

REPORT

**WEBINAR
SERIES ON
TROPICAL FRUITS
RAMBUTAN**

Enhancing Global Consumption and Trade of Rambutan

18 May 2023




International Tropical
Fruits Network (TFNet)

**INTERNATIONAL WEBINAR SERIES
ON MINOR TROPICAL FRUITS:
'ENHANCING GLOBAL
CONSUMPTION AND TRADE OF
RAMBUTAN'**



**International Tropical
Fruits Network (TFNet)**



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1.0. EXECUTIVE SUMMARY

The global rambutan industry has experienced significant growth and development over the years. The Rambutan, a tropical fruit native to Southeast Asia, is currently produced in a number of nations all over the world. Rambutan production has expanded beyond its traditional cultivation regions, such as Indonesia, Thailand, Malaysia, and the Philippines. Other countries, including Vietnam, Sri Lanka, India, Australia, and parts of Central and South America, have also begun cultivating rambutan to meet the rising demand. This geographical diversification has contributed to increased global production. Asia-Pacific remains the largest consumer market for rambutan, with countries like Indonesia, Thailand, and Malaysia having a strong cultural affinity for the fruit. However, there has been a noticeable surge in demand from North America, Europe, and other regions, fueled by changing dietary preferences, expanding international trade, and the availability of imported fruits in supermarkets and specialty stores.

In addition to growing export markets, other trends influencing the rambutan trade include rising e-commerce platforms, concerns on quality and safety, and sustainability concerns. As the global production and trade of rambutan continue to grow, there are increasing efforts to

improve its cultivation and post-harvest practices to ensure that the fruit meets international quality standards. These trends are likely to continue in the future, creating new opportunities and challenges for rambutan producers and traders globally.

As part of TFNet's ongoing series of international webinars on minor tropical fruits, this third webinar delved into the various aspects of the rambutan industry especially in Asia, including production, consumption, trade, challenges, and future prospects. The webinar held on the 18th May 2023 was jointly organized with the Malaysian Department of Agriculture (DOA).

The aim of the webinar was to:

- a. To share information among stakeholders on the various initiatives to increase rambutan production and markets, including cultivar development, best farm practices, postharvest management, inputs for the food industry, research and development focus and policies to encourage its cultivation.
- b. Gauge the current scenario and deliberate on the potential of rambutan as another globally popular and traded fruit.

A total of 170 participants joined the webinar to engage in presentations and discussions which featured four international experts from three rambutan producing and importing countries, namely Indonesia, Malaysia and China.

Mr. Christopher Biai highlighted the rambutan industry in Malaysia, emphasizing its potential and favourable climatic conditions for production. He added that efforts are underway to develop disease-resistant and early-yielding rambutan varieties. Malaysia has 52 registered rambutan varieties at present. Under the current 12th Malaysia Plan, the cultivation area is anticipated to grow, as rambutan has been placed as one of the focus fruits for export. He also highlighted the fluctuation in market prices for the fruit, influenced by factors such as popularity and competition with other major tropical fruits.

Dr. Meiyin He discussed the market potential of rambutan in China, highlighting Thailand's dominance in rambutan trade. China is a net importer of rambutan, facing a trade deficit. Limited cultivation areas and consumer awareness pose challenges for rambutan development in China. Efforts are being made to address these challenges through preservation techniques and freshness extension methods.

Prof Dr. Sobir provided insights into rambutan production, consumption, and market in Indonesia. Rambutan is considered a major tropical fruit in Indonesia, but it faces competition from other fruits. Production has increased over the years, with Java Island accounting for the majority. Consumption has seen a declining trend among younger consumers. Rambutan exports from Indonesia have been decreasing, influenced by various factors.

Dr. Johari Sarip discussed the breeding and improvement of rambutan varieties in Malaysia. Two breeding strategies were adopted, including selecting seedlings from existing germplasm collections and breeding new clones through open pollination. Two promising new clones, Mutiara Merah and Mutiara Wangi, were developed and released in 2019.

Overall, the discussions showcased the potential, challenges, and ongoing efforts in rambutan cultivation and market development in Malaysia, China, and Indonesia. The presentations offered insights into the cultivation techniques, post-harvest practices, and the current market scenario, while shedding light on the various government support and initiatives, which can be emulated by other countries. Though some countries such as China at present remain net importers for rambutan, this scenario may change given the dynamism of the market and influence of other factors such as strong government backing, as observed in other countries such as Malaysia and Thailand. Greater promotional efforts are a must to create awareness of the fruit especially among younger consumers. Strategies such as varietal improvement, market expansion, and addressing consumer preferences were proposed to further revitalize the rambutan industry.

The subsequent panel discussion revealed that while the development of rambutan remains slow compared to other minor fruits, there is great potential for the fruit considering future markets in Asia and the Middle East based on demographic factors and the anticipated increase in exports due to the diaspora or spread of Asians to other countries for work or migration. In addition, panelists concurred that ongoing efforts must be made to promote the consumption of rambutan as a healthy fruit alternative.

2.0. WEBINAR PRESENTATIONS

2.1. Rambutan Cultivation and Market in Malaysia

Mr. Christopher Biai, Department of Agriculture, Malaysia

Mr. Christopher Biai discussed the cultivation and market of rambutan in Malaysia. His presentation covered an overview of the rambutan industry in Malaysia, supply and demand, market analysis, and future prospects. He also shared nutritional facts about rambutan and the different varieties of the fruit grown in Malaysia. Mr. Christopher emphasized the potential of rambutan in Malaysia, highlighting the favorable climatic conditions for its production. Ongoing efforts are being made to develop new disease-resistant and early-yielding rambutan varieties. Currently, there are 52 registered rambutan varieties in Malaysia, with the top five varieties being Deli Baling (R193-red variety), Anak Sekolah (R191-red variety), Deli Cheng (R170-red variety), Oh Heok (R162-red variety), and Muar Gading (R156-yellow variety). In 2019, MARDI introduced two new varieties, Mutiara Merah (AG28) and Mutiara Wangi (GB44), which have received positive feedback for their commercial value. Under the 11th Malaysia Plan (2016-2020), the Department of Agriculture developed a 300-hectare area for rambutan cultivation through the Rambutan Cluster Development Project, involving 620 farmers. The project focused on rehabilitating existing farms, with only a small portion allocated for new plantations (10-15%). The current 12th Malaysia Plan (2021-2025) aims to increase the rambutan cultivation area, with hectareage expected to remain consistent in the coming years as more emphasis is given to rehabilitating existing areas. In 2021, the main production areas were Sarawak (5,521 hectares, producing 11,296 tonnes), followed by Johor (1,781.89 hectares, producing 9,182 tonnes), and Sabah (1,631 hectares, producing 5,071 tonnes). Regarding market prices, the farm price of the Anak Sekolah (R191 variety) rambutan in 2021 was RM2.90, with wholesale and retail prices at RM4.90 and RM7.80, respectively. In 2023, the farm price increased to RM3.45, while the wholesale and retail prices were RM4.75 and RM6.80, respectively. The decrease in wholesale price in 2022 can be attributed to the lower popularity of rambutan compared to durian, especially

during the durian season. Mr. Christopher also provided an overview of rambutan utilization in 2021, with production reaching 55,627 tonnes/year and total consumption at 57,754 tonnes. The per capita consumption (PCC) was 1.6 kg/year, indicating sufficient domestic supply, and the self-sufficiency ratio (SSR) was 99.4%. Import dependency ratio stood at 3.8%, with rambutan being imported mainly from neighboring countries like Thailand. Singapore and Brunei were the major importing countries in 2021, with imports of approximately 1,798 tonnes and 650 kgs, respectively. Regarding exports, there was an increase in export volume in 2018 by 2,156 tonnes, followed by decreases in 2019 and 2020, and another increase to 1,799 tonnes in 2021 (more than half of the export volume in 2020). Malaysia has applied for the export of fresh rambutan to the USA since 2006, but negotiations are still ongoing due to the stringent phytosanitary requirements set by the US, with the service cooperation agreement under draft. Other issues and challenges persist in the export of rambutan. These include the lengthy processing time due to the distant market routes, difficulties in extending the shelf-life for export (currently limited to 10 days under 10 degrees Celsius), a shortage of labor and skilled workers, and inconsistent supply from farms. As the way forward, the following strategies were proposed. Firstly, through rehabilitating existing areas. Secondly, by expanding into new areas with new varieties, and thirdly by increasing production specifically for export with the ultimate aim of reducing import dependency.

2.2. Market Potential Analysis of Rambutan in China

Dr. Meiyin He, South China Agricultural University, Guangzhou, China

Dr. Meiyin begins by discussing the global origins and distribution of rambutan. She highlighted Thailand's dominance in rambutan trade as the leading exporter, accounting for approximately 8% of global production. Moving on to China, she notes that it is a net importer of rambutan, facing a perennial trade deficit. Rambutan cultivation in China is limited to specific regions such as Hainan and Yunnan, resulting in relatively small acreage. Despite the limited cultivation, China does engage in some level of export, with around 0.51 tonnes of rambutan exported in 2022 to countries like Russia (0.33 tonnes) and Macau (0.18 tonnes). Dr. Meiyin provided data on China's major import markets and their rambutan share from 2017 to 2022. Vietnam was a significant importer, with 455.66 tonnes accounting for USD 319,221 in 2022, followed by Thailand with 468.42 tonnes amounting to USD 1,491,405 in the same year. Dr. Meiyin also mentions that Chinese rambutan is not well recognized in the market and is sold at a higher price compared to importing countries. Consumer awareness and knowledge about the fruit are lacking. Interestingly, she shares that on e-commerce platforms, domestically sold rambutan is priced notably higher (84 yuan/kg) than imports from Thailand (60 yuan/kg) and Vietnam (46 yuan/kg). In China, the main challenges in rambutan production include the lack of suitable cultivation areas and a limited market range, which restricts sales radius. However, efforts are being made to address these challenges through strategies like low-temperature preservation and the use of biological agents to extend the freshness of locally produced rambutan. In conclusion, rambutan development in China still has a long way to go and faces difficulty penetrating a market dominated by other popular tropical fruits among Chinese consumers.

