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MEOA BULLETIN

THE MALAYSIAN ESTATE OWNERS' ASSOCIATION

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Editorial

Message from the Editor …

In this special bumper issue, we have included articles from our Taiwan Trip team. In appreciation of the diverse range of agricultural topics written by Trip participants who come from different walks of life, we maintained the format of the articles unique to each contributor's style. Additionally, we welcome young first-time contributors KJ Yap & Victor Sanjay, whom we hope can contribute to future issues of our Bulletin. We will also have young editors of the Bulletin who I know will do an excellent job.

Another notable 'first' – we are going 'Green' in this issue! With no hardcopies printed, MEOA is doing its small part in conserving our environment. This also means that we are able to keep the cost of publication to a minimum and advertisement-free, probably another 'first' for a Bulletin in our industry.

Lastly, before you proceed to the articles, do give a few moments to the following special note from guest editor and tireless Taiwan Trip Captain, Mr Amit Guha.

- **Mahbob Abdullah** (Editor)

This issue covers the Field Trip to Taiwan (from 13th to 20th Nov 2016) where members pretty much saw the whole spectrum of agricultural activities in the young island nation whose real development started after the Nationalist Gen. Chiang Kai-shek escaped there from China in 1949 when the communist under Mao Zedong was gaining power on the mainland. In fact, as informed by our tour guides, Taiwan's development in terms of infrastructure and industries really was started by Chiang Kai-shek's son Chiang Ching-Kuo from the late 1970s when he realized that the Nationalists would not be taking over mainland China and they had to stay put in Taiwan for the long term.

The tour for MEOA was organized by a Malaysian, Prof. (Dr) Ng Lean Teik, chair of the Agricultural Chemistry Dept. at the National Taiwan University and who previously was at FRIM (Forest Research Inst. of Malaysia). An exuberant individual, we could not have found a better person to introduce us to Taiwan's history, culture, cuisine and the numerous and diverse agricultural activities there – and that too from a Malaysian perspective – and in English! Prof Ng had roped in the services of the friendly Tony Lee (of RTS tour agency) who had planned the detailed logistics of the 7-day trip. He did an admirable job handling 26 people – not easy when getting so many to stick to hectic time sensitive daily schedules for a whole week! From bus travel, hotels, meals and agri / farm visits, everything moved like clockwork. And we got a lot of infomation on Taiwan's history, geography and climate – along with a good dose of humour!

First, a little background on Taiwan's geography and climate… Taiwan is an elongated "banana shaped" island lying in a south-to-north direction located some 180 kilometres off the south-eastern coast of mainland China. The eastern two-thirds consist mostly of five rugged mountain ranges parallel to the east coast, and the rest is flat to gently rolling plains in the west, where the majority of Taiwan's population reside.

Taiwan is geologically a tilted fault block. The tectonic boundary that formed these ranges is still active, and the island experiences many earthquakes, a few of them highly destructive. There are also many active submarine volcanoes in the Taiwan Straits.

The island lies across the Tropic of Cancer, and its climate is influenced by the East Asian Monsoon. It ranges from tropical in the south to sub-tropical in the north, and its agriculture land-use pattern reflects this with the tropical crops (like Guava) and Tilapia fish grown in the south and the more temperate crops in the cooler northern latitudes.

Northern and Central Taiwan has a humid subtropical climate, with substantial seasonal variation of temperatures, while most of southern and south-eastern Taiwan has a tropical monsoon climate where

seasonal temperature variations are less noticeable with temperatures typically varying from warm to hot. During the winter (November to March), the northeast experiences steady rain, while the central and southern parts of the island are mostly sunny. The summer monsoon (from May to October) accounts for 90% of the annual precipitation in the south, but only 60% in the north. The average rainfall is approximately 2,600 mm/annum.

The east coast of the island experiences regular typhoons during the annual typhoon season (an average of 4 typhoons a year) and as such no major settlements are found there. Almost all of the population of Taiwan is found along the west coast – from Taipei in the north to Kaohsiung in the south.
The eastern mountains are heavily forested and home to a diverse range of wildlife, while land use in the western and northern lowlands is intensive.

We started off the tour from Taipei (after flying in the previous day) driving north and east into the hills of Yilan to see Kumkuat farming and fruit processing. On the way back to Taipei city, we stopped to visit the Green Onion Farm. And while on the way back to the hotel in the city in the evening, we got to climb up Taipei 101 – a treat!

Over the next 6 days, we travelled southwards by bus on Taiwan's west coast.
In between, we got to stay at the Fleur de Chine Hotel on Sun Moon Lake - a very pristine and beautiful lake where Chang Kai-shek used to go for his holidays. We even did a cruise to visit an ancient temple.

Some of the diverse agricultural activities we visited on the whole west coast of the Taiwan island…

- Kumkuat Fruit Tree farm and processing facility (in Yilan north-east of Taipei city)
- Green Onion farm
- Visit to various Agri Machinery manufacturers
- The tissue culture propagation and growing of the orchid Phalaenopsis sp. [by both - Royal Base Corporation (Sunpride brand) and Taisuco]
- Fungus cultivation systems for Shiitake, King Oyster and Black Mushroom production (in Taichung)
- Greenhouse Hydroponic Vegetable cultivation (in Nantou Puli)
- Closed Environment Agriculture (CEA) Systems for Tomato growing
- At the Pingtung Agricultural Biotechnology Park (PABP) – (near Kaohsiung – south Taiwan):
    - Dayi Agritech's substrate production for plant growth media, and
    - Taikong Corp.'s Ornamental Fish & Shrimp breeding (transgenic)
- Tilapia fish breeding and rearing farms (in Tainan)
- Organic Farm visit (in Tainan)
- Guava farm cultivation practices

At the end of the 6-day field tour, all very tired, we took the High-Speed Train from Kaohsiung back to Taipei (about 400km in 1 hour 45 minutes) to catch our flight back to Malaysia the following day.
Prof Ng, in addition to arranging a very educational tour of Taiwan's agriculture industry, also made sure we got to taste a good sampling of regional Taiwanese cuisine during the trip. We all overate!

The articles in this issue cover what we got out of the visits to the individual agricultural enterprises. They are written by various members who were a part of the tour for the benefit of all MEOA members. So, enjoy the read…and the information!

- **Amit Guha** (Guest Editor)

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Farewell Message from MEOA President Joseph Tek

Dear Members,

First and foremost, my appreciation to En Mahbob Abdullah, our MEOA editor for the kind opportunity to pen down a few words in this bulletin issue.

A presidency can pass in the blink of an eye. It was on 25th March 2015 in Johor Bahru that I took over the presidency from our beloved late "Uncle Boon" - but it seems just like yesterday. I had already been on the post for three full years and I feel that it is time to pause and pass the baton to others. It has been a great privilege and an honour to serve as the President of MEOA.

What surprises and challenges lie ahead for the Malaysian plantation fraternity? What should we be mindful to promote and what would we need to change for the better? What forces from within and beyond the shores of Malaysia that would affect the plantation industry, and how would we, in turn, aspire to live out both the realities and perceptions? These are no easy questions to answer, to be sure. The sage Yogi Berra once said, *"It's tough to make predictions, especially about the future."*

As all leaders are compelled to do, I want to believe that I did my imperfect best to deliver on the undertaking of a vision mapped out three years ago against a blueprint of MEOA's directions and strategies. But perhaps my most important personal observation, one in which I believe just as genuinely today, is that the choices about where to go and what to do would not be mine alone. It was our shared destiny. It was to the few dedicated MEOA Councillors that have made this shared journey worth it. I am indeed proud of what we – as a team, have accomplished. Humbly, I thank you.

We have bolstered our strategies and directions as an association "of, for and by members". We have carried out some very innovative activities, including the 'RAISE' and 'LAB' seminars and visits; while strengthening our engagements with other relevant stakeholders both within our industry and beyond. We have welcomed new members, gladly embraced diversity and managed the intergenerational shift. And we have also made strides in keeping our members connected through various platforms, while espousing an ongoing learning and sharing of experience amongst MEOA members, often with or without an effective secretariat support. I could not be more pleased and proud with our accomplishments together. The credit is shared and belongs to the few Councillors who were hard-working, passionate and were 'out-of-the-box' thinkers and doers.

There are of course plenty of tasks left for the next President and his team to work on, and they will do so in collaboration with members and the relevant stakeholders. It will entail convocation and sometimes a cacophony of many voices, but prayerfully packed with actions. Let us remember that we have an important mission to continue nurturing and sustaining the plantation industry in Malaysia- for God has so bountifully blessed us with the right climatic factors and the '*know-hows'*. Equally imperative is for us to diligently engage with the relevant stakeholders to nurture and provide the industry with the '*must-haves'*. This demands of us to rise up, to contribute and find the common grounds to be the 'voice of reason' for our cherished industry.

While it is not my job to set the agenda for my successor, that scheme will surely include continuing our focus on productivity cum innovations and managing the sustainability aspects of this industry. I love the MEOA that we have shaped it together. It was the camaraderie of friends sharing a common bond of passion and destiny. I hope that you can feel the same way too.

I will be following and contributing in some but lesser ways on MEOA's ongoing evolution, but will do so with pride, affection and gratitude for all that we have achieved and will achieve.
Thank you for being part of that journey.

Sincerely,

Joseph Tek Choon Yee
MEOA President (Terms 2015/16 - 2017/18)

Palm Oil, An Update

By Ng Say Bock and Vincent Ng
Virgin Palm Sdn. Bhd. (1254697-V)

Introduction

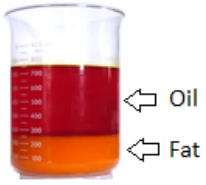
Often one can come across the tagline: **"Saturated fats cause heart diseases," or "Palm oil is a saturated fat".**

These smear campaigns are aimed at demonizing tropical oils and specifically palm oil. The negative labelling had stigmatised palm oil. This is a ploy used by the competitor to hide the harmful health problems caused by trans fats or "artificial saturated fats" they had produced, and through deceitful marketing, portrayed it as a natural saturated fat issue [1]. Time magazine, based on a report published in American Journal of Preventive Medicine, mentioned that Denmark having banned trans fats recorded that between 2003 and 2012, deaths caused by cardiovascular disease slid from 359.9 to 210.9 per 100,000 people [15]. US FDA ban starts in 2018 [16].

The American scientist who promoted the Mediterranean diet, Ancel Keys, first hypothesised that dietary saturated fat causes cardiovascular heart disease and should be avoided [2]. A physiologist by training, Ancel Keys also ended up in the nutrition committee of American Heart Association (AHA). In 1961, AHA endorsed Ancel's hypothesis as a dietary guideline [11]. On 15th June 2017, AHA's presidential address once again called for saturated fats to be replaced by polyunsaturated and monounsaturated fats [21]. Mr Taubes, an investigative science journalist, found AHA cherry-picked and use severely deficient data to support their stand on saturated fats. He also proved beyond a reasonable doubt, that the evidence against saturated fat is inconsistent, weak, and unreliable [6]. To add salt to saturated fats' wound, the sugar industry secretly paid three Harvard scientists to shift the heart diseases and sugar link and blamed it on saturated fats [7].

Lately, meta-analysis, a statistical method that combines many separate but similar studies and pool the data to develop a single conclusion, has shown that saturated fat is not linked to heart diseases [3], [4]. The US Dietary Guidelines Advisory Committee is withdrawing its warning on cholesterol, and hopefully saturated fats will follow suit, as it was reported that subsequent studies have failed to confirm saturated fats and heart diseases risk [20]. Before going into detail, it is necessary to understand the relevant terms used and their meaning.

Is it Palm oil or Palm fat?



The term is often used interchangeably to mean the same thing. Strictly speaking, there is a difference. At 20^{o}C, if it is liquid, it is oil. And if it is solid, it is fat. Palm oil is unique as it has natural fractions of both oil and fat. Oil ratio is three and a half more than fat [8]. This makes palm oil a highly versatile oil and can be used in a lot of applications, be it food or non-food!

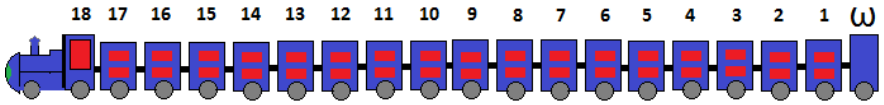
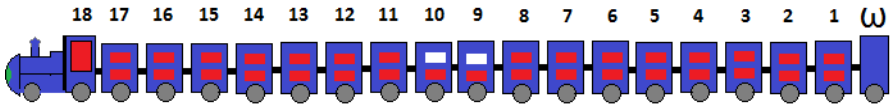
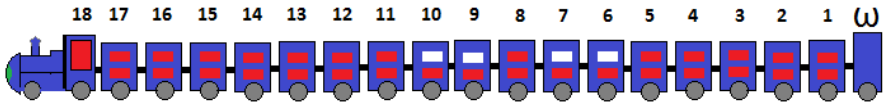
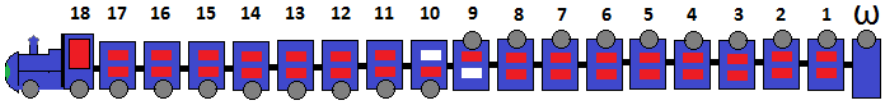
Types of oils and fats: the train analogy

The properties of the oils and fats are largely governed by the types of fatty acids present. These fatty acids are further grouped together based on the number of vacant spaces within each acid.

To illustrate, think of a fatty acid as a train with a range of carriages. In each carriage, there are two vacant seats. If the seats in all the carriages are taken, the train is said to be **saturated**. If one seat each

in the adjoining carriage is vacant, it is said to be **monounsaturated**. Likewise, two or more seats in the adjoining carriages are vacant, it is termed as **polyunsaturated**.

Polyunsaturated oils are very unstable. They have poor shelf life, which means the oil that is produced cannot be kept for long before turning bad (rancid). Such oil cannot be used for frying or for making solid products such as cakes, biscuits or pastries unless they are **hydrogenated.** Going back to the train analogy, hydrogenation process is like "forcing passengers to occupy the vacant seats" to stabilise it. In other words, it is an "artificial way to saturate" the oil. The hydrogenation process also creates another type of acid called **trans fatty acid,** which is a twisted form of the natural oleic acid. The analogy of the types of fatty acids is as sketch below:

 Fatty acid is a long chain of carbon atoms (like train carriages) which are fully occupied by hydrogen atoms (2 passengers per carriage). The chain has varying length, and each has a name. E.g. 18-carbon is named Stearic acid.	**Saturated** Stearic acid
 The long chain of carbon atoms where only one adjoining pair of carbon is unoccupied. The rest are occupied by hydrogen atoms. Starting from the omega (ω) end, carbon number 9 and 10 are vacant. It is also called Omega 9 acid.	**Monounsaturated** Oleic acid
 The long chain of carbon atoms where **two sets of adjoining pair** of carbon are unoccupied. The rest are occupied by hydrogen atoms.	**Polyunsaturated** Linoleic acid
 During hydrogenation, hydrogen atoms (passengers) are "forced" to occupy the "vacant seats" of polyunsaturated acid. This creates another type of acid called trans fatty acid. In this case, it's named Elaidic acid. Carriages 1 to 9 are inverted while 10 to 18 are on track. This is different from natural oleic acid where all the carriages are on the same side. Their properties are very different. E.g. Melting point of Elaidic acid is 45^0C, while Oleic acid is 13^0C. Note: Our body temperature is 37^0C.	**Trans fatty acid** Elaidic acid (a trans isomer of oleic acid)

Is Palm oil saturated or unsaturated?

This is best answered by referring to Malaysian Standard, MS814:2007. The fatty acid composition for palm oil as quoted [9]:

Type of Fatty acids	Name	Range	Mean	Standard deviation
C12	Lauric	0.0 – 0.5	0.2	0.10
C14	Myristic	0.9 – 1.5	1.1	0.08
C16	Palmitic	39.2 – 45.8	43.5	0.95
C18	Stearic	3.7 – 5.1	4.3	0.18
C20	Arachidic	0.0 – 0.5	0.2	0.16
Saturated			**49.3**	
C16:1	Palmitoleic	0.0 – 0.4	0.2	0.05
C18:1	Oleic	37.4 – 44.1	39.8	0.94
Monounsaturated			**40.0**	
C18:2	Linoleic	8.7 – 12.5	10.3	0.56
C18:3	Linolenic	0.0 – 0.6	0.3	0.07
Polyunsaturated			**10.6**	

The overall composition is:

Palm Oil	Mean
Saturated	**49.3%**
Unsaturated	**50.6%**

The points to note are:

- **The arithmetic mean shows that palm oil is more than 50% unsaturated. By a simple majority rule, palm oil is "unsaturated". It is wrong to label palm oil as "saturated".**
- **Apart from having natural liquid and solid fractions, there is another feature about palm oil, it naturally has nearly equal saturated and unsaturated portions.**

This is a classic case of the proverbial "half empty or half full glass of water" expression. How one interprets it depends on one's state of mind and intention. This is best defined by the Cambridge dictionary, which says:

> **"The glass is half empty" refers to an attitude of always thinking about the bad things in a situation rather than the good ones."**

As evident from the abovementioned, palm oil has more oil than fat and it's slightly more unsaturated than saturated. Based on these facts, palm oil should be labelled as an "Unsaturated oil". One can only surmise that whoever had labelled palm oil as a "saturated fat" had chosen to disregard or distort the facts because of ulterior motives.

Saturated fat and heart disease

In the 1950s, heart disease was America's number one killer and when President Eisenhower had a heart attack in 1955, there was a desperate need for answers [11]. It was Ancel Keys who hypothesised that dietary saturated fat causes cardiovascular heart disease and should be avoided [2]. The suggestion, as can be expected, was readily accepted.

In 1958, Keys's subsequent observational "Seven Countries Study" demonstrated heart disease could be linked to poor nutrition. Keys, a physiologist, also ended up on the nutrition committee of AHA. In 1961, AHA issued the country's first ever guidelines targeting saturated fat [11]. The guidelines had remained unchanged for many decades. On 15th June 2017, AHA's stand was reaffirmed via its presidential address, which concluded that based on evidence, it called for a reduction in saturated fat and replace it with polyunsaturated and monounsaturated fat [21].

American Heart Association cherry picking data on saturated fats

Mr Gary Taubes, an award-winning science writer, author and a prominent investigative journalist took AHA to task in a post published by Cardio Brief, a source for new and important information about cardiovascular medicine.

AHA pretends to be science-based but is not. There is no strong scientific basis to support their guidelines, and are therefore opinions. Their recommendation that saturated fats be replaced with polyunsaturated fats, is based on cherry-picked and severely deficient data. With the devastating precision of a prosecuting attorney, Taubes lays out the case against the AHA paper. He doesn't prove that saturated fat is innocent, but that's not his goal. He does prove, beyond a reasonable doubt, that the evidence against saturated fat is inconsistent, weak, and unreliable. "If the data doesn't exist, you must acquit," I suppose he might say [6].

Taubes, was also quoted in Olive Health News, said "The AHA ignores results from some of the biggest studies ever conducted, including the Minnesota Coronary Survey, Sydney Heart Study and the Women's Health Initiative" [10].

One such example is the Sydney Heart Study quoted below:

Sydney (Diet) Heart Study

In this cohort, substituting dietary linoleic acid in place of saturated fats increased the rates of death from all causes, coronary heart disease, and cardiovascular disease. An updated meta-analysis of linoleic acid intervention trials showed no evidence of cardiovascular benefit. These findings could have important implications for worldwide dietary advice to substitute omega 6 linoleic acid, or polyunsaturated fats in general, for saturated fats [12]. These results clearly contradict AHA's guidelines and as Mr Taubes quite rightly said, the results were ignored.

Nutritional policy: Personal ambition, bad science, politics and bias.

Wall Street Journal too ran an article by Nina Teicholz, another investigative journalist and author of the International (and New York Times) bestseller, The Big Fat Surprise. She too questioned the saturated fat link. The nutritional policy, she writes, had been derailed over the past half-century by a mixture of personal ambition, bad science, politics and bias.

She added that there is no solid evidence to back up the idea that saturated fats cause disease. Critics have pointed out that Dr Keys violated several basic scientific norms in his study. For one, he didn't choose countries randomly but instead selected only those likely to prove his beliefs, including Yugoslavia, Finland and Italy [11]. Keys's original studies covered twenty-two countries out of which only seven countries were chosen.

Saturated fat and heart disease: A questionable link

In the last four years, two meta-analysis studies on saturated fats were published in reputable journals are mentioned below. Also included is a diet intervention study from Norway. Meta-analysis is a method for systematically combining pertinent qualitative and quantitative study data from several selected studies to develop a single conclusion that has greater statistical power [13].

1. **New study: Total saturated fatty acids not linked to coronary disease risk**

   On 18th March 2014, *The Annals of Internal Medicine* published a report of an international group led by University of Cambridge, pooled data from 72 separate studies that included over 600,000 participants in 18 different countries. Their pooled analysis showed that whether measured in the bloodstream or as a component of diet, total saturated fatty acid was not linked to coronary disease risk [3].

2. **Saturated fats have no association to increased heart disease**

A study by McMaster University, Canada which analysed results from 50 observational studies was published in the *British Medical Journal* in 2015. The study found no association between a high intake of saturated fat and an increased risk of heart disease and other life-threatening diseases [4].

3. A high intake of good quality saturated fat tolerable, maybe even healthy

Another Norwegian diet intervention study was published in The American Journal of Clinical Nutrition, 27 December 2016. The results indicate that most people probably tolerate a high intake of saturated fat well, if the fat quality is good, and the total energy intake is not too high. It may even be healthy [5].

In June 2015, American Oil Chemists Society, AOCS reported a promising sign that the US Dietary Guidelines Advisory Committee is withdrawing its warning on cholesterol. Perhaps saturated fats will follow suit. These main points were extracted from an article in AOCS's publication.

AOCS: Big fat controversy - Changing opinions about saturated fats

Nutritionists have long vilified saturated fat for its propensity to raise LDL ("bad") cholesterol levels in the blood. Although initial epidemiological studies associated saturated fat intake with heart disease risk, subsequent studies have failed to confirm the link. Saturated fat raises HDL ("good") cholesterol levels, perhaps ameliorating its effects on LDL cholesterol. An unintended consequence of a low-fat diet may be increased carbohydrate intake, which could actually raise heart disease risk compared with a higher-fat diet [20].

Not all saturated fats are the same

A closer look at only the saturated fatty acids components of both animals and vegetable oils may help us understand the situation better.

Saturated components of some animal and vegetable oil. [9], [19]

	Lauric, C_{12}	Myristic, C_{14}	Palmitic, C_{16}	Stearic, C_{18}
Animal				
Beef tallow		6.3	27.4	14.1
Butter	2.5	11.1	29.0	9.2
Lard		1.3	28.3	11.9
Vegetable				
Coconut	45.4	18.0	10.5	2.3
Corn		1.4	10.2	3.0
Olive			6.9	2.3
Palm oil	0.2	1.1	43.5	4.3
Peanut			8.3	3.1
Soybean	0.2	0.1	9.8	2.2
Sunflower			5.6	2.2

In palm oil, the predominant saturated acid is palmitic acid, and, to a lesser extent, stearic acid. The Cambridge team concluded:

> "Within saturated fatty acid, the researchers found weak positive associations between circulating palmitic and stearic acids (found largely in palm oil and animal fats respectively) and cardiovascular disease…" [3]

Palm oil, the fall guy

The saturated fat mentioned so far referred mainly to red meat and dairy products. AHA's recommendation is to switch to polyunsaturated vegetable oils, namely corn, soybean and canola. These oils require hydrogenation to mimic saturated oil. When health problems related to trans fats

arose, labelling tropical oils as "saturated fat" fits the bill as no distinction is made between artificial or natural saturated fat. This made palm oil the main fall guy.

The real health culprit is Trans fats

Dr Mary Enig, an internationally renowned nutritionist and lipids biochemist, is known for her unconventional positions on the role saturated fats play in diet and health. Her views appeared in "The big fat controversy" [1].

The real health culprit is not saturated fats but rather trans fats, which were introduced into the food supply in great quantity by the soy industry in the 1950s. This is when partially hydrogenated fats were developed to imitate naturally saturated fats and to expedite the production of processed foods.

To create the solid substance, manufacturers typically take vegetable fats and bombard them with hydrogen, turning them into the solids used in commercial baked goods or to make shortening from vegetable oil. "They have a different shaping than the normal kind of fatty acids that are in the food supply or in the tissues of the body," Enig says. "Trans fats also have a higher melting point, all of which can make them very harmful to the system."

The food industry has so cleverly marketed these trans fats, insists Enig, and so regularly bad-mouthed saturated fats, that in the last 30 years their dogma has been accepted as gospel by the medical establishment – and, by extension, the general public, which is why low-fat, processed foods are so prevalent and popular these days.

Trans fats are deadly

Consumption of industrial trans fats was associated with a 34 per cent increase in death for any reason [14]. Time magazine carried an article that Denmark's trans-fat ban in 2004 worked based on an article published in the American Journal of Preventive Medicine on 9th September 2015. Between 2003 and 2012, deaths caused by cardiovascular disease slid from 359.9 to 210.9 per 100,000 people, a 9-point drop. Between 2004 and 2006, cardiovascular disease mortality rates dropped by 4%—the equivalent to 750 fewer deaths per year in that period [15].

On 16 June 2015, the US Food and Drug Administration gave the food industry three years to eliminate artery-clogging artificial trans fats from the food supply, a long-awaited step that capped years of effort by consumer groups and is expected to save thousands of lives a year [16]. On 14 August 2015, in the British Medical Journal, experts from Oxford and Liverpool Universities suggested that banning trans fats from processed foods could save around 7,200 deaths from heart disease in England over the next five years [17]. In Malaysia, popular commercial pastry shortening samples were found to contain up to 34.4% trans fats [18].

Harvard scientists paid to shift blame from sugar to saturated fat

The Journal of the American Medical Association, JAMA dropped the bombshell by reporting that the Sugar Industry paid scientists to shift blame on saturated fat. This was picked up by various newspapers and excerpts from The New York Times on 12th September 2016 [7].

The sugar industry paid scientists in the 1960s to play down the link between sugar and heart disease and promote saturated fat as the culprit instead, newly released historical documents show.

The internal sugar industry documents, recently discovered by a researcher at the University of California, San Francisco, and published Monday in JAMA Internal Medicine, suggest that five decades of research into the role of nutrition and heart disease, including many of today's dietary recommendations, may have been largely shaped by the sugar industry.

"They were able to derail the discussion about sugar for decades," said Stanton Glantz, a professor of medicine at U.C.S.F. and an author of the JAMA Internal Medicine paper.

The documents show that a trade group called the Sugar Research Foundation, known today as the Sugar Association, paid three Harvard scientists the equivalent of about $50,000 in today's dollars to

publish a 1967 review of research on sugar, fat and heart disease. The studies used in the review were handpicked by the sugar group, and the article, which was published in the prestigious New England Journal of Medicine, minimized the link between sugar and heart health and cast aspersions on the role of saturated fat.

Even though the influence-peddling revealed in the documents dates back nearly 50 years, more recent reports show that the food industry has continued to influence nutrition science.

Conclusion

Palm oil is a good oil. It is tainted by unscrupulous competitors in a non-level oils and fats playing field. Currently, there is an outstanding issue of 3 MCPD, a suspected carcinogen to be managed. Palm oil is non-GMO and is mechanically extracted. This is a very strong plus point which will give the oil an edge over its competitors - oilseeds that are mainly solvent extracted. Palm oil extraction efficiency is about 92% compared to around 98% with solvent. Preventing remnant oil recovered from being added back into the system to increase oil extraction is the first step in preventing 3 MCPD. As consumers ourselves, we must adhere to the universal rule: "Food safety MUST precede profits", failing which, we are no better than the manufacturers of trans fats!

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8	http://bepi.mpob.gov.my/news/detail.php?id=3045
9	Adapted from Malaysian Standard, MS814:2007. Palm Oil Specification (2nd Revision)
10	https://www.oliveoiltimes.com/olive-oil-health-news/experts-dispute-aha-warning-saturated-fats-coconut-oil/58005
11	https://www.wsj.com/articles/the-questionable-link-between-saturated-fat-and-heart-disease-1399070926
12	http://www.bmj.com/content/346/bmj.e8707
13	https://en.wikipedia.org/wiki/Meta-analysis
14	https://fhs.mcmaster.ca/qa/network/fats.html http://www.bmj.com/content/351/bmj.h3978
15	http://time.com/4025570/denmark-trans-fat-ban/
16	https://www.nytimes.com/2015/06/17/health/fda-gives-food-industry-three-years-eliminate-trans-fats.html
17	http://www.bmj.com/content/351/bmj.h4583
18	http://palmoilis.mpob.gov.my/publications/TOT/TT540.pdf
19	http://www.drtimdelivers.com/nihtalk11macmic082508/nihtalk11_files/nihtalk11_20060.PNG
20	https://www.aocs.org/stay-informed/read-inform/featured-articles/big-fat-controversy-changing-opinions-about-saturated-fats-june-2015
21	http://circ.ahajournals.org/content/early/2017/06/15/CIR.0000000000000510

Permission to publish this paper is given by Mr Ng Say Bock, a chemical engineer with over 40 years' experience in the palm oil industry. The opinions stated in this article are entirely those of the writers, and the Bulletin is thankful for their contribution.

Managing Rubber Plantations During Low Natural Rubber Price

By K J Yap

I was an investment banker before helping my family to run our rubber plantation.

Running a rubber plantation business is relatively simple compared to many other businesses.

First, I do not have to worry about my supplier. My main supplier is my rubber trees, which constantly produce latex for me as long as the weather permits. Second, I do not have to worry about customers either. Unlike many other businesses, I do not need to compete with other rubber plantations to sell my products. Natural rubber is a basic commodity, mainly (about 80%) to be made into tyres. Its price is quoted every day in LGM and we, as a price taker, have to sell at whatever price quoted on that day. And the best part of it, we sell our natural rubber on cash basis. Running a cash-generating business with no competition on supplier and customer with other industry players, I find rubber plantation rather easy to manage.

Except that the natural rubber price now is too low.

Although the rubber planters do not compete with each other, natural rubber itself competes with synthetic rubber, which is mainly polymer synthesised from petroleum byproducts. The competition dated back in 1939 when The United States was cut off from its sources of natural rubber in the Pacific during World War II. In order to meet its needs for this vital material, the US government built synthetic rubber plants and the industry operated them. Synthetic rubber production jumped from 8,000 tons in 1941 to 820,000 tons in 1945 before the war ended. As of 2014, the synthetic rubber production has achieved 14.2 million tonnes while natural rubber production was 12.1 million tonnes.

Despite the fact that world natural rubber consumption was 9.314 million tonnes in 9 months 2015 while world natural rubber production was 8.862 million over the same period, the rubber price dives south corresponding to the crude oil price. The cheap crude oil price offers a cheap alternative for natural rubber consumption. As the result, the price of natural rubber has plunged from an average of RM 16.725 per kg in February 2011 to RM 4.5403 per kg in February 2016, forcing many rubber tappers out of work.

Facing such great difficulty for rubber plantations to stay afloat, management knowledge has never been more critical than now, particularly in shaping good company culture and implementing innovative cost-efficient planting and harvesting methods.

A good culture is vital to a company's success during good times and survivability during bad times. Since 2012 as the rubber price was dropping, I have taken several measures to build a strong company culture. When I decided to run the rubber plantation business, I had a 60-year-

vision for my plantation and I shared it to all my co-workers all the time.

First, I want my rubber trees to be tapped for at least 20 years before felling; hence, I need minimal bark consumption and zero wounding on my trees. In order to achieve these two objectives, I educate my rubber tappers the art of rubber tapping – by explaining how the trees grow with the cambium, how the rubber latex is produced from lactiferous vessels etc. With basic knowledge of rubber trees, the rubber tappers understand the theory why they should not wound the trees and how to tap to achieve better result. On top of it, every year I organise 2-3 times festive banquets and show them the history of rubber trees, from how it was brought to Southeast Asia by Sir Henry Wickham to how rubber traders on Singapore River of those days grew their business into SGX today. I also organise annual rubber tapping competition to further promote the art of tapping and the pride of good tapping skills among rubber tappers. Moreover, new technology such as innovative design of rubber tapping knife from Thailand helps me to minimise human error in rubber tapping and reduce the wounding, if any, to minimal. With activities in improving co-workers' stature and the help of innovative technology, I am achieving less than 1% wounding in my rubber trees and on average less than 2cm per 10 tappings.

Second, I want to maintain a sustainable high yielding plantation. Sufficient fertilisers are essential to replace the loss of nutrients from rubber latex harvesting. I conduct foliar and soil sampling yearly to have an agronomical understanding of my plantation. I can save cost on fertilisers by giving only what is needed by the plants without waste or loss in fertiliser. As chemical fertiliser application has some side effect to the soil structure, I use the latest biotechnology to sustain biogeochemical cycle in my soil by inoculating bacteria and fungus in the soil regularly. Bacteria and fungus have the function to facilitate the uptake of certain nutrients from the soil such as by the mechanism of nitrogen fixing and phosphorus solubilising, thus reducing the need of chemical fertiliser. Furthermore, they are proven to prevent or suppress certain diseases. With minimal disease attacks, I can maintain the planting density to sustain my yield per hectare. In addition, bacteria and fungus promote the roots growth. My trees were able to achieve harvestable diameter within 4 years. This has greatly reduced the time needed to recover my investment.

Third, I want to maintain low cost management. When the rubber price started falling since 2013, I discussed the costing openly and regularly with my co-workers, from my top managerial team such as estate manager and to my rubber tappers. I want them to understand the company situation and solve issues together. For example, to increase the productivity of herbicide spraying, I had my tractor modified into a fire truck-like machine which can spray herbicide more efficiently. And the extra workers saved from the increased efficiency were trained to become rubber tappers.

In another example, I had separated rubber tapping and rubber collecting into two tasks done by different individuals. According to Adam Smith, the specialisation and concentration of the workers on their single subtasks often lead to greater skill and greater productivity than would be achieved by the same number of workers each carrying out the original broad task. Under such scheme, skilled rubber tappers can tap up to 1,500 trees from normally 900 trees. As the result, the tappers can increase their income despite the reduced rate per kg harvested. In turn, I need fewer tappers with lower harvesting cost per kg.

It is a challenging task for me to run a rubber plantation., in particular in a low commodity price environment. But rubber price always fluctuates.

Who knows if the price points upward tomorrow? Most importantly, as a leader of the company, I must think of alternative ways to help all the stakeholders to survive now, and together make a fortune when the time is right.

Orion Biosains is Changing the Oil Palm Industry One Tree at a Time

By Tony Favello

Orion Genomics LLC

The demands for food will continue to rise. The world's population is growing by 80 million people each year and is estimated to exceed 9 billion by 2050. A larger population will need more food and renewable fuel, two factors which place mounting pressure on many agricultural sectors, including oil palm.

One approach to meet future food and fuel demand is to better understand the crop plants that supply needed resources.

In the past, many crops, including oil palm, have been extensively studied at a macro level to understand water, soil, nutrient, breeding and many other visible traits. However, since the publication of the oil palm genome in 2013[1] by the Malaysian Palm Oil Board (MPOB) and US based Orion Genomics, the oil palm industry has moved into an era of molecular precision agriculture. It is now possible to utilize DNA tests to improve various genetic traits of oil palm. One trait of key interest and importance is oil yield.

Researchers at the MPOB and Orion Genomics were able to use the oil palm genome sequence to discover the *SHELL* gene[2]. This gene is responsible for the oil palm shell thickness trait which predicts 30% of the oil yield of palm fruit. Typically, oil palm seed companies cross maternal palms yielding thick-shelled *dura* fruit with paternal palms that yield either no fruit at all, or infrequent shell-less *pisifera* fruit to obtain hybrid seeds that produce palms with the preferred thin-shelled *tenera* fruit. However, absolute control of this breeding process is often difficult. It can result in the unintended planting of palms that will produce non-*tenera* fruits with suboptimal yield.

The discovery of the *SHELL* gene led to a deeper understanding of the *SHELL* gene's function. This in turn has led to the development of an innovative DNA-based screening test to identify and cull low-yielding non-tenera palms at the nursery stage. *By using this simple process, DNA extracted from a nursery palm leaf punch can be analyzed to determine whether a seedling will ultimately produce high-yielding tenera fruit, or low-yielding dura or pisifera fruit.* The capability to identify low yielding palms early in the planting process allows nursery and plantation owners to exclusively plant genetically confirmed higher yielding *tenera* palms in the field. This is significant as planting a high yielding *tenera* palm on average results in a 30% increase in oil production over a low yielding *dura* palm over the productive life of the tree. By maximising the productivity of current land area devoted to palm oil production, the planting of genetically confirmed *tenera* palms reduces the need for newer planting areas, offering a green, sustainable solution for meeting the growing demands for palm oil.

To determine the economic impact of SHELL gene testing, a group of researchers from MPOB, Orion Genomics and the Balsa Group measured baseline non-tenera contamination rates in independent planting sites in Malaysia. The group found that 10.9% of palms were the low yielding non-tenera type, and using a 48 parameter, 4 stage economic model, the team projected that *SHELL* testing in the independent planting sector alone, representing just 15% Malaysian oil palm planted area, would contribute RM 1.05 BN to the Malaysian economy annually at steady state[3]. The oil palm industry and government tax revenues would

also increase significantly, underscoring the significant impacts of *SHELL* gene testing on both sustainability and gross national income.

The positive impact to the world as well as the Malaysian economy as a result of oil palm *SHELL* testing is clearly evident, and Orion Biosains SDN BHD is prepared to make them a reality. To do this, Orion Biosains licensed the rights to patents covering the *SHELL* gene discovery from MPOB and has developed a highly automated process to commercialize the *SHELL* testing services. Orion Biosains, a BioNexus status company, has its global headquarters in Puchong, Selangor Malaysia, with state of the art sample collection kit manufacturing, DNA isolation and DNA analysis equipment. This cutting edge service lab, recently featured by the BBC as one of 8 of the world's most disruptive companies in 2016[3], can manufacture thousands of sample collection devices a day and process millions of DNA samples annually.

Orion Biosains ships customers the SureSawit™ Sample Collection Kits which include patent pending sample collection devices that enables customers to easily collect leaf samples and tag the sampled trees. The leaf samples are sent to Orion's service lab in Puchong for processing and analysis, and a simple report is sent back to customers. In early 2016 Orion Biosains launched its early access program for the SureSawit Services. Working with the MPOB and industry leaders, to date they have tested tens of thousands of oil palm samples from nurseries, plantations and small holders in an effort to increase awareness of the value of the SureSawit collection kit and SureSawit SHELL system. Orion Biosains is pleased to launch the SureSawit Services with the SureSawit SHELL assay to the entire oil palm industry in May 2016. Orion Biosains is also very pleased to announce the planned launch of the SureSawit *VIR* test, to determine the presence of the *VIR* (of fruit colour) gene that can improve harvesting accuracy of oil palm fruits[5], and the SureSawit *Karma* test, to screen for potential mantling abnormality in nursery clonal palms[6].

You can know more about Orion Biosains at their website, www.orionbiosains.com.

[1] Singh, *et al.* (2013) Oil palm genome sequence reveals divergence of interfertile species in Old and New worlds. *Nature* 500: 335-9.

[2] Singh, *et al.* (2013) The oil palm SHELL gene controls oil yield and encodes a homologue of SEEDSTICK. *Nature* 500: 340-4.

[3] Hope, Katie. (2016) Could a Plastic Punch Revolutionise the Lives of Palm Oil Subsistence Farmers? *BBC News/Business*. 10 May 2016. Web. 24 May 2016. <http://www.bbc.com/news/business-36244547>.

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Visit to United Malacca Berhad on 8th September 2017
Bukit Senorang Estate

by Sanjay Vohrah

Several months ago the idea about a private visit was agreed by Peter Benjamin, and it turned out that together with Jeffrey Ong we had 32 in the team making the trip.

We believe that the discussions can be useful for our next meeting on better automation at LAB on 22 and 23 November 2017.

We saw some of the work:

A) **Mechanisation for Manuring/ Fertilising**
We saw a spreader which holds up to almost 300 kg of urea in a poly-tank. The mechanism to propel the fertiliser is the axle driven centrifuge "pump" and the conveyor directs the fertilizer to where it is supposed to go. The company uses only straight fertilisers.

Peter Benjamin explained:-

1) His idea of automation was not to cut costs but to keep them low while making sure the job is done.
2) It will help solve the labour shortage that is going to get worse. Indonesian workers may not be ready to come over when they can earn as much back home and costs of living are lower.
3) Savings will add up with less need for housing, staff benefits, levies, and other cost for staff welfare.
4) However one must weigh these savings against the heavy capital costs, with a risk of failure or cost overrun in some circumstances.

Comments:-

Kenneth Jacobs:

1) For this machine to work, it needs free flow fertiliser.
2) For some straight fertilisers such as urea, 2% of moisture content can cause excessive caking.
3) During the application the size of the particles matters as it affects the "throw" or distribution.
4) The spreader effectiveness depends on the axle speed which will decide how far the fertiliser goes, and how the required quantity is distributed. Secondly, the grinding effect can hinder the "throw" and very fine particles will land near the equipment.
5) Size separation will occur during natural movements. This hinders its use for granular fertilisers as the centrifugal mechanism crushes the granules, causes blockage due to irregular sizes, and that can jam the mechanism.
6) The spreader covers the area well, but there can be wastage outside the sweet spot.

Jack Khor:

1) Why does the company prefer to use a poly-loader?
2) He noted the corrosion on the frame shows the corrosive nature of the compounds. A comparison is shown in the table below.
3) The centrifugal system is driven by the axle of the pull train. As such the distance thrown will depend on the tractor's speed.

Poly loader	Stainless Steel
Pros	
1) Lighter 2) Cheaper to acquire 3) Mounts easily	1) Strong 2) Can be coated to reduce friction 3) Easier to maintain in the longer term 4) Corrosion resistant
Cons	
1)Static charges cause some particles to cling to wall 2) Breaks easily when hit by sharp objects 3) May not stand rough handling 4) Excessive load can cause deforming	1) Expensive to acquire 2) The weight can be an issue at steep slopes

Jeffrey Ong:

He has found that the stainless steel version has proven to be effective.

He says that automation is essential due to the worsening labour shortage. In this case regular team work is key, preferably formed by husband and wife or other members that allows an increased output and adds income for the family. The spreader can cover more areas with fewer people.

During replanting, some difficult areas not suitable for mechanisation can be left out, even if it can lead to a lower planting density. He referred to research which found that the planting density variance may not affect the output per hectare significantly. On the other hand, the work in such areas can incur much higher costs with little extra income. He says automation has helped in his area, including reduced chemical use, which is ideal for his cattle.

B) **Spraying of Herbicides**

The estate fabricates a tractor-mounted sprayer and adds a Taiwanese pump with multiple nozzles to provide an even distribution across the required area. This operation reduces the need for labour tremendously.

C) Blower mister

This is adapted from a machine to control bagworms. The blower is turned to face the grass. It has found several other uses that can cut costs. For grasses, it can be used against certain weeds. At some stage the company may find it possible to use only a grasscutter.

D) **Ganoderma Management Using Mycoplex**

Gan Tee Jin:

He observed that for treatment it doesn't matter what micro organisms were introduced, and some that already exist naturally can be useful. From his experience, diseased palms responded well when treated with dried sludge from POME treatment ponds, together with soil-mounding. Together they can improve the ecosystem and promote the growth of beneficial microbes that are already in the soil.

Our thanks to Mr Peter Benjamin, Mr. Chia Thim Siong and their team for making this visit such a pleasant experience.

MEOA's 2017 mechanisation LAB - "Mechanise or Perish"

by Siow Yuen Seng

"Mechanise or Perish", blunt yet impactful – this was the topic of MEOA's 2017 mechanisation LAB (Learning and Brainstorming) forum. This was MEOA's 2nd ever forum dedicated to Mechanisation, a buzz word in the oil palm industry of late. The event was held over 2 days in the headquarters of Eurostar, and was free for MEOA members – thanks to the generosity of all our sponsors!

Like all attendees, I was greeted by the usual blue & yellow machines on offer by Eurostar, but I was left red-faced when I mistakenly signed my name underneath "Perish", obviously the wrong side of the welcome banner.

Mechanise or Perish!

The strong sun greeted us as we viewed the parade of Eurostar machinery. Even the most seasoned planters sought refuge under the shade but the sun was much welcomed after weeks of daily rain pounding the coast of Malacca. I think the traditional bomoh rites worked after all… perhaps with anti-rain dance, chillies, onions & satay sticks.

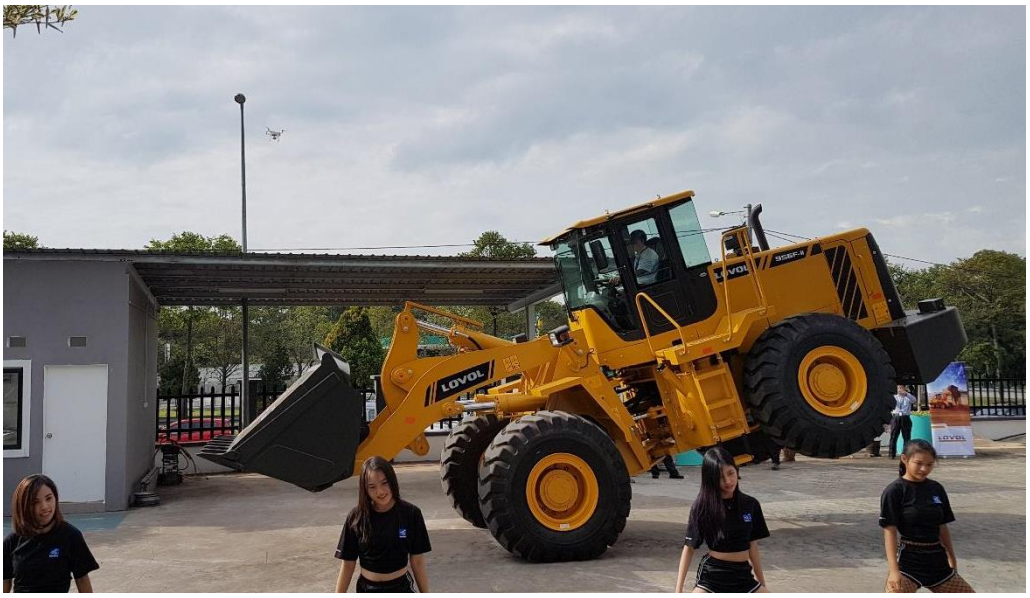
Planters under the shade

Chemical sprayer

Grabber

Fertilizer spreader

The highlight of the parade was the inaugural 'Dancing Tractor' show, a display of strength & agility of a big machine, as it popped and locked to the tune of "Gangnam style". Its twists and turns were expertly manoeuvred by the Lovol team flown in specially for our Mechanisation event. Lovol is a leading manufacturer of agricultural machinery and also Eurostar's principal equipment supplier based in Shandong, China. Although operating in over 120 countries with 15,000 employees, Lovol is focused on aiding our mechanisation effort and sent a team of engineers to sit in and understand our needs and problems.

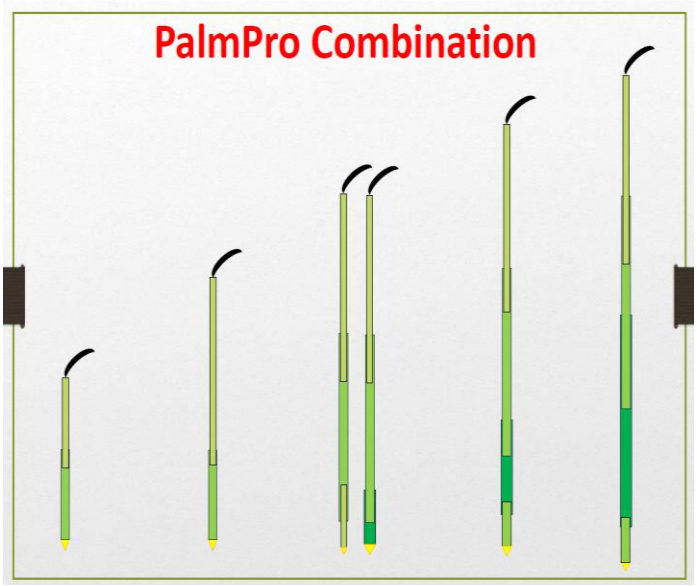


Dancing Tractor Showcase - Chinese machinery synchronised to a Korean dance tune, accompanied by Malaysian dancers. A truly Asian performance.

The Lovol team

Other tools & machinery were also on display. An interesting product was the PalmPro graphite harvesting pole. Considerable research & development of over 9 years had been put into designing the PalmPro which is about 30% lighter than the commonly used aluminium pole, which translates into harvesting efficiency and ultimately maximising the productivity of the harvester. Length is adjustable by attaching extensions, a versatile tool suitable for harvesting tall palms.

PalmPro Harvesting Pole



Customisable PalmPro length

We were given a demonstration of drone technology by Poladrone and how it can help our mapping & surveying process. The application of drone and autonomous vehicle technology was further elaborated by AAR in their aptly titled presentation, "The Innovative Frontier of Digital Technologies and Tools for Oil Palm Plantations" which gave us a taste of oil palm 'precision farming' - how mobile technology, artificial intelligence, internet of things, etc can perform remote sensing & add value to a plantation's decision support system. The 64,000 dollar question then is – how are we going to embrace this fourth industrial revolution?

AAR presentation

Poladrone

This year, we were privileged to have 5 companies share their mechanisation experience, Sime Darby, IJM, Sawit Kinabalu/EMPA, Gan Teng Siew Realty and our mechanisation champion, Ladang Dafa. I saw pictures of grabbers, bins systems, mini-tractors, mini excavators, and a host of facts & figures affirming the general idea that mechanisation is a MUST. At the time of writing this article, I am still digesting the information in the powerpoint slides, which have the presenters had kindly made available to the MEOA.

Gan Teng Siew Realty

Sime Darby Plantations

IJM Plantations

Ladang Gafa

After our President's customary closing speech, where he thanked our Chinese guests in fluent Chinese & gave tokens of appreciation to presenters, I embarked on yet another 2-hour drive back to Johor Bahru and my mind started to ponder.

Having been involved in oil palm industry for a few years now, I realised that it is the norm for growers in the industry to keep quiet about what they were experimenting or implementing. Perhaps most do not wish to share until concrete results have been achieved. This is why I really do appreciate the information presented during this forum and I further applaud the gestures of sharing with the industry.

Two years on, I observed that the word 'mechanisation' generates a lot more interest than it used to. First case in point, this forum drew overwhelming response as registration for the forum was maxed out in 2 days. Secondly, we had 5 plantation growers sharing their mechanisation experience as opposed to our lone Mr Jeffrey Ong & team, two years ago. It would seem that not only are growers embracing the idea of mechanisation but more are willing to open up to share & exchange information on learning about what is good or what went wrong. To avoid 're-inventing the wheel' as our President terms it.

As a veteran of mechanisation, Mr O.K. Chew, took us down memory lane with pictures of various machinery seen during his career, I realised how far the industry has come, i.e. from manual human labour to animals to the various machinery, and yet progress in our sector does not seem fast enough. This is especially apparent when one views on YouTube, the level of mechanisation or automation being applied in other agriculture businesses.

Personally, I think Mr Thaya of Sime Darby summed up the industry's conundrum well – "The industry is facing the twin convergence of increasing minimum wages and difficulty of attracting labour due to conventional work methods. Mechanisation and automation incorporating work process changes are the only options to sustain the industry."

I wish there was an easy way out. But unfortunately as Malaysians, we have no options, we must mechanise, for nothing else can help us, and not even the bomoh can save us from Perishing!

Saving Time on Estates

By Mahbob Abdullah

I have learned to save time even from the early days of running a Division.

There were many things to be done.

Saving time was essential in order not to miss muster. In the bathroom I had developed a routine, with brushing my teeth, then shaving and so on. With all the kit being arranged in one place, it did not take me long to take each step smoothly, while my mind thought about the work to be done that day. I would have stepped out of the bathroom without wasting any time. Usually my shorts, shirt and other items of clothing including long stockings would be laid out by my wife. Getting dressed was done smoothly, and after a quick cup of coffee I was out of the house and on the way to the muster ground.

After muster, I would plan my inspection based on the muster-chit that I read, and then told the driver the areas I wanted to visit. Even as a Divisional Manager, which was the equivalent of an Assistant, I was provided a driver and a Volkswagen. It was a wise policy decision by the company. I could travel on the road and think about company matters rather than using valuable time negotiating corners. I told the driver to head for the work places in the right order so that we did not have to go up and down and waste time on the road.

Certainly if there was a new activity such as building a road, I would want to be there so that it would start off right. Similarly I would be there when the work started on poisoning unproductive palms. Mistakes would be irreversible. Then I would move on to the next place on the list, such as harvesting.

Normally I would also have the supervisor walking with me when I was in the field. It was also a time to chat on work, and meet the headman as well. We had to agree on how things should be done. Some extra time could be spent checking the workers, and letting them know you were checking, and getting feedback. When a thing was not done well, I would tell the conductor and headman, who would pass the message to the workers as part of their role. I refrained from scolding the workers directly.

That was the beauty about working in a plantation. Many people helped me in their supporting roles. My job was to get things done well. I had servants at home, a driver, gardeners, a tea lady in the office, and a secretary to organise my meetings. My wife made sure I went to muster. In the field I had supervisors with experience, and headmen with long service in directing the workers. So my only job was to see that things were done in the right way.

On top of that working in the field was fun. In the early morning, the air was fresh, the sun was up, and the activity was at its busiest. There would be a break at ten a.m. to go home and have breakfast for half an hour, and it was a short drive to my house, when the coffee and papaya were all I would take, and after lighting my pipe for a good smoke, I would put on my shoes again. The car engine would be running as I stepped in and we did the other half of the morning's round.

Later as estate manager I had more issues to think about. Usually I would think about them in the office in early morning. Visits to the Divisions were almost always pre-planned, without haste, to see that things were ticking along like clockwork. Lunchtime was usually at 1.30 pm and there was time for a nap before I went to the office arriving at 3 pm, which lasted to about 5 pm or a bit later.

In the office the most likely time-wasters can be the telephone. When picked up, you stop what you are doing, and it is hard to get back to your train of thought. I could be with the team to deal with fertiliser schedules, or trying to figure out the crop forecast, or checking the costs reports. My former boss, Leslie Davidson, would say that he did not want any phone calls to be put through when he was holding a meeting, except from the Queen of England, or his wife. So far as I knew the Queen did not call. But usually it was his wife Olive who would call,

at just a minute after five pm. We would smile, as it meant end of meeting. For sure he would declare the meeting over, as he skipped up to the hill for there his tea was ready at home.

Of course it needed a strong will not to pick up the phone, and go on with the work. Some managers I knew would set a time to return the calls. Nowadays with the hand phone, and short messages facility, the calls can be avoided even more easily.

Some Planters would say the in-tray could have sections for interesting but not important, important but not urgent, and then urgent and important. Having a habit in looking into the in-tray, I would often spend time on the interesting papers. Ideally, I should always attend to the important ones first, and then give a reply promptly. Another director I worked for, Dato' Mohamed Sulaiman in Sime Darby Plantations, could give a reply on the same day, even if it was only a scrawl to say yes or no. All were very glad to get answers swiftly.

Another head of a company in Lever Brothers in Kuala Lumpur where I was on the board, had a clear desk. Dr Okko Muller told me he had his team to delegate to. He was a German, and had an awesome level of concentration. He was calm, and no one had heard him raise his voice. He later went on to be a main board member of Unilever in London.

On the estate I held a weekly briefing session when I had my say, and requested feedback. Decisions would be recorded in the minutes. Meetings started sharp on time, and usually ended within the hour.

For sure, the workload gets heavier today with more regulations to cope with, and more issues such as shortage of workers. So one has to choose what should come first. The rest can be delegated. But one has to check, and know the major points to look for, to stop things from going wrong. Usually I put a priority on the recovery of fruit, ripeness standard, and the application of fertiliser. I also checked if the person directly supervising the tasks had the training and the courage to direct their workers to do things correctly.

I found that Saturday afternoons would be an agreeable time to catch up on sleep, and on Sundays I would take a rest with a storybook. Falling sick due to fatigue is not going to help you in your work, and being forced to stay in bed is likely to be a big waste of time.

On Sunday before the sun went down, I might use the quiet time to polish my shoes, to be ready for the week ahead, while thinking what would need to be done. If you read the book *My American Journey* by General Colin Powell, who rose to lead the American armed forces, his hobby on weekends was to repair engines of old Volvo cars. I enjoyed polishing shoes, from an old habit that started from my time at a military school, and I could do it while I felt completely relaxed.

With enough rest, I could step out again on Monday morning, with a fresh mind.

MEOA 33RD ANNUAL GOLF TOURNAMENT

Friday 21st April 2017

At Tiara Melaka Golf & Country Club

Golf Tournament – Acknowledgement

IJM PLANTATIONS BHD
UNITED MALACCA BERHAD
AGROMATE (M) SDN BHD
E-KOMODITI SDN BHD
EUROSTAR SDN BHD
UNION HARVEST SDN BHD
WELL BLOSSOM SDN BHD
G-PLANTER SDN BHD
LINTRAMAX (M) SDN BHD
CAROTINO SDN BHD
E6 SOLUTIONS
BEHN MEYER AGRICARE (M) SDN BHD
HAP SENG FERTILIZER SDN BHD
SYARIKAT KERATONG SDN BHD
PENDANG NURSERY SDN BHD
FHENG KONG ENGINEERING SDN BHD
KUALA LUMPUR KEPONG BERHAD
AMBERTON TRANSPORT SDN BHD
INTERWAY TRANSPORT SDN BHD
KIM LOONG RESOURCES BHD
TAK PLANTATION SDN BHD
AVERY MALAYSIA SDN BHD
ALL COSMOS INDUSTRIES SDN BHD
MALAYSIAN ROCK PRODUCTS SDN BHD
WENG FOOK TYRES & BATTERIES SDN BHD
KOTA TINGGI ESTATE SUPPLIES SDN BHD
ORIENTAL FOOD INDUSTRIES HOLDINGS BHD
YARA INTERNATIONAL (M) SDN BHD
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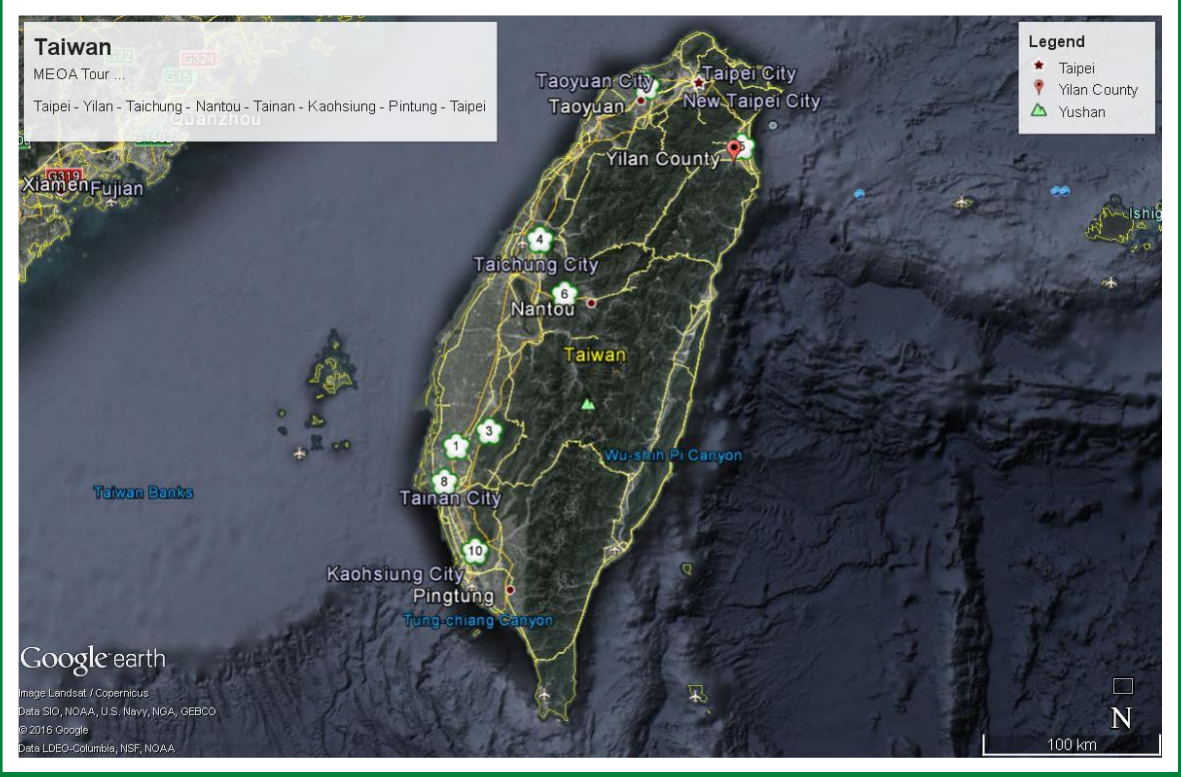
AGRICULTURE IN TAIWAN

SPECIAL EDITION



Leafy Vegetable Production by Hydroponics in Greenhouses

Nung Fu Agriculture Farm 弄福農場 https://www.facebook.com/nungfufarm/

Visited 14 November 2016

By Philip Loo

Members visited a Greenhouse farm in Nantou, Taiwan where leafy vegetables were grown hydroponically.

Its owner, Mr Chen, who graduated from the National Pingtung University of Science and Technology, welcomed members and walked us through the various stages of growing the veggies. His greenhouse is sized at 2910 square meter, divided in 19 sections and produces amazing 4500kg green leaf vegetables per month.

Greenhouse Hydroponic System Design

In his greenhouse leafy vegetable production system, Mr Chen uses hydroponic culture beds made of high density polyform covered by PU sheet.
Using high density polyform is light weight, low cost, durable and easy to construct. This specially designed water flow units are easily connected to construct the water flow beds.
Such efficient and cost effective way of constructing the water flow beds, marks a breakthrough in hydroponics technology. I was very impressed with the design and am looking forward to adopt the concept in my future system.

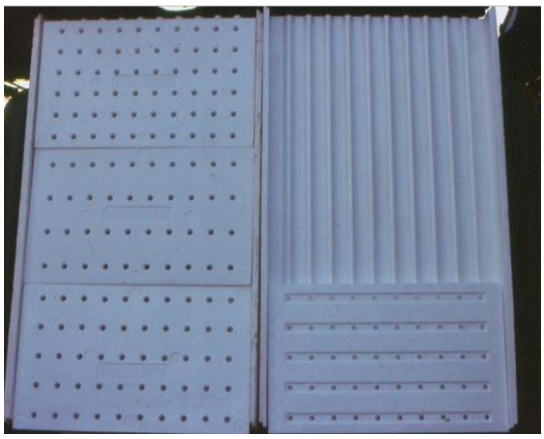
Leafy green vegetables grown hydroponically in a greenhouse

This design blended NFT (Nutrient Film Technique) and DWC (Deep Water Culture), which I call it SFT (Shallow Flow Technique). It leverages on the advantage of DWC and NFT to enjoy the best of both worlds. I believe this is a very cleverly designed system.

Each of the Connecting Water Flow Units is: Length 180cm, Width 102cm and Height 14.5cm.
Planting Board's dimension is: Length 96cm, Width 60cm, Height 3.5cm.

Connecting Water Flow Units

Length 180cm, Width 102cm and Height 14.5cm.



Planting Boards

Length 96cm, Width 60cm, Height 3.5cm.

According to Mr Chen, each water flow bed normally connects 25 planting boards. However, it can be more. He uses 45 planting boards length in a grow bed. If the grow bed were longer, it would need more frequent water circulation to ensure even distribution of nutrients and also dissolved oxygen to the plant roots.

Each polyform Planting Board costs about NT70, which is about RM10.

The 2910 sq.m greenhouse is divided into 19 sections – from which 1 section is harvest and replant up every day. In this manner, the greenhouse produces up to 4500kg of leafy vegetables every month.

Seeding process

The seeding process i.e. planting in germination beds, is relatively fast and high volume as he uses a seeding machine to place the seeds in the germination beds. This save a lot of man power that would otherwise needed to do the tedious and repetitive job. Each germination cubical in the germination beds is placed with 12 seeds - which is surprisingly high. In my experience, only 1 or a maximum 3 is put in as insurance and to ensure a higher germination rate. I guess, this also depends on what type of vegetables are grown, species germination rates etc.

Using this greenhouse-hydroponic and seeding/planting method, vegetables can be harvested more quickly in shorter intervals – 30% to 50% faster. This effectively means that 2 cycles of vegetables can be grown in the greenhouse hydroponic system compared to 1 cycle in conventional soil based farming. The green leafy vegetables in his farm are usually harvested in 25 days.

Lush green leafy veggies growing in the Planting Boards over continuous flow nutrient solution

Temperature control

The shading system, supplemented by overhead air circulation fans and vents in the roof, enables temperatures throughout the greenhouse to be well and optimally controlled during all seasons.

The greenhouse uses 2 types of sun shade. A 90% cut off shade is used cover up areas where workers are working, while a 50% cut off shade is used for the vegetable growing areas.

All the shades have a sliding mechanism build in. During hot summer days, the shade will be applied during the day, while in the other seasons when sunlight is less/minimal, the shade is minimally used or not needed at all. I liked his simple and cost-effective design of the mechanism.

Pest & Disease control

Having the hydroponic system inside of a greenhouse, saves about 80% in pesticides and pest control costs. The greenhouse prevents most insect pests and most diseases from coming into the greenhouse. Inorganic pesticides are only used during the seeding stage, after which only emulsified mineral oils, beneficial bacteria and organic pesticides are used to contain pest infestations and fungal infections.

Nutrient Solution

The hydroponic system uses 6 × 1-tonne water tanks or drums buried in the ground as a nutrient solution mixer. Each of these mixers supplies and supports 3 sections of his 19 sections of greenhouse planting areas.

No additional device or mechanism to add oxygen into the recycling nutrient solution system is used. The Venturi effect to bring oxygen into the nutrient solution when it is being pumped into the grow beds is sufficient to oxygenate the nutrient solution reaching the plant roots. When the nutrient solution / water returns into the mixer tanks and falls in by gravity flow, natural oxygenation occurs due to fall height when the oxygen dissolves into the recycling nutrient solution.

Soil buried - Water – Nutrient Solution Mixer Tanks (with heating/cooling element)

From experience, it was noted that good plant health and growth rates was achieved mainly by optimal control of nutrient solution / overall water temperatures in the system *and* by keeping pH at between 6.0 to 6.5.

Circulating nutrient solution under the planting boards that hold the plants

When asked, how he manages the recycling of nutrient solution water, Mr Chen said that they will add the same proportions of nutrient into the water and use again. This is repeated for 3 growth cycles. At the end of the 3 growth cycles, they will use the residual water to water plants grown outside the greenhouse – in this farm, the pineapples. This is one of the biggest setback for hydroponic farming. As far as I understand, most farmers do not have an eco-friendly way to treat this waste water prior to disposal. At least in Mr Chen's case, he is using it to water the plants outside the greenhouse.

We observed that he has pineapple plants planted all around his greenhouse.

Pineapples grown outside the greenhouse get the nutrient solution
that is disposed of by the greenhouse hydroponic system

Harvest & Packaging

As the 2910 sq.m greenhouse produces up to 4500kg of hydroponically grown leafy vegetables every month, there is a packing section in the greenhouse where the vegetables are packed without removing its roots. This is to keep the leafy vegetables fresh longer, thereby extending their shelf life.

Leafy vegetables are packed together with their roots so as to keep them fresh longer

I ended the visit to this farm with a very crucial question that I believe everyone is interested to know… "Can his method and size be profitable?" He answered with confident "Yes".

Greenhouse owner, Mr Chen (R) with Philip Loo of Loo Urban Farms

Greenhouse owner, Mr Chen (in red T-shirt) with MEOA members

I would love to ask him more about hydroponics and look at his farm in more detail. Unfortunately, the sun had set and we all had to move on.

There was one important part we did not manage to see… how his seeding process was done and what kind of seeding machine is used.

We also didn't have a chance to ask him about his King Oyster Mushroom cultivation. It seems that he has been quite successful in this venture as well.

Nevertheless, it had been a very interesting and educational visit.

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TYPES OF HYDROPONIC SYSTEMS

By Philip Loo

What is Hydroponics?

Let's take a glance at what hydroponic actually is.

Hydroponics is a planting method where plants grow in a growing medium with water and nutrients. It is a soilless farming method.

Early hydroponics was traced back to the Hanging Gardens of Babylon and the Floating Gardens of China - this is thousands of years ago. Modern hydroponics was popularized by William Frederick Gericke in 1929, who was working at the University of California - Berkeley.

Today Hydroponics farming has been seen in 6 basic types of hydroponic systems:-

1. Wicking bed
2. DWC – Deep Water Culture
3. Ebb and Flow (Flood & Drain),
4. Fertigation or Drip (recovery or non-recovery),
5. NFT (Nutrient Film Technique) or SFT (Shallow Flow Technique) and
6. Aeroponic.

There are hundreds of variations on these basic types of systems, but all hydroponic methods are essentially a variation (or combination) of these six.

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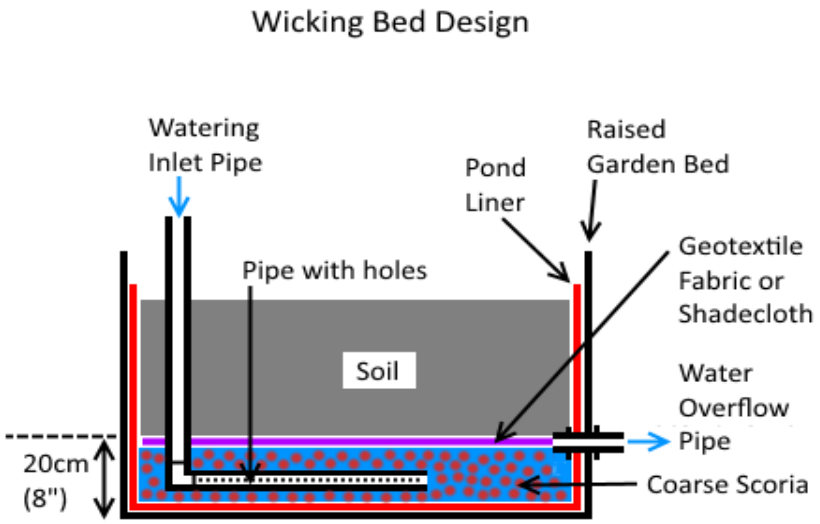
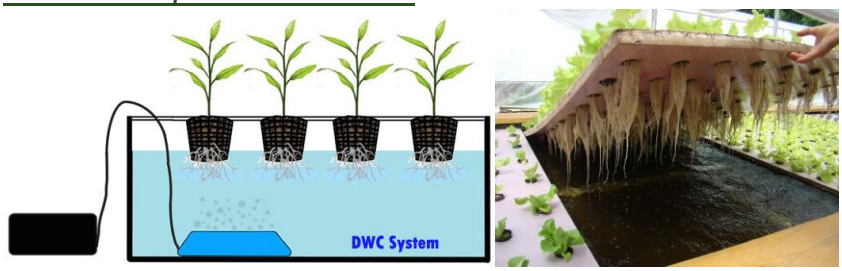
TYPES OF HYDROPONIC SYSTEMS

Schematics

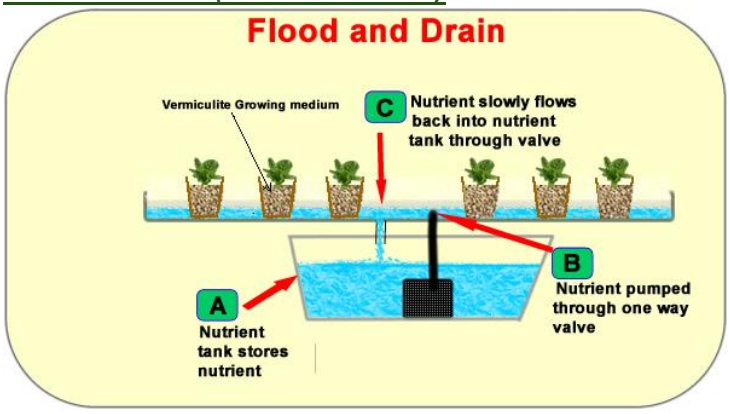
Wicking bed



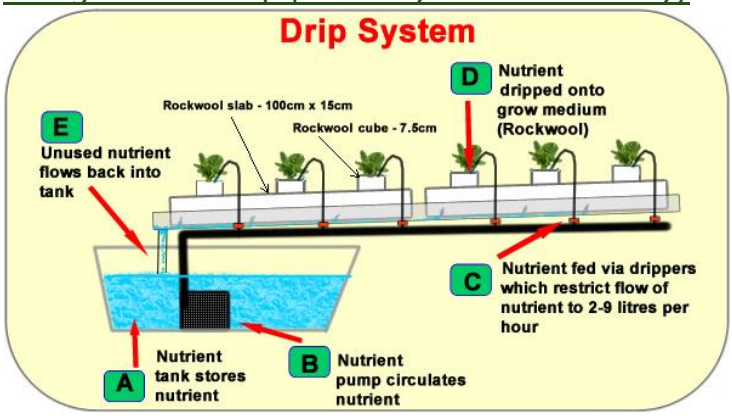
DWC – Deep Water Culture



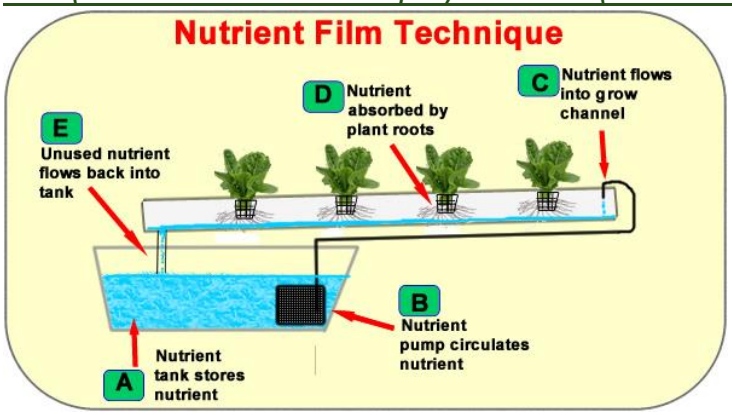
Ebb and Flow (Flood & Drain)



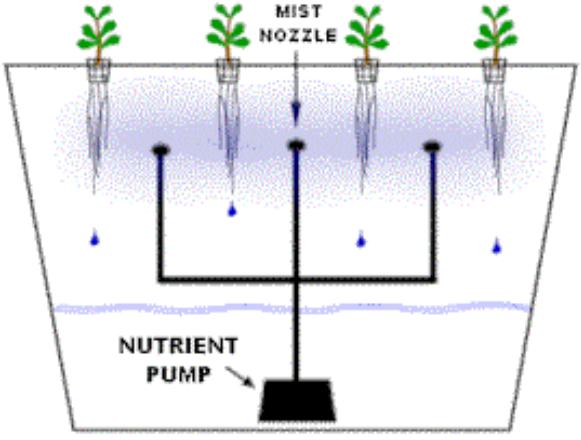
Fertigation or Drip (recovery or non-recovery)



NFT (Nutrient Film Technique) or SFT (Shallow Flow Technique)



AEROPONICS



Visit to CEA Greenhouse for Tomato cultivation

(High-tech CEA Greenhouse for Tomato cultivation)

Ten-Wei Horticultural Production Cooperative (**Changhua, Taiwan)**

Visited 15 November 2016

By Amit Guha

Members of MEOA visited Ten-Wei's Horticulture's CEA (Controlled Environment Agriculture) Greenhouse designed for highly automated Tomato cultivation in Changhua, Taiwan on Tue Nov 15 2016.

Since Tomatoes (Solanum lycopersicum) grows best at 18-27°C, in regions where temperatures fluctuate outside of this range or where seasonality has to be accounted for to get more crop cycles in a calendar year, the most suitable cultivation method to grow this crop on a commercial basis is by growing the crop is inside climate controllable greenhouses using hydroponic - fertigation systems – as is done in the temperate Netherlands – and now in sub-tropic Taiwan and temperate Japan.

Tomato cultivation in CEA Greenhouse

Tomato Cultivation in a CEA Greenhouse

The salient features of how tomatoes are grown in the particular greenhouse system that we visited on this trip to Taiwan is given here.

Some basic CEA Greenhouse Design and Operating parameters of the CEA Greenhouse:

Greenhouse (GH) Size - 0.7 ha (7000 sq m) CEA Greenhouse of Dutch design.

Greenhouse Climate Control Systems:

- Optimum light control inside the GH is achieved by Fixed Partial and Variable Shade control systems i.e. by GH roof material (fixed shading) and adjustable inside shade nettings (variable shading). (In this GH no artificial light system was installed).
- continuous inside and outside weather monitoring and analysis for automated computer controlled in-greenhouse climate control (system provided by Priva, Holland)
- Dual Air Control intake/exhaust system - dual system i.e. below soil / substrate growing media slabs near floor base as well as above plant level. (Mainly for temperature regulation and air mixing within GH).
- Water Mist Spraying into plant canopy to control in-GH Temperature-Humidity levels.

Tomato-vine Cultivation / Growing Protocol:

- Growing Media - Cocoa Peat in slab bags (into which the Tomato F1 seeds are germinated)
- Drip Irrigation direct to soil / substrate growing media slabs.
- Nutrient application to plant vines effected via Drip Irrigation (Fertigation)
- Pollination of flowers on the vines is by use of Bumble Bees imported from Belgium – (brought in every 6 weeks).
- Fungal control effected preventatively by heating Sulphur at midnight using powered heaters (at slightly above canopy level).

Operating Metrics:

- Crop Production/Yields: 23 tons/sq m/yr - over 2 crop cycles in a year - i.e. 11.5 tons/crop cycle. (Note: each crop cycle runