valued for its fast growth, producing fruits within two to three years after transplanting. The fruit is seasonal, with harvests between May to July and September to November, yielding up to 200 kg per tree annually. In Malaysia, crystal longan fetches a price of MYR10 to MYR35 per kg, depending on genotype, locality, and seasonality.

According to studies, there is increased demand for the fruit because it fast growing with high yields, increasing use for landscape and timber, all fruit parts can be utilized and its high nutrition content. Crystal longan is rich in vitamins, antioxidants, and minerals, with a high fructose content that contributes to its sweetness. The fruit also contains significant amounts of vitamin C, comparable to citrus fruits. The plant parts of Pometia pinnata have therapeutic potential due to the presence of polyphenols, alkaloids, flavonoids, terpenoids, saponins, and coumarins, offering properties such as anti-diabetic, anti-HIV, anti-neurotic, anti-obesity, anti-

hypertension, and antimicrobial effects.

While there is potential for commercial cultivation, several challenges hinder the commercialization of crystal longan. These include the need to identify suitable varieties, lack of comprehensive research on good agricultural practices, post-harvest management, poor resource management, and limited awareness among consumers and farmers. Furthermore, there is a lack of innovative products developed from the fruit, weakening its market presence. Dr. Shiamala shared her views that to develop and commercialize crystal longan, it is crucial to create awareness about the fruit's nutritional properties and market value. Identifying superior varieties and conducting research to determine the most suitable genotypes for various regions is essential. Developing good agricultural practices, including proper cultivation practices, fertilizer requirements, and pest and disease management, is vital. Enhancing market linkage by focusing on developing innovative products and expanding market opportunities is also important. Collaboration among farmers, government agencies, and research institutions in joint initiatives can promote commercial cultivation and market development.

Crystal longan cultivation in Malaysia holds significant potential as a productive agricultural venture. By addressing existing challenges and leveraging emerging opportunities, stakeholders can promote the sustainable growth of crystal longan production both in Malaysia and globally.

4.0. QUESTION AND ANSWER SESSION

Moderator for Q and A and Panel discussion: Yacob Ahmad, Advisor, International Tropical Fruits Network

4.1. Responding to a comment that the crystal longan has a high floral abortion rate and whether this affects fruit production, Dr. Shiamala responded that the high rate of flower loss in crystal longan, was when thousands of flowers exhibit a male-to-bisexual flower ratio of 2:1. Despite this, the successful fruit production rate is relatively high, and this is attributed to minimal pest and disease issues and good fruit development.

On the diverse genotypic variations and selection of suitable genotypes. Dr. Shiamala also clarified that the differences in skin color among genotypes are due to genetic factors and cross-pollination, resulting in varieties with various colours such as purple, green, and yellow.

To a follow up question by the moderator, on the genotypes to which have to potential to be developed, Dr. Shiamala suggested focusing on the purple and green genotypes for commercial cultivation due to their favourable flavor, texture, and production qualities adding that these genotypes are already widely cultivated in East Malaysia.

4.2. To a question on mechanized pruning for longan, Dr. Jing Wang replied that the model is being developed based on the current model used for litchi.

4.3. To a question posed on the 11 to 35 percent postharvest losses in longan and what measures are taken to minimized this, Dr. Hahn responded that effective pest and disease control especially witches broom, antracnose and fruit flies, before harvest and proper harvesting techniques are crucial to overcome this.

4.4. To another question for Dr. Hanh on the short shelf life of the fruit, and whether postharvest management are according to international guidelines, she mentioned that farmers are guided before the harvest, to harvest the fruit at the correct maturity. It is important to note that each longan variety has different harvest times seasonal issue. Usually, the fruit is harvest 120 days after fruit set and the change in colour of the skin. Farmers should also properly time the fertilizer applications before harvest to reduce post-harvest losses. Treatments for post-harvest disease have evolved, with the use of sulphur dioxide (S02) being discontinued. Instead, under current safety guidelines, hot water treatment is employed to reduce post-harvest diseases. Temperature and weather conditions play a significant role in post-harvest management as they can greatly influence the quality and shelf life of the harvested longans. Mechanical injuries, which can occur during transport, can be minimized by keeping longans in containers when transporting from the farm to the packing house. Implementing pre-cooling measures immediately after the fruit arrives from the farm to the packing house is crucial. This step helps maintain the quality and prolong the shelf life of the longans.

Dr. Hanh's response was further confirmed by postharvest researcher from SOFRI, Vietnam Dr. Nguyen Thanh Tung, postharvest researcher from the same institute.

4.5. Responding to a comment on the center of origin for longan, Dr. Shiamala suggested that the common longan (Dimocarpus longan) originates from Southeast China. The botanical genus Dimocarpus is recognized worldwide, while Pometia belongs to a different genus, leading to taxonomical confusions due to similarities among genotypes. More research is needed to clearly classify these genotypes, particularly for Pometia pinata. The Chinese presenter meanwhile suggested that the Thai longan variety may have originated from China based on genome sequencing activities carried on so far. There was a suggestion from Dr. Chunyu from Fruit Tree Research Institute, GDAAS, China on the existence of two centres of origin for longan with one being in East Asia, and the other in Southeast Asia. Moderator added that many of these varieties may have been introduced, adding that crossing between longan and crystal longan, maybe an interesting exercise in the future.

5.0. PANEL DISCUSSION SESSION

During the panel discussion, the moderator guided each presenter to share their insights on strategies for expanding longan production, addressing challenges, and emphasizing the focus of research and development in their respective countries.

5.1. Referring to the low domestic market in Vietnam, moderator asked Dr. Hanh why this is so despite the extensive production area of 82,000 hectares and with more than half been exported to China.

The slow growth in farmer income compared to other crops, pest and disease issues, and the preference for exporting high-profit fruits like durian were cited as reasons for the stable but unexpanded cultivation area. In addition, many areas in Vietnam cultivate varieties of longan that are not of high quality, making it difficult to compete in the export market where high standards are required. Additionally, new pests such as the plant scales and diseases such as longan witches' broom have emerged, affecting the quality and yield of the longan crop. Efforts are being made to apply advanced technology to improve fruit quality.

On the country's focus, Dr. Hanh further mentioned that the Vietnamese government has several plans to address these issues, which includes maintaining the current cultivation area and develop new longan varieties to improve quality and yield. Efforts will be made to select suitable markets for export and to build a traceable brand name for Vietnamese longan. Studies on Integrated Pest Management (IPM) and Integrated Crop Management (ICM) will be enhanced to ensure the good quality of longan fruits.

5.2. Moderator referred to the molecular research conducted on unilateral cross incompatibility and use of boron to alleviate the problem and whether there are already recommendations for farmers to adopt.

Dr. Jin Wang clarified that ongoing research on mechanisms of unilateral cross incompatibility (UCI) is basic research for improving breeding, and thus is not applicable for commercial growers. Development of the longan is also based on litchi research

5.3. Moderator asks Dr. Chaireni if there are any programs to improve production in Indonesia since production is still low while the potential for growth is good.

There was still a need to import fruits from Thailand and Vietnam as production was not sufficient to meet the growing local demands. Dr. Chaireni elaborated on the difficulties in establishing longan plantations in Indonesia citing high costs, complex propagation methods, inability to provide large amounts of seedlings to farmers, and the need for expensive chemical boosters to stimulate flowering in lowland areas. The challenges in obtaining licenses for chemical use and the reliance on chemical imports from Thailand to boost flowering of longan further complicates efforts for the expansion of longan production areas in the country.

5.4. To a comment by the moderator on developing Cystal Longan as an intercrop, as an agroforestry option and potential for expansion in Malaysia, Dr. Shiamala responded that incorporating crystal longan into agroforestry systems presented a practical option including as a border tree around large plantations.

5.5. Dr. Shiamala continued with the potential for expanding longan production in Malaysia.

Malaysia's current production area of 35 hectares was insufficient despite the growing domestic demand for the fruit. This can partly be attributed to the fact it is not listed as a priority fruit crop in the country. Farmers needed to be incentivized and attracted to grow longan, which can be a way to grow the market. In addition, market development and promotional efforts were necessary to boost the domestic longan cultivation in Malaysia to reduce dependency on imports.

5.6. The panel discussion continued with the moderator inviting the panellists to provide further insights into the future of longan cultivation and research:

a. Presenter from Vietnam, Dr. Hanh emphasized the importance of pest and disease control, and research to improve fruit quality with the need to assist farmers for increasing their income.

b. Dr. Jin Wang from Fruit Tree Research Institute, GDAAS, China cited future research in the pipeline to breed new longan varieties with diverse pericarp colours.

c. The presenter from Indonesia, Dr. Chaireni Martasari stated on the immediate need is to

improve floral inducing techniques and propagation of recommended planting mateials for longan and called for international collaboration between longan exporting countries such as China and Vietnam.

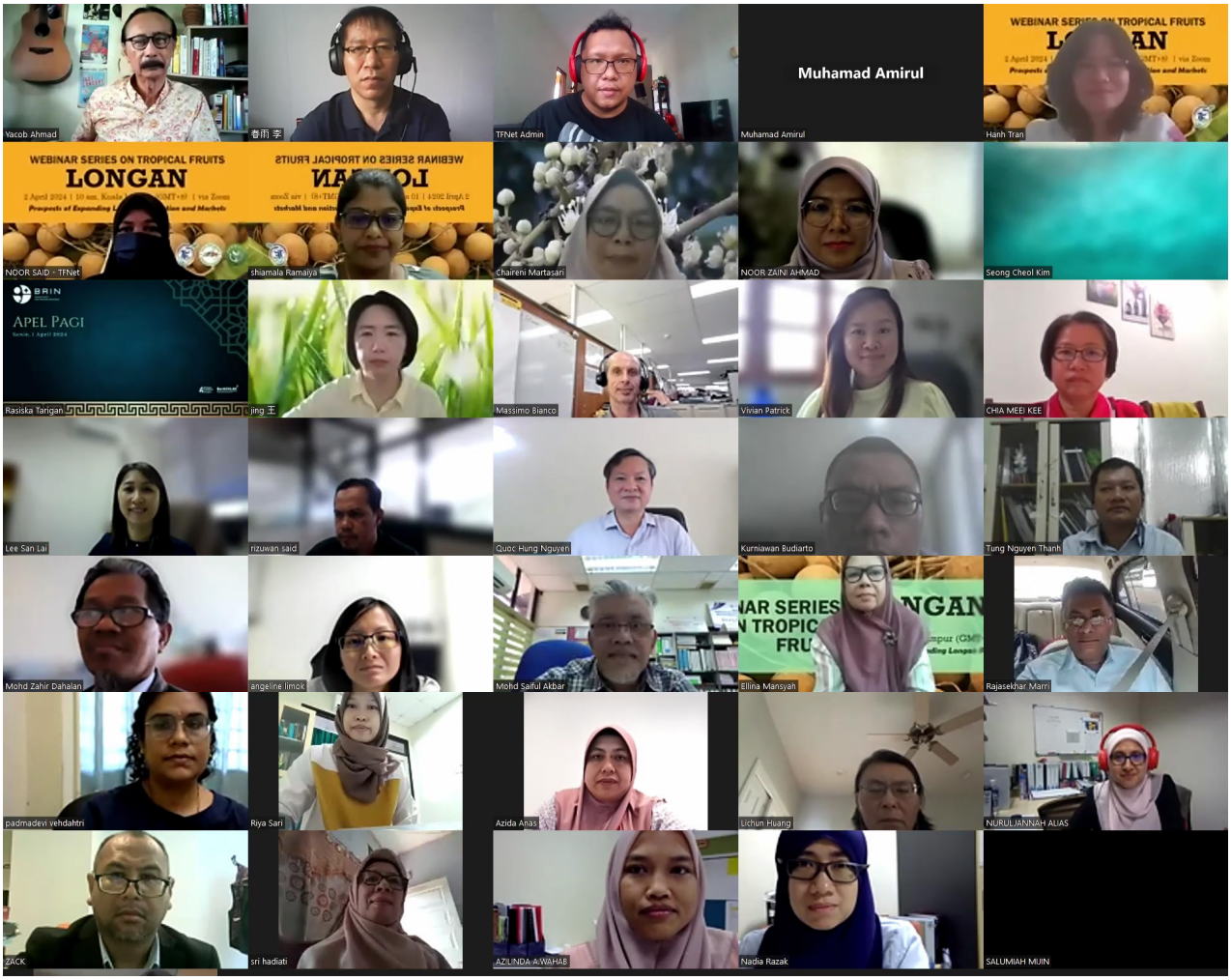
d. Presenter from Malaysia, Dr. Shiamala advocated for raising awareness among consumers and farmers and creating innovative products to popularise longan in Malaysia as done in the case of litchi.

The Q and A and panel discussion underscored the significant potential for expanding longan cultivation through improved research, mechanized methods, pest and disease management, and market development. The need for international collaboration and innovative approaches was highlighted to enhance the longan industry regionally. Moderator concluded that TFNet plays an important role in these international collaboration by providing a platform for stake-holders to interact and discuss solutions that can benefit industry players.

APPENDIX

Select Photos

Panel discussion



Participants

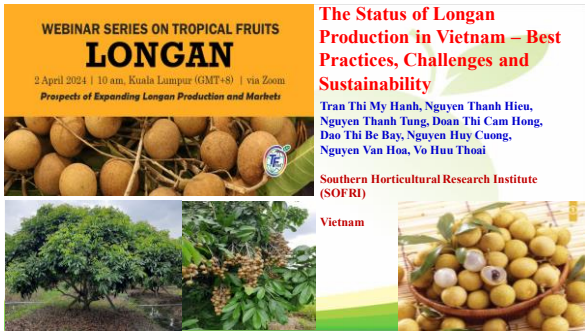
Program

Time	Content	
10:00 - 10:10 am	Introduction Yacob Ahmad, TFNet Advisor	
10:10 - 11:30 am	Presentations Moderator: Yacob Ahmad, TFNet Advisor	
		The Status of Longan Production in Vietnam – Best Practices, Challenges and Sustainability Dr. Tran Thi My Hanh, Deputy Head of Plant Protection and Senior Researcher, Southern Horticultural Research Institute (SOFRI), Vietnam
		Investigating the Mechanisms of Unilateral Cross-incompatibility (UCI) in Longan Dr. Jing Wang, Institute of Fruit Tree Research, Guangdong Academy of Agricultural Sciences
		The Status of Longan Cultivation in Indonesia – best practices, challenges and market Dr. Chaireni Martasari, National Research and Innovation Agency, Malang, Indonesia
		An Assessment of the Potential of Crystal Longan Cultivation in Malaysia Dr. Shiamala Devi Ramaiyah, Senior Lecturer, Faculty of Agriculture and Plantation, University Putra Malaysia (Bintulu Campus)
11:30 - 12:00 pm	Q & A, Panel discussion Moderator: Yacob Ahmad (TFNet) Panel: All speakers Topic: Challenges and opportunities in expanding Longan production and markets	

Powerpoint Presentations

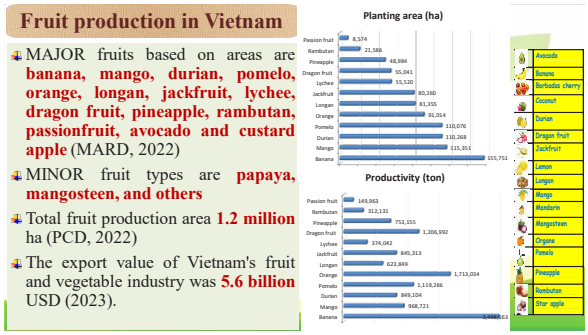
The Status of Longan Production in Vietnam – Best Practices, Challenges and Sustainability

Dr. Tran Thi My Hanh, Deputy Head of Plant Protection and Senior Researcher, Southern Horticultural Research Institute (SOFRI), Vietnam

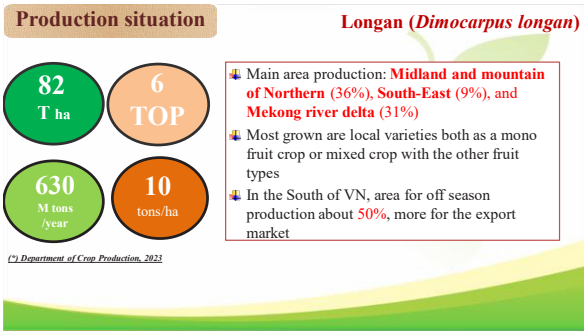


1

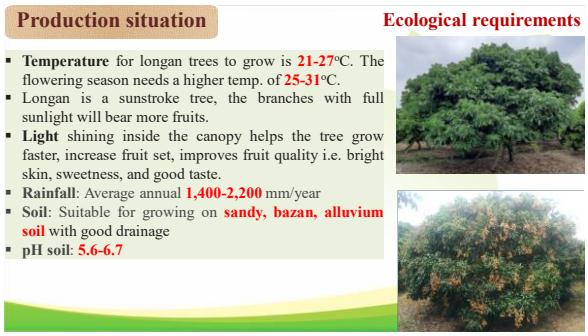
2



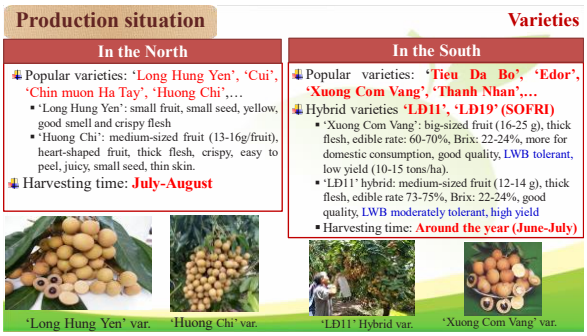
3



4



5



6

Production situation

Recent status in longan production

Longan production in Vietnam from 2018-2022

	2018	2019	2020	2021	2022
Area (ha)	78,803	79,355	83,024	82,528	81,355
Productivity (tons)	541,381	507,930	589,242	602,845	623,849

Source: PCD, Vietnam

- Expansion in production area has been stable
- Productivity is gradually increased

7

Production management

Cultivation practices

- Planting distances vary from **5 x 5 m** to **6 x 6** m (Density planting **280 - 400** trees/ha).



8

Production management

Cultivation practices

Canopy management

- Prune the tree after harvesting to reduce insects and diseases, improve tree health and fruit quality.
- After harvest, prune diseased branches, branches close to the ground, and branches standing in the center of the canopy to create ventilation for the tree.

Pruning the tree after harvest


The tree has an evenly canopy after pruned

9

Production management

Cultivation practices

Fertilizer

- Nutritional content needed by longan trees: **N>K>Ca>P>Mg>S**
- The recommended NPK amount for longan trees from 8-15 years old is **0.8-1.5** kgN **+ 0.4-0.7** kgP_2O_5 **+ 0.8-1.5** kgK_2O/tree/year
- OM: **10-30** kg/tree/year

Foliar application of borax at @ 2 g/l was sprayed on leaves at stage of inflorescence 10 cm in length gave the best result in increasing fruit set and yield (Doan Thi Cam Hong, 2008)

Applied of GA_3 20-40 ppm in blossom 20%, 50% at 7 and 8 weeks interval after fruit set which were increased in number of fruit/panicle (23.3-29.0 fruit/panicle); weight of fruit (9.31-11.17 g/fruit); yield (38-46.7 kg/tree), the color of fruit has bright yellow when compared to control (Doan Thi Cam Hong et al., 2010)

Spray combined NAA (20 ppm) and GA_3 (5 ppm) reduced of fruit drop and increased the yield of longan (Nguyen An De, 2009)

10

Production management

Cultivation practices

Irrigation

- Study on the amount of water needed for longan tree at each development stage
- Apply economic of irrigation system to longan production.

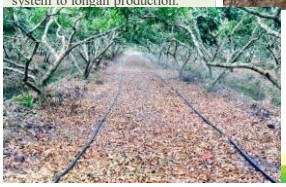



Table. Irrigation for longan tree in the reproductive stage

Irrigation time	Tree age	Amount of irrigation water/time
Post-harvest stage	4- 6	20-30
	7-10	30-50
	>10	50-70
Pre flowering stage	4- 6	10-15
	7-10	20-30
	>10	30-40
Flowering, fruit set stage	4- 6	20-30
	7-10	30-50
	>10	50-70
Developing fruit stage	4- 6	20-30
	7-10	30-50
	>10	50-70
Mature fruit stage	4- 6	15

11

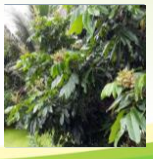
Production management

Cultivation practices

Flowering treatment

- Some varieties can have natural floral induction i.e 'Long', 'Giong', and 'Xuong Com Vang', flowering in March to April and harvesting from July to August.

- For varieties that need flowering treatment, the time and method of treatment depends on each variety. In general, flowering treatment is usually done from Sept. to Dec. (off season) and harvesting from Jan. to April




12

Production management

Cultivation practices

Flowering treatment

- Floral induction techniques on longan varies depending on the season and varieties
- Leaf age at the time of chemical application is also an important factor affecting longan flowering
- The common techniques used include branch girdling, collar drenching with $KClO_3$ (@ 40-60 gram/m canopy diameter).

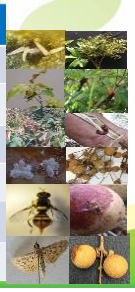
Collar drenching with $KClO_3$ around canopy of longan plant

13

Production management

Important pests

Insects	Infested rate (%)
Eriophyid mite (*Eriophyes dimocarpi*)	80-100
Litchi leafminer (*Conopomorpha litchiella*)	20-30
Stem borer (*Chlumetia transversa*)	25-30
Mealybug (*Planococcus lilacinus, Ferrisia virgata*)	70-80
Fruit fly (*Bactrocera dorsalis, B. correcta*)	60-100
Fruit borer (*Conogethes punctiferalis, Deudorix epijarbas amatius, Conopomorpha sinensis*)	50-70



14

Production management

Important diseases

Diseases	Yield losses (%)
Longan witches broom (Eriophyid mite *Eriophyes dimocarpi*)	70-100
Fruit rot (*Phytophthora palmivora*)	20-40
Dead branch (*Ceratocystis fimbriata*)	25-30

15

Production management

Management of important pests and diseases

Longan witches broom syndrome

- **Importance**: Very important
- **Distribution**: mainly in the South of Vietnam
- **Host**: 'Tieu Da Bo' var., 'Edor' var.
- **Resistant**: 'Xuong Com Vang', 'Long', 'LD19 hybrid',...

- Prune and destroy infected shoots after harvesting (30-35 cm in length);
- Increase apply double of K_2O quantity and using OM with 10 kg/tree;
- Spray Sulfur or neem @ 0.5% to control eriophyid mite

Paecilomyces sp. against *E. dimocarpi*

Predatory mite *A. longispinosus* is feeding on *E. dimocarpi*

16

Production management

Management of important pests and diseases

Fruit borer

- **Importance**: Very important
- **Distribution**: All over the country
- **Host**: All varieties of longan, rambutan, durian, lychee,...

- Balanced and applied fertilizer at the right time to help flowering and fruit set at the same time to easy pest control
- Use mesh netted bag to cover longan fruit cluster with size of 30 x 50 cm, bagging at 30 days after fruit set to control fruit borers
- Set up light traps to attract fruit borer adults

Mesh netted bag

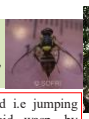
17

Production management

Management of important pests and diseases

Fruit fly

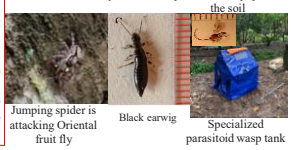
- **Importance**: Very important
- **Distribution**: All over the country
- **Host**: All varieties of longan, rambutan, mango, lychee, pomelo,...



- Protect NE available in the orchard i.e jumping spider *Plexippus paykulli,* parasitoid wasp,...by using less toxic pesticides
- Set up the sticky traps to attract the adults
- Set up traps of SOFRI-Protein, SOFRI-tru ruoi bait (sweet sour bait) to attract fruit fly adults
- Increase apply OM combined with SOFRI-Paecilomyces (*Paecilomyces* spp.) ($1x10^8$ spores/g) in the soil to control fruit fly pupae
- Rearing and releasing Black earwig *Chelisoches morio*, parasitoid wasp *Diachasmimorpha longicaudata* to manage fruit fly

Set up SOFRI-tru ruoi trap to attract fruit fly adults

Paecilomyces lilacinus parasitized ff pupae in the soil



Jumping spider is attacking Oriental fruit fly

Black earwig

Specialized parasitoid wasp tank

18

Production management

Management of important pests and diseases

Fruit rot, causal by *Phythophthora* spp.