2.3. Status of production, consumption and market of Rambutan in Indonesia

Prof Dr. Sobir, Center of Tropical Horticulture Studies, IPB University, Bogor

Indonesia

Prof Sobir discussed the production, consumption, and market of rambutan in Indonesia. He spoke on the origin and distribution of the rambutan, citing some wild relatives existing in Indonesia including Maritam (*Nephelium mutabile*), Kapulasan (*N. ramboutan-ake*), Sibau (*N. junglandifolium*), Kalamangis (*N. uncinatum*), Ridan (*N. maingayi*), and Ihau (*Dimocarpus malesianus*). Rambutan is considered a 'major' tropical fruit in Indonesia, although it faces competition from other fruits such as bananas, mangoes, papayas, salak, pineapple, and jackfruit. Over a period of twenty years (2002-2021), rambutan production in Indonesia has seen a three-fold increase, moving from the eighth position in 2002 (296,103 tonnes/year) to the ninth position in 2021 (874,562 tonnes/year). Despite the increasing trend, production fluctuates from year to year, largely attributed to weather anomalies. Zooming into the production trend in the recent five years (2017-2021 data), annual production increased 1.5 folds. However, the yield per tree did not correlate with the number of harvested trees due to factors like disease and fruit drop. Rambutan production occurs throughout the year in Indonesia due to its geographical location near the equator. The Southern part of Indonesia experiences higher production during the first and fourth quarters, with flowering induced at the end of the dry season (August or September), resulting in peak production during the fourth quarter. The distribution of rambutan in Indonesia is concentrated in Java Island, accounting for 53% of production, followed by Sumatra (23%) and Kalimantan (9%), totaling 85% of the share. These areas are lowlands and have wet climates, similar to other producing countries like Malaysia, Thailand, and Vietnam. Java Island has a wide cultivation of rambutan by farmers, while in the other two locations, rambutan is naturally found near forests. Generally, in Indonesia, rambutan is typically grown in lowlands with wet climates, often in mix production systems where it is cultivated alongside durians and mangosteens. Rambutans are propagated through seedlings, resulting in high variation in terms of quality and appearance. Currently, 20 varieties of rambutan have been registered in Indonesia, with popular ones including Rapih and Binjai. Consumption of rambutan in Indonesia has witnessed a declining trend in the last five years (2018-2022), attributed to the lack of recognition among younger consumers who prefer more practical fruits. Rambutan is also consumed in minimally processed forms such as juice, cocktails, and various snacks (kerepek rambutan and kerepek biji rambutan using vacuum-fry method). In terms of marketing, farmgate prices in Indonesia are lower than in Malaysia, with higher prices observed during certain months (April, May, June and July). Rambutans are primarily sold fresh in street stalls or through mobile vehicles, and rarely found in supermarkets. Rambutan exports from Indonesia have been decreasing steadily in the last decade. In 2022, the export volume was 695.4 tonnes (USD583,591). Export is influenced by factors such as domestic price, export price, exchange rates, previous year export volume, domestic production, and fruit quality.

2.4. Cultivar development and breeding of Rambutan in Malaysia

Dr. Johari Sarip (Breeder/Fruit Consultant)

Dr. Johari presented the extensive work conducted in MARDI for the breeding and improvement of rambutan varieties in Malaysia. To kickstart his presentation, he highlighted the reproductive characteristics of the fruit, namely that its a heterozygous and cross-pollinated species, which results in a significant amount of genetic variability in seedling progenies. Early cultivation in Malaysia involved using seeds, but because of the long selection process, a few trees were chosen and registered as the R-series by the Malaysian Department of Agriculture (DOA). 62 clones

are available at present in Malaysia. Despite the availability of many clones, the local rambutan industry was not experiencing a positive growth. As such, a need to arose to identify superior varieties to revitalize the industry in Malaysia. To achieve this, two breeding strategies were adopted. The first strategy involved screening and selecting rambutan seedlings from an existing germplasm collection. This process included 323 accessions (bud-sticks) from trees collected throughout Malaysia, grafted, and planted at the Kemaman genebank in 1985. The performance of these grafted plants was closely monitored, and qualitative (flavour and texture) and quantitative data (fruit size and weight) were recorded. The initial selection did not render favourable results as performance was still below par compared to commercial varieties. Consequently, a second strategy was implemented, focusing on breeding and selecting F1 progeny. The second strategy aimed to obtain, select, and characterize new rambutan clones developed through the open pollination method. Dr Johari pointed that this particular method is suitable for creating genetic variation in heterozygous fruit trees with single-seeded and sensitive flowers. He went on to expound the process whereby two maternal parents (R99 and R134) along with 16 other paternal parents were planted closely in an F1 breeding plot in 1981 to produce open-pollinated seeds. A total of 10,000 open-pollinated seeds were harvested from the maternal parents and germinated in the F1 plot in 1989. Out of these, 5,400 F1 progenies germinated, and 3,199 progenies survived for further assessment. During field observations, male plants were found to produce flowers earlier than hermaphrodite plants, but the ratio of female to hermaphrodite plants was 1:1. Dr. Johari showcased the variation in F1 fruits and explained the segregation of the F1 population in terms of colour, spintern lengths, with some exotic progenies identified (e.g., absence of spinterns, seedless fruits, fruiting on small branches). He also discussed the fruit maturity period, fruit size, and the number of fruits per panicle in F1 progenies. To eliminate undesirable progenies, four independent culling levels (ICLs) were conducted, resulting in the selection of 30 progenies. These progenies were then ranked using a selection index based on desirable traits divided into a plant category and fruit category. The selection index took into account the value of the traits and their economic importance. Dr. Johari presented the scores and corresponding weightages for selected traits. At the end of the selection process, 25 progenies had higher selection indexes compared to the maternal parents. However, further investigations, such as determining the percentage of pollen viability and conducting compatibility studies, were necessary. Additionally, the percentage of male and female flowers per inflorescence had to be determined. After the final assessment, four new clones were shortlisted, surpassing the R191 (standard check variety – Anak Sekolah also known as the Rong Rien in Thailand). The most promising progenies were GB-44, IE-20, EH-57, and AG-28. Following an eight-season localized stability test and reproductive system study, the AG-28 and GB-44 progenies were selected for release on July 29, 2019, as new rambutan clones named Mutiara Merah and Mutiara Wangi, respectively.

3.0. QUESTION AND ANSWER SESSION

Mr. Yacob Ahmad from TFNet was moderator for the Questions and Answers session and panel discussion. The questions fielded during the Q and A were those that were asked prior to the webinar and during the session.

To a question on leaf margin necrosis which is common in rambutan, the moderator responded that normally, it is due to water stress. There is also the possibility of potassium deficiency if it occurs on the lower leaves. To a question on the current trade of rambutan, moderator said that

in addition to the points discussed in presentations by Dr Sobir of Indonesia and Mr. Christopher Biai from Malaysia it will be further discussed in the panel. Responding to a question on the selection of suitable varieties, Dr. Johari explained that in the Malaysian context, variety selection is based on the issues faced by the industry. He mentioned that agroclimatic and soil suitability are important considerations, including early or late fruiting varieties that would prolong the season availability of the fruit. This is in addition to other positive characteristics such as fruit quality, yield and taste.

To a question on the possibility of incorporating rambutan trees in an agro-forestry environment, Dr. Sobir said that this is practiced in Indonesia where tropical fruits including good rambutan varieties are planted alongside forest trees, which can provide extra income for farmers. The farmers also need to operate as groups or cooperatives to sustain the initiative.

To a query on irrigation, moderator responded that irrigation is normally required in dry areas and especially during plant establishment.

Responding to a comment on postharvest technologies to improve shelf life, Mr. Christopher Biai related the trials conducted in Malaysia, adding that at ambient temperature the popular R191 can stay fresh for 4 days, while at 10 degrees centigrade, the fruits can last until 10 days. Freezing the fruits did not help as it caused the flesh to become soft and mushy. Dr. Sobir added that varieties like 'Rapih' from Indonesia can last 6 days in ambient temperature because the spinterns are shorter and exorbitantly priced. Mr. Christopher also commented that canning is an option, however, utilization of the canning facility has to take into account the time when the fruit is not in season.

Before the panel discussion, the session moderator invited Sabine Altendorf from the FAO, to share information on the current efforts by the organization to include minor fruits such as rambutan as a mainstream fruit crop. Sabine began by saying that there is limited data on minor tropical fruits. However, recently a proposal to update the HS codes (harmonised system) for tropical fruits has been submitted to the World Customs Organisation, with support from many countries, including the US, and it is hoped that soon (2027) more minor fruits will have assigned codes. This will also depend on the trade quantum for the fruit types that has to be substantial. She added that while perishability is a main issue, low consumer awareness and less availability in distant markets are current obstacles to develop rambutan. More must be done to promote the fruit in terms of its health benefits. Sabine added that there is potential to develop rambutan considering the global access due to migration and demography, at the same time benefits of consuming the fruit should be highlighted and actively promoted.

Summarising the presentations, and introducing the panel discussion, the moderator reiterated that consumption and market seems to be an obstacle in developing the fruit. Yacob gives the examples of reduced consumption of the fruit in Indonesia in recent years, and the static production and demand in Malaysia. This situation is further exacerbated by the very poor demand of the fruit in China. However, looking at the positive side, there are also factors such as the diaspora of Asian communities who are familiar with the fruit and the potential for them to popularise it. In addition, rambutan is also competing with other more popular fruits such as durian or pitaya, but, it has to be noted these fruits too were less developed maybe 25 years ago and it took some time for them to become popular. Using this example, the moderator suggested

that it will also take some time for rambutan to be developed into a popular fruit.

4.0. PANEL DISCUSSION

The panel discussion was conducted through responses by the presenters on questions or comments posed by the moderator, on the state of rambutan development in their respective countries.

In his presentation, Dr. Sobir commented on the low demand for rambutan in Indonesia, which prompted a question on whether steps are taken to improve the situation. Dr. Sobir responded that the 2 main factors attributed to low consumption of the fruit are the lack of interest by younger consumers who prefer fruits that are more convenient to eat, referring to the skin of rambutan that needs to be peeled before being consumed. He added that production has also been erratic and low because of the lack of commercial farms because most of the rambutans are produced from mixed backyard cropping system. Dr. Sobir also reiterated that rambutan has been listed as a fruit to be developed in Indonesia and the 'Rapih' variety which has a longer shelf life has been promoted including growing them commercially.

Moderator then directed a question to Mr. Christopher Biai of the Malaysian Department of Agriculture regarding the slow development in the consumption and market of the fruit in Malaysia. Mr. Christopher reminded that rambutan is listed as a fruit to be developed for the domestic and export market and the export program to the USA is still ongoing. The mock export trial to the USA has indicated some positive indications and forthcoming field audits from the US importers are expected to move this effort forward. Currently reducing the supply chain with the use of e-commerce by young consumers are some alternatives to market the fruit. Malaysia recently experienced a glut in production which has led to fruits being unsold and wasted. Even though processing through canning is an option, the seasonal nature of the fruit makes it unsustainable. Increasing domestic consumption and exports are the best options for Malaysia.

Responding to the moderator's comment on the very limited market in China, Dr. Mei Ying from Southern China Agricultural University, indicated that this is due to the preference for litchi which is more available and cheaper in price. Rambutan in China is produced in Hainan Island and are also very expensive. Therefore, currently, it is not a choice fruit for the Chinese market, and it would take time to promote and develop rambutan further.

