Study tour to Singapore & Malaysia incorporating 7th international pineapple symposium in Malaysia

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Quadrant Australia Pty Ltd

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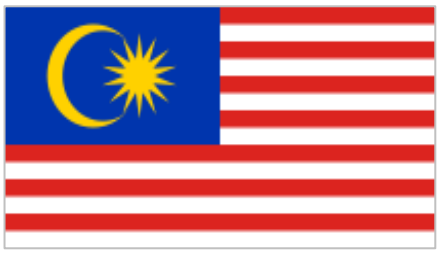
Pineapple study tour to Singapore & Malaysia

Incorporating the 7th International Pineapple Symposium in Malaysia

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The purpose of this report is to inform members of the Australian pineapple industry what was learnt on the tour which travelled to (a) Singapore, a significant market, trader and importer of fresh fruit and (b) Malaysia, significant producer of pineapple, hosts of the 7th International Pineapple Symposium and intending exporter of pineapple to Australia.

The project was funded by the grower members of the tour, viz. Tullamore Pines, C. Doyle, Forster Bros Farming Co, GO Pike & Sons, Jalhive, Pace Farming and Piñata Marketing through their Voluntary Contributions and was assisted by contributions from Horticulture Australia Ltd (HAL) and in-kind by the Department of Employment, Economic Development & Innovation.

The tour was organised by Quadrant Australia Ltd.

31 October 2010

PINEAPPLE TOUR TO SINGAPORE & MALAYSIA

11 – 18 July 2010

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MEDIA SUMMARY

A group of eleven Australians (ten growers and one extension officer) travelled to Singapore and Malaysia to gain an insight into the import/export, marketing and value-adding of pineapple and to attend the 7th World Pineapple Symposium, visit farms, fruit packing facilities, a research station and a value-adding factory.

In Singapore discussions were held with an Austrade official, a fruit importer and a market agent and the group visited the Pasar Panjang fresh fruit markets and a range of supermarkets. The group found that the quality and standard of MD2 fruit arriving from Dole in the Philippines was very high and that there was a wide variety of value-added, convenient, semi-processed pineapple products available in the supermarkets.

The International Pineapple Symposium held in Johor Bahru, southern Malaysia was attended by over 400 delegates from 16 countries and the tour group was able to learn the latest developments in R&D and maintain and expand a valuable network of growers and technical people from around the world.

The Malaysian government is committed to expanding and developing their pineapple industry and is putting significant resources into R&D and export development. They are very determined to export fresh and semi-processed pineapple to Australia, the latter permitted since April 2010. Furthermore, they are starting to switch over to varieties (especially MD2) that are more productive and appealing to consumers. They could be a serious competitor in the Australian market.

Although much of the Malaysian pineapple industry is on peat soils where the potential to mechanise is virtually non-existent this is offset by low labour rates.

Malaysia is very advanced in the development of value-added pineapple products. They have an impressive array of pineapple-derived products ranging from ‘high fibre’ biscuits and deep fried dried pineapple chips to clothing material.

It is recommended that Australian growers continue to attend world pineapple symposia to keep up to date with developments in the international industry, learn about the competition, make new contacts and maintain existing ones.

The findings of the tour will be reported to others in the Australian industry by means of a detailed illustrated report, a presentation at the annual industry field day and through presentations and discussions at the pineapple growers’ regional study group meetings.

The next International Pineapple Symposium will be in Australia in 2014.

ITINERARY

Day 1 – Sunday 11 July
Fly from Brisbane to Singapore arriving about 8pm.

Day 2 – Monday 12 July
Breakfast meeting with Rheka Isaac from Austrade in Singapore who put us in the picture regarding fresh fruit imports and trading in Singapore, especially pineapple.

Travelled to the office of fresh fruit importer FreshMart Singapore Ltd and spoke to the owner Peter Ko and assistant Sher Ling.

Visited Singapore's Pasir Panjang fresh fruit markets and as well as seeing pineapples from Philippines, Thailand and Malaysia saw a wide variety of fruit and vegetables from many different parts of the world.

At lunch time we visited two supermarket chains stores, one slightly up-market and the other cheaper, to see how they presented and displayed their fruit and vegetables, especially pineapple, the prices, and the range of semi-processed fresh pineapple products on offer.

After a brief tour of the city we headed north across the island calling in to the Kranji war memorial before crossing the causeway into the city of Johor Bahru, Malaysia to check into our hotel and attend the symposium welcome reception.

Days 3 & 4 - Tuesday 13 and Wednesday 14 July
Attended the symposium sessions, viewed the many posters, interacted with people at the trade displays and networked with other delegates. Attended the symposium gala dinner on Tuesday night.

Day 5 – Thursday 15 July
Participated in the symposium field trip which visited an export packing shed and associated farm on mineral soils, a research farm on peat soils, a factory that produces a wide range of pineapple products and after lunch attended the opening of the Pineapple Kiosk in the town of Pontian which promotes the pineapple industry and sells a range of pineapple products.

Day 6 – Friday 16 July
After checking out of our hotel in Johor Bahru we headed to the pineapple museum in Pontian, here we learnt about the history of the industry in Malaysia and their varieties and learnt how pineapple fibres are extracted from the leaves to be woven into fabric.
We then visited a pineapple farm on peat soil of several hundred hectares run by FIMA, we discussed pineapple production practices used in Malaysia with the manager and viewed the planting process in operation.
The tour group then headed for the historic port town of Melaka (on the Straits of Malacca) visiting a rubber plantation along the way and learning how to tap a rubber tree.

Day 7 – Saturday 17 July
After leaving Melaka we called into an oil palm plantation to have this crop explained to us. We then drove on to Kuala Lumpur where we had a tour of the city before having lunch then heading to the airport for our flights back to Brisbane via Singapore.

Day 8 – Sunday 18 July
Arrived back in Brisbane about 7am.

INTRODUCTION

A group of 11 Australians (10 growers and one extension officer) travelled to Singapore and Malaysia to gain an insight into the importing, marketing and value adding of fresh pineapples, to attend the 7th World Pineapple Symposium and to visit farms and fruit packing facilities in Malaysia.

Participants were Michael Cruice (Dayboro), Chris Doyle (Amamoor), John Forster (Glasshouse Mountains), Ellison, Leone & Scott Maxwell (Maryborough), Simon Newett (Queensland Agri-Science, DEEDI, Nambour), Colin & Gladys Pace (Rollingstone, NQ), Adam Pike (Glasshouse Mountains) and Stephen Scurr (Mareeba, NQ).

The Queensland pineapple industry continues to be faced with major challenges, the latest of which include the application by Malaysia to export fresh pineapples to Australia. Adapting to the changes resulting from the sale of Golden Circle Ltd (pineapple processor) to Heinz Ltd is another current challenge.

In these times of change it is more important than ever that we in Australia keep in touch with the international pineapple scene and are exposed to the latest technical developments around the world so that our industry can successfully adapt and survive internationally.

The overall aim of the tour was to expose a critical mass of Australian pineapple growers to the world pineapple industry (including export and marketing trends), make them more aware of the competition, learn new techniques, network with key people and act as a catalyst for changes in the Australian industry upon their return.

The International Symposium is held every 3 or 4 years and is a good opportunity to network with technical people and growers from pineapple growing countries around the world and to catch up with the latest developments in pineapple research, packing and marketing.

Malaysia recently commenced in earnest its application to export fresh pineapple to Australia, and we discovered whilst in Malaysia that as from April this year they are permitted to export semi-processed fresh pineapple products to Australia.

SINGAPORE

AUSTRADE MEETING

A breakfast meeting was held with Rehka Isaac, Business Development Manager, Food and Beverage, Singapore Australian Trade Commission (Austrade) at our hotel.

The Singapore population

Rehka gave us an insight into the Singapore market. The population of Singapore is 4.9 million of whom 3.6m are citizens and the balance are transient expatriate workers (many of whom we witnessed later in the day doing the daily commute back to Malaysia). Apparently the expatriate workforce has a significant effect on buying trends. The standard of living in Singapore is high, the average income for a family in Singapore is equivalent to AUD 2,500 per month (AUD 32,500 per annum). There is a general sales tax (GST) of 7%. Official unemployment figures are 2.4%. There is no dole but there is some support via community centres. Medical care is partly subsidised and superannuation (called the 'Provident Fund' in Singapore) requires an employer to contribute an amount equivalent to 15% of a person's wage and the employee must contribute 10% of their wage. Most Singaporeans own a unit by the time they have worked for 15 to 20 years. There are rules which ensure the maintenance of a pre-determined ethnic mix in the country even down to the level of the individual housing estate. This mix is mainly made up of Chinese (who traditionally have small families), Malays (traditionally have large families) and Indians. 74% of the Singapore population is Chinese, 15% Malay and 7% Indian and Eurasian. Life expectancy is 80 years.

Food imports

More than 90% of food is imported into the country and for this reason the Singapore government doesn't want to have all its imported "eggs in one basket" therefore it has a policy of encouraging food imports from a very wide range of countries and companies.

Since Singapore has virtually no agriculture there are no quarantine restrictions on food imports, however there are limits set on pesticide residue levels. Also there are no duties on imported products with the exception of alcohol, vehicles, tobacco and petroleum products. English is one of four official languages in Singapore (the others being Bahasa Malay, Mandarin and Tamil) but English is the language of instruction in schools and other educational institutions. These are some of the reasons why Singapore is an attractive country to do business with.

Fruit imports

In terms of overall 'fruit, nuts and peels' imported into Singapore for 2009 Australia was the 5th largest source with AUD 49m worth after USA with AUD 88m, China with AUD 74m, Indonesia with AUD 59m and Malaysia with AUD 51m. Next biggest were South Africa, Thailand, NZ, Philippines and Korea.

The most popular fruit are citrus, whilst mangoes, apples, bananas, papaya, table grapes, mangosteen and stone fruit are also popular.

Rehka provided tonnage and value of pineapple imports to Singapore for 2006, 2007, 2008 and 2009 and the list of countries from which all 'fruit, nuts and peel' by value were imported into Singapore.

In 2009 a total of 16,144 tonnes of fresh or dried pineapple valued at AUD 5.7m were imported into Singapore. Malaysia was the biggest source with 12,385 t, followed by Thailand with 1,909 t, Philippines with 1,823 t, Indonesia with 13 t and Taiwan with 7 t. A figure of 1.4 t is recorded as having been imported from Australia.

Pineapple only accounts for 1.1% by value of 'fruit, nuts and peel' imports into Singapore (AUD 5.7m out of a total of AUD 489m). It should also be noted that a significant volume of imported goods get re-exported.

Australian fruit and vegetable products are counter seasonal with Europe and North America. It takes 5 days to ship product by sea from Perth and 11 to 13 days from the east coast of Australia. The main fruit and vegetable products from Australia are non-tropical crops including citrus, stone fruit, grapes and berries. At other times of year these products come from Europe and North America.

Fruit outlets

Traditionally most fruit used to go from the wholesale markets to "wet markets" but the latter are disappearing for hygiene reasons and are being replaced by supermarkets. Usually the local importer is also the distributor to supermarket chains and food service outlets.

Amongst the various supermarkets in Singapore are a number owned by the Dairy Farm Group (head office in Hong Kong) which has 21% of the market and their outlets are called 'Cold Storage' established in 1903, 'Market Place' (high end) and 'Shop and Save' (cheaper).

Another dominant chain interestingly was established and is owned by the National Trade Union Council (NTUC) established in 1970 to give workers access to reasonably priced food. Their outlets are the 'Fairprice' stores and the 'Fairprice Finest' stores (the latter targets the upper end of the market including expatriates). The Fairprice chains have 48% of market share.

80% of the population lives in Housing Development Board (HDB) units (these can usually be identified by the bamboo washing lines that poke out of the windows and can quickly be brought in when it rains).

Other supermarkets in Singapore include two of the top end French 'Carrefour' outlets which are very up-market and Euro-centric.

Some supermarkets are now importing directly and even have contract growers including some in West Australia but we were told that importers won't go out of business.

Singapore consumers are very finicky and prefer fruit with a good shape, no blemishes, and seeds that are not too big. They are always willing to try new products. Australian fruit and vegetables have a reputation for being of high quality but it was pointed out to us that for Asians price is still very important.

DISCUSSIONS WITH FRUIT IMPORTER 'FRESHMART SINGAPORE P/L'

Mr Peter Ko (owner) and Ms Sher Ling spent about an hour with us at their premises discussing the fruit market in Singapore. Their business has about 50 employees.

Peter explained that in Singapore most of the tropical fruit (e.g. melons, pineapple, papaya) comes from Malaysia, the vegetables from China and Vietnam and citrus, grapes, berries and stone fruit from USA, China and Korea and counter season from Australia and NZ.

Travel times from Australia are one day by air and from the east coast 10 to 11 days by direct ship and about 13 days if the ship has a stop over.

Pineapple imports from the Philippines are from Dole and S&W (a Del Monte brand) and are the MD2 variety. Pineapple imports from Thailand are generic and travel by truck through Malaysia; they are mainly the translucent "Honey Pineapple". Pineapple imports from Malaysia are half the price of those from the Philippines.

Freshmart does re-packaging for supermarkets into house brands and into punnets. The company also does some re-exporting into Indonesia and Malaysia.

Shelf life is an important factor for Freshmart's business and Peter gave us the following typical shelf lives for different fruit:

Apples	21 – 35 days
Grapes	14 – 21 days
Stone fruit	14 – 21 days
Pineapples from the Philippines	5 days
Berries	3 – 7 days
Custard apple (from Natures Fruit Co, Sunshine Coast)	less than 7 days

Peter pointed out that the same fruit arrives from different countries in a wide range of packages e.g. oranges:
15 kg packages from California
18 – 20 kg packages from Australia
20 – 22 kg packages from South Africa

Asked about what happens to all the cardboard cartons Peter said that someone actually pays him for it (between 20c and 40c per kilogram).

Avocados are imported from Australia but also from South Africa, Mexico, Israel and California.

Some ethylene ripening of avocados and mangoes is undertaken depending on the time of year.