- **Importance**: Important
- **Distribution**: All over the country
- **Host**: All varieties of longan, rambutan, lychee,...

- Increase pH soil (5.5-6.5)
- Apply lime on the soil, 2 times after harvesting and begin raining season
- Use SOFRI-Trichoderma combined with OM to control the fungi in the soil
- Stop watering when serious disease.



19

Production management

Management of important pests and diseases

IPM package for longan in Vietnam

- ✓ Prune low longan canopy for easy management of pests and diseases;
- ✓ Prune and destroy infected shoots after harvesting (30-35 cm in length);
- ✓ Bag fruit cluster at 30 days after fruit set;
- ✓ Use balance fertilizer and enhance use OM;
- ✓ Set up light traps to monitor fruit borer and other pests;
- ✓ Set up sweet sour baits, protein baits to control fruit flies;
- ✓ Use SOFRI-PAECILOMYCES, SOFRI-METARHIZIUM, SOFRI-TRICHODERMA products to control mealybugs, eriophyid mite, fruit fly pupae and fruit rot;
- ✓ Spray Sulfur or neem extract at @ 0.5% to control eriophyid mite;
- ✓ Soft pesticides: Spirotetramat, Chlorantraniliprole, Clothianidin, Buprofezin, and Azoxystrobin to control mealybugs, fruit borers and fruit rot when needed.

The longan orchards under IPM practices brought higher economic efficiency, reduced pesticides used (2-3 times/crop), increased food safety, and sold longan at better prices as compared to non-IPM practices.

- **2016-2021**: Built 04 production models applying IPM package on longan crop with an area of 73.42 ha.


20

Harvest & post-harvest

Harvesting

- From flowering to harvesting 119-126 days, depending on the growth status when the skin turns yellow-brown;
- Harvest when the weather is cool and dry. Avoid harvesting when it is too sunny, after rain or fog
- May to November (peak period June to July).

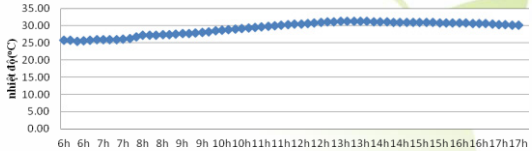


Longan harvested in the sunny season


Longan harvested in the rainy season

21

Harvest & post-harvest



- The appropriate harvest time for longan is **7-11** am to be effective in limiting diseases and maintaining post-harvest quality
- Effective post-harvest treatment time for longan around **4 hours** after harvest to limit disease development and maintains quality during post-harvest storage.

22

Harvest & post-harvest

Harvest and post-harvest handling following GAP guidance for longan in Vietnam

23

Harvest & post-harvest

Post-harvest

- Packaging: stored in mesh bags with weights 2, 5, and 10 kg quantity
- Outside the mesh bag, there is usually a hard plastic basket or Packed directly into a carton
- Truck (about 20 tons/truck) for longan transport.



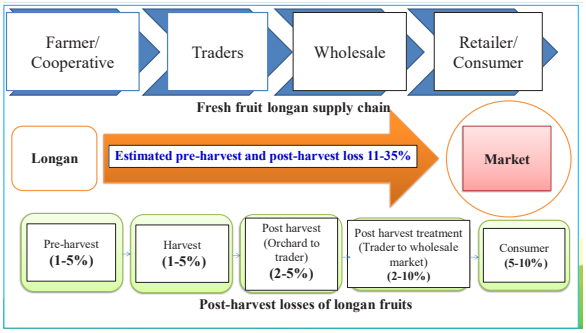
24

Harvest & post-harvest

Post-harvest losses

Heat damage	Cold damage	Cacbonic gas Damage	Post-harvest disease
• Browning in fruit skin • Excessive soft tissue of fruit flesh • Quick water loss	• Browning on the surface and under fruit skin • Darker flesh color	• The skin and flesh change browning and appear soggy of flesh • Loss of taste	• Browning on the skin of the fruit • Appear and browning and soggy flesh • Strange tastes

25



26

Harvest & post-harvest

Processing products

- Dried product
- Longan pollen
- Longan syrup
- Canning
- Longan wine
- Longan soaked in sugar

Dried product

Longan soaked in sugar

Longan wine Canned juice

27

Market and export

- More for export and small amounts for domestic consumption
- Importing countries mainly **China** and smaller amounts to US, EU countries, Canada, New Zealand, Australia, Japan, Korea,…
- Longan export is decrease from 2019 to now

Recent status in longan exports

Longan export value in Vietnam from 2016-2023

	2016	2018	2020	2023
Value (m US)	22.5	270.8	21.2	14

28

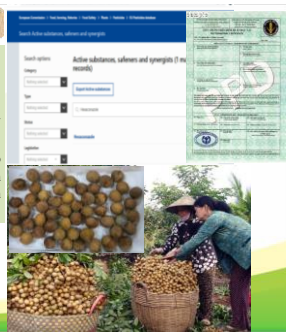
Challenges in longan production

- Small land holders
- Fruit quality market competitive
- Climate changing (flood, salinity, drought)
- Emerging pests and diseases (land snails, fruit flies, and LWB) problem
- Lack of IPM knowledge of farmers in controlling pests and diseases and lack of bio-products, reliance on pesticide dealers.

29

Challenges in longan market

- Inefficiently approaching market information
- Post-harvest losses (11-35%)
- Lack of longan trade names
- Plant quarantine regulations are increasingly stricter in many export markets
- Longan export value decreased due to exporters focused on exporting durian because it was more profitable than longan export.



30

Production sustainability

- Vietnamese fruit products, including longan, are being exported to more than 185 countries. The reason is partly due to the establishment and management of Production Unit Codes (PUCs) and Packing House Codes (PHCs), meeting the traceability requirements of agricultural products of many markets.
- Vietnam has established many cooperatives or farmer groups that apply GlobalG.A.P/VietGAP/organic standards in longan production to produce uniform and safe products
- Building processes and models for longan producing low-carbon, reducing production costs through replacing old varieties with good quality and LWB resistant varieties, adjusting the use of fertilizers, controlling pests and diseases following IPM or biology approach,…

Longan production model following VietGAP in the North

Longan production model following VietGAP in the South

31

Future plans

- MARD had orientation for development of 14 key fruit trees by 2030, including longan with a stable area of about 85 thousand ha, the output of 700-750 thousand tons
- Develop new varieties: easy to floral induction, big-size fruits, bright skin color, thick and dry flesh, small seed, resistant to LWB and have a long storage time
- Develop technologies for improvement of fruit quality i.e ICM, IPM, and Post-Harvest Quality Management (PQM)
- Manage certified PUCs and developed new PUCs for domestic consumption and export
- Conduct supply and value chain analysis as well as marketing studies, and value-adding on food, and pharmaceutical products
- Pay attention to building trade names for longan.

32

Acknowledgments

We would like to thank TFNet, SOFRI, and others for allowing us to share our experiences at the Webinar.

33

THANK YOU FOR YOUR ATTENTION!

Southern Horticultural Research Institute (SOFRI)

https://sofri.org.vn
phongkhoahocvahtqtsofri@gmail.com
sofrivn.contact@gmail.com

34

Investigating the Mechanisms of Unilateral Cross-incompatibility (UCI) in Longan

Dr. Jing Wang, Institute of Fruit Tree Research, Guangdong Academy of Agricultural Sciences

WEBINAR SERIES ON TROPICAL FRUITS

LONGAN

Investigating the Mechanisms of Unilateral Cross-Incompatibility (UCI) in Longan

Jing Wang

wangjing@gdaas.cn

1

Introduction:

2

Introduction:

Institute of Fruit Tree Research
Guangdong Academy of Agricultural Sciences

Longan Germplasm Resource Nursery in Guangdong Province

3

Background

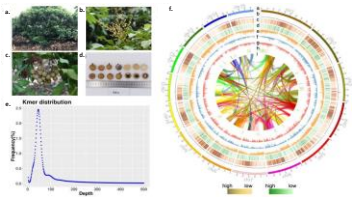
4

Contents:

目录

5

Part 1: longan genome and population genetic diversity



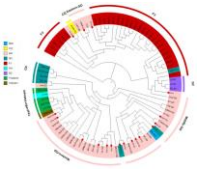
A chromosome-level longan genome was 455.5 Mb in size, and 98.7% of sequences were anchored onto 15 chromosomes.

Wang et al., (2022) *Hortic Res.*

6

Part 1: longan genome and population genetic diversity

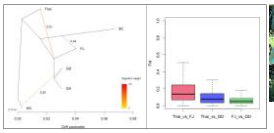
Geographic distribution of longan germplasm



Longan biogeography as a major contributing factor for genetic diversity.

7

Part 1: longan genome and population genetic diversity



Wang *et al.*, (2022) *Hortic Res.*

Thailand populations was distant to Chinese populations.

'Yidou' ♀

'Shixia' ♂

F1 with heterozygous advantage?

8

Longan in Thailand

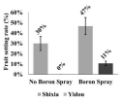
9

Part 2: Boron and Unilateral cross-incompatibility

The unilateral cross incompatibility (UCI) exists when Yiduo is used as a female parent and Shixia (a famous Chinese cultivar) as a male parent.

Wang *et al.*, (2022) *Front Plant Sci*

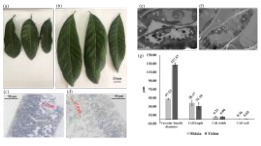
mg/kg	pH	K	Ca	Mg	Fe	Cu	Zn	B
Thailand orchard		58.7	342	120	163.6	31.0	33.1	5.0
Guangdong orchard	4.5	82.9	415.7	24		1.7	3.3	6.17



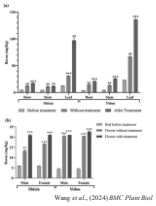
Boron application can rescue the cross-compatibility between Yidou and Shixia.

10

Part 2: Boron and Unilateral cross-incompatibility



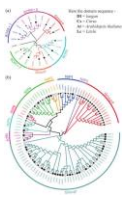
Yidou is a high boron demanding cultivar although the boron level in leaves and flower were higher than Shixia .

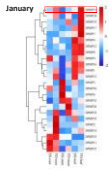


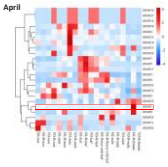
Wang *et al.*, (2024) *BMC Plant Biol*

11

Part 2: Boron and Unilateral cross-incompatibility







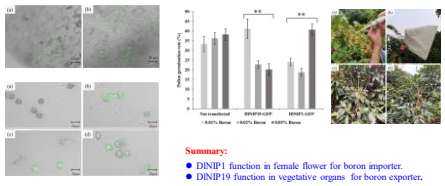
DlNIP19 expressed only in vegetative organs of Yidou.

DlNIP1 only in flower of Shixia.

Wang *et al.*, (2024) *BMC Plant Biol*

12

Part 2: Boron and Unilateral cross-incompatibility



Summary:

- DINIP1 function in female flower for boron importer.
- DINIP19 function in vegetative organs for boron exporter.

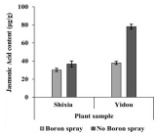
13

Part 2: Boron level in rootstocks

In future, we would utilize HLGY as rootstock of Yiduo.

14

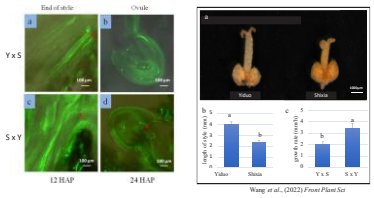
Part 2: Boron and JA



Boron application can downregulated the JA level in female flower of Yiduo.

15

Part 3: JA-DISPH5 regulates UCI

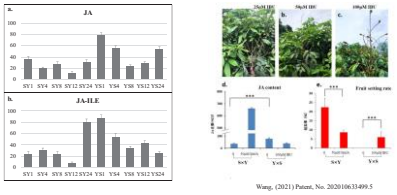


Wang et al., (2022) *Front Plant Sci*

Yiduo as female showed inhibited pollen tube growth.

16

Part 3: JA-DISPH5 regulates UCI

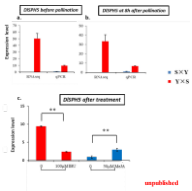


Wang, (2021) Patent, No. 202010633499.5

Inhibitors of JA biosynthesis (IBU) can broken UCI phenomenon of Yiduo.

17

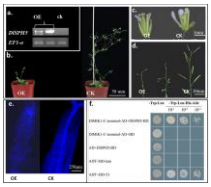
Part 3: DISPH5 as a secreted peptide



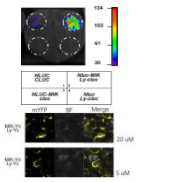
DISPH5 was located in the extracellular space.
And its expression was regulated by JA.

18

Part 3: DISPH5 interact with DIMIK1



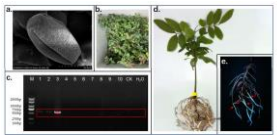
The overexpression of *DISPH5* in Arabidopsis inhibits pollen tube growth , resulting in sterilization.



DISPH5 can interact with pollen protein kinase DIMIK1. unpublished

19

Part 3: DISPH5 interact with DIMIK1



DISPH5 overexpressed longan seedlings

Summary:

- DISPH5 functions in the downstream of JA-UCI pathway.
- DISPH5 was secreted into extracelluar and interacted with pollen expressed kinase DIMIK1 , as female-pollen interaction.

20

Discussion:

- Exogenous Boron can facilitate fruit setting of longan 'Yiduo'.
  - Is there other environmental factors necessary?
- JA biosynthesis inhibitor can also broken UCI by decreasing the expression of DISPH5. How does JA regulate DISPH5?

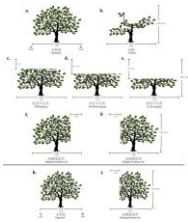
21

Additional : Longan

Exploration Mechanized Cultivation Mode of LONGAN

22

Mechanized prunning model and fruit detection



FT-NIR Analyzer

Camera

23

Acknowlegement:

Prof. Jiangsuang Li
Prof. Dongmei Han
Dr. Dongliang Guo
Dr. Shilian Huang
Dr. Xinmin Lv
Dr. Junbin Wei

Prof. Guo Li
School of Advanced Agricultural Sciences

Yiyun Wang

Boyun Wang

Fundings: Guangdong Basic and Applied Basic Research Foundation(2022A1515012271)
Key-Area Research and Development Program of Guangdong Province(2022B0202070002)

24

The Status of Longan Cultivation in Indonesia – best practices, challenges and market

Dr. Chaireni Martasari, National Research and Innovation Agency, Malang, Indonesia

Status of Longan Cultivation and Market Prospect in Indonesia

Chaireni Martasari, Agus Sugiyatno, Emi Budiyati

NATIONAL RESEARCH AND INNOVATION AGENCY. REPUBLIC OF INDONESIA

International webinar on Prospects of Expanding Longan Production and Markets

2 April 2024

1

OUTLINE

I. INTRODUCTION
II. STATUS OF PRODUCTION
III. MARKET
   a. TRADITIONAL MARKET
   b. PICKING TOURISM
   c. PROCESSED PRODUCT
IV. GOVERNMENT PROGRAMS

2

I. INTRODUCTION

- Based on history, longan is a subtropical plant that was known 2000 years ago, originating from the South China region then spread to Indochina, Malaysia and India
- Initially utilized more for its medicinal properties, not as a table fruit.
- Longan belongs to the Sapindaceae family, a close relative of rambutan, lychee and matoa.

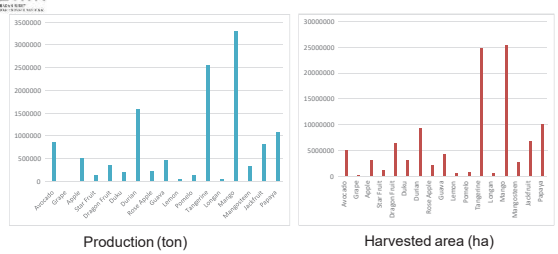
3

Longan propaganda for health

- Reduces stress and insomnia
- Strengthens bones
- Keep your heart healthy
- Prevents kidney stones

4

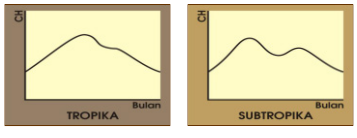
II. STATUS OF PRODUCTION



Source : BPS RI,2023

5

- In Indonesia, highland longan grows at an altitude of 500 - 900 m above sea level.
- Highland longan centers are in Magelang, Temanggung, Ambarawa, Salatiga (Central Java) and Tumpang/Poncokusumo, Batu (East Java): subtropical rainfall patterns



Rainfall Pattern

6

- The longan movement in Indonesia began around 2000 with the presence of lowland longan varieties Diamond River, Pingpong and Itoh (Bangkok longan)
- Lowland longan centers: Demak, Semarang, Kendal, Yogyakarta, Singkawang, seeds spread throughout Indonesia (± 300,000 seeds)

Advantages:
- Fast growth: grafted seeds bear fruit after 8-12 months, from grafting bear fruit after 1.5-2 years, while from seeds bear fruit after 3 years
- Appealing fruit appearance: large size (pingpong), sweet taste (pingpong, itoh)

7

LONGAN IN INDONESIA

LOCAL VARIETIES	INTRODUCTION VARIETIES
■ Center in medium - highland areas (Magelang, Ambarawa, Temanggung, Batu, Poncokusumo, Selarong etc.)	■ Center in low - medium altitude areas (Semarang, Prambanan, Demak, Singkawang, etc.)
■ Flowering naturally caused by temperature	■ Flowering naturally and with treatment (mechanical and chemical)
■ Example varieties: Kopyor, Batu, Selarong, Pringsurat, Mutiara Poncokusumo	■ Example varieties: Pingpong, Diamond River, Itoh, Crystal, Kateki, Biaokhiao, Puangray
■ Sweet fruit flavor with ■ TPT content < 22% Brix	■ Taste Sweet to very sweet with TPT > 22% Brix
■ Fruit skin color brown - dark brown dark	■ Light brown fruit skin color

8

■ Local Longan Famous Varieties

- **Lengkeng Selarong (Yogyakarta)**

Tree Canopy :
- Lush
- Widen

Foliages : Dark green, Thick, Curved upwards

Productivity : Medium

Fruit Skin color :
- Brown
- Slightly Thick

Taste : Sweet

Fruit Flesh: Thin, Seedy, Juicy

9

- **Lengkeng Batu/Pringsurat (Temanggung)**
- **Highland**

Tree Canopy :
- Lush
- Widen

Foliages : Dark green, Thick, Rigid, Curved upwards from the center line

Productivity : Medium

Skin color :
- Brownish,
- Slightly thickl

Taste : Sweet

Fruit flesh : Slightly thick, Medium seeds (N), slightly Juicy

10

- **Lengkeng Mutiara Poncokusumo (Malang)**

Tree Canopy :
- Lush
- Widen

Foliages : Dark green, Thick, Rigid, Curved upwards from the center line

Productivity : Medium

Fruit skin color :
- Brownish
- Slightly thick

Taste : Sweet

Fruit flesh : Slightly thick and juicy, medium seed

11

- **Lengkeng Kateki**

Tree canopy : Rimbun, melebar

Foliages : Green, wide, with wavy edges

Productivity : high

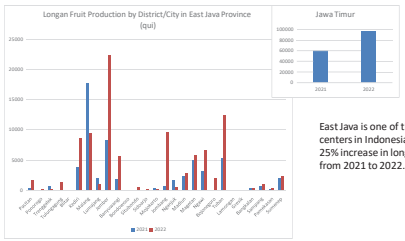
fruit skin : Brownish, slightly thick

Taste : Sweet

Fruit flesh : Slightly thick and juicy, medium seed

12

CHALLENGES OF LONGAN CULTIVATION IN INDONESIA



East Java is one of the largest longan centers in Indonesia, experiencing a 25% increase in longan production from 2021 to 2022.

13

SEED PRODUCTION

- The high interest of farmers to grow longan every year has an impact on the need for longan seeds.
- The availability of rootstocks is still rare due to the availability of local longan fruits are seasonal and the storability of the seeds is not long. This has an impact on the price of seeds (expensive).
- In vitro culture assistance in rootstock supply needs to develope

14

FLOWER STIMULATION

- Low temperature helps longan flowering in subtropical areas
- Therefore the highlands are a suitable area for litchi cultivation in Indonesia initially.
- But for cultivation on lowland, longan plants require induction by application of synthetic chemicals for flowering
- The material commonly used is a strong oxidizer that is often used in the manufacture of explosives where its circulation is limited so that the price of the active ingredient is expensive and requires licensing in its purchase.
- Meanwhile, those circulating in the form of technical products are products that are also not cheap

15

FLOWER STIMULATION (BOOSTER)

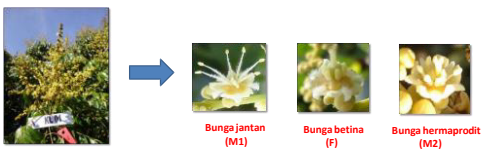
- Low temperature helps longan flowering in subtropical areas
- Therefore the highlands are a suitable area for litchi cultivation in Indonesia initially.
- But for cultivation on lowland, longan plants require induction by application of synthetic chemicals for flowering
- The material commonly used is a strong oxidizer that is often used in the manufacture of explosives ($KClO_3$)where its circulation is limited so that the price of the active ingredient is expensive and requires licensing in its purchase.
- Meanwhile, the technical products are not cheap (import)

16

Booster Application

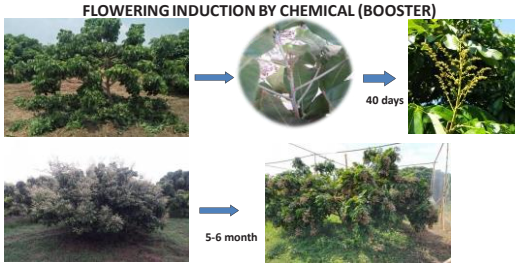
17

- Based on the sex type, there are three types of longan flowers, namely male, female and pseudo-hermaphrodite. Each variety has a different flower type



18

FLOWERING INDUCTION BY CHEMICAL (BOOSTER)



19

PEST AND DISEASE

- Leaf-boring caterpillars, borer caterpillars, fruit flies, "dompolan" bugs and **bats** are important pests in longan plants.
- Bat pests attack in the fertilization phase. To avoid bat attacks, it can be done by wrapping / crossing the fruit with woven bamboo or sacks. Another way is by providing safety nets around the plant or garden. The disadvantage of using safety nets is that the cost will be very expensive.
- "Upas" fungus, white root, black root, leaf spot and root rot are diseases that are often found in longan plants.

20

WRAPPING to avoid Bats attack

21

III. MARKET

A. TRADITIONAL MARKET (FRESH FRUIT)

Jakarta Semarang Ungaran

22

B. PICKING BY YOUR OWN FARM

The picking tour is a big attraction for tourists and very profitable for longan plantations.

23

C. PROCESSED PRODUCT

Imported product

24

Coffee bean from Lengkeng Seed "Koleng" Brand from Sidoarjo

The method of preparation is similar with regular coffee beans. Firstly, The longan seeds are separated from the pulp. Then they are washed and dried. Next, they are roasted and ground.

25

Longan Chips

26

BRIN

PROGR

1. Reseacrh and Development of New variety and Pests and deseases
2. Expanding area / replanting in the areas previously planted with lengkeng (Kampung Lengkeng)
3. Support for good quality of seedlings production and distribution
4. Support for training for Cultivation, Controlling Pests and Deseases dan post harvest
5. Linking farmers to the market
6. Facilitate access to the plantation area in the low land

27

28

An Assessment of the Potential of Crystal Longan Cultivation in Malaysia

Dr. Shiamala Devi Ramaiyah, Senior Lecturer, Faculty of Agriculture and Plantation, University Putra Malaysia (Bintulu Campus)

Kampus Bintulu Sarawak

Current Status and Prospects of Crystal Longan (Pometiapinnata J.R. Forst& G. Forst) in Malaysia

Ts. Dr. Shiamala DeviRamaiya
Senior Lecturer Department of CropScience Faculty of Agriculture and Food Sciences Universiti Putra Malaysia Bintulu SarawakCampus
Expertise: Agronomy(Pomology)
shiamala@upm.edu.my 086-855392 /+6016-2353440

PERTANIAN • INOVASI • KEHIDUPAN
BERILMU BERKAT

www.btu.upm.edu.my upmkb

1

Presentation Outlines

SapindaceaeFamily in Malaysia
Longan Production in Malaysia
Indigenous Longan Crystal
Longan (Pometiapinnata)

- Crystal Longan Genotypes
- Origin & Distribution Current Status &
- Market Demand in Malaysia
- Uniquenes
- Potential for Commercial Cultivation •Constraints •Strategies

Conclusio n

2

Sapindaceae Family in Malaysia

- Sapindaceae is also known as the soapberry family, consists ~1900 species from 140 genera (Buerki, 2019). It has whitish fruit with fleshy aril, which is an outgrowth of the ovule that envelops the seed (Paull & Duarte, 2010)
- Delicious sweet flesh with aromatic flavour makes it popular worldwide and suitable for processed food (Sukmandari et al., 2017)

3

Production of Longan (Dimocarpus longan) In Malaysia

Table 1: Hactareage of other fruit crops by State, Malaysia.

Negeri / State	LONGAN (Longan) Keluasan / Hectareage (Ha)	Luas Berhasil / Harvested Area (Ha)	Pengeluaran / Production (Mt)
JOHOR	18.60	18.00	554.60
KEDAH	13.20	13.20	119.75
KELANTAN	-	-	-
MELAKA	-	-	-
NEGERI SEMBILAN	1.40	1.40	32.61
PAHANG			
PERAK			
PERLIS	-		-
PULAU PINANG	0.40	0.40	3.50
SELANGOR	2.00	2.00	4.50
TERENGGANU			
SEM. MALAYSIA *Peninsular Malaysia*	**35.60**	**35.00**	**714.96**
SABAH	-	-	-
SARAWAK	-	-	-
W.P. LABUAN	-	-	-
MALAYSIA	**35.60**	**35.00**	**714.96**

(Source: Fruit Crop Statistic, DOA, 2022)

4

Indigenous Longan (Dimocarpuslongan ssp. malesianus)

Kakus Dimocarpuslongan subsp. malesianus

Sau Dimocarpuslongan subsp. malesianus

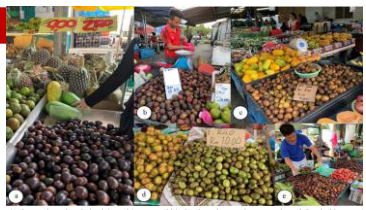
Isau Dimocarpuslongan subsp. malesianus

5

Pometia pinnata J.R. FORST & G. FORST

Kingdom	: Plantae
Phylum	: Spermatophyta
Subphylum	: Angiospermae
Class	: Dicotyledonae
Order	: Sapindales
Family	: Sapindaceae
Genus	: Pometia
Species	Pometiapinnata (USDA, 2022)

❖ According to Jacobs (1962) there are eight forms that have been recognized and given the taxonomic status of completeness under P. pinnata based on the inflorescence, leaflet midrib, and nerves.



Various coloured and sized Crystal Longan sold in local markets and supermarket. a) Purple big crystal longan, b) Mixed coloured crystal fruit c) Yellow and rainbow-colored fruit d) Small green fruit, e) small mixed coloured fruit

❖ Island Lychee, Crystal Longan, Crystal Lychee, Fijian Longan, Matoa, Kasai, Tawa, etc (Thomson and Thaman, 2006)

The basic characteristics: Single big seed, thick white flesh and hard coated skin having a combination flavourof rambutan, durian, and lychee (Sukimanet al., 2018)

6

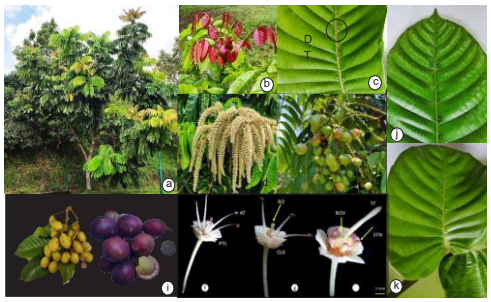
Origin & Distribution

World map indicating geographical distribution of Pometiapinnata at region of Asia Pacific

1-Solomon Islands, 2-PNG, 3-Samoa, 4-Fiji (Melanesia and Polynesia), 5-Java, 6-Indonesia, 7-Kalimantan, 8-Sarawak, Sabah (Malaysia) & Brunei, 9- Peninsular Malaysia, 10-Sumatra, 11-Philippines, 12-Thailand, Vietnam, Laos & Myanmar (Southeast Asia) 13-Sri Lanka & Andaman Island (India)-(South Asia), 14–Taiwan & Yunan (South China)-(East Asia)

7

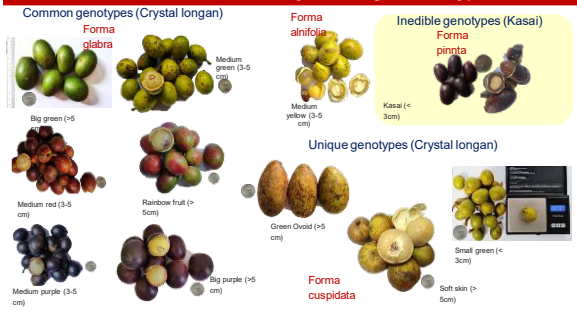
General Morphology of Crystal Longan



(a) The tree with colourful foliar, (b) bright red young foliar, (c) presence of leaf domatia (DT), (d) inflorescence arranged in panicles, (e) True male flower with functionally anther (AT), (f) functionally male flower with rudimentary ovary (RO), (g) bisexual flower which functionally female with 5 staminodes (STN) and bicarpullate ovary (BOV), and (i) a bunch of P. pinnata fruit in ripeningstage.

8

Underutilized Fruit of Crystal Longan Genotypes



9

Hard skin tree

Variables	Hard skin genotypes			Soft skin	Kasai
	Purple	Green	Red		
Leaves					
Leaf length (cm)	35.703 ± 8.4330	32.920 ± 9.470	35.474 ± 8.126	17.898 ± 6.113	22.514 ± 8.628
Leaf width (cm)	12.054 ± 6.368	12.334 ± 3.911	12.579 ± 10.033	8.281 ± 4.970	7.278 ± 1.515
Leaf Surface	Shiny	Shiny	Shiny	Dull	Shiny
Flower					
Flower length(cm)	9.431 ± 0.588	11.419 ± 2.0391	8.574 ± 1.082	9.445 ± 0.667	9.064 ± 0.441
Flower width (cm)	5.000 ± 1.212	4.629 ± 0.882	4.065 ± 0.633	5.396 ± 0.457	4.674 ± 0.311
Ovary colour	Yellow	Yellow	Yellow	Red	Red
Fruit					
Attached pulp	Detachable from the seed	Detachable from the seed	Detachable from the seed	Detachable from the seed	Attached to the seed
Skin Hrdness	Hard (cracked open)	Hard (cracked open)	Hard (cracked open)	Soft (peeled off)	Hard (cracked open)

Soft skin tree

Kasai

10

11

Seasonality and Productivity

Seasonal

May-July, and September-November (Arumugamet al., 2022)

Production
•200 kg per tree/year
•6 tons/acre/year (Andirerei, 2019)

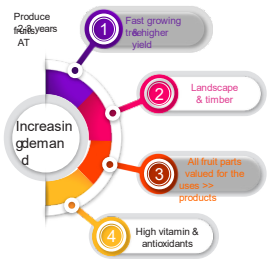
Price RM 10-35 per kg

- It is just sold as a whole fruit only

Various colouredand sized Crystal Longan sold in sibulocal markets

12

Fruit Demand and Their Utilizations



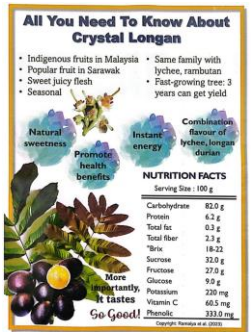
(Moog et al. 2008; Orwa et al. 2009; Ngah 2014; Fern 2019)

Fig. 20: Planted at roadsides and in the parks due to its spectacular shiny reddish bunches of new leaves.

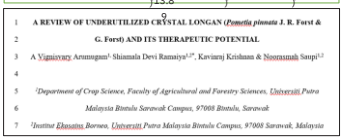
Malaysia (Sarawak)	Traditiona treatmen fo chicken pox from the infusion of the hot water extract from the bark.	Thomson and Thaman (2006)
West Sumatera Indonesia	The bark and stem has been traditionally used to treat mouth infection, stomach pain, diarrheal, dysentery and obstetric gynaecological complaints	Trimedonaet al. (2015)
Melanesia and Polynesia PNG, Indon	Consume fresh, fuelwood, Craft wood, boat & raft making.	Thomson and Thaman (2006)
Malaysia	Eat ra and edibl produc development juice syrup. Roasted seeds used to treat deep pains in the bones, migraine headache, fever.	Thomson and Thaman (2006)

13

Uniqueness of Crystal Longan



Description	Unit	Longan	Lychee	Rambutan
oBrix		18.0	12-15	15-
Sucrose	/100	41.3	35-40	19
Fructose	/100	4	10-12	9.32
Glucose	/5	13.8	5-10	2.6
		Yang et al. (2021)	Wang et al. (2014	Chen et al. (2018



A REVIEW OF UNDERUTILIZED CRYSTAL LONGAN (*Pometia pinnata* J. R. Forst & G. Forst) AND ITS THERAPEUTIC POTENTIAL

A Vigniyary Arumugam[1] Shiamala Devi Ramaiya[1,2*], Kaviaraj Krishnan & Noorasmah Saupi[1,2]

[1]Department of Crop Science, Faculty of Agricultural and Forestry Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak

[2]Institut Ekosains Borneo, Universiti Putra Malaysia Bintulu Campus, 97008 Sarawak, Malaysia

This species has been shown to have phytotherapeutic properties such as antidiabetic, anti-HIV, antidiuretic, antiobesity, antihypertension, and antimicrobial effects, which can be attributed to the presence of polyphenols, alkaloids, flavonoids, terpenoids, tannin, saponin, and coumarin compounds (56 journals).

14

Growing Interest

Business

Sarawak's Crystal Longans take centrestage at Expo Malaysia Fest 2023

SINGAPORE: Crystal longans from Sarawak has caught the attention of many, and it is the main focus of the ongoing Expo Malaysia Fest 2023.

This four-day event started on July 27, 2023, and is taking place at the Singapore Expo in Changi.

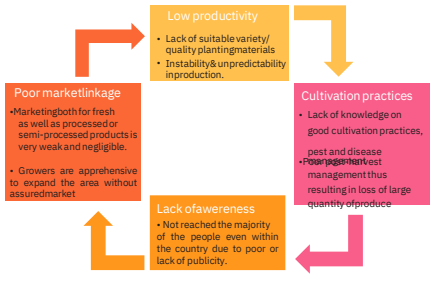
A Bernama survey found that Singaporeans did not miss the opportunity and patiently lined up to get this fruit, also known as Brazilian longan, which can usually be found in the Lundu and Kota Samarahan areas, Sarawak.

15

Potential for Commercial Cultivation

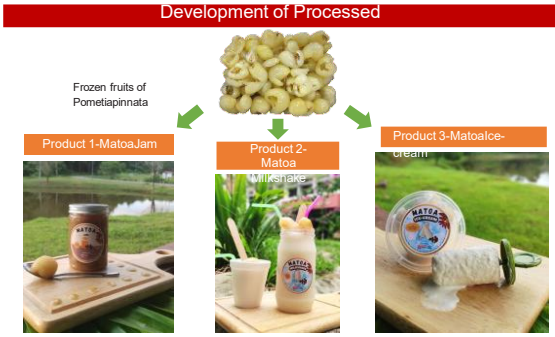
16

Constraints



17

Development of Processed

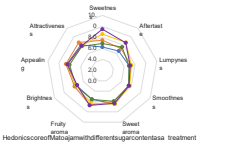


18

Sensory data for processed Pometia pinnata products-

The formulation of Matoa jam using different

formulations	Formulation	Ingredient used: Crystal longan pulp (g)	Sugar (g)	Additional ingredient: Pectin (g/kg)	Water (mL)
T	Formulation 1	200	1	3	8
1	1	20	8	3	8
2	2	0	5	3	0
T	Formulation 3	20	3	3	8
3	3	0	0	3	0
T	Formulation 4	20	4	3	8
T	Formulation 5	20	5	3	8



Hedonicscoreof Matoajamwithdifferentsugarcontentasa treatment

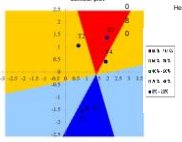
✓ T5 has the highest score of 7.5-most preferred formulation (0 g sugar addition), while T1 has the lowest score- 10g sugar.

Feedback from respondents from survey

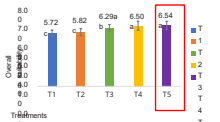
2023 Panelists preferred T5 due to its fruity aroma

✓ and fibrous texture of the jam with a moderate sugar level.

✓ It is a perfect combination with a jam tart and biscuits as a filling- Respondants prefer not to add much pectin to balance the taste.



Internal Preference Mapping on Matoa jam with different sugar content as a treatment



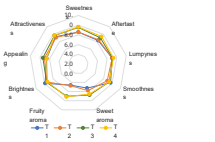
Overall acceptability score of Matoajam with different sugar content as a treatment

19

Sensory data for processed Pometiapinnata products-Matoaice-

The formulation of Matoa ice-cream using different

formulations	Formulation	Ingredient used: Crystal longan pulp (g)	Additional ingredient: Whole milk (mL	Condense milk (mL)
T	Formulation 1	50	20	1
1	1	10	0	0
T	Formulation 2	0	20	1
2	2	15	0	0
T	Formulation 3	0	20	1
3	3	20	0	0
T	Formulation 4	20	20	1
4	4	20	0	0
T	Formulation 5	20	20	1
5	5	20	0	0



Hedonicscoreof Matoaice-creamwithdifferentfruitamountasatreatment

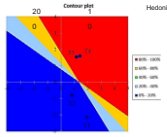
✓ Panellists preferred T3 & T4 as it is the higher amount of fruit used (150-200 g).

✓ According to Arshad et al. (2022), ice-cream based on sweet fruits much preferred with no added sugar is produced. Fajar and Hanisa (2022) stated that matoa ice-cream gives a refreshing taste and sweet taste when addition of matoa as 48.7%.

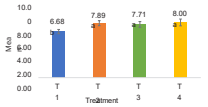
Feedback from respondents from survey

2023 Fruit means the product > sweet taste

✓ Panelists suggests this product be sold with supermarket



Internal Preference Mapping on Matoa ice-cream different fruitamountasatreatment



Overall acceptability score of Matoa ice-cream with different fruit amountasa treatment

20

Strategies

Createawareness	Among the people and give widepublicity	1
Qualityplanting materials	Identifying superiorvarieties	2
Goodcultivation practices	Accurate assessment of nutritional requirements, reorientingin site-specific constraint-based fertilization, P&D management, postharvestmanagement	3
Developing market linkages	Develop the assured market linkages & encourage the growers to produce more in order to get the volume of produce for the processing units & productdevelopments	4
Collaboration	A concerted effort is required to raise awareness, and expand joint initiatives among all potential stakeholders; farmers, governmentagencies, and researchinstitutions	5

21

Conclusion

Crystal Longan cultivation in Malaysia holds significant potential as a lucrative agribusiness venture.

By addressing existing challenges and capitalizing on emerging opportunities, stakeholders can foster the sustainable growth of Crystal Longan production.

22

Acknowledgement

International Tropical Fruits Network (TFNet) Mr. Yacob

Ahmad Rohi for the grants & My researchteam

UPM for Facilities

My undergraduate & postgraduate students; VignisvaryArumugam, GerevieveBangi, Christ LaursenAnak Winston Stephen

Collaborators& Farmers

23

Thank You

Lawati kami

upmkb

Universiti Putra Malaysia Kampus Bintulu Sarawak

Jalan Nyabau, 97008 Bintulu, Sarawak, MALAYSIA

24

INTERNATIONAL TROPICAL FRUITS NETWORK
P.O. Box 334, UPM Post Office
(Block C8, MARDI Headquarters)
43400 Serdang, Selangor
Malaysia

Tel. No.: 603-8941-6589
Fax No.: 603-8941-6591
Email: info@itfnet.org
Website: www.itfnet.org