Dr. Johari from Malaysia responded to the moderator's comment on whether the new varieties introduced by MARDI (Malaysian Agricultural Research and Development Institute) are already available and distributed to growers. He reminded that the new varieties are early fruiting varieties which will benefit growers. MARDI is also introducing the variety through matured grafting on older varieties to replace older varieties that are less productive and marketable. The new varieties GB44 and AG28 are also available for sale as grafted plants to farmers.

In his concluding remarks, moderator Yacob, mentioned that fruits in the same family such as litchis and longan have had the same issues with shelf life and postharvest management, which have been overcome through concerted research and development and aggressive marketing. These fruits have already been exported to Western, Middle Eastern countries and throughout Asia. Going by this experience, the same can be applied to rambutan.

While its development remains slow compared to other minor fruits, there is still big potential for rambutan considering future markets in Asia and the Middle East based on demographic factors and the anticipated increase in exports due to, the diaspora or spread of Asians to other countries for work or migration.

Consumer demand is complex and unpredictable, but with the production of clean, safe, nutrient heavy, plus with new consumer attractive cultivars and aggressive promotion, the popularity of rambutan can be enhanced. Indonesia and Malaysia have also included rambutan as one of the fruits to be developed in the coming years, along with other fruits such as durian and pitaya.

As agreed by presenters, there must be continuous efforts to encourage consumption of rambutan as a healthy fruit in combination with other fruit types.

Moderator Yacob concluded that he hoped the webinar had been informative and useful in understanding the challenges in promoting rambutan as a popular choice fruit among consumers and to improve its marketability.

5. CLOSING REMARKS

Overall, the discussions showcased the potential, challenges, and ongoing efforts in rambutan cultivation and market development in Malaysia, China, and Indonesia. The presentations offered insights into the cultivation techniques, post-harvest practices, and the current market scenario, while shedding light on the various government support and initiatives, which can be emulated by other countries. Though some countries such as China at present remain net importers for rambutan, this scenario may change given the dynamism of the market and influence of other factors such as strong government backing, as observed in other countries such as Malaysia and Thailand. Greater promotional efforts are a must to create awareness of the fruit especially among younger consumers. Strategies such as varietal improvement, market expansion, and addressing consumer preferences were proposed to further revitalize the rambutan industry.

6. APPENDICES

6.1. Program

Date: 18 May 2023 (Thursday)

| Time | Content |
|----------------|---|
| 2.00 – 2.10 pm | Introduction Dorothy Chandrabalan (TFNet) |
| 2.10 – 3.30 pm | Presentations Dorothy Chandrabalan (TFNet) |
| | a. Mr. Christopher Biai Director, Crop Industry Development Division, Dept. of Agriculture Malaysia 'Rambutan cultivation and market in Malaysia' |
| | b. Dr. Meiyin He, Assoc Professor, College of Economics and Management, South China Agricultural University, Guangzhou, China 'Market potential analysis of Rambutan in China' |
| | c. Prof. Dr. Ridzwan Sobir, Center of Tropical Horticulture Studies, IPB University, Bogor, Indonesia 'Status of production, consumption and market of Rambutan in Indonesia' |
| | d. Dr. Johari Sarip Independent Consultant 'Cultivar development and breeding of Rambutan in Malaysia' |
| 3.30 – 4.00 pm | Q & A, Panel discussion Moderator: Yacob Ahmad (TFNet) |
| All speakers | Challenges and opportunities in developing Rambutan for the global market |

6.2. PHOTOS



TFNet Acting CEO Dorothy Chandrabalan Introduces the webinar.



Mr. Christopher Biai, Director, Crop Industry Development Division, Dept. of Agriculture, Malaysia

52 registered variety

Popular Variety

- R193 – Deli Baling (Red)
- R191 – Anak Sekolah (Red)
@Rong Rien
- R170 – Deli Cheng (Red)
- R162 – Oh Heok (Red)
- R156 – Muar Gading (Yellow)

Mr. Christopher Biai presenting ‘Rambutan cultivation and market in Malaysia’

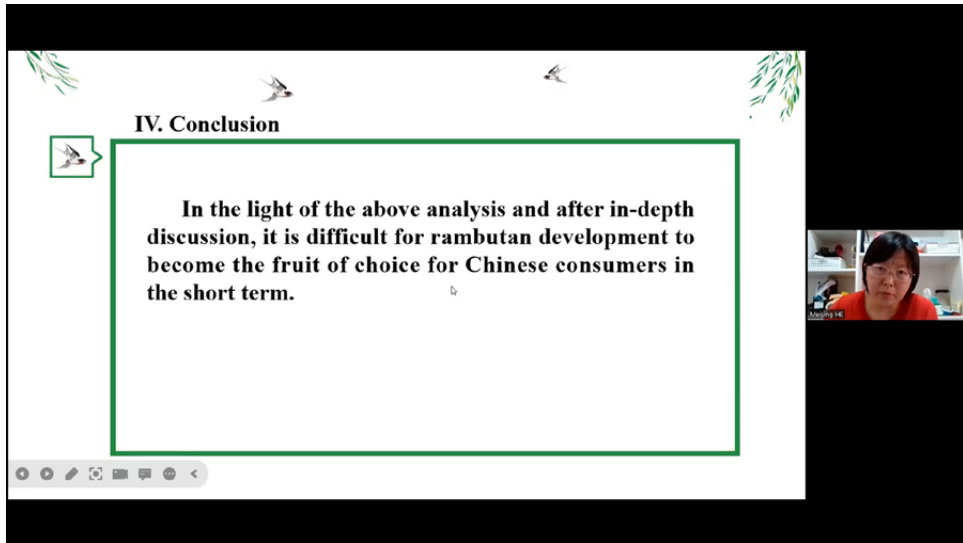
**WEBINAR SERIES ON TROPICAL FRUITS
RAMBUTAN**
Enhancing Global Consumption and Trade of Rambutan

18 May 2023
2 pm, Kuala Lumpur (GMT+8)
via Zoom

**MARKET POTENTIAL ANALYSIS OF
RAMBUTAN IN CHINA**

DR. MEIYING HE
Associate Professor
College of Economics and Management
South China Agricultural University
Guangzhou, Guangdong
China

Dr. Meiyin He, Assoc Professor, College of Economics and Management, South China Agricultural University, Guangzhou, China



Dr. Meiyin He presenting 'Market potential analysis of Rambutan in China'



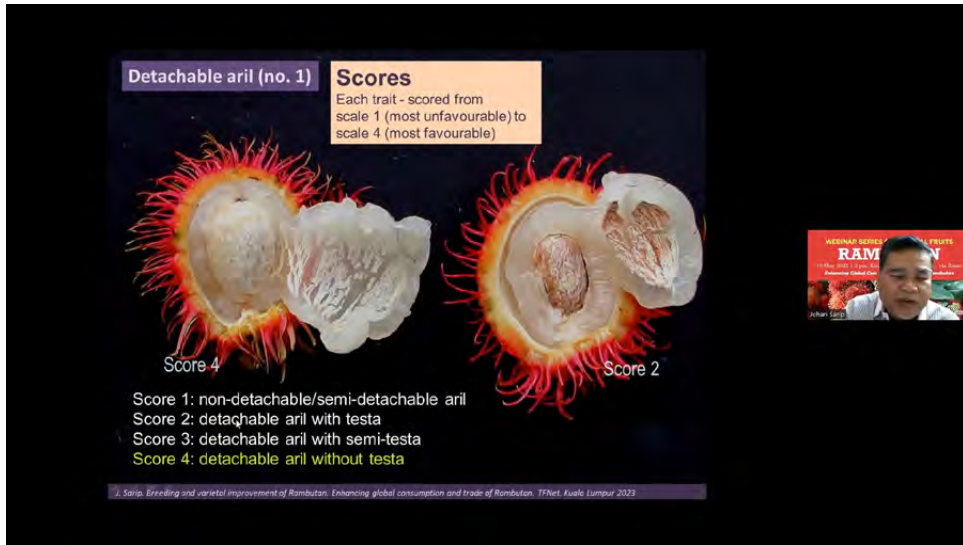
Prof. Dr. Ridzwan Sobir presenting Center of Tropical Horticulture Studies, IPB University, Bogor, Indonesia



Prof. Dr. Ridzwan Sobir presenting 'Status of production, consumption and market of Rambutan in Indonesia'



Dr. Johari Sarip, Independent Consultant

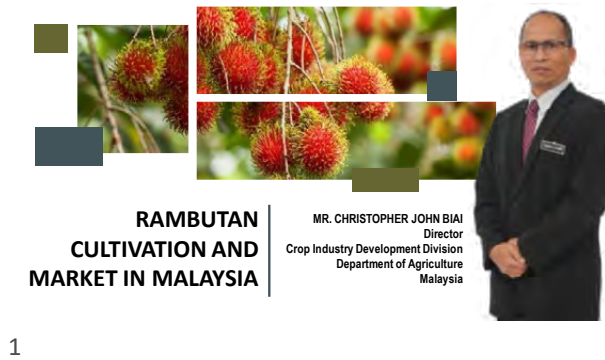


Dr. Johari Sarip presenting ‘Cultivar development and breeding of Rambutan in Malaysia’



Mr. Yacob Ahmad, TFNet Advisor, chairing the panel discussion with the presenters.

6.2. POWERPOINT PRESENTATIONS



RAMBUTAN CULTIVATION AND MARKET IN MALAYSIA

MR. CHRISTOPHER JOHN BIAI
Director
Crop Industry Development Division
Department of Agriculture
Malaysia

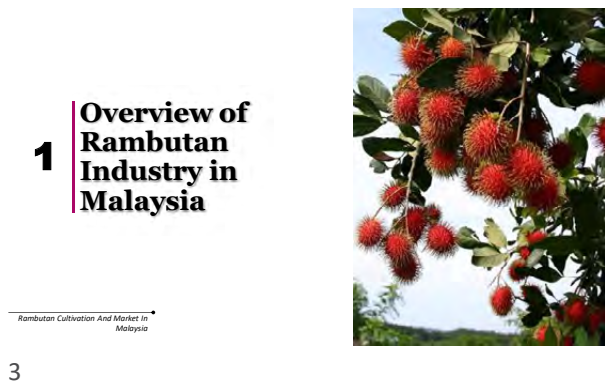
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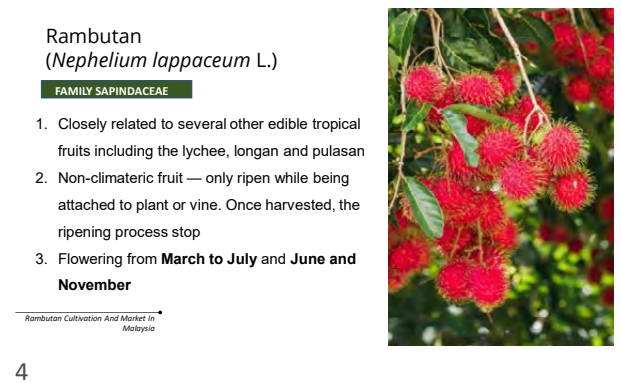
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1 Overview of Rambutan Industry in Malaysia

Rambutan Cultivation And Market in Malaysia

3




Rambutan (*Nephelium lappaceum* L.)

FAMILY SAPINDACEAE

1. Closely related to several other edible tropical fruits including the lychee, longan and pulasan
2. Non-climateric fruit — only ripen while being attached to plant or vine. Once harvested, the ripening process stop
3. Flowering from **March to July** and **June and November**

Rambutan Cultivation And Market in Malaysia

4

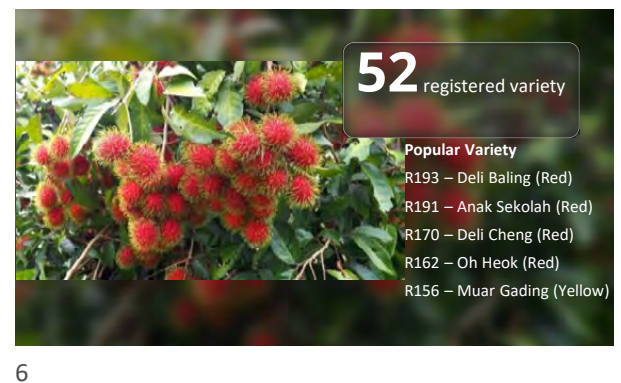


Rambutan Potential in Malaysia

- 01 - suitable climate allows rambutan to thrive
- hot and humid weather allows rambutan to yield twice a year
- 02 New variety that is resistant to diseases and early yielding

Rambutan Cultivation And Market in Malaysia

5



52 registered variety

Popular Variety

- R193 – Deli Baling (Red)
- R191 – Anak Sekolah (Red)
- R170 – Deli Cheng (Red)
- R162 – Oh Heok (Red)
- R156 – Muar Gading (Yellow)

6

UTILIZATION OF RAMBUTAN IN 2021



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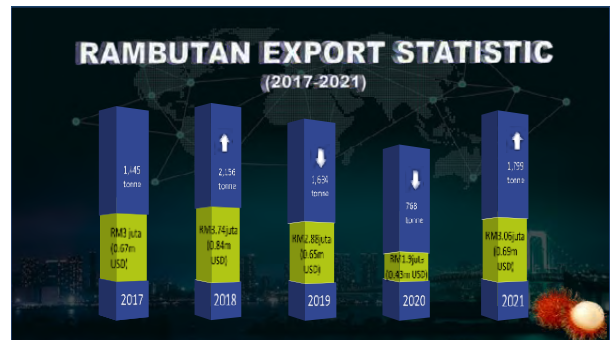
3 Market Access



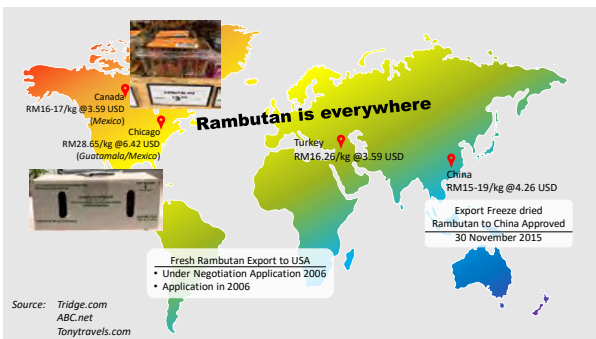
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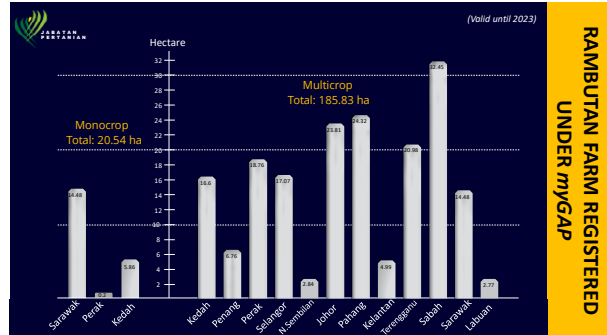
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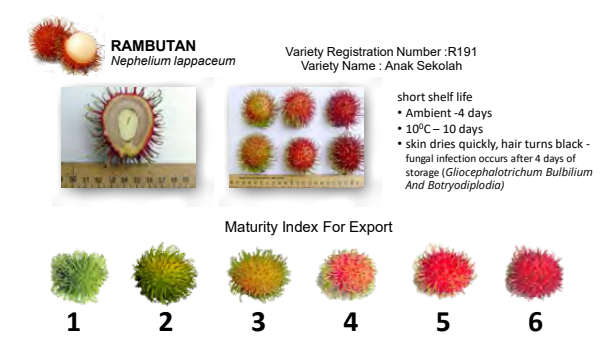
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Rambutan Mock Trial Export to the USA
(27 – 28 July 2020)

- 1 Harvesting
- 2 Grading
- 3 Transport to Export Treatment Center

25

Rambutan Mock Trial Export to the USA
(27 – 28 July 2020)

- 4 Washing and drying
- 5 Grading and packaging
- 6 Insect decontamination

26

Simulation of Rambutan Irradiation Test In Malaysian Nuclear Agency
(27 – 28 July 2020)

- 7 700 kg of treated fresh rambutan
- 8 Dosimeter installation for dos mapping
- 9 Dose mapping

Source : MALAYSIAN NUCLEAR AGENCY

27

Rambutan Mock Trial Export to the USA
(27 – 28 July 2020)

- 10 Irradiated Rambutan
- 11 Storage at 10°C and transport by air or sea

D_{min}: 450 Gy
D_{max}: 825 Gy
USDA requirements 400-1000 Gy

28

Video on Rambutan Mock Trial Eksport to the USA

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EXPORT CHALLENGES

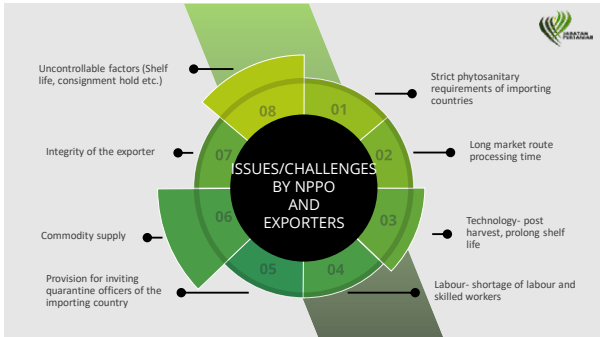
- Rejection of the use of low-density polyethylene packaging plastic material(LDPE)
- Insect proof irradiation treatment center
- Draft service cooperation agreement(CSA)

Source : MALAYSIAN NUCLEAR AGENCY

Rambutan Cultivation And Market In Malaysia

EXPORT RAMBUTAN TO USA

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4 Way Forward

Rambutan Cultivation And Market In Malaysia



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12MP Development Project

Long Term Crop Development Project

Rambutan, Durian, Rambutan, Mango, Mangosteen, Star fruit

To Increase production for export and reduce import dependence

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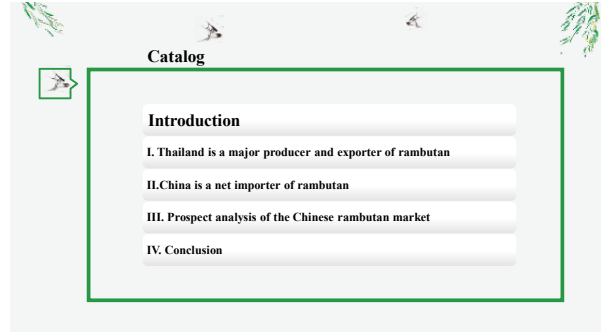
THANK YOU

Director
Crop Industry Development Division
Department of Agriculture
Malaysia

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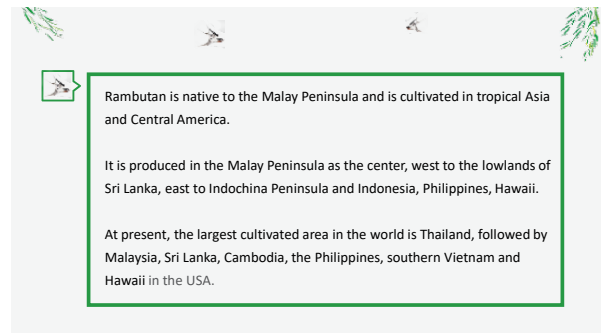
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I. Thailand is a major producer and exporter of rambutan

Thailand is the largest producer of rambutan, with the main growing centre being the province of Chanthaburi, followed by the provinces of Chumphon and Surat Thani, with **red and golden rambutan varieties** available from May to August. 2021 saw 208,400 acres of rambutan harvested in Thailand, **down 1.42% year-on-year**, with **production of 283,600 tonnes**, up 5.00% year-on-year, and an acreage yield of 1.36 tonnes, an increase of 6.25% year-on-year.

As the main producing country, Thailand rarely imports rambutan.

Thailand is a major exporter of rambutan, with exports accounting for approximately 8% of total production. The main export markets are China, Vietnam, Malaysia, Myanmar, Laos, UAE, etc. In 2022, Thailand exported 28,200 tonnes of rambutan, an increase of 60.24% year-on-year; the export value was Baht 852 million, an increase of 48.57% year-on-year.

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Table 1 Thailand rambutan production and trade data

| Year | Planted area (million acres) | Harvested area (million acres) | Capacity (million tonnes) | Acreage (tonnes) | Export volume (tonnes) | Export value (Billion Baht) |
|------|------------------------------|--------------------------------|---------------------------|------------------|------------------------|-----------------------------|
| 2017 | 25.62 | 24.28 | 24.78 | 1.02 | 2199.26 | 1.41 |
| 2018 | 23.93 | 22.36 | 25.98 | 1.16 | 2895.97 | 1.91 |
| 2019 | 23.25 | 21.36 | 28.00 | 1.31 | 2527.41 | 1.55 |
| 2020 | 23.08 | 21.14 | 27.01 | 1.28 | 2253.77 | 1.43 |
| 2021 | 22.61 | 20.84 | 28.36 | 1.36 | 3056.33 | 2.11 |
| 2022 | 22.15 | 20.74 | 26.60 | 1.28 | 2892.52 | 2.28 |

Data source: Thailand Agricultural Economics Office

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II. China is a net importer of rambutan

1. Production

The acreage of rambutan in China is relatively small, with only a few areas such as Hainan, Taiwan and Xishuangbanna in Yunnan growing it. The fruit is ripe for picking from May to August, with July being the peak season. In 2022, Baoting County planted 30,000 mu of rambutan, up 20.00% year-on-year; production was 20,500 tonnes, down 8.89% year-on-year; and the output value was nearly 410 million yuan, up 13.89% year-on-year. an increase of 13.89%.