R2E2, Honey Gold and Kensington Pride mangoes are imported from Australia; Peter prefers the R2E2 because it is robust, has good shelf life and is the cheapest.

Peter's trucks are at the airport at 2am and return with air freighted fruit by 7am. Clearance time from the sea port docks takes as little as 1 hour with the paper work being done in-house via computer. There are 10 km of docks in Singapore and they reputed to be amongst the busiest in the world.

VISIT TO SINGAPORE'S PASIR PANJANG FRESH FRUIT MARKETS

Sher Ling from Freshmart took us to the Pasir Panjang fresh fruit markets (equivalent to Brisbane's Rocklea markets) and introduced us to one of the wholesalers, Alan, at Satoyu Trading P/L. Alan had 10 kg cartons of MD2 (MG3) fruit being marketed as 'Tropical Gold' from the Philippines which were attractive, nicely presented and tasted good. Surprisingly the brix was only 12. There were also 15 kg cartons of pineapples from Thailand, 9 fruit per carton, each fruit individually wrapped in newspaper and standing upright with cardboard dividers between fruit. Alan said that the 'Tropical Gold' retailed for about AUD 2.50 to 3.30 whilst the Malaysian fruit (probably the 'Josapine' variety) retailed for about AUD 0.82 each. After spending some time at Satoyu Trading we had a general tour of the markets and saw a range of pineapple varieties from Thailand, Malaysia and the Philippines in packaging ranging from loose in large woven baskets, individually wrapped in newspaper within cardboard boxes and in cartons.

Some of the pineapples had long stems still attached; this reportedly gives them a longer shelf life.

We also saw pineapples that had not developed crowns – apparently this is a result of having been treated with 3-chlorophenoxypropionic acid (known under the trade names as Fruitone® and Swelpine®) which is banned in Australia but still used in some countries to swell the pineapple size.

We saw a very extensive range of fruit and vegetables from a very wide range of countries including Driscoll's strawberries from USA, mangoes from Pakistan, Australian avocados from Childers, Australian melons from Rapisardas on the Burdekin, carrots from WA, cherries from USA, citrus from Argentina, USA and Australia, bananas from the Philippines and mangosteens from Thailand.

VISITS TO SUPERMARKETS

In order to see how pineapple was being presented and marketed in the retail area we visited a couple of supermarkets. The first a 'Cold Storage' supermarket (relatively up-market) in the Great World City shopping centre on Kim Seng Promenade and a 'Fairprice' supermarket (relatively low priced outlet catering for workers) in Killiney Rd, Orchard Grand Court.

What impressed us at the 'Cold storage' supermarket were the high standard of presentation and the large proportion of fruit and vegetables that were semi-prepared for the convenience of the consumer. Pineapple was no exception with several different semi-processed products for sale which included whole skinned pineapple 'slugs' in a plastic pouch, skinned and cored whole pineapple in plastic tubs, chunks and spears in plastic pouches with a plastic eating fork and loose spears. Whole pineapples were also available.

Prices at the 'Cold Storage' supermarket were:

Whole MD2 fruit (Philippines)	AUD 3.80
Skinned and cored in a plastic tub	AUD 4.00
Skinned slug in plastic pouch	AUD 2.80
250g tub of pineapple chunks	AUD 1.85

The 'Fairprice' supermarket was clearly more 'down' market with more whole fruit and canned pineapple products and cheaper prices.

Prices at the 'Fairprice' supermarket were:

Whole MD2 'Gold' fruit (Philippines)	AUD 2.50
Whole Josapine 'Honey' (Malaysia)	AUD 1.00
Canned pineapple (Philippines & Thailand)	AUD 1.00 to 1.40

SYMPOSIUM

The theme of this symposium was **'Global Pineapple Industry – The Way Forward'**.
It was organised by the Malaysian Agricultural Research and Development Institute (MARDI), the Malaysian Pineapple Industry Board (MPIB) and the International Horticultural Society (IHS) in cooperation with the Department of Agriculture, Malaysia (DOA), Federal Agricultural Marketing Authority (FAMA) and the International Tropical Fruits Network (TFNet). The major sponsors were the Ministry of Agriculture and Agro-based Industry Malaysia (MOA) and Tourism Malaysia.

The symposium convenor was Tengku Ab. Malik Bin Tegku Maamun.

The International Pineapple Symposium is held approximately every 3 years; previous events have been as follows:

1st	1992	Hawaii
2nd	1995	Martinique
3rd	1998	Thailand
4th	2002	Mexico
5th	2005	South Africa
6th	2007	Brazil
7th	2010	Malaysia

At this symposium there were over 400 delegates representing over 16 countries. On the program were 32 presentations and 115 posters (see Appendices).

The next symposium will be held in Australia in 2014.

WORLD PINEAPPLE SCENE

World pineapple production and exports in 2008 from the major producing countries

Country	**Production (million tonnes)**
Brazil	2.49 (13% of global production)
Thailand	2.28
Philippines	2.21 (0.29 exported)
Indonesia	1.62
Costa Rica	1.6 (1.4 exported)
China	1.4
India	1.3
Indonesia	1.3
Taiwan	0.45
Other countries	5.3
Total	**20**

In 2008 pineapple made up about 25% of tropical fruit produced in the world. Global production of pineapple increased by a massive 45% in the 11 years between 1997 and 2008 reaching 20m tonnes. Costa Rica accounts for ¾ of the world's export supply.

Fresh pineapple
MD2 was first released in 1996. In the 10 years between 1997 and 2007 the global demand for fresh pineapples increased by 180% from 0.9m tonnes to 2.5m tonnes. Costa Rica and the Philippines are the main exporters. Costa Rica's production went from 0.25m tonnes in 1997 to 1.35m tonnes in 2007 (a 5.4 fold increase)! Most of the world's exports of fresh pineapple are now the MD2 variety. The main importers are the USA, European Union and Japan. US imports have tripled since 1997 and this is largely as a result of MD2 coming onto the market. There has been a 12% growth in the EU market for pineapple between 2000 and 2008.

Canned pineapple
Over the same 10 year period the export of canned pineapples increased by 46% from 0.8m tonnes to 1.17m tonnes. Thailand, Indonesia and the Philippines account for 69% of canned pineapple volume and the main importing countries were USA, Germany, Russian Federation, Netherlands and Spain.

Juice
Worldwide there has been a significant increase in the quantity of pineapple concentrate being produced.

Developments in the Philippines
Philippines produced 2,198,497 tonnes in 2009 from a planted area of 58,823 ha. Dole Philippines grows 20,000 ha of pineapples.

In 2009 Dole Philippines had 58% and 48% of the canned and fruit cup (diced fruit) market respectively in the USA. Whilst Del Monte had 9% and 37% respectively.

The biggest fresh fruit exporters were Dole, Del Monte and a farmers' cooperative. 65% of the fresh fruit is exported to Japan. There has been a huge increase in demand from China and S Korea which has prompted agri-businesses to expand production by 10 to 20% this year. Other countries importing fruit from the Philippines include the Middle East, NZ, Hong Kong, Canada, Guam, Russia and Germany. The domestic demand in the Philippines is expected to increase by 4 to 7 % per annum over the next 10 years.

Developments in Thailand
More than 95% of production in Thailand is for processing. 90% of pineapples are produced by small holders with an average planting of about 2.6 ha. Production costs are approximately US$0.12 per kg, the canning process costs another 12c and other costs another 12c. There are more than 30 processing plants but they are only working at $^{2}/_{3}$ capacity. The main problems facing the industry are irregular supply of pineapple, shortage of labour and declining production area due to expansion of plantings of oil palm and rubber.

SOME INFORMATION PRESENTED AT THE CONFERENCE

Control of reniform nematodes in Hawaii – Koon-Hui Wong, University of Hawaii
The current standard practices on affected soils in Hawaii is to deep plough with a subsoiler then fumigate with Telone. Growing a crop of sunnhemp (*Crotolaria juncea*) in combination with a soil solarisation treatment is being investigated as an alternative to chemical fumigation to control Reniform nematodes. A 4 to 7 month crop of sunnhemp is grown then incorporated and followed by a 3 month solarisation treatment. A heat of 42ºC is required for 14 hours to kill reniform nematodes, however the solarisation treatment did not achieve the required temperature deeper than the top 10cm of soil. Upon incorporation sunnhemp releases an allelopathic compound which affects the nematodes. This compound allows the reniform nematode to develop but delays their maturity and they don't form their tough survival form. Sunnhemp was effective in suppressing reinform nematodes for 3 months after planting, it also improved soil biodiversity, enriched soil nutrients and in combination with solarisation reduced weed pressure by $^{2}/_{3}$ for up to 2 months. It was found that standard practices reduced soil health.

Recent research on the use of Aviglycine (AVG, ReTain®) to reduce the incidence of natural induction (natural flowering) – Johnny Lopez, New Mexico State University
The susceptibility of a range of varieties:

Smooth Cayenne<CO2<Queen<MD2<Tainan<Perola
Less susceptible *More susceptible*

Natural flowering is most likely to occur between May and August in the Southern Hemisphere and between November and February in the Northern Hemisphere.

ReTain® can be applied directly to the plant core or as a spray. It must be applied **prior** to conditions that would trigger natural induction. An application only prevents natural induction for 7 to 14 days and it is very expensive so to be used economically the grower needs to follow the stage of the crop and the expected weather conditions closely in order to know when to apply it in order to keep the number of applications to a minimum. In a trial carried out in Taiwan, ReTain® was applied with a cattle drencher into the plant core at concentrations ranging from 100ppm to 200ppm and compared to a Control with no treatment. There was

80% natural induction in the Control treatment whilst less than 30% in plants treated with ReTain®, greater effectiveness was achieved using higher concentrations and volumes. If used too late ReTain® causes a deformity in the fruit with the upper eyes (fruitlets) of the fruit not developing to full size.

Use of ReTain® on Rough Leaf (Queen) pineapple in South Africa - El-Marie Rabie
El-Marie Rabie, technical officer with the South African pineapple growers has been trialling ReTain® at higher volumes and lower rates. She has reduced natural induction to 2 to 4% using ReTain® at a rate of just 30 to 45ppm in volumes of 2000 L/ha.

Other uses of pineapple
Spray dried pineapple powder (e.g. for use as flavouring)
High fibre drink
Bio-degradable plastic made using pineapple leaf fibre

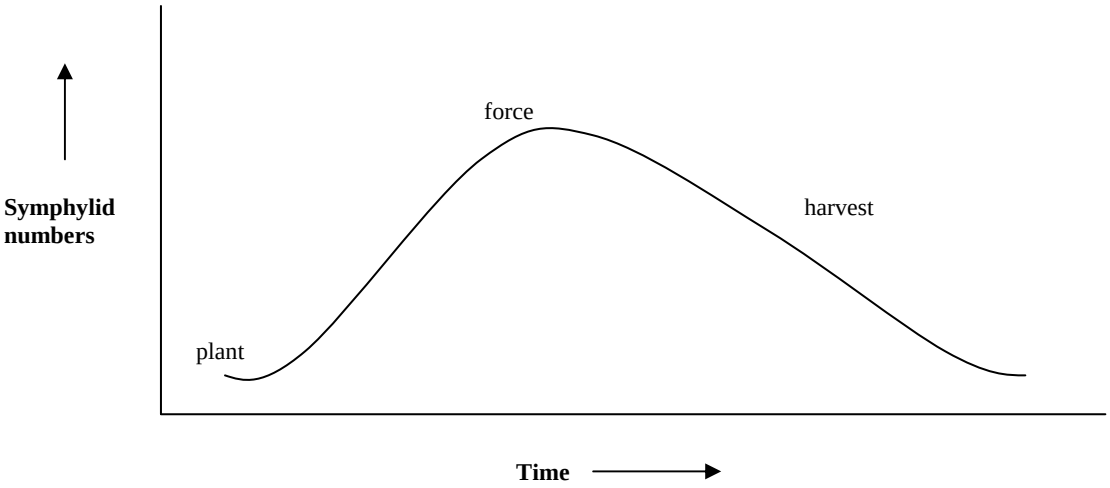
Studies of the pineapple leaf fibre reveal that it has a hollow structure, a high capacity to absorb water, it dries quickly, kills *Aurococcus* and *E. Coli*, expels acarids and eliminates bad smells.

Use of methyl bromide for disinfestation of fruit destined for export markets
A trial was done in Malaysia to test the effect of methyl bromide fumigation on pineapples destined for export to countries such as Australia. Two varieties, Josapine and N36, and three doses, 24, 26 and 28 g/m^3 were tested. Fruit was stored at 10ºC for 10 days and then evaluated. Whilst the treatment was effective in killing mealybugs it was not recommended for the varieties Josapine and N36 because of the negative effect it had on the quality of the fruit. Josapine was particularly badly affected. The higher the dose and the longer the fruit was stored the worse it was affected.

Symphylid baiting
Although symphylid numbers do increase when a crop of pineapples is present then diminish after the crop is harvested (see diagram below), classical fallows are generally not effective in reducing symphylid numbers because symphylids are 'polyphagous' i.e. they have a wide range of food sources that they can survive on.

To assess the level of symphylids in a field a system of monitoring was described. Perforated pots baited with slices of potato are buried about 6" deep in the field (potato slices were found to be better than corn seedlings). The easiest way to assess these baits is to put the sample in a bucket, fill the bucket with water and any symphylids present (especially juveniles) will float to the top. To recover live symphylids it is better to manually sort through the potato and soil contents of the bait pot rather than using the bucket of water method.

Figure: Typical population of symphylids over time.



Fresh cut pineapple
Some characteristics of fresh cut fruit:

- It is 'ready to eat'
- The tissue is still living
- The aroma is contained
- It is designed to be convenient
- It has a short storage life, e.g. for most pineapple products this is 2-3 weeks. The smaller the fruit pieces the shorter the life.
- It must be good quality to start with.

Fresh pineapple market – Carolina Dawson
World pineapple production is 20 million tonnes. This makes it the 7th biggest fruit crop of the world, coming after pears but ahead of peaches and nectarines. Pineapple production has doubled in the past two decades and quadrupled since the early 1970s. Asia accounts for more than 50% of world production but Thailand lost its position as biggest world producer to Brazil and its position is now threatened by the Philippines.

Cote D'Ivoire was the biggest world exporter prior to 1990 accounting for 90% of exports but it was slow to adopt MD2 variety and now only accounts for 5% of world pineapple exports.

Over the past decade pineapple consumption grew by more than 200% in Europe (per capita consumption is now 1.8 kg in Europe) and 242% in USA. Del Monte made a big investment in pineapple. However, figures for 2009 showed that production decreased for the first time in many years. Time will tell whether this was an aberration due to the global financial crisis and/or poor seasons or due to consumption reaching a saturation point. The most important reason is thought to be over-production of MD2 coupled with a decline in overall fruit quality following the appearance of new players in the export market. The "sweet" varieties have lost some of their premium price and pineapple in USA and Europe has lost its "niche" market position to become a "mass" or "ordinary" product.

POINTS THAT CAME UP IN DEBRIEF SESSIONS

- The reason for the long stems seen on some fruit in the Singapore markets is for extending shelf life.
- Pineapple in Malaysia has to compete with other industries for land and labour.
- Gas ripening is used in Malaysia.
- Ethrel and carbide are sometimes used together for flower induction.
- In Thailand it costs between AUD 0.12 and AUD 0.15 to produce a pineapple. Processing fruit sells for about AUD 0.12 whilst fresh fruit sells for about AUD 0.25.
- The cost to produce pineapple on one of the peat farms we visited was AUD 0.12.
- Prof Duane Bartholomew's quote suggested that we reflect on the differences and benefits between "teaching someone how to grow pineapples" and "teaching someone how pineapples grow".
- The industry in Australia needs to keep a close eye on overseas developments and make rapid changes where necessary or it will be out-competed by some overseas countries.
- The Malaysian industry appears to be controlled by the government much more than it is in Australia and they are really trying to expand and promote the industry and to push pineapple exports.
- Ellison said that in Melbourne the trend was that 5 times more semi-processed pineapples are sold than fresh whole fruit.
- As a guide, it was suggested at the conference that a pineapple plant needs to have 35 leaves before it is induced to flower.
- The concept of pricing pineapple in the supermarket as $/kg instead of $/fruit was discussed. It was pointed out that pineapple is actually good value for money when compared on a price per kg basis with other fruits but when pricing pineapples on a per kg was tried customers were leaving the fruit behind at the checkout once they had been weighed and the price worked out.
- The farms in NE India are very small but because of their primitive production methods the fruit can be classed as organic, they could have a big impact on organic markets if they get organised.
- Minimally processed Malaysian fruit has been allowed to be imported into Australia since April 2010.
- Malaysian minimally processed fruit currently only has a shelf life of about 2 weeks.

- MARDI is huge but production practices don't appear to have changed much for years although they do have a pineapple breeding program.
- A tractor driven onto the peat soils on the experimental farm sank and has never been recovered.
- Pineapples tend to have a higher brix when grown on mineral soils.
- The strain of MD2 we saw in Malaysia appears a bit different from the one we have in Australia in that the core is thicker and also the top 1" to 5" of the leaf tip is spiny.
- Mealy Bug Wilt is a common problem around the world.
- Lantana is a problem weed in Malaysia too.
- World pineapple consumption has been increasing significantly.
- Australian yields are amongst the best in the world.
- Malaysia is looking to the smaller growers to increase average yields.
- Even though labour is cheap in Asia, availability is a problem just as it is in Australia – people prefer to work in other industries.

MALAYSIA

Malaysia was a former British colony and consists of West Malaysia on the Malay Peninsula (south of Thailand and Burma) and East Malaysia on the island of Borneo which include the states of Sarawak and Sabah. Malaysia lies between 2º and 7º north of the equator.

The population of 28 million consists of 60% Malays, 30% Chinese and 10% Indian. 60% are Muslims, 19% Buddhists, 9% Christian and 6% Hindu. Most of the businesses are owned by the Chinese.

In 1957 West Malaysia gained its independence from Britain followed by East Malaysia in 1963. In 1965 Singapore left Malaysia to be an independent nation.

Two monsoons occur per year, the SW monsoon between June and October, and the NE Monsoon from the South China Sea between November and May. The latter is the wetter one and most of the resorts and schools, particularly on the east coast of the Peninsula and in East Malaysia, close down between November and December because it is so wet.

Many of the plantation workers come from Bangladesh on a 5 year work permit whilst many of the construction workers come from Indonesia. It is estimated that there are 3 million migrant workers in Malaysia at any one time.

The main industries in Malaysia in order are:

1. Electronics
2. Tourism
3. Palm oil
4. Petroleum and gas

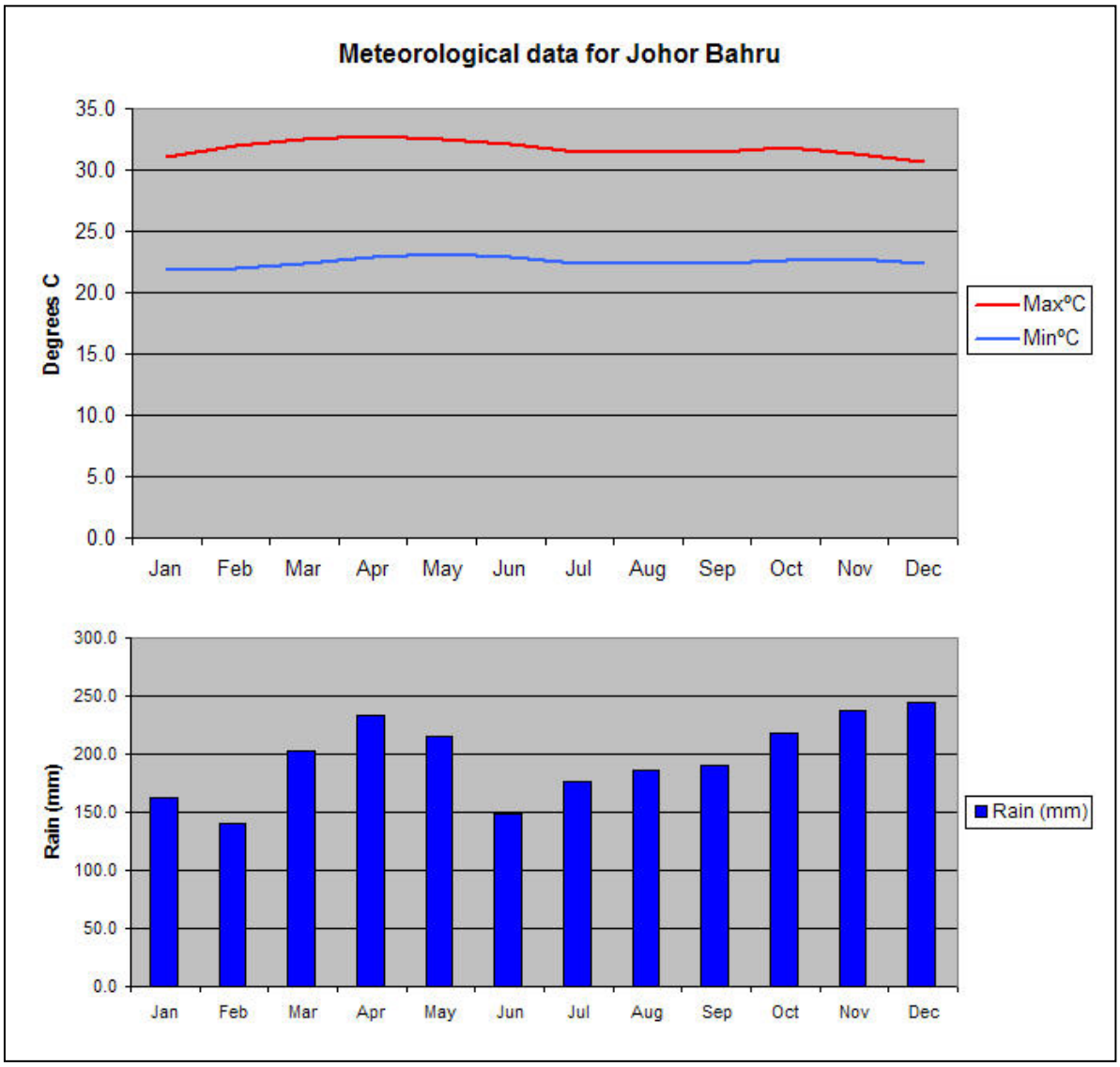
Industrial activity includes the manufacture of the "Proton" brand of cars.

CLIMATE OF JOHOR BAHRU, SOUTHERN MALAYSIA

The state of Johor where most of the pineapple is grown is situated at about 2º north of the equator. The climate is a wet equatorial one with around 2500 to 3500mm rain per year (100" to 140") in Western Malaysia (e.g. Johor) whilst Eastern Malaysia (the provinces of Sarawak and Sabah on the island of Borneo) gets around 4000mm rain (160") per year. About 40% of the rain falls between October and December. Apart from the high rainfall the other noticeable fact about the climate is the lack of variation in the temperatures throughout the year. According to research the optimum temperatures for growing pineapple are a daily maximum of about 30ºC and a daily minimum of about 20ºC, the temperatures shown below for Johor Bahru are very close to this.

Climate of Johor Bahru

Month	*Average Max ºC*	*Average Min ºC*	*Monthly rainfall (mm)*
Jan	31.0	21.9	162.6
Feb	32.0	22.0	139.8
Mar	32.5	22.4	203.4
Apr	32.8	22.9	232.8
May	32.5	23.1	215.3
Jun	32.1	22.9	148.1
Jul	31.5	22.4	177.0
Aug	31.5	22.4	185.9
Sep	31.5	22.4	190.8
Oct	31.8	22.6	217.7
Nov	31.3	22.7	237.6
Dec	30.6	22.4	244.5
Averages	***31.8***	***22.5***	***196.3***
Total			***2355.5 (93")***



PINEAPPLE INDUSTRY IN MALAYSIA

The heyday of the Malaysian pineapple industry was in the 1960s and 1970s when it was ranked as one of the top 3 pineapple producers in the world, production subsequently declined but it was identified by the Malaysian government in their National Agricultural Policy 3 (NAP3) to undergo major development and it is believed that Malaysia still has great potential to expand.

Production has diminished over the past 30 years because of a decrease in yield and the susceptibility of Josapine to Bacterial Heart Rot (BHR) (*Erwinia chrysanthemi*) on mineral soils.

The pineapple industry in Malaysia is unique because the majority of the crop is planted on peat soil which is considered marginal for most other agricultural crops. However the inability to mechanise on this type of soil is a severe disadvantage in the face of labour shortage and rises in other input costs. There is an emerging interest in planting fresh fruit varieties on mineral soil to obtain better quality produce.

In 2008 there were 15,500 ha planted to pineapple with an annual production of 384,672 tonnes of which about 78% (301,000 t) is grown for the fresh market. Given that ratoon crops are rarely grown in Malaysia and that the plant crop cycle is about 12 months, the average yield works out to be around 25 t/ha.

62% of the area planted to pineapples in Malaysia is farmed by small holders with an average planting of 1.2ha and this is often intercropped with oil palm and/or rubber trees. The other 38% is produced on much larger plantings referred to as “estates”.

In terms of competitiveness, the Malaysian pineapple industry was identified to be on a par with Thailand, (between 2000 and 2008) and better than Indonesia, China and India but well short of the competitiveness of the Philippines.

As in Australia, Malaysian pineapple growers have to compete for resources especially labour. These days people would rather work in the city and the younger generation are generally not interested in staying on the land. This problem has been rectified to some degree by employing guest labour from countries including Bangladesh and Indonesia.

Organisations that play an important role in developing the Malaysian pineapple industry:

- The Malaysian Agricultural Research and Development Institute (MARDI) – focuses mainly on research.
- Department of Agriculture Malaysia (DOA) – focuses mainly on extension work with growers.
- Federal Agricultural Marketing Authority (FAMA) – marketing including capacity building, supply chain management and market intelligence.
- The Malaysian Pineapple Industry Board (MPIB) – focuses mainly the commercial side of the industry.

In Malaysia, petrol and diesel are subsidised by the government to encourage development. Petrol costs the consumer the equivalent of AUD 0.60 per litre.

Export

In 2008 Malaysia exported 34,637 tonnes of pineapple. The export revenue for pineapple from Malaysia in the last 5 years ranged from AUD 12 - 21m per year, of which AUD 8m (in 2008) was for fresh fruit.

The government is actively involved in promoting an expansion of the pineapple industry.

Average yields per year in Malaysia are only about 25 t/ha in spite of the fact that ratoons are seldom grown and growth rates are fast. The table below gives a broad comparison between the industries of Malaysia and Australia.

Comparison between pineapple industries in Malaysia and Australia

	Malaysia	**Australia (2009/10)**
Production (t)	385,000 tonnes	85,000 tonnes
Area (ha)	15,500 ha (9,610 ha small holders) (5,890 ha estates)	Approx. 4,000 ha
Typical cycle	Plant crop only – takes 11 to 17 months	4 year cycle for a plant & ratoon crop and fallow. Plant crop takes about 20 months Ratoon crop takes about 15 months
Typical yield (t/ha) **- plant crop** **- ratoon crop**	 25 t/ha n/a	 95 t/ha 70 t/ha
Typical farm size (ha)	Small holders: 1.2 ha Estates: much larger	About 35 ha
Number of growers	Approx. 8,000 small holders, & a number of estates.	Approx. 80 growers
Predominant farm ownership	Family farms and a number of large estates	Family farms
Main market	Domestic and export	Domestic
Predominant focus	Strong push by government to expand industry and market fruit overseas	Domestic fresh fruit expanding significantly. Processing and fresh fruit markets now about the same size

GROWING PINEAPPLES ON PEAT SOILS IN MALAYSIA

Much of the pineapple industry in Malaysia has been based on 'peat' soils although more recently the industry has expanded onto normal soils as well; the latter are referred to as 'mineral' soils in Malaysia to distinguish them from peat.

There are 2 million hectares of peat soil in Malaysia (6.5% of the total geographical area) of which 16,000 ha are now being used for agriculture. Essentially these are swamps (or former swamps) where plant matter hasn't decomposed because it has been underwater (out of reach of oxygen), thus organic matter has accumulated over thousands of years and is usually many metres deep. The pH of these peat soils is very low (about 3.5) which means that *Phytophthora* root rot is suppressed and not a problem. At these low pHs calcium deficiency could be a problem but the peat contains high levels of this element.

Peat soil areas destined for crop growing are partially drained to reduce the water table by about ½ to 1m, this is achieved by a network of drains cut into the peat and the height of the watertable can be controlled to some extent by inserting or removing simple gates at points along the drainage network. Due to the very acidic pH of the peat the number of different crops that can be successfully grown is limited; pineapple and oil palm are two that can be. The unavoidable downside of dropping the watertable is that the peat near the surface is exposed to oxygen and therefore oxidises, decomposing gradually, thus lowering the soil surface by several metres after several decades of farming.

The table below gives a comparison between properties of peat soils compared with typical pineapple soils in Queensland.

Property	Peat soil	Typical pineapple soil in Queensland
pH	3.5 (very acid)	4.5 (strongly acid)
Bulk density (relative weight)	0.25	1
Organic matter content	50%	1 to 2%
Cation exchange capacity (ability to retain nutrients)	118	3 to 5 (Darling Downs black soils are around 30)

The big disadvantage of growing crops on peat soils is that farming practices cannot be mechanised because machinery simply sinks, therefore farming on peat soils is labour intensive.

Getting rid of the old crop: without tractors and implements the spent plants can't be eliminated by mechanical mulching and hoeing, instead the plants are usually sprayed (by hand using backpack sprayers) with a chemical "frost" such as Grammoxone, allowed to dry out then set fire to. Sometimes the water table needs to be dropped a little to allow this to happen, however if it is dropped too much then the peat at the surface dries out and it can catch fire too!

Planting: all planting must be done by hand on peat soils. On the large commercial farm we visited this was done by stretching out a prepared cord along the intended planting row, this cord had a mark at each planting site along the row. Next, a worker walks briskly down the length of the cord with a stout wooden pole of about 2.5" diameter plunging a sharpened end about 9" into the peat at each mark, he is followed by someone with pineapple suckers which are planted into each of these holes.

Spraying, fertilising and harvesting: On the peat farms that we visited there were no access roads established from which to operate boom equipment therefore all spraying and harvesting was done by hand. The latter using machetes and baskets carried on the back. It appeared that sometimes the baskets were mounted on bicycles that were pushed down the walkways.

Typically only a plant crop is grown, and the length of this plant crop only cycle is:
Planting till forcing – 7 to 11 months
Forcing till harvest – 4 to 6 months
Thus the plant crop cycle takes 11 to 17 months.

MAIN VARIETIES

Only in the last few years have the Malaysians realised the benefits of MD2 and started to grow it in commercial quantities. The advantages are higher yields and worldwide market acceptance.

Until the adoption of MD2, the main varieties grown in Malaysia have been Roughs and varieties related to Singapore Spanish. Singapore Spanish types were grown because Smooth Cayenne types are difficult to induce in their tropical climate. The varieties grown include:

Spanish types:
'Maspine'
'Gandul'
'Masmerah'

Rough leaf:
'Moris' (Rough Queen type) (the name 'Moris' appears to be a corruption of 'Mauritius')

Others:
'Josapine' (cross between 'Johor' and 'Sarawak'), said to be a good variety on the peat soils.
'N36' (cross between 'Gandul', a Spanish type, and Smooth Cayenne, good for canning and fresh
'Sarawak' (a Smooth Cayenne)
'Crystal Honey Pine'
'Yankee'
'MD2'

'MD2' is sometimes marketed as 'Golden Juanita' whilst N36 is marketed as 'Juanita'

YIELDS, MARKETING AND PRICES

Malaysia is very advanced in the development of value-added pineapple products. They have an impressive range of pineapple-derived products including 'high fibre' biscuits, sweet and sour sauce, dried, candy, jelly, powder, deep fried dried pineapple chips, 'high fibre' juice, jams, flavoured coffee, tarts and clothing material.

Currently they can grow a pineapple for AUD 0.12 and this will probably fall further and their prices improve as they grow more of the higher yielding MD2 variety.

As is the case in Australia they find it difficult to get labour but solve this by employing guest labour from overseas.

SYMPOSIUM TECHNICAL TOUR

JTP TRADING (PINEAPPLE GROWING & EXPORT BUSINESS)

This business has its own farm and export packing shed. The farm is on 'mineral' soils (in Malaysia soils that aren't peat soils are referred to as 'mineral' soils) and they are taking the opportunity to mechanise wherever possible. At the time of our visit JTP had 200 ha of pineapples planted on mineral soils that were previously planted to oil palm, however they are planting up an additional 20 ha per month and this was being achieved with a mechanical planter. Planting beds were not used here and were not seen anywhere in Malaysia during our visit.

Most of the farm is being planted to MD2 (marketed at 'Golden Juanita') and to N36 (marketed as 'Juanita'). Josapine is no longer planted because it is susceptible to Bacterial Heart Rot *(Erwinia chrysanthemi)*. Fruit is packed the day after being picked and is exported to Dubai for 8 to 10 months of the year. They are seeking market access to China for 2 months of the year. The grading and packing operation is very manual, fruit are stacked on the concrete floor in the shed prior to packing and cartons are individually weighed. However the end product looks good and shipping containers are filled at the shed.

MPIB PINEAPPLE TECHNOLOGY DEVELOPMENT CENTRE (RESEARCH FARM ON PEAT)

A visit was made to an MPIB research farm, situated on peat, which had a large collection of different pineapple varieties. The peat on this farm was now 3m deep and the watertable about ½ m below the surface. Hand harvesting of Roughs was demonstrated, this was done by workers equipped with a machete and a back mounted basket made from wire chicken netting.

The opportunity was taken to examine the nature of the peat soils. These soils are dark brown to black, contain 50% organic matter and have a pH of about 3.5 – the very acid pH suppresses any development of *Phytophthora* rot. They have an incredibly high Cation Exchange Capacity (a measure of potential fertility) but apparently pineapples do not perform as well on peat soils as they do on mineral soils. The water table is kept about ½ m below the surface and when one jumps on the peat the surrounding area 'wobbles'. It is very easy to push a stick a long distance down into the peat with little resistance. Some of the plants we pulled up had very little root system and there was evidence of mealy bug and MBW present.

Staff cut up fruit of several different varieties for tasting by delegates. Nearby was a demonstration of a walk-behind hand-steered motorised device which had spikes on the wheels for making planting holes into which suckers were pushed.

Pineapple leaves down the walkways were trimmed off using machetes shortly before harvest to improve accessibility for pickers.

MPIB/MOA PINEAPPLE FACTORY

A tour was made of a pineapple processing factory which appeared to be a joint venture between the pineapple board (MPIB) and MOA with research input from MARDI staff. Here they were making a number of innovative pineapple products including fried/dried pineapple chips. Hygiene and the quality of the products appeared to be of a high standard.

OTHER TECHNICAL VISITS

PINEAPPLE MUSEUM

A visit was made to the pineapple museum near Pontian where the history of the pineapple industry in Malaysia was recorded and where some of the early tools used in growing them were on display. A demonstration was given of how pineapple fibres are removed from leaves for the production of thread for uses such as the weaving of highly valued shirts and wedding gowns, it appeared to be a very slow and labour intensive process.

'FIMA' FARM

After a proposed visit to 'Lee' farms was turned down by the owners a visit to the FIMA farm was arranged but on the understanding that we would not take photographs. The reason for this sensitivity appeared to stem from the bad press Malaysia has been getting from international media about the destruction of rainforests to make way for oil palm plantations and other crops. Apparently foreign journalists have been visiting the country, taking a lot of photographs and returning to their own countries and writing disparaging illustrated articles on this subject.

This farm was 730 ha and included some oil palm. The manager said that 320 ha are planted to pineapple.

Plant spacing was 51cm x 30cm (20" x 12") on the flat (it is not possible to mound up the peat soil) giving a plant density of 65,400/ha (26,500/acre). Using the marker string, hole-making pole and manual planting system (described above), suckers were being planted at a rate of 3,000/man/day.

The main varieties planted were N36 and Josapine although they had a nursery where they were bulking up MD2 numbers. Josapine is susceptible to *Phytophthora* and Bacterial Heart Rot.

Only a single crop was being grown (no ratoons) but it only took 12 months to reach harvest from planting. The manager said it was costing the equivalent of AUD 0.12 to produce 1 fruit. Fruit was selling for AUD 0.80 each and they were trying to cut out the middle man.

Weedicides being used were Diuron, Gespex and Basta. They were using either Paraquat or Roundup to spray off the mother plant after harvest then the watertable was dropped a little and once the plants dried off it was set fire to, ensuring that the top player of peat did not catch fire.

The farm was very flat, which is characteristic of a peat swamp and the water table only about ½ m below the surface with drains everywhere. The drains contained fish which we were told the workers fished for on their day off. No red mites were seen, probably because it is so wet there.

Farm staff here (mainly Bangladeshis) were paid the equivalent of AUD 2/hour and supplied with basic accommodation and food. They worked 9 to 10 hours per day for 6 days a week. This farm employed 4 to 5 management staff and about 60 workers.

The yields being achieved were low, only about 35 t/ha, and losses from bacterial heart rot reported to be high. Higher yields are expected from MD2.

OIL PALM – *ELAESIS GUINEENSIS*

The first oil palm was introduced to Malaysia from West Africa in 1848 and now there are 1.3 million ha planted in Malaysia. Typically the planting density is 360 plants/ha and a yield of 3 t/ha/yr is required to break even. It has many uses including in the manufacture of soaps, margarines, cooking oils and biodiesel but it is also used in fuel for its anti-freeze properties and for this reason is blended into aircraft fuels.

A hybrid oil palm plant costs about AUD 7.70 from the nursery and it costs about AUD 10,400 to establish a hectare of oil palm. Hybrid varieties bear their first bunches in year 3 whilst non-hybrids take about 5 years.

The first bunches of fruit (a bunch contains several hundred fruit and weighs about 24 kg) are harvested from hybrids within 3 years and the typical commercial life of an oil palm plantation is 15 years. At about 8 years old each palm is yielding about 8 bunches of fruit per year. Under ideal conditions yields reach 20 t/ha/yr

which at 25% oil content yields 5 t oil/ha. Maintenance includes cutting fronds to allow the next bunch to develop unimpeded and applying fertiliser quarterly. Cut fronds can be fed to goats. After 15 years the palms are pushed over and new trees planted, the old ones are left to decompose and recycle. Fruit bunches are taken to a collection centre and then on to a factory where oil is extracted by crushing. Immature bunches are rejected and not paid for.

Rats eating the oil palm kernels can be a problem in the plantations leading to losses of 15 to 20%. Snakes (particularly cobras) build up in numbers to utilise this food source but they become a problem for farm workers and only reduce rat damage by about 2%. To help solve the problem barn owls have been introduced and they have brought rat damage levels down to 5%. Dovecotes (raised nesting boxes) are established in the plantations at a rate of about 1 per ha for the owls to shelter and nest in.

RUBBER – *HEVEA BRASILIENSIS*

The first rubber tree was introduced to Malaysia from its native Brazil in 1884 (this tree is still alive). Although not as important as it used to be before the advent of petro-chemical based rubber, there is still a viable rubber industry in Malaysia that caters for higher quality rubber products such as surgical gloves. Natural rubber now accounts for just 15% of the world's rubber. Korea is a big market for Malaysia. A rubber plantation yields about AUD 13,000/ha/yr.

Malaysia was the largest producer of plantation rubber in the 1970s. It is now the 3rd largest producer of 'natural' gloves. Rubber tapping starts at 4am whilst the temperature is still cool. If rubber is delivered to the factory in the liquid form (before it hardens) the rubber tapper is paid more for it. A good tapper can tap 300 trees before 7am. Tapping is done with a special tapping knife but if a tree is cut (tapped) the wrong way it can die.

The British brought a mainly Indian workforce to Malaysia to tap rubber and work the tin mines and established good infrastructure.

The factory for making rubber out of the collected latex generates a very bad smell so factories are located well away from population centres.

Apparently rubber tree timber makes nice furniture.

Noticeable were the rows of a teak-like timber planted alongside the highway, *Chukurasia tabularis* (Burma almond wood or Chickrassy) which not only serve to absorb traffic fumes but will also be a valuable source of timber in the future.

Also noticeable near the highway in the south of the country were new housing estates mainly being built to house the large numbers of workers who commute by motorbike each day to work in Singapore. These workers use a quick system of electronic cards and an electronic fingerprint recognition system to cross the border at the start and end of each day.

DISCUSSION

World pineapple production increased by 45% between 1997 and 2008, this is a massive increase and is at least partly the result of the release of the new fresh fruit eating variety MD2 in 1996. It clearly illustrates the potential impact that a good variety can have on an industry and the benefits that can flow from a plant breeding program.

The Singapore fruit importing and distribution system is well organised and efficient. The market caters for a range of different socio-economic levels providing a number of products ranging from relatively expensive, high quality, attractively presented semi-processed pineapple products aimed at convenience (e.g. a skinned and cored whole slug for AUD 4.00), high quality trays of MD2 whole fruit from Dole in the Philippines, to cheap whole fruit of local varieties imported in bulk containers from Thailand retailing for AUD 1.00 each.

Austrade's trade commission staff in Singapore are able to provide detailed statistics on the Singapore market and provide advice to potential exporters from Australia.

The pineapple symposium proved a valuable meeting at which to learn more about the international pineapple industry, make valuable contacts, discuss production and marketing methods in other countries, learn about potential competitors and find out some of the latest technical developments. Once again for Australian grower tour members it was a valuable opportunity to get to know fellow producers better and discuss their own industry, this fact came out strongly in the evaluation.

Malaysia is making a concerted effort to expand their pineapple industry and has Australia firmly fixed as one of its export destinations. We learnt that as from April this year (2010) the Australian authorities gave Malaysia permission to export semi-processed product to Australia, it was disappointing that the Australian industry did not appear to be informed of this decision and we had to find out from the Malaysians.

Malaysia's pineapple production practices on peat soils are forced to be labour intensive owing the fact that the peat will not physically support the weight of machinery. Production on the mineral soils are being mechanised along the lines of the Australian system (rotary hoes, planters and booms) and MD2 is starting to replace some of the more dated varieties and to improve profitability and quality of fruit in the market. However the area of mineral soils in Malaysia that is available for pineapple may be limited. Interestingly, like Australia, they have difficulty attracting labour to work in pineapple but they do have access to guest workers from countries such as Bangladesh and Indonesia.

Malaysia has the strain of *Erwinia chrysanthemi* that causes Bacterial Heart Rot (also known as 'ghost disease') which we need to keep out of Australia. This disease can have a serious effect on productivity; some pineapple varieties are more susceptible than others.

The range of different pineapple products made in Malaysia is impressive. It may not be economical to make some of these products in Australia given our high cost of labour but nevertheless it opened our eyes to the potential of pineapple based products that can be made.

Trial work is continuing with ReTain® (AVG) in different countries to combat natural flowering particularly in hybrids. We should follow these developments closely as it may eventually be an economical practice to help solve this issue which affects our industry as well as others.

Mealybug wilt appears to be a problem that affects most of the industry around the world.

The fact that *Phytophthora* was not a problem in the peat soils even though it has a water table as high as ½ m from the surface underlines the importance of having a low pH to suppress this disease. Whilst we would not want to go as low as pH 3.5 (which they have in the peat) it brought home to us the importance of having a low soil pH to combat *Phytophthora* root and heart rot.

An evaluation of the tour can be found as an Appendix in this report.

CONCLUSIONS AND IMPLICATIONS

The introduction of a single good pineapple hybrid can have a huge impact on the viability of a country's pineapple industry.

The Malaysian pineapple industry, strongly backed by their government, is very serious about expanding and developing their industry and exporting more pineapple to Australia in both fresh and semi-processed form. Coupled with their low wage rates this is likely to have an impact on Australia's pineapple industry, especially as they plant more of their industry to MD2.

Attending the conference, learning first hand about the fruit market in Singapore and the pineapple industry in Malaysia have all given us a better understanding of the world pineapple scene.

Malaysia has been very innovative in developing a wide range of pineapple-based products some of which may have some potential on the Australian market especially those where the health-giving properties of the fruit can be promoted.

Malaysia has the strain of *Erwinia chrysanthemi* which causes Bacterial Heart Rot in pineapples; we need to do all we can to keep Australia free of this serious disease.

The quality and presentation of Dole's cartons of MD2 'Tropical Gold' pineapple in the Singapore market is a standard for us to aim for.

The potential for establishing valuable contacts at these meetings should not be underestimated. We share many of the same problems in pineapple production as other countries so by attending international symposia and touring overseas farms there is great potential to learn new ways of tackling them.

The Australian industry is still a world leader in field practice & research.

Although much of the Malaysian pineapple industry is on peat soils where the potential to mechanise is virtually non-existent this is offset by low labour rates.

The next International Pineapple Symposium will be in Australia in 2014.

RECOMMENDATIONS

- Encourage a critical mass of Australian representatives to attend future international symposia and tour other pineapple producing countries to keep up to date with developments in the international industry, learn about the competition, make new contacts and maintain existing ones.
- Maintain contact with the technical network established.
- Maintain strict quarantine restrictions to keep diseases such as Bacterial Heart Rot *(Erwinia chrysanthemi)* and pests such as Grey Pineapple Mealy Bug *(Dysmicoccus neobrevipes)* out of Australia.
- Look for ways to commit more resources to the breeding and testing of new varieties of pineapple for our conditions in Australia.
- Follow the research developments of ReTain® (AVG) to combat natural flowering as it may eventually become an economical practice to help solve this problem in Australia.

TECHNOLOGY TRANSFER

A comprehensive 37 slide MS PowerPoint presentation of the tour was made and shown to growers at the Annual Pineapple Industry field day on 30 July 2010 at Yeppoon. This presentation will be shown to growers again at their smaller study group meetings this time with input from growers who went on the tour and with more time for discussion and comment.

Copies of this report together with the photographic illustrations will be made available to all growers via the study group meetings and to others involved in the Queensland pineapple industry.

Individual tour members will be assisting with the presentations and discussion of the tour with other members of their study groups and local growers.

ACKNOWLEDGEMENTS

We would like to acknowledge the support of Horticulture Australia Ltd, the Queensland Department of Employment, Economic Development and Innovation, Quadrant Australia Ltd, Jodie Campbell (DEEDI) who organised contacts in Singapore, our tour guide Abdul in Singapore and in Malaysia our guide Lawrence and driver Din, and the various other people overseas who gave generously of their time and knowledge.

APPENDIX I: CONTACTS

Name & title	Company/ organisation	Country	Item of interest	Contact details
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APPENDIX II: CONFERENCE PROGRAMME

PROGRAM 7TH INTERNATIONAL PINEAPPLE SYMPOSIUM
13-15 July 2010, Persada Johor International Convention Centre, Johor Bahru, Malaysia

12 July 2010 (Monday)
Setting up of posters Cocktail reception Registration
DAY 1: 13 July 2010 (Tuesday)
08.00 – 09.00 Registration
09.00 – 10.00 Opening Ceremony Opening remarks by Chairman of the Organizing Committee Welcoming address by Director General MARDI Opening address by the Hon. Minister of Agriculture and Agro-Based Industry
10.00 – 10.30 Tea Break and Poster Session
Session 1: Industry and Trade
10.30 – 11.00 **Paper 1: Lead Paper** **Overview on the world trade of pineapple for global markets** -Yacob Ahmad International Tropical Fruit Network (TFNet) 11.00 – 11.15 **Paper 2** **Rejuvenating the pineapple industry and trade in Malaysia** -Mat Hassan Othman Malaysian Pineapple Industry Board (MPIB), Malaysia. 11.15 – 11.30 **Paper 3** **The Philippines pineapple industry** -Leo Padila Balito, Dole Philippines

11.30 – 11.45
Paper 4
Current situation of pineapple production in Taiwan
-Zen-Hong Shü
Meiho Institute of Science and Technology, Taiwan

11.45 – 12.00
Paper 5
Status of pineapple industry in Thailand
-Jingtair Siriphanich
Kasetsart University, Thailand

12.00 – 12.15
Paper 6
Pineapple cultivation in North East India – A perspective venture
-Akali Sema
Central Institute of Horticulture, India

12.15 – 12.30
Paper 7
Improvement of Indonesian pineapple competitiveness through the empowerment of small scale farmers
-Winny Dian Wibawa
Ministry of Agriculture, Indonesia

12.30 – 13.00 Poster Session

13.00 – 14.00 LUNCH

Session 2: Biotechnology and Breeding

14.00 – 14.30
Paper 8: Lead paper
Review of genetic improvement in pineapple
-Garth M. Sanewski
Agri-Science Queensland, Australia.

14.30 – 14.45
Paper 9
Pineapple breeding -Fulfilling expectations of the global supply chain
-Chan Ying Kwok
Malaysian AgriFood Corporation Berhad (MAFC), Malaysia

14.45 – 15.00
Paper 10
Pineapple breeding for quality improvement in South of Vietnam
-Nguyen Trinh Nhat Hang
Southern Fruit Research Institute (SOFRI), Vietnam

15.00 – 15.15
Paper 11
To be confirmed by TFNet

Session 3: Plant Physiology and Cultural Practices

15.30 – 16.00
Paper 12: Lead Paper
Ecophysiology of pineapple
-Duane Philip Bartholomew
University of Hawaii at Manoa, U.S.A

16.00 – 16.15
Paper 13
Innovative cultural practices of pineapple on tropical peat lands
-Mohammed Selamat Madom
Malaysian Agricultural Research and Development Institute (MARDI), Malaysia

16.15 – 16.30
Paper 14
Sunn hemp cover cropping and solarization as alternatives to soil fumigants for pineapple production
-Koon-Hui Wang
University of Hawaii at Manoa, USA

16.30 – 16.45
Paper 15
Recent research on AVG prevention of natural induction
-Johnny Lopez
New Mexico State University, USA

16.45 – 17.00
Paper 16
Pre and post harvest metabolism of pineapple crown leaves
-Maurice De Proft
Katholieke Universiteit Leuven, Belgium
17.00 – 18.00
Pineapple Working Group Meeting

18.00 – 18.20 Tea Break

20.00 GALA DINNER

DAY 2: 14 July 2010 (Wednesday)

Session 4: Pest and Disease Management

08.30 – 09.00
Paper 17: Lead Paper
Overview of the pineapple interagrated pest management
-Aristoteles Pires de Matos
Embrapa Cassava & Tropical Fruits, Brazil

09.00 – 09.15
Paper 18
Biological control of pineapple (Ananas comosus) black rot pathogen by an isolate of Trichoderma asperellum
-Shanthi Wilson Wijeratnam
Industrial Technology Institute, Sri Lanka.

09.15 – 09.30
Paper 19
Development and evaluation of a standard method for sampling and monitoring Hanseniella sp (symphylid) in pineapple.
-Alain Soler
CIRAD, France

09.30 – 09.45
Paper 20
Further characterization of pineapple Mealybug Wilt associated viruses in Hawaii
-John Hu
University of Hawaii at Manoa, USA

09.45 – 10.00
Paper 21
Rearing Mealybugs for efficacy studies with pesticides
-Glenn Taniguchi
University of Hawaii, U.S.A

10.00 – 10.15
Paper 22
Nematode suppression and yield improvement potential of organic amendments in pineapple (Ananas comosus L. (Merr.) production
-Kingsley Osei
CSIR-Crops Research Institute, Ghana

10.15 – 10.30
Paper 23
Vermicompost tea and BTH effects on pineapple heart rot.
-Brent Sipes
University of Hawaii, Honolulu, USA

10.30 – 11.00 Tea break/Poster session

Session 5: Postharvest and processing

11.00 – 11.30
Paper 24: Lead Paper
Quality maintenance of pineapple in postharvest handling
-Abdullah Hassan
Malaysian Agricultural Research and Development Institute (MARDI), Malaysia

11.30 – 11.45
Paper 25
Pineapple leaf fibres-composites applications at macro and nano sales
-Alcides L. Leao
ESP -São Paulo State University, Brazil

11.45 – 12.00
Paper 26
An electrochemical DNA sensor for the detection of TP synthase gene expression in fresh-cut pineapple
-Nareumon Yamkate
Chulalongkorn University Bangkok,Thailand,

12.00 – 12.15
Paper 27
Colorimetric detection of yeast in fresh-cut pineapple based on Blue Silver Nanoparticle
– Piyarat Kamduang
Chulalongkorn University Bangkok, Thailand

12.15 – 12.30
Paper 28
Improving baking quality of cookies made from pineapple (ananas cosmosus) decanter / agro waste as a novel functional food
-Chek Zaini Hassan
Universiti Sains Islam Malaysia

12.30 – 13.00 Poster Session

13.00 – 14.00 LUNCH

Session 6: Consumer and Marketing

14.00 – 14.30
Paper 29: Lead Paper
To be confirmed by TFNet

14.30 – 14.45
Paper 30
World trade of Malaysian pineapple
-FAMA (Malaysia)

14.45 – 15.00
Paper 31
SPS requirements with respect to the world pineapple markets
– Datuk Roseley Dato' Haji Khalid
Department of Agriculture, Malaysia

15.00 – 15.15
Paper 32
Consumer perceptions, utilization and preferences toward pineapple in Malaysia
-Rozhan Abu Dardak
Malaysian Agricultural Research and Development Institute (MARDI),
Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia

15.15 – 16.30
PANEL DISCUSSION
'Global pineapple industry: The way forward
Moderator: Chan Y. K. (Malaysia)

16.30 – 16.45 ISHS remarks –Chairman, Pineapple Working Group 16.45 – 17.00 Closing Address
17.00 – 18.00 Hi-Tea
DAY 3: 15 July 2010 (Wednesday) TECHNICAL VISIT

APPENDIX III: LIST OF PAPERS & POSTERS PRESENTED AT CONFERENCE

LIST OF ABSTRACTS FOR ORAL PRESENTATIONS

SESSION 1: INDUSTRY AND TRADE

S1-1 Global overview and trade of the pineapple industry
Yacob Ahmad, International Tropical Fruit Network (TFNet), Malaysia

S1-2 Rejuvenating the pineapple industry trade in Malaysia
Mat Hassan Othman, Malaysian Pineapple Industry Board (MPIB), Malaysia

S1-3 The Philippines pineapple industry
Leo Padila Balito, Dole Philippines

S1-4 Current situation of pineapple production in Taiwan
Zen-Hong Shü, Meiho Institute of Science and Technology, Taiwan

S1-5 Status of pineapple industry in Thailand
Jingtair Siriphanich, Kasetsart University, Thailand

S1-6 Pineapple cultivation in North East India – A perspective venture
Akali Sema, Central Institute of Horticulture, India

S1-7 Improvement of Indonesian pineapple competitiveness through the empowerment of small scale farmers
Winny Dian Wibawa, Ministry of Agriculture, Indonesia

SESSION 2: BIOTECHNOLOGY AND BREEDING

S2-1 Review of genetic improvement in pineapple
Garth M. Sanewski, Agri-Science Queensland, Australia

S2-2 Pineapple breeding – Fulfilling expectations of the global supply chain
Chan Ying Kwok, Malaysian AgriFood Corporation Berhad (MAFC), Malaysia.

S2-3 Pineapple breeding for quality improvement in South of Vietnam
Nguyen Trinh Nhat Hang, Southern Fruit Research Institute (SOFRI), Vietnam

S2-4 An electrochemical DNA sensor for the detection of ATP synthase gene expression in fresh-cut pineapple.
Nareumon Yamkate, Chulalongkorn University Bangkok, Thailand

SESSION 3: PLANT PHYSIOLOGY AND CULTURAL PRACTICES

S3-1 Ecophysiology of pineapple
Duane Phillip Bartholomew, University of Hawaii at Manoa, USA

S3-2 Innovative cultural practices of pineapple on tropical peat lands
Mohammed Selamat Madom, Malaysian Agricultural Research & Development Institute (MARDI), Malaysia

S3-3 Sunn hemp cover cropping and solarisation as alternatives to soil fumigants for pineapple production
Koon-Hui Wang, University of Hawaii at Manoa, USA

S3-4 Recent research on AVG prevention of natural induction
Johnny Lopez, New Mexico State University, USA

S3-5 Pre and post harvest metabolism of pineapple crown leaves
Aristoteles Pires de Matos, Embrapa Cassava & Tropical Fruits, Brazil

SESSION 4: PEST AND DISEASE MANAGEMENT

S4-1 Overview of the pineapple integrated pest management
Aristoteles Pires de Matos, Embrapa Cassava & Tropical Fruits, Brazil

S4-2 Further characterization of pineapple Mealybug Wilt associated viruses in Hawaii
John Hu, University of Hawaii at Manoa, USA

S4-3 Development of degenerated primers to detect different viruses associated with Mealybug wilt of pineapple
Eduardo Chumbinho de Andrade

S4-4 A bait and trap method for sampling symphylid populations in pineapples
Paul Alex Marie Alphonsine, CIRAD, France

S4-5 Rearing Mealybugs for efficacy studies with pesticides
Glenn Taniguchi, University of Hawaii, USA

S4-6 Nematode suppression and yield improvement potential of organic amendments in pineapple (*Ananas comosus* L. (Merr.) production
Kingsley Osei, CSIR-Crops Research Institute, Ghana

S4-7 Vermicompost tea and BTH effects on pineapple heart rot
Brent Sipes, University of Hawaii, Honolulu, USA

SESSION 5: POSTHARVEST HANDLING AND PRODUCT DEVELOPMENT

S5-1 Quality maintenance of pineapple in postharvest handling
Abdullah Hassan, Malaysian Agricultural Research & Development Institute (MARDI) Malaysia

S5-2 Handling of fresh-cut pineapple for fresh consumption
M. N. Latifah, H. Abdullah, I. Ab Aziz, M. S. Faridah, O. Fauziah and Y. Talib

S5-3 Pineapple leaf fibres-composites applications at macro and nano sales
Alcides L. Leao, ESP – São Paulo State University, Brazil

S5-4 Colorimetric detection of yeast in fresh-cut pineapple based on Blue Silver Nanoparticle
Piyarat Kamduang, Chulalongkorn University Bangkok, Thailand

S5-5 Improving baking quality of cookies made from pineapple (*Ananas cosmosus)* Decanter/agro waste as a novel functional food
Chek Zaini Hassan, Universiti Sains Islam Malaysia, Malaysia

S5-6 Production of pigments from bacteria grown in solid and liquid pineapple waste
Wan Azlina Ahmad, Universiti Teknologi Malaysia, Malaysia

SESSION 6: CONSUMER AND MARKETING

S6-1 Fresh pineapple market from the banal to the vulgar
Carolina Dawson, CIRAD, France

S6-2 SPS requirements with respect to the world pineapple markets
Arizal Arshad, Department of Agriculture, Malaysia

S6-3 Consumer perceptions, utilisation and preferences toward pineapple in Malaysia
Rozhan Abu Dardak, Malaysian Agricultural Research and Development Institute (MARDI) Malaysia

LIST OF ABSTRACTS FOR POSTER PRESENTATIONS

SESSION 1: INDUSTRY AND TRADE

P1-1 The better approach to pineapple farming for smallholders – A research finding from two case studies in Malaysia
N. I. Nik Mohd Yusoff, W. H. Wan Sabri and S. Z. Irina

P1-2 Measuring competitiveness of Malaysia's pineapple trade market: A comparison between the selected exporting countries
A. Roslina and A. Abu Kasim

P1-3 Pineapple production and research in China
G. Sun

P1-4 Pineapple production in the CNMI
D. Nandwani

SESSION 2: BIOTECHNOLOGY AND BREEDING

P2-1 Micropropagation of Maspine pineapple treated with 6-benzylaminopurine thought in vitro technique
A. R Zuraida, A. H. Nurul Shahnadz, C. M. Z. Che Radziah, C. M. Z, A. Hartinee and B. Naziah

P2-2 Pineapple (Ananas comosus (L.) Merr.): Isolation, identification and screening of bacterial endophytes form pineapple for cytokinin-like compounds
C. Y. Loh, Y.Y Tan and S. J Bhore

P2-3 Identification and characterisation of differentially expressed microRNAs during fruit ripening in pineapple (Ananas comosus var. comosus)
N. H. M Yusuf and S. V Kumar

P2-4 Potential pineapple for landscaping in Malaysia
Z. Rozlaily and R. Melor

P2-5 Difference in sugar content and enzymes related to sucrose metabolism of pineapple different sections
M. A Dou and X. P Zhang, G. M Sun

P2-6 Difference in sugar content of fruit harvested in different month pineapple and its relation to sucrose metabolism

X. M Zhang, L. Du, Y. Yao, J. Li, M. A Dou. G. M Sun

P2-7 Frequency and distribution of Simple Sequence Repeats (SSRs) in pineapple fruit transcriptome
W. D Ong and V. S Kumar

P2-8 Cluster analysis using quantitative, qualitative and molecular variables for genetic diversity studies in pineapple genotypes
C. de Fatima Machado, F. V. D Souza, J. R. S Cabral and C. A da Silva Ledo

P2-9 F_1 hybrid pineapple (Ananas comosus L.) resistant to bialaphos herbicide
S. Suneerat

P2-10 Gene regulation of fruit development by MicroRNAs
X. W Yew and V. S Kumar

P2-11 The vegetative 'snake' stem pineapple: is it heritable or physiological
R. Melor

P2-12 Root-knot and reinform nematode resistance bioassays of pineapple subjected to genetic modification and tissue culture
B. Sipes

P2-13 Molecular Overview of Genes Involved in Pineapple Fruit Development
J. Koia, M. Richard and J. Botella

P2-14 Phenotypic variability in selected population of hybrid progenies derived from piping leaf base
A. M Noorman and R. Melor

P2-15 Ulam: A novel pineapple variety
J. C Acosta, R.Lledo and N. L Agulay

SESSION 3: PLANT PHYSIOLOGY AND CULTURAL PRACTICES

P3-1 Leaf gas exchange of pineapple as influenced by fruit
T. E Marler

P3-2 Observation on flesh cell development of pineapple fruit by flow cytometry and histological analysis
Y. H Li and G. M Sun

P3-3 Role of calcium on internal browning of pineapples
P. Issaya, J. Chompoo and S. Jingtair

P3-4 Refining ReTain© treatments to control natural induction of flowering of 'MD-2' pineapple in Hawaii
D. P Bartholomew, G. Uruu, J. A Lopez and D. Leep

P3-5 The effect of NaCl on the mineral nutrient and photosynthesis pigments content in pineapple (Ananas comosus) in vitro plantlets
A. Aziz

P3-6 Partitioning of dry matter in fruiting and vegetative pineapple plants of homogeneous age
T. E Marler

P3-7 New formulation for flower induction of pineapple var. Maspine
M. Malip

P3-8 Effect of gibberellic acid and N-(2-chloro-4-pyridyl)-N'-phenylurea treatments on fruit quality of pineapple
Y. H Li and G. M Sun

P3-9 Outline of pineapple growth model in very clear-cut natural conditions of Reunion Island

P3-27 Effect of planting density on growth, development and yield of cayen pineapple in irrigation procedures in Nghe An province
Q. H Nguyen, T. K Dao and T. T. H Nguyen

P3-28 Bioaccumulation of Hg, Pb, As and Cd by *pineapple* (Ananas comosus. (L). Merr) var *Giant Kew* and its implication as an agroforestry crop for ex-tin mines in Peninsular Malaysia
L. H Ang, L. K Tang, W. M Ho, H. T Fui and M. Ramli

P3-29 Effects of soil treatments on vegetative growth of pineapple (Ananas comosus) var. sugarloaf grown on sand tailings
L. K Tang and L. H Ang

P3-30 Availability of Maintain© CF 125 for commercial production of pineapple planting material
N. Bhushan Mańdava

P3-31 Forcing of Tainon17 pineapple with calcium carbide (CaC_2) and/or ice cold stress under field conditions
C. C Jer, M. Subbiyan, L. L Yi, M. S Ching, S. S Wen, F. L Pei and H. L Chin

P3-32 Micropropagation of pineapple var. Maspine through direct and indirect regeneration system
H. Aziyani, M. B. M Fhaizal, j. Mahanom, M. J Noor Baizura, S. Intan Zahrah, Y. K Chan and K. Norzulaani

SESSION 4: PEST AND DISEASE MANAGEMENT

P4-1 Complete Lab-on-a-chip system for simple and rapid detection of pineapple mealy bug wilt-associated viruses (PMWaVs)
C. Piyasak and C. Peerasak

P4-2 A simple and rapid colorimetric detection of pineapple mealy bug wilt-associated viruses (PMWaVs) based on gold nanoparticle
Y. Najwa, C. Peerasak and C. Piyasak

P4-3 Development of degenerated primers to detect different viruses associated with mealybug wilt of pineapple
E. C. Andrade, K. C. Santos and P. E. Meissner

P4-4 Effect of methyl bromide fumigation against Mealy Bug on pineapples var. N36 and Josapine
O. Mohd. Shamsudin, M. S. Mohamed, Z. Sulaiman, M. Pauziah, B. A. Rashid, Z. Ngizailah and K. Mahmud

P4-5 Varietal responses to Mealy Bug infestation on pineapples grown on peat soil
O. Mohd. Shamsudin, Y. Suhana and R. Melor

P4-6 Evaluation of the potential of different rotation crops to control *Rotylenchulus sp.* and *Hanseniella sp* in pineapples
A. Soler, J.M. Gaude, and P.A. Marie-Alphonsine

P4-7 Occurrence of cucumber mosaic virus on pineapple in Malaysia
S. Norsailawati, M. N. Mohamad Roff., Z. Sidek and S. Kamaruzaman

P4-8 Screening of MARDI's Josapine somaclonal variation in the field for selection of potential BHR resistant or tolerant
L. Rozeita and R. Kogeetha

P4-9 Effect of *Dicranopteris linearis* debris on weed emergence and pineapple growth in pineapple field
T.V. Chong, A. Nor Aris & A. A. Amarudin

P4-10 Plant parasitic nematodes associated with pineapple in Peninsular Malaysia
A. Mohd. Nazarudin

P4-11 Alternative control of pineapple fusariosis on irrigated MD2 cultivar in Brazil
R. A. Carvalho, E. F. de Oliviera, J. T. de Lacerdo, M. B. Neto

P4-12 Evaluation of ornamental pineapple hybrids for resistance to *Fusarium, subglutinans*
E.H. de Souza, R. O. Trocoli, A.P. de Matos, D. S. C. Junior, F. V. D. Souza, M. A. P. de Carvalho Costa

P4-13 Pineapple germplasm and Fusariosis resistance
D. T. Junghans and P. M. Aristoteles

P4-14 Nematodes on pineapple grown on peat soil
N. H. Nik Masdek

P-15 Pineapple integrated pest management; an overview
P. M. Aristoteles, N. F. Sanchez, F. A. Teixeira and A. H. Simão

P4-16 Pineapple research and development status in centre for tropical fruit studies, Bogor Agricultural University
G. S. Sobir, N. Arif, S. Laode and N. Fatimah

P4-17 Beekeeping in pineapple smallholdings: A case of *Apis Mellifera*
Mohd. Mansor and M. Zakbah

P4-18 Transmission characteristics of pineapple mealybug wilt associated virus-2 by the grey pineapple mealybugs Dysmicoccus neobrevipes in Hawaii
C. V. Q. Subere, D. M. Sether, W. B. Borth, M. J. Melzer and J. S. Hu

SESSION 5: POSTHARVEST HANDLING AND PRODUCT DEVELOPMENT

P5-1 Effect of maturity stages on chemical properties and sugar contents in Smooth Cayenne pineapple fruit
J. Adisak and J. Jintana

P5-2 Effect of storage time on physical, chemical properties and sensory attribute of Queen pineapple fruit
C. N. Linh and J. Adisak

P5-3 Morphology, physical and chemical properties of Queen pineapple fruit
D. T M Quyen, L. H Hai, J. Adisak and P. Rachtanapun

P5-4 Changes and distribution of aroma volatile compounds from pineapple fruit during postharvest storage
C. B. Wei, S. H. Liu, X. P. Zang, L. L. Lv and G. M. Sun

P5-5 Surface coating treatments influence fruit weight loss and fruit surface microstructure of N36 and Gandul pineapples
O. Zaulia, M. Suhaila, O. Azizah, and M. Mohammed Selamat, S. Jinap, M. Habsah, A. M. Norzaimawati and M. N. Azhar

P5-6 Effect of postharvest heat treatments on microstructure changes of pineapples skin and flesh
O. Zaulia, M. Suhaila, O. Azizah, and M. Mohammed Selamat, S. Jinap, M. Habsah, A. M. Norzaimawati and M. N. Azhar

P5-7 Effect of methyl bromide fumigation on Josapine and N36 pineapples
M. Pauziah, S. Ahmad Tarmizi, H. Abdullah, M. S. Mohammed, O. Mohd. Shamsuddin and M. Norhayati

P5-8 Quality changes of pineapple (*Ananas comosus* var. Josapine) as affected by controlled atmosphere conditioned

M. Razali, O. Zaulia, M. Habsah, D. Che Omar and M. Z. Zaipun

P5-9 Pineapple under agri export zone of India
P. Deb, P. K. Paul, N. Bhowmick and C. P. Suresh

P5-10 Effect of temperature on the rheological behaviour of Josapine pineapple pulp (*Ananas comosus* L.)
S. Rosnah, W. D. Wan Ramli, T. Mohd Sobri, H. Osman, I. Coskan

P5-11 Effect on relation of chemical properties and acceptability of Smooth Cayenne pineapple
J. Jintana, W. Chatlada and J. Adisak

P5-12 Effect of oxygen scavenger application to the quality of fresh-cut pineapple
M. N. Latifah, I. Ab Aziz, O. Zaulia, O. Fauziah and Y. Talib

P5-13 Effect of citric acid treatment to the quality of fresh-cut pineapple
M. N. Latifah, O. Zaulia,, M. P. Nur Aida, O. Fauziah, M. Hariayah and Y. Talib

P5-14 Physiochemical characteristics and acceptability of pineapple salsa
M. N. Latifah, H. Abdullah, I. Ab Aziz, M. S. Faridah, O. Fauziah and Y. Talib

P5-15 Development of slicing machine for fresh-cut pineapple
S. Saiful Bahri, D. Mohd Nazrul Hisham, M. Nur Ilida, M. Kasmah and A. Fauziah

P5-16 Effect of different storage duration and storage life and quality fresh cut pineapple cv. Josapine
Y. Nor Hanis Aifaa, O. Zaulia, M. P. Nur Aida, M. Habsah, M. N. Azhar and M. Z. Zaipun

P5-17 Effect of ozonated water wash on quality of fresh-cut Josapine pineapple during storage
M. P. Nur Aida, M. Hairiyah, W. H. Wan Mohd Reza and M. Nur Ilida

P5-18 Effect of hydrogen peroxide on quality of fresh-cut pineapple stored at 5ºC
M. P. Nur Aida, M. Hairiyah, W. H. Wan Mohd Reza and M. Nur Ilida

P5-19 Evaluation of the browning activity of minimally processed pineapple treated with citric acid
R. Nur Azlin, M. N. Latifah, M. T. Mohd Kamal, M. Habsah and R. Mohd Amin

P5-20 Quality Evaluation for fresh-cut pineapple in different cutting shapes
M. R. Bizura Hasida, L. M. Latifah, W. H. Wan Reza, M. Z. Zaipun and O. Fauziah

P5-21 Microbiological quality of fresh-cut pineapple with application of oxygen absorbent in packaged
M. Nur Ilida, M. P. Nur Aida, A. S. Asiah and M. Hairiyah

P5-22 Effect of alginate and gellan-based edible coatings on quality of fresh-cut pineapple during cold storage
A. Nima, O. Azizah, M. H. Hasanah, C. P. Tan, M. A. Noranizan

P5-23 Standard operating procedure on processing and yield assessment of pineapple and other tropical fruit juices using Voran Pressing 500
T. Siti Zalita, M. Miradawati, F. Mohd Iqram, I. Hassan Fahmi, A. B. Fadzilah Adibah, A. S. Shah Julian and M. R. Sharifah Ameelia Akma, C. H. Leong and M. S. K. Feffery

P5-24 Pineapple juice potential as anti cancer agent in A2780 ovarian cancer cell line
A. G. Madihah, M. Miradawati, A. T. Siti Zalita and A. M. Fadzilah Adibah

P5-25 Production and properties of spray dried pineapple juice
A. Mohd. Suhaimi, O. Abd Malik, O. Ahmad Shokri and S. Asmui

P5-26 Tropical Fruits fibre juice drinks
H. Faridah, M. Z. Rahimah and D. Mohd Zin

P5-27 Non-destructive sterilization process of pineapple juice
M. Mirdawati, A. T. Siti Zalita and A. M Fadzilah Adibah

P5-28 Food products from Ananas
C. A. Zainun

P5-29 Processing of dehydrated candied pineapple using candying machine
C. A. Zainun and C. M. N. Nik Mohd Faiz

P5-30 Quality and acceptability of pineapple pickles
C. A. Zainun, B. Rokiah and C. M. N. Nik Mohd Faiz

P5-31 Accelerated shelf life studies of high energy pineapple granola bar
M. Sharifah Samsiah, A, Noor Azizah and M. S. Latifah

P5-32 Production of high bromelain nutraceutical drink
S. S. Poh, A. T. Siti Zalita, A. M. Fadzilah Adibah

P5-33 Use of response surface methodology to optimisation of extraction of enzymes from pineapple pulp
A. S. Costa, C. R. Da Silva, L. M. S. Costa, N. A. D. M. Barros, M. G. B. Koblitz, E. Viana, F. V. D. Souza

P5-34 Effect of ore treatments on vacuum fried pineapple snack – A preliminary investigation
H. A. Hasimah, I. Zainun and B. Norbaiti

P5-35 Effect of polyols and polydextrose on the physical characteristics of sugarless pineapple tart
K. K. Hazila, Z. A. Mohamad, D. Rokiyah, N. Nur Elyana and W. Hamidah

P5-36 Dietary fibre powder from pineapple by-product as a potential functional food ingredient
H. I. Aida, H. Mahanom and A. S. Norhartini

P5-37 Proximate composition and physicochemical properties of pineapple gums
M. Tun Norbrillinda, I. Aida Hamimi and W. A. Wan Anis

P5-38 Effect of temperature and pH on viscosity of pineapple gums
M. Tun Norbrillinda, I. Aida Hamimi and W. A. Wan Anis

P5-39 Performance of pineapple leaf fibre (PALF) reinforced high impact polystyrene (HIPS) composites
J. P. Siregar and S. M. Sapuan

P5-40 Development of biodegradable plastic utilizing pineapple leaf fibre
H. M. Akmal and C. C. Tiah

SESSION 6: CONSUMER AND MARKETING

P6-1 Ex post impact assessment of pineapple technology on peat soil
M. L. Raziah and A. R. Alam

P6-2 Scenario and prospect of Malaysia's pineapple industry
M. L. Raziah and N. O. Nik Rahimah

P6-3 Consumer preferences towards pineapple varieties in Malaysia
S. Syahrin Suhaimee

P6-4 Selected fruit characteristics of pineapple base on consumer preference study
Z. A. Ahmad Zairy, A. H. Noorlidawati

P6-5 Consumer acceptations towards Malaysian minimally processed pineapple in Singapore food market
A. B. Noorlidawati, A. D. Rozhan, M. N. Latifah, A. Abu Kasim, M. P. Nuraida and O. Fauziah

P6-6 Economic analysis of mechanized system for a large scale pineapple production in mineral soils in Malaysia
A. R. Khairul Fithri, C. H. Mohammud, H. Abd. Rahim, M. Noor Al Anuar and A. Aris

APPENDIX IV: EVALUATION OF TOUR

Participants were asked to complete an evaluation survey on their return to Australia.

Q1. FROM WHAT YOU LEARNT DURING THE TOUR, WHAT WERE THE THREE MOST IMPORTANT IMPLICATIONS FOR THE AUSTRALIAN PINEAPPLE INDUSTRY?

Threat of imports because of cheap cost of production.
Pressure from Malaysia to import pineapples into Australia backed by their government.
Threat of pineapple imports from Malaysia.
Threat of imports from Malaysia.
The threat of imports is still real and government backed.
Export of fruit.
Australia letting Malaysian pineapples come here.
Real threat of pineapple imports from Malaysia. With this import risk also comes a very real biosecurity risk from *Erwinia* disease.
Future disease from imports.

Malaysia is trying very hard to sell pineapples in every possible way.
Minimally processed pineapple products.
Malaysia has invested substantially in value adding to fresh pineapple production.
Malaysia is much more advanced than Australia in minimal processing and other pineapple products.
Maximisation of fruit usage and minimal work.

Pineapple industry is supported by the Malaysian government which isn't here at all.
Malaysia's department of Ag is behind their pineapple industry and would help develop export markets.
Pineapple growers have strong government support.
Regarding the import threat, the Malaysian government strongly supports its industry.

Learning how other countries grow pineapples.
Our Asian neighbours have advantage in labour rates and public sector research.
Will be expanding their MD2 production. Fresh fruit import in the future with good quality fruit.

Labour is an issue for them so could make them more competitive, going more mechanised maybe.
Cheaper fruit from other countries with cheap labour.

To see at what stage their industry is at especially when they are trying to export to Australia.

The Australian industry is still a world leader in field practice & research.

Q2. IN ONE OR TWO SENTENCES WHAT WERE THE MAIN BENEFITS FOR YOU IN TAKING PART IN THE TOUR?

Talking to other people at meeting.
Meeting people at the symposium and discussing what they do on their farms.
Being able to meet and enter into discussions with growers from other countries at the symposium.
To gain an overview of the world industry and industry trends. Consumption has increased dramatically in the last 10 years and if the Australian industry is to survive then product innovation is required.
To see pineapples grown in different climates and soil types and how different varieties respond.
The main benefits on this tour were to see first hand the differences in farming practices between Australia and Malaysia.
The opportunity to see and meet people from other countries and generally open my eyes to how other cultures live.
Seeing how another country grows pineapples and their achievements and challenges.
Seeing how the underdeveloped nation of Malaysia has out developed the rest of the world when it comes to optimising the output of a single unit of fruit through product diversification.

Listening to guest speakers from other countries on their growing of organic pineapple and their future marketing prospects. World shortage of pineapples.

Q3. HOW WOUD YOU VALUE THE FOLLOWING ASPECTS OF THE TOUR? (use a scale of 1 to 10, where 1 is a waste of time and 10 is extremely valuable)

a) Singapore importers, fresh fruit market and retail shop visits?
7, 6, 9, 9, 8, 5, 8, 7, 9 (average 7.6)

b) Symposium itself (Mon evening till Wed) – presentations, posters, networking?
9, 8, 9, 7, 8, 8, 8, 4, 8 (average 6.8)

c) Symposium field trip (Thu) - packing shed, research farm & processing factory, kiosk?
6, 10, 9, 8, 9, 8, 9, 6, 9 (average 8.2)

d) Pineapple farm visit on Friday?
8, 8, 9, 8, 6, 7, 7, 6, 5 (average 7.1)

e) Interaction with other tour members?
10, 8, 9, 10, 10, 10, 10, 8, 9 (average 9.3)

f) Establishing new contacts?
10, 10, 9, 8, 10, 10, 9, 7, 9 (average 9.1)

Additional comments:

- All of the above are important and are part of the process of hoping to be at the head of the pack in our chosen industry.
- Very interesting tour and great to see Australian growers supporting Australian industry.
- The only reason I gave (b) a 7 was that a lot of the presentations went over my head.

Q4. FROM THE EXPECTATIONS YOU HAD PRIOR TO THE TOUR HOW SATISFIED WERE YOU WITH WHAT YOU SAW AND LEARNT (on a scale of 1 to 10) AND PLEASE GIVE REASONS

8: Growing pineapples in Malaysia I think would be better on mineral soil. Peat soils were not what I expected.

Having been to two gatherings previously I found this tour well organised and well lead and covered all aspects of the industry in sufficient detail.

9: As a fresh fruit grower I believe we saw a great range from field trials, growing, packing, retail, export and the different products they are making from pineapple e.g. clothes, beauty products, minimal processed.

A little disappointed with the few farms we saw for the tonnage they provided.

8: Was hoping to see through a cannery, also to see a rubber factory and palm oil factory. Although Lawrence did a good job in telling us what he knew about it.

7: Was hoping to see through FIMA cannery to see processing. Other parts of the tour were about what I expected.

10: Very satisfied.

8: The production was as I had expected, backward from ours. However the marketing and product diversity far exceeded my expectation.

9. Well organised 2 days of symposium as well as tour of farms. Very good forum for meeting fellow pineapple people from the world stage.

Very useful, it allowed us to see how they grow the pineapples which I believe it leaves a lot to be desired.

Q5. DID YOU HAVE SUFFICIENT OPPORTUNITY TO ASK QUESTIONS AND DISCUSS YOUR OPINIONS DURING THE TOUR?

Yes 9. No 0

Q6. HOW USEFUL WERE THE DEBRIEFING SESSIONS/DISCUSSIONS IN THE EVENINGS?

They are important as they give the attendants the opportunity to get an amalgam of the facts and information presented on the day.
Great. Sometimes other's spoke about things they saw in a different way to how I saw it!!
Very useful.
It made you recall what we were told during the day.
Very good.
Very useful.
Very informative.

Q7. OVERALL, HOW WORTHWHILE WAS THE TOUR FOR YOU & WHY?

I believe the tour was well organised.
As I am still involved in the industry I like to know what is happening in the fore front of research and innovation.
Very worthwhile trip. Great people on our tour and always good to see how other's run their farms and the different industries we saw.
Excellent - view things differently. Learn to mix and see other people's point of view.
It was a very interesting and worthwhile tour. Enjoyed listening to other countries about their problems and how they were dealing with their situations.
Tour was very worthwhile in gaining insights to Malaysia's industry and also other countries pineapple industries as outlined at symposium.
The tour was very worthwhile as it gave a complete overview of growing pineapples in Malaysia and insights to other pineapple growing countries.
The tour confirmed my beliefs in minimal process and its future in the market place.
Well organised as planning tour. Very informative.

Q8. IF YOU WERE TO TAKE PART IN ANOTHER STUDY TOUR IN THE FUTURE

What aspects of this tour would you want to preserve?

It was the first symposium I have attended. I think it was well run.
The tour was fine. However it could be extended in length to give participants further opportunity to explore the country and culture.
I liked all of it. We were on the go and saw a fair bit of country but were not rushed.
The same number in group (large numbers hard to organise). 8-10 days is about right length of time on tour.
The symposium, technical tours, farm visits of other crops.
Symposium, technical walk, visit to "Friday's" restaurant!!!
Symposium, farm tours.
Simon did a great job co-ordinating and organising and cannot think of anything I would not want to preserve.
Wholesale markets & tour to farms.

What changes would you like to see in how the tour is organised and/or conducted?

To have one day to ourselves to shop and generally just look around (should be in the middle of the tour).
It was well organised, no hassles. Just a day or two longer in each country or sight seeing.
Tour could be extended by a couple more days before and after symposium, more casual farm visits to private farms.

More farm/packing shed tours.
The only change I would have is leave 1 day spare in the middle of the week to relax or do your own thing.
More time for lay days as tour was a bit rushed just 2 days.

B. TECHNOLOGY TRANSFER PLAN

Illustrated MS PowerPoint presentation of the tour to growers at the 2010 Annual Pineapple Field Day on 30 July at Yeppoon.

Show MS PowerPoint presentation again to growers at individual study group meetings in late 2010/early 2011 on this occasion with more time available for discussion and with input and comment from local study group members participated in the tour.

Distribution of copies of this detailed report to growers at study group meetings.

ANY OTHER COMMENTS

Thank you Simon for organising the group.
Thanks Simon for a job well done as tour leader.
Enjoyed the company of all who went on the trip, you did well Simon.
A good job done Simon, thank you again.
Unforgettable experience.
Tour was well run by Simon. Great company on the tour. All put their point of view forward when asked.
Looking forward to future tours.

APPENDIX V: ABSTRACT & LIVING MULCH POSTER PRESENTED AT CONFERENCE

Living mulch as a management tool for reducing inter-row soil erosion in pineapples

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Abstract
Pineapple cropping soils are most vulnerable to erosion from the bed-forming stage until canopy closure of the inter-row space. One of the main issues associated with pineapple production in Australia is loss of soil and sediment in runoff water. Previous research clearly shows that soil losses are higher in the first 10 to 12 months when the inter-row surface is exposed to raindrop impact prior to canopy closure. Living mulch is a green cover crop established in the inter-row space and on the sides of the bed at the same time as the pineapples are planted, the mulch is killed with weedicide prior to seeding but the leaves and roots remain effective in a protective role for some time. A trial on a sandy loam soil with a slope of 3% used sediment collection troughs to compare this treatment with standard practice. Inter-row cover reduced soil loss by 54 tonnes/ha (68.7 t vs 14.7 t) compared with bare inter-rows over the 17 month trial period.

Other apparent benefits of living mulch include better drainage for *Phytophthora* control (the beds retain their height for longer and the inter-rows remain free of silt). The range of species used as living mulch, oats (*Avena sativa*), white French millet (*Panicum miliaceum*) and forage sorghum (*Sorghum bicolor*), are not hosts for nematodes in South East Queensland and they have also demonstrated allelopathic properties against weeds. Cost savings include less work retrieving soil from silt traps.

Keywords: Pineapple, Soil erosion, Mulch, Weed control, Drainage

Living mulch as a management tool for reducing inter-row soil erosion in pineapples

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Simon Newett

STANDARD PRACTICE

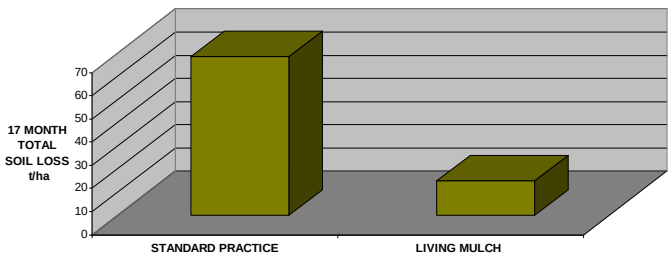
OATS/SORGHUM IN WALKWAYS

17 MONTHS LATER:

69 tonnes soil lost per ha

Soil lost was collected and measured.

15 tonnes soil lost per ha



	Standard practice	Living mulch	Difference	Rainfall
	Soil loss (t/ha)	*Soil loss (t/ha)*	*%*	*mm*
Oct-06	7.3	0.7	90	35
Dec	4	1	75	246
Mar-07	42.2	7.3	82.8	229
May	1.8	0.7	63	51
Jul	4.5	1.1	76.4	141
Aug	2.5	0.7	72.9	220
Nov-07	6.5	3.4	47.8	83
17 MONTH TOTAL	**68.8**	**14.9**	**78.5**	**1005**

Seeder box for planting mulch. Tractor wheels press seed in.

Living mulch sprayed off with weedicide before going to seed.

More information

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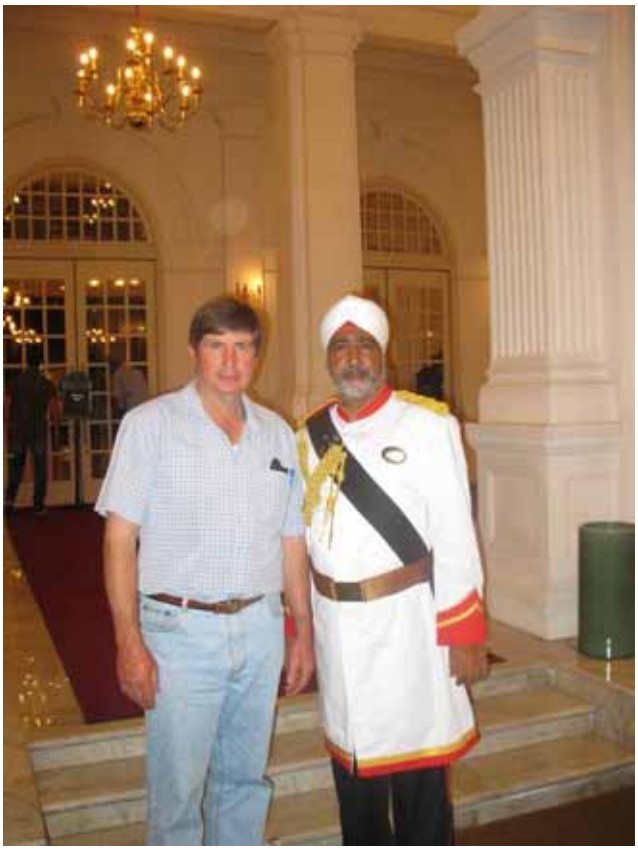
Queensland Government

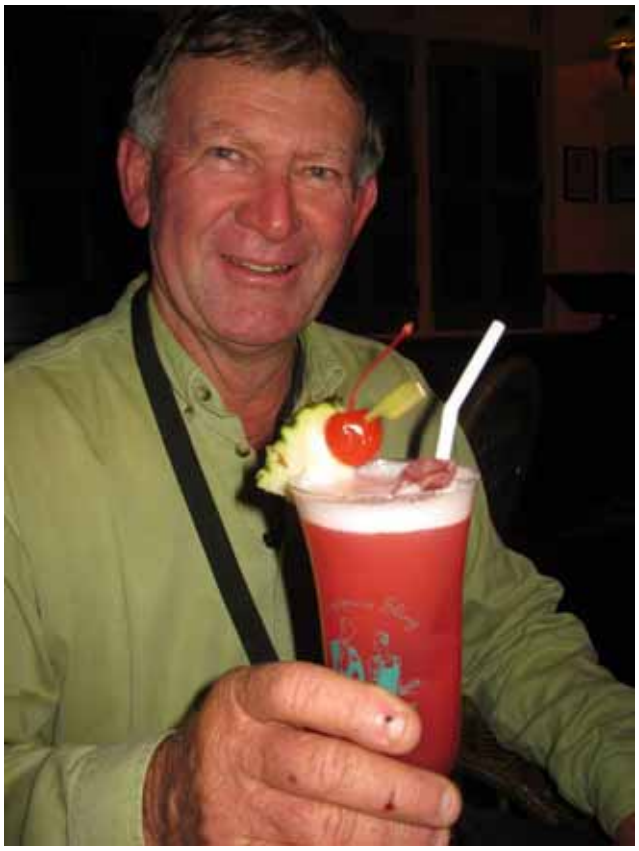
Thanks to Chris Doyle, Leone Maxwell and Simon Newett for the photos in this report.

Map of West Malaysia and Singapore showing areas visited

Tour group under the live pineapple arch at the pineapple kiosk in Pontian, from left: bus driver for the day, Gladys Pace, John Forster, Col Pace, Leone Maxwell, Simon Newett, Ellison Maxwell, Stephen Scurr, Scott Maxwell, Chris Doyle, Michael Cruice and Adam Pike

Tour group from left: Adam Pike, Gladys Pace, Col Pace, Leone Maxwell, Ellison Maxwell, Stephen Scurr, Chris Doyle, John Forster, Michael Cruice, Scott Maxwell and Simon Newett,





Meeting the locals and enjoying a Singapore Sling at the famous Raffles Hotel in Singapore

Old and new architecture in Singapore – Chinese pagoda and recently opened Marina Bay Sands

A Chinese Buddhist shrine at one of the market agent's stands at the markets

Dole MD2 from the Philippines seen in the Pasar Panjang fresh fruit and vegetable markets in Singapore was the stand-out best quality, well presented and good tasting. Alan from Satoyu Trading picks one for us to taste.

Pineapples at the Singapore market were in a range of different packaging and containers and were mainly from Philippines, Malaysia and Thailand. Some of the Spanish types had long stems attached reportedly to extend shelf life. At top left are pineapples treated with Swelpine® (also sold as Fruitone®) which blows up the size of fruit but interferes with the formation of the crown; its use is not permitted in Australia

Whole and semi-processed fresh pineapple in a 'Cold Storage' supermarket in Singapore. Clockwise from top left: Attractive display of fruit including Philippines MD2, prepared fruit in display cabinet including pineapple spears for $1 each, skinned slug, chunks and spears in tubs supplied with a plastic fork, whole cored and peeled slugs in tubs sitting on ice in the display. Prices in Singapore dollars (worth about AUD 0.82 during our visit).

Persada Johor conference centre in Johor Bahru

Old fort in Johor Bahru

Sultan's palace in Johor Bahru now a museum

Col Pace with Bhusan Mandava from USA who supplies Maintain® to the Australian industry

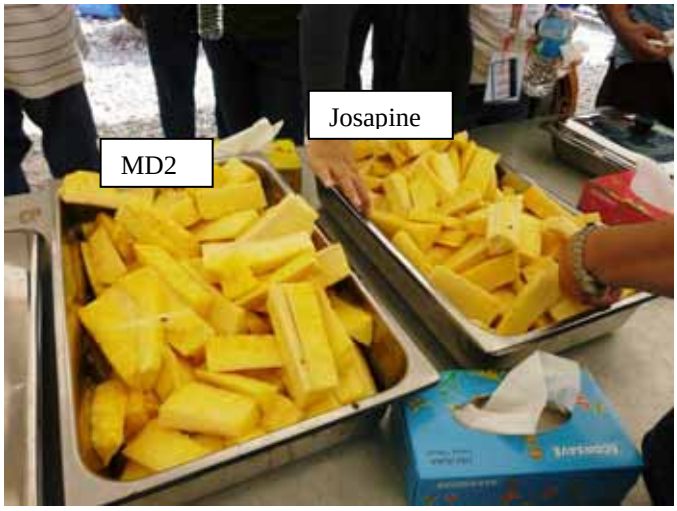
A presentation in progress at the conference

Networking dinner with the South African contingent including El-Marie Rabie and Dave Murray

Simon Newett with Prof Duane Bartholomew, well known (semi-retired) pineapple researcher from the University of Hawaii

Part of the Australian contingent including Mike Smith and Garth Sanewski at the conference gala dinner

Peat soils on the MARDI experimental station. Clockwise from top left: the dark peat soil (it has a pH of 3.5, an organic matter content of 50% and a Cation Exchange Capacity of about 120), this drain in the peat reveals the old timber which was part of the forest that formed the peat, the water table in these ex-swamps is always close to the surface, a MARDI employee about to push this pole straight down into the peat demonstrating both how deep and how soft these soils are, a walk-behind hand-steered motorised device which had spikes on the wheels for making planting holes into which suckers were planted, no bedding-up machinery can be used in the peat because would sink.



Some of the different varieties grown in Malaysia. Clockwise from top left: rough leaf, another rough leaf, Mauritius MacGregor from Australia, a comparison of Josapine and Maspine, N36, chopped up MD2 and Josapine.

On the JTP farm on mineral soils the opportunity is taken to mechanise. This ex-oil palm farm is being planted to MD2 and N36 for export. Suckers are used for planting material but no mounding is used. Oil palms can be seen in the background.

At the JTP packing shed. Clockwise from top left: Banner showing their brands, fruit stockpiled prior to packing, weighing a carton of N36, carton of six N36 ('Juanita'), part carton of eight MD2 ('Golden Juanita'), cartons of MD2 ready to go, loading a container bound for Dubai.

Value-adding products made using pineapple include (clockwise from top left):'breaded pineapple', pineapple roll, candied pineapple, pineapple sauce, pineapple jam, high fibre pineapple drink, pineapple powder, pineapple desert sauce, pineapple jelly, pineapple sweet and sour sauce, special occasion clothes made from pineapple fibre, pineapple paceri (a curry sauce), pineapple juice, high fibre pineapple biscuits, fried and dried pineapple chips.

More value-adding pineapple products for sale at the pineapple kiosk "Casa Anasia" in Pontian include (clockwise from top left): pineapple chips, pineapple-flavoured coffee, cosmetics, pineapple tarts, dehydrated pineapple snacks and cans of pineapple juice. Frequent reference is made to pineapple's health giving attributes.

Rubber plantation. 'Tapping' with the special tool. A slither of bark is taken off each day to open the wound and cause the sap to bleed out, this is collected in a small bucket with the help of a little spout at the lowest point of the cut.

Oil palm plantation showing how the bunches of fruit are borne amongst the leaf bases. Bunches of fruit typically weigh about 24 kg each and the reddish orange fruit contain about 25% oil.
A very good plantation yields about 5 t oil/ha/year.

A sample of the exotic tropical fruit grown in Malaysia. Clockwise from top left: Rambutan, mangosteen, cut mangosteen, our guide Lawrence with durian ("tastes like heaven, smells like hell"), cut durian, unidentified legume.

Clockwise from top left: Fibre extraction from pineapple leaves, rickshaws and church in historical Melaka, the Petronas towers in Kuala Lumpur until recently the tallest building in the world, Leone and Gladys outside the National Palace, the Sultan Abdul building, and inside the batik factory.