9

Table 2 Production of red mullin in Baoting, Hainan

| Year | Area (million mu) | Production (million tonnes) | Value of output (billion yuan) |
|------|-------------------|-----------------------------|--------------------------------|
| 2016 | 1.75 | 1.40 | 1.68 |
| 2017 | 1.00 | 0.20 | -- |
| 2018 | 1.80 | 1.46 | -- |
| 2019 | 2.50 | 2.15 | -- |
| 2020 | 2.50 | 2.20 | 3.38 |
| 2021 | 2.50 | 2.25 | 3.60 |
| 2022 | 3.00 | 2.05 | 4.10 |

10

2. China's export trade in rambutan

China is a net importer of rambutan and maintains a perennial trade deficit. 2022 Chinese imports of rambutan were US\$1,810,600 and exports were US\$0.05 million, resulting in net imports of US\$1,810,100.

China has a relatively small area under rambutan cultivation and exports are relatively small. 0.51 tonnes of rambutan were exported from China in 2022, down 73.14% year-on-year; the export value was US\$0.05 million, down 92.37% year-on-year.

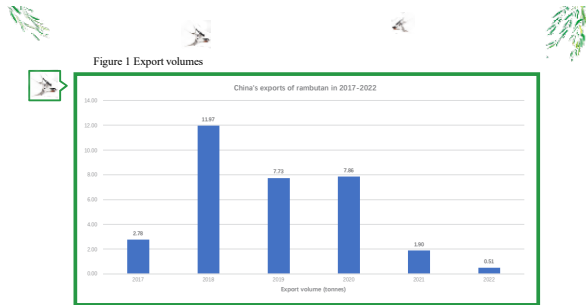
The main exporting countries (regions) of Chinese rambutan were the Russian Federation and Macau, China. The total amount exported to Russia was 0.33 tonnes, accounting for 63.73% of the total export volume, and the export value was US\$453, accounting for 83.27% of the total export value; the total amount exported to Macao, China was 0.18 tonnes, accounting for 35.29% of the total export volume, and the export value was US\$91, accounting for 16.73% of the total export value.

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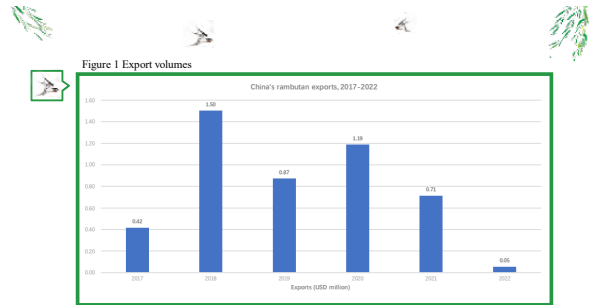
Table 3 China's major export markets and share of rambutan in 2017-2022

| Year | Trading partners | Amount (USD) | Quantity (tonnes) | Market share by amount (%) | Market share by quantity (%) |
|------|------------------|--------------|-------------------|----------------------------|------------------------------|
| 2017 | China Macau | 1073 | 1.67 | 25.73% | 59.97% |
| | Russia | 3097 | 1.11 | 74.27% | 40.03% |
| 2018 | China Macau | 1507 | 2.36 | 10.03% | 19.70% |
| | Kazakhstan | 1966 | 0.95 | 13.08% | 7.92% |
| 2019 | Russia | 11556 | 8.66 | 76.89% | 72.37% |
| | China Macau | 3196 | 5.01 | 36.53% | 64.74% |
| 2020 | Russia | 5553 | 2.73 | 63.47% | 35.26% |
| | China Macau | 3642 | 5.73 | 30.63% | 72.93% |
| 2021 | Russia | 8248 | 2.13 | 69.37% | 27.07% |
| | China Macau | 103 | 0.20 | 1.44% | 10.64% |
| 2022 | Russia | 7031 | 1.70 | 98.56% | 89.36% |
| | China Macau | 91 | 0.18 | 16.73% | 18.00% |
| | Russia | 453 | 0.33 | 83.27% | 64.36% |

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3. China's import trade of rambutan

The list of fresh fruit types and exporting countries/regions that have been granted inspection and quarantine access to China, published by the General Administration of Customs of China on 10 March 2023, shows that four countries, namely Malaysia, Myanmar, Thailand and Vietnam, have market access to export rambutan to China.

In 2022, China imported 924.07 tonnes of rambutan, up 11.88% year-on-year; imports accounted for 28.8% of Hainan Baoting's production. The import value was US\$1.810 million, down 11.60% year-on-year.

The main importing countries of rambutan in China are Thailand and Vietnam. Imports from Thailand amounted to 468.42 tonnes, accounting for 50.69% of total imports and US\$1,491,400, or 82.37% of total imports; imports from Vietnam amounted to 455.66 tonnes, accounting for 49.31% of total imports and US\$319,200, or 17.63% of total imports.

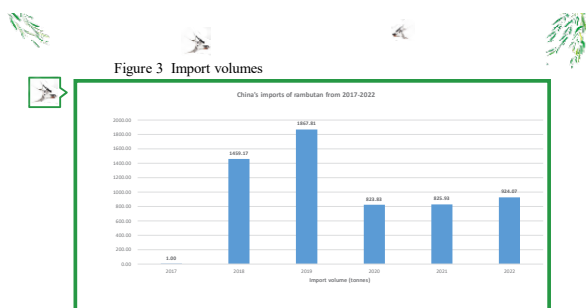
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Table 4 China's major import markets and share of rambutan in 2017-2022

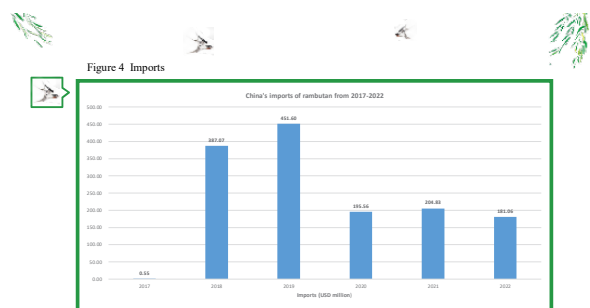
| Year | Trading partners | Amount (USD) | Quantity (tonnes) | Market share by amount (%) | Market share by quantity (%) |
|------|------------------|--------------|-------------------|----------------------------|------------------------------|
| 2017 | Vietnam | 5544 | 1.00 | 100.00% | 100.00% |
| | Thailand | 3858145 | 1439.01 | 99.68% | 98.62% |
| 2018 | Vietnam | 12512 | 20.16 | 0.32% | 2.38% |
| | Thailand | 4345985 | 1653.05 | 96.24% | 88.50% |
| 2019 | Vietnam | 169976 | 214.76 | 3.76% | 11.50% |
| | Thailand | 1899733 | 756.47 | 97.14% | 91.82% |
| 2020 | Vietnam | 55845 | 67.36 | 2.86% | 8.18% |
| | Thailand | 1995789 | 758.03 | 97.43% | 91.78% |
| 2021 | Vietnam | 52546 | 67.90 | 2.57% | 8.22% |
| | Thailand | 1491405 | 468.42 | 82.37% | 50.69% |
| 2022 | Vietnam | 319221 | 455.66 | 17.63% | 49.31% |

Data source: China Customs

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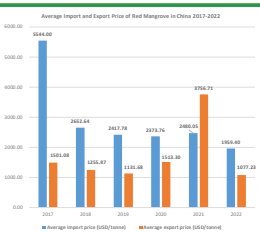


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4. Comparison of import and export prices

China's average export price of rambutan was significantly lower than the average import price, with both prices trending downwards in 2022 compared to 2021.

2022 China's average import price of rambutan was US\$1,959.40 per tonne, a decrease of 20.99% year-on-year, while China's average export price of rambutan was US\$1,077.23 per tonne, a decrease of 71.33% year-on-year.



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III. Prospect analysis of the Chinese rambutan market

1. Chinese rambutan is not well recognised in the market and is sold at a high market price

The rambutan is a niche fruit in the Chinese market, not many people understand and have eaten this fruit, and those consumers who have bought and eaten it do not have a high recognition of the rambutan, generally agreeing that it is not as good as lychee. However, compared with other tropical fruits such as litchi, the selling price of rambutan is generally higher, and the price of Hainan fruit is higher than that of Thailand, which is higher than that of Vietnam. 4 May 2023 in the e-commerce platform query of rambutan price shows: Vietnam imported rambutan 23 yuan/catty, Thailand imported rambutan 30 yuan/catty, Hainan Baoting rambutan 42 yuan/catty.

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2. The annual production of rambutan in China accounts for only 7.9% of Thailand's annual production, and imports are less than 4.5% of annual production, so the market supply is low

In terms of production and imports of rambutan, the Chinese market is low in supply. There are very few areas in China that can meet the conditions for rambutan cultivation, and at present only Baoting County in Hainan is the most suitable for cultivation, with a small area under cultivation and a low yield, with an annual production of 22,500 tonnes in 2021, compared to 283,600 tonnes in Thailand, the main production area, with China's annual production accounting for only 7.9% of Thailand's. China's imports of rambutan are also small, with a production of 20,500 tonnes in 2022 and an import volume of 924.07 tonnes, with imports accounting for only 4.5% of China's annual production.

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3. Thailand is a major producer but not a major exporter of rambutan, with exports accounting for only 6.2% of production

Thailand is a large producer of rambutan. While the planted area and harvested area remain stable, the total production and acreage show a year-on-year increase, with a total production of 283,600 tonnes and acreage of 1.36 million in 2021; the export volume of rambutan in Thailand was 17,616.76 tonnes in 2021, accounting for only 6.2% of the total production, with a large amount of rambutan being sold in the Thai domestic market.

22

4. Unstable storage and transportation limits the sales radius

The biggest dilemma facing the rambutan is that it can't be planted, released or transported, its market range is limited and its sales radius is too short.

Due to the special structure of its rind, rambutan will brown within 3 days after harvesting, lose water or even develop a sour wine taste in 3-4 days at room temperature, and may spoil in a week's time.

In addition, it is extremely difficult to transport. The crux of the problem lies in the spines on the outside of the rambutan fruit skin, which are easily broken and contain tannins, which accelerate the browning of the fruit and its deterioration time. According to reports, the vast majority of imports and sales of red mullein produced in Baoting County do not leave Hainan Province, Guangdong Province and Yunnan Province (Xishuangbanna is also planted), and a very small proportion is sold to the north.

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Current mainstream measures to extend the freshness of rambutan include spraying chemicals (previously it was also exposed that unscrupulous traders used preservatives in excess and in violation of the law to extend the freshness period of rambutan), low temperature preservation (tropical fruits will brown in low temperature for a long time), high temperature pretreatment insurance, biological agents to preserve freshness, air conditioning to preserve freshness, etc.; although there are many measures, they will only extend the freshness period by half a month at most.

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IV. Conclusion

In the light of the above analysis and after in-depth discussion, it is difficult for rambutan development to become the fruit of choice for Chinese consumers in the short term.

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THANK YOU

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Production, Consumption and, Market Rambutan Indonesia

Sobir, Awang Maharjaya, and Ellina Mansyah
Center for Tropical Horticulture Studies
IPB University



1

Origin and distribution of Rambutan

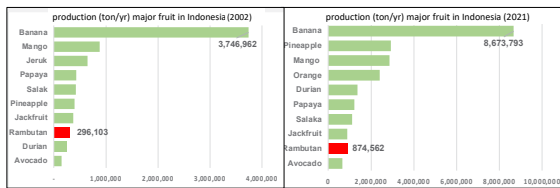
Rambutan originated from South-east Asia region, and distributed tropical area in Asia and Africa

- Rambutan relatives in Indonesia
1. Maritam (*Nephelium mutabile*)
 2. Kapulasan (*N. ramboutan-ake*)
 3. Sibau (*N. junglandifolium*)
 4. Kalamangis (*N. uncinatum*)
 5. Ridan (*N. maingayi*)
 6. Ihau (*Dimocarpus malesianus*)



2

Positioning Rambutan in Indonesia

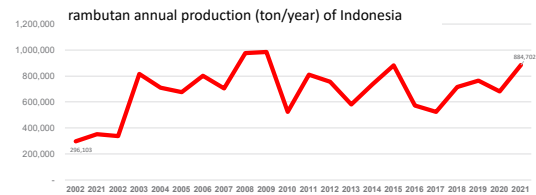


Rambutan production in Indonesia increase three folds in 20 years (2002-2021), however in term of rank slight down from no 8 to no 9



3

Rambutan production trend



Despite rambutan production in Indonesia increase in 20 years, production year on year data revealed fluctuation, indicated rambutan production in Indonesia following three annual bearing, slight change related to wheatear anomaly



4

Rambutan production recent trend

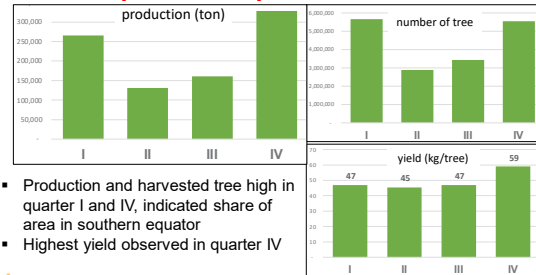


- In last 5 years annual production increase 1.5 folds, and first three annual bearing pattern started in 2018 until 2020.
- Number of harvested trees not resemble to annual production due to change in yield/tree



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Rambutan production pattern

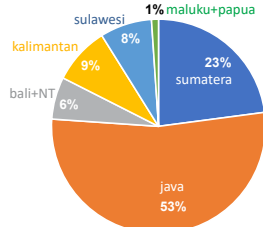


- Production and harvested tree high in quarter I and IV, indicated share of area in southern equator
- Highest yield observed in quarter IV



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Rambutan production distribution

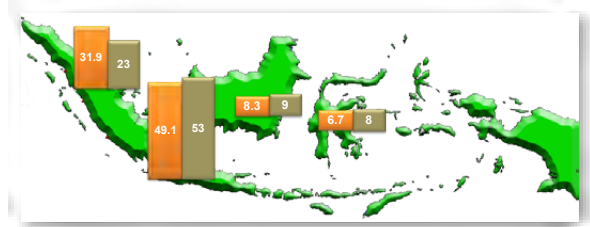


Most rambutan in Indonesia produced in Java, Sumatera and Kalimantan, indicated that wet climate was suitable for production of Rambutan



7

Rambutan production distribution

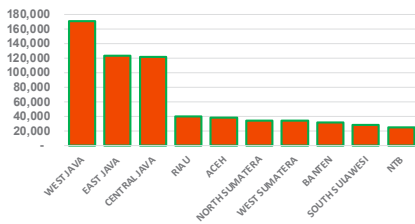


Comparison distribution 2002 to 2021, indicated increase role of Java island in Rambutan Production



8

Rambutan production distribution



Three main province in Java island share highest rambutan production following province in Sumatera



9

Rambutan Production System



Most rambutan in Indonesia grown in the lowland up to 600 m asl. with wet climate in backyard cultivation system



10

Rambutan Released Varieties

| No | Name | Origin |
|----|---------------|--|
| 1 | Binjai | Ragunan, DKI Jakarta |
| 2 | Rapih | Ragunan, DKI Jakarta |
| 3 | Lebak Bulus | Ragunan, DKI Jakarta |
| 4 | Antalaji | Sungai Andai, Kalimantan Selatan |
| 5 | Sibongkok | Sungai Lulut, Kalimantan Selatan |
| 6 | Sibatuk Ganai | Sungai Andai, Kalimantan Selatan |
| 7 | Garuda | Sungai Andai, Kalimantan Selatan |
| 8 | Nona | Kab. Kampar, Riau |
| 9 | Narmada | Lombok, NTB |
| 10 | Brahrang | Brahrang, Langkat, Sumatera Utara |
| 11 | Tangkue Lebak | Kab. Lebak, Jawa Barat |
| 12 | Kundur | Kab. Kep. Riau, Riau |
| 13 | Zamal Mahang | Hulu Sungai Tengah, Kalimantan Selatan |
| 14 | Parakan | Tangerang, Banten |
| 15 | Walaha | Kuningan Jawa Barat |
| 16 | Mubin | Depok, Jawa Barat |
| 17 | Sibatulawang | Banjar, Jawa Barat |
| 18 | Ajalaka | Cianjur, Jawa Barat |
| 19 | Asmara | Ciamis |
| 20 | Pirba | Kuburaya |



11

Rambutan Released Varieties



12

Most Popular Varieties

Rapiah, released in 1985, originates from Pasar Minggu, characterized by sparse and relative short hair, brix 20–22% (already sweet prior to mature), dry, chewy, easy separated from seed and thick flesh, shelf life 6 days, fruit weight 25 – 30 gr/fruit.



Binjai, Released in 1985, originates from the Binjai region, with slightly rough and sparse fruit hair, 21-22% brix, the fruit flesh is dry, chewy, and easy separated, with a fruit weight of 40-45 gr/fruit.



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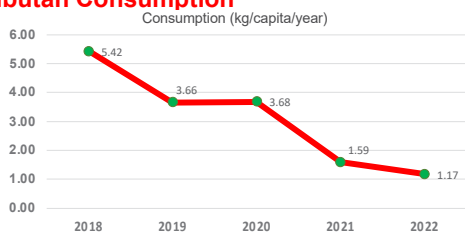
Rambutan Potential Varieties



14



Rambutan Consumption



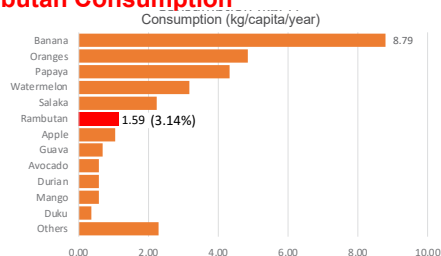
Rambutan consumption tend to decrease in last 5 years



15



Rambutan Consumption



Rambutan consumption (2021) rank no 6 after banana, Oranges, Papaya, Watermelon and Salaca



16



Rambutan Consumption

most rambutan fruit consumed fresh

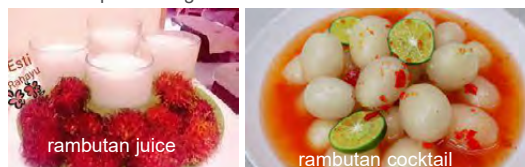


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Rambutan Consumption Variation

minimum processing



18



Rambutan Consumption Variation

Fried



19

Rambutan Marketing

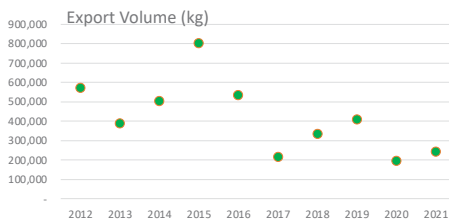


most rambutan fruit marketed freshly in street stall, with highest price around II and III quarter



20

Rambutan Export

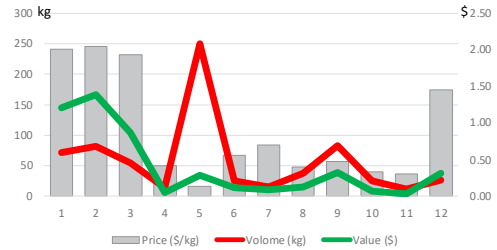


Rambutan export tend to decrease in last 10 year. In 2022 United Arab Emirate, Saudi Arabia, Qatar, Uni Europe, Taiwan, Singapore, and USA, with volume of 695.4 ton equal to 583,591 US\$.



21

Rambutan Export



rambutan export highest volume in I quarter, however highest price in II quarter



22

Rambutan Export

Rambutan export from Indonesia determinate by several factor including:

- Domestic Price
- Export Price
- Rupiah exchange rate
- Previous year export volume
- Domestic Production
- Fruit Quality



23



24

Breeding and Varietal Improvement of Rambutan (*Nephelium lappaceum* Linn) in Malaysia

Johari Sarip
lab@hikmah.fkm.umkl.com



1

Second strategy

Breeding and selection of F₁ progeny

Main Objective

- To obtain, select and characterise new clones of rambutan developed through open pollinated method

Other Objectives

- To characterise the F₁ population
- To develop Selection Index
- To study reproductive system
- To identify early season progeny



4

Rambutan

- Sapindaceae family (about 125 genera, 1000 species)
- Well distributed in West and East Malaysia, and Sumatra, Indonesia
- Diploid (2n=22), Heterozygous and cross-pollinated species
- Genetic variability among seedling progenies

Local industry is not significantly increased

Rambutan variety need to be improved

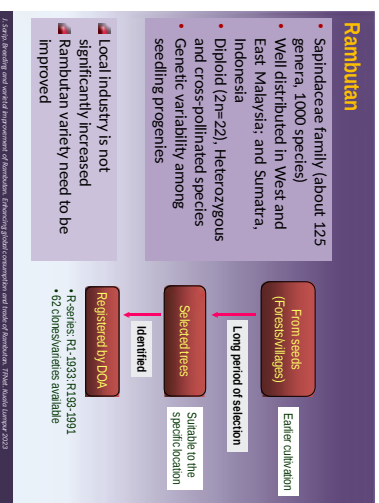
From seeds (Forests/Villages) → Enter cultivation

Long period of selection → Suitable to the specific location

Selected trees → Identified

Registered by DOA

- R-series: R1, R3, R193-1991
- G2 clones/varieties available



2

Breeding Approach

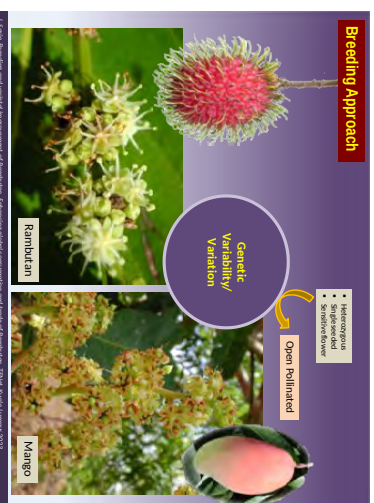
Genetic Variability/Variation

- Heterozygous
- Reproductive system

Open Pollinated

Rambutan

Mango



5

Two strategies to improve rambutan varieties

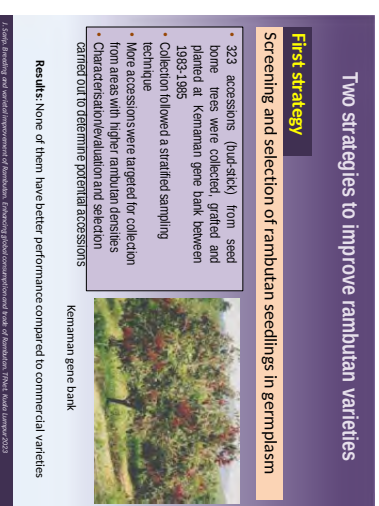
First strategy

Screening and selection of rambutan seedlings in germplasm

- 323 accessions (bud-stick) from seed borne trees were collected, grafted and planted at Kemaman gene bank between 1983-1985
- Collection followed a stratified sampling technique
- More accessions were targeted for collection from areas with higher rambutan densities
- Characterisation/evaluation and selection carried out to determine potential accessions

Kemaman gene bank

Results: None of them have better performance compared to commercial varieties



3

Methodology

Maternal Parents
 R99, R4, R1, R134

Paternal Parents
 R4, R4, R7, R9, R137, R138, R153, R154, R157, R160, R161, R162, R168 and R170

Open Pollinated

Only seeds from maternal parent were collected

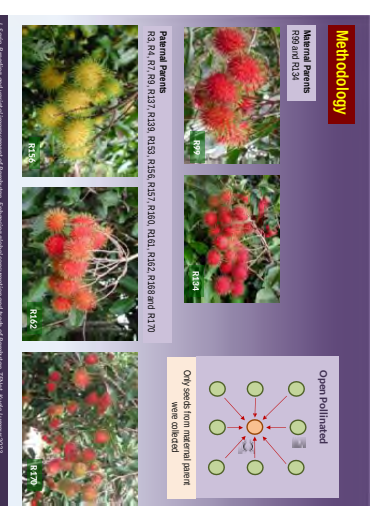
R99

R134

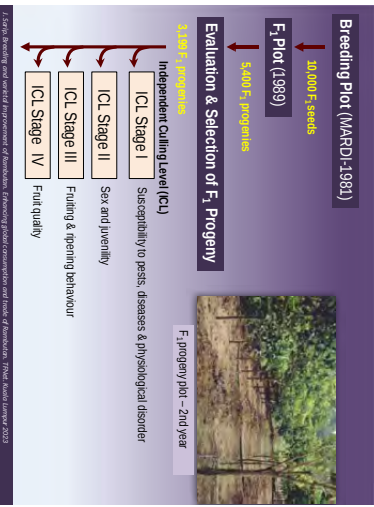
R160

R162

R167

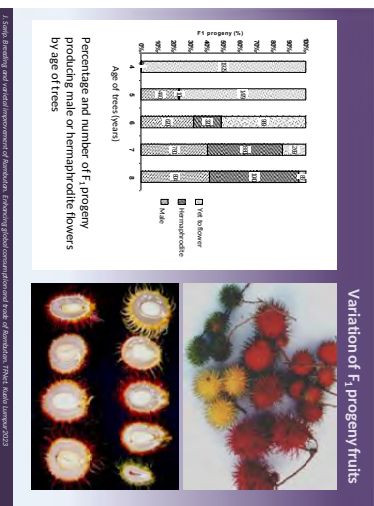


6



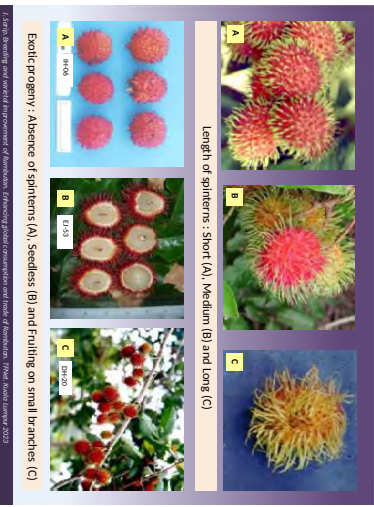
7. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

7



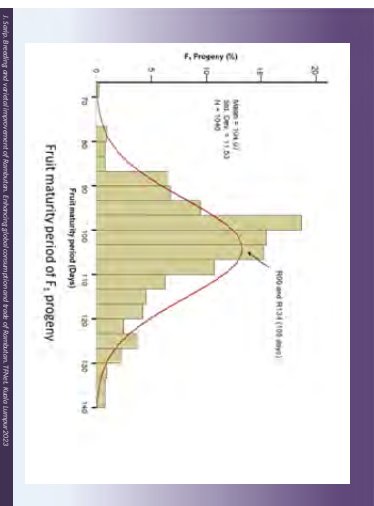
8. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

8



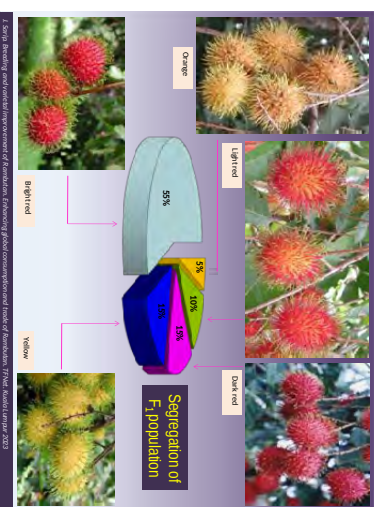
10. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

10



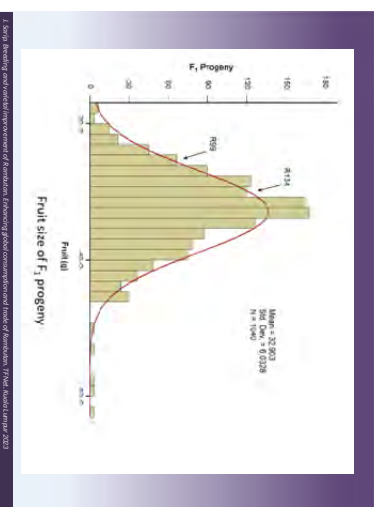
11. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

11



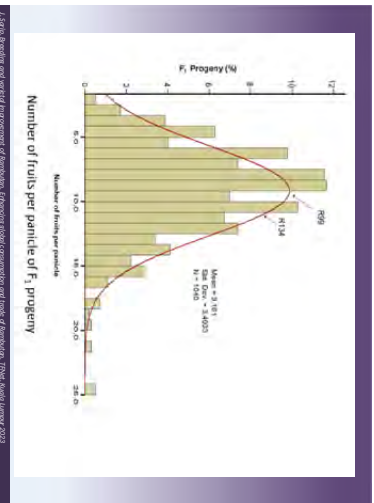
9. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

9



12. F₁ Progeny plot and overall improvement of Amurhemp. Enhanced global competitiveness and trade of Amurhemp. IPAG, Mizui, January 2023

12



13

Independent Culling Level (ICL)

3,199 progenies (7 year-old)
 1,270 ↓ Level I
 1,929 progenies (8 year-old)
 889 ↓ Level II
 1,040 progenies (9 year-old)
 593 ↓ Level III
 447 progenies (10 year-old)
 417 ↓ Level IV
 30 selected progenies

The best progenies were identified

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Independent Culling Level (ICL)

3,199 progenies (7 year-old)
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 30 selected progenies

The best progenies were identified

- Highly susceptible to Diseases (219 plants)
- Pests (975 plants)
- Physiological disorder (76 plants)

Seed bank (Concomitantly collected)

Snow mold (Meloid mycelium)
 Many fungi (Phycomycota etc)

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Independent Culling Level (ICL)

3,199 progenies (7 year-old)
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 1,040 progenies (9 year-old)
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 30 selected progenies

The best progenies were identified

- Highly susceptible to Diseases (219 plants)
- Pests (975 plants)
- Physiological disorder (76 plants)

Fungus infection

Gall

Bark borer

Hemiptera

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Independent Culling Level (ICL)

3,199 progenies (7 year-old)
 1,270 ↓ Level I
 1,929 progenies (8 year-old)
 889 ↓ Level II
 1,040 progenies (9 year-old)
 593 ↓ Level III
 447 progenies (10 year-old)
 417 ↓ Level IV
 30 selected progenies

The best progenies were identified

- Male plants: 804 plants
- Long juvenile: 88 plants

Fruits from male plant

Hemiphragmoid flowers

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Independent Culling Level (ICL)

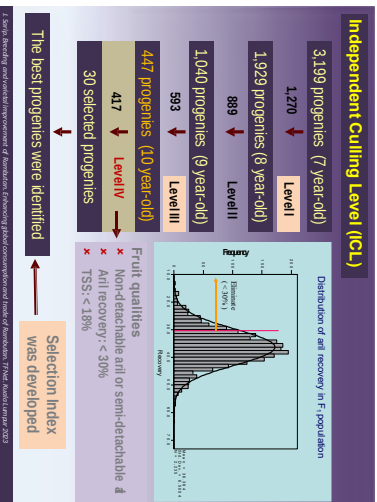
3,199 progenies (7 year-old)
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 593 ↓ Level III
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 30 selected progenies

The best progenies were identified

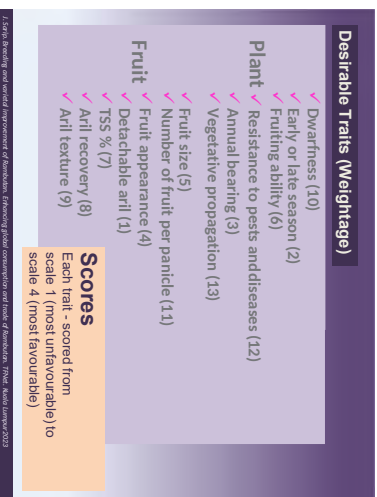
- No produced fruit every year - 421 plants
- Non-synchronous opening - 172 plants

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20



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22



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Fruit appearance (no. 4)

| Why unattractive (1) | Category (Sub-score) | | | |
|-----------------------|----------------------|----------------|---------------------|------------|
| | Unattractive (2) | Attractive (3) | Very attractive (4) | |
| Spineless length (mm) | < 2. > 12 | 10-11 | 7-9 | 3-5 |
| Spineless colour | Yellowish green | Reddish yellow | Reddish green | Green |
| Shin colour | Dark red and orange | Yellow | Light red | Bright red |

Score 1: sub-score = 3
 Score 2: 3 < sub-score ≤ 7
 Score 3: 7 < sub-score ≤ 12
 Score 4: sub-score = 12

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Fruit Size (no. 5)

Score 1: FS < 25 g
 Score 2: 25 g ≤ FS < 35 g
 Score 3: 35 g ≤ FS < 45 g
Score 4: 45 g ≤ FS

Fruiting Ability (no. 6)

Score 1: Low
 Score 2: Medium low
 Score 3: Medium high
Score 4: High

TSS % (no. 7)

Score 1: TSS < 18 %
 Score 2: 18 % ≤ TSS < 20 %
 Score 3: 20 % ≤ TSS < 22 %
Score 4: 22 % ≤ TSS

Ail Recovery (no. 8)

Score 1: AR < 30 %
 Score 2: 30 % ≤ AR < 38 %
 Score 3: 38 % ≤ AR < 45 %
Score 4: AR ≥ 45 %



Score 1: Low
 Score 2: Medium low
 Score 3: Medium high
Score 4: High

Score 1: FS < 25 g
 Score 2: 25 g ≤ FS < 35 g
 Score 3: 35 g ≤ FS < 45 g
Score 4: 45 g ≤ FS

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Ail Texture (no. 9)

Score 1: soft and watery
 Score 2: soft and semi-watery
 Score 3: dried and semi-crunchy or semi-dried and crunchy
Score 4: dried and crunchy

Dwarfness (no. 10)

Score 1: > 4.5 m
 Score 2: 4.5 m ≤ height < 3.0 m
 Score 3: 3.0 m ≤ height < 1.5 m
Score 4: ≤ 1.5 m

Number of fruits per panicle (no. 11)

Score 1: 1 - 5
 Score 2: 6 - 10
 Score 3: 11 - 15
Score 4: > 15




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Resistance to pests and diseases (no. 12)

Score 1: susceptible
 Score 2: medium susceptible
 Score 3: medium resistance
Score 4: resistance

Vegetative propagation (no. 13)

Score 1: success < 25 %
 Score 2: 25 % ≤ success < 50 %
 Score 3: 50 % ≤ success < 75 %
Score 4: success ≥ 75 %






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Development of Selection Index (SI)

SI - Progeny traits and their economic importance

- Thirteen selected traits:
 - Six traits on plant
 - Seven traits on fruit
- Each trait - scored from scale 1 (most unfavourable) to scale 4 (most favourable)

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Selection Index

(1) - very important
 (13) - less important



| Selected traits | Weightage | Score | | | | Weightage Score | | | | | |
|-----------------------------------|-----------|-------------|----|----|----|-----------------|-------------|-------------|-------------|-------------|-------------|
| | | No. progeny | 23 | 24 | 25 | No. progeny | 23 | 24 | 25 | 26 | 27 |
| Data | | | | | | | | | | | |
| Dwarfness (10) | 0.04 | 1 | 2 | 2 | 2 | 0.04 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| Exploitation (2) | 0.14 | 1 | 2 | 2 | 2 | 0.14 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| Fruit quality (6) | 0.07 | 3 | 2 | 2 | 2 | 0.21 | 0.14 | 0.14 | 0.07 | 0.14 | 0.14 |
| Resistance to P & D (12) | 0.02 | 4 | 4 | 4 | 3 | 0.08 | 0.08 | 0.08 | 0.08 | 0.06 | 0.06 |
| Annual bearing (9) | 0.12 | 3 | 3 | 3 | 3 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 |
| Vegetative propagation (13) | 0.02 | 3 | 4 | 2 | 2 | 0.06 | 0.08 | 0.04 | 0.04 | 0.02 | 0.02 |
| Plant | | | | | | | | | | | |
| Fruit size (5) | 0.10 | 2 | 2 | 2 | 2 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| Number of fruits per panicle (11) | 0.11 | 3 | 3 | 3 | 4 | 0.33 | 0.33 | 0.44 | 0.44 | 0.33 | 0.33 |
| Fruit appearance (4) | 0.15 | 2 | 3 | 3 | 4 | 0.30 | 0.45 | 0.30 | 0.45 | 0.60 | 0.60 |
| Detachable seed (1) | 0.07 | 2 | 3 | 3 | 4 | 0.14 | 0.21 | 0.21 | 0.28 | 0.21 | 0.21 |
| TSS % (7) | 0.07 | 2 | 3 | 3 | 4 | 0.14 | 0.21 | 0.21 | 0.28 | 0.28 | 0.28 |
| Ail recovery (8) | 0.07 | 2 | 3 | 3 | 4 | 0.14 | 0.21 | 0.21 | 0.28 | 0.28 | 0.28 |
| Ail texture (9) | 0.05 | 4 | 3 | 3 | 4 | 0.20 | 0.15 | 0.15 | 0.20 | 0.20 | 0.20 |
| Total | | | | | | 2.51 | 2.59 | 2.38 | 2.28 | 2.81 | 2.81 |

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Selected progenies

| Progeny/Clone | Scientist index |
|---------------|-----------------|
| PR-43 (1) | 3.11 |
| PR-44 (1) | 3.10 |
| PR-45 (1) | 3.10 |
| PR-46 (1) | 3.10 |
| PR-47 (1) | 3.10 |
| PR-48 (1) | 3.10 |
| PR-49 (1) | 3.10 |
| PR-50 (1) | 3.10 |
| PR-51 (1) | 3.10 |
| PR-52 (1) | 3.10 |
| PR-53 (1) | 3.10 |
| PR-54 (1) | 3.10 |
| PR-55 (1) | 3.10 |
| PR-56 (1) | 3.10 |
| PR-57 (1) | 3.10 |
| PR-58 (1) | 3.10 |
| PR-59 (1) | 3.10 |
| PR-60 (1) | 3.10 |
| PR-61 (1) | 3.10 |
| PR-62 (1) | 3.10 |
| PR-63 (1) | 3.10 |
| PR-64 (1) | 3.10 |
| PR-65 (1) | 3.10 |
| PR-66 (1) | 3.10 |
| PR-67 (1) | 3.10 |
| PR-68 (1) | 3.10 |
| PR-69 (1) | 3.10 |
| PR-70 (1) | 3.10 |
| PR-71 (1) | 3.10 |
| PR-72 (1) | 3.10 |
| PR-73 (1) | 3.10 |
| PR-74 (1) | 3.10 |
| PR-75 (1) | 3.10 |
| PR-76 (1) | 3.10 |
| PR-77 (1) | 3.10 |
| PR-78 (1) | 3.10 |
| PR-79 (1) | 3.10 |
| PR-80 (1) | 3.10 |
| PR-81 (1) | 3.10 |
| PR-82 (1) | 3.10 |
| PR-83 (1) | 3.10 |
| PR-84 (1) | 3.10 |
| PR-85 (1) | 3.10 |
| PR-86 (1) | 3.10 |
| PR-87 (1) | 3.10 |
| PR-88 (1) | 3.10 |
| PR-89 (1) | 3.10 |
| PR-90 (1) | 3.10 |
| PR-91 (1) | 3.10 |
| PR-92 (1) | 3.10 |
| PR-93 (1) | 3.10 |
| PR-94 (1) | 3.10 |
| PR-95 (1) | 3.10 |
| PR-96 (1) | 3.10 |
| PR-97 (1) | 3.10 |
| PR-98 (1) | 3.10 |
| PR-99 (1) | 3.10 |
| PR-100 (1) | 3.10 |

Controlled pollination

Results on 1-hour bagging study

A and B: Flowers before the anthers were identified and wrapped. C: Fruit were identified and wrapped. D: No fruit set.

Maternal Parents: R34 (0.35%)
 Progeny: F50 (0.7)

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Four selected new clones compared to R191

| No. | Characteristics | R191 | GB-44 | EH-57 | IE-20 | AG-28 |
|-----|---------------------------|--|-------------------------|----------------------------|----------------------------|-------------------------|
| 1. | Yield per plant (5 years) | 19.5 kg | 26.2 kg | 37.2 kg | 12.3 kg | 32.2 kg |
| 2. | Fruit size | 37.7 g | 37.2 g | 35.7 g | 42.0 g | 35.7 g |
| 3. | TSS % | 21.2% | 21.8% | 21.1% | 22.2% | 18.8% |
| 4. | Detachable fruit * | Detached with testa | Detached with semitesta | Detached with semitesta | Detached with semitesta | Detached with testa |
| 5. | Anti-leakage | Firm & dried | Crunchy & dried | Firm & dried | Firm & dried | Firm & dried |
| 6. | Anti-leakage | 46.5% | 48.3% | 49.4% | 46.7% | 46.5% |
| 7. | Anti-leakage | medium | strong | medium | medium | medium |
| 8. | Fruit production ** | Peak season | Early 12 weeks | Late 12 weeks | Peak season | Early 12 weeks |
| 9. | Fruit appearance | a. oval round b. Mature skin colour c. Spines colour | oval red green | oval light red green | oval round red green | oval dark red red |



IP-PVP

* Anti-leakage test: a. Firm & dried; b. Crunchy & dried; c. Firm & dried

** Peak season

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Conclusion

- Open pollination method - useful to create variation
- Four ICI method - successful to eliminate 3,169 non-promising progenies
- SI comprising economic importance was successfully developed to determine the best progenies
- GB-44, IE-20, EH-57 and AG-28 are the most promising progenies
- Eight season localized stability test and reproductive system study: AG-28 and GB-44 progeny were chosen to be released as New Rambutan Clones namely Mutira Merah and Mutira Wangi respectively on 29 July 2019. Both of the clones is going to be commercialized.



* Anti-leakage test: a. Firm & dried; b. Crunchy & dried; c. Firm & dried

** Peak season

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Thank You



Acknowledgements

- Project Team
- MARDI & UKM
- Malaysia Gov.

* Anti-leakage test: a. Firm & dried; b. Crunchy & dried; c. Firm & dried

** Peak season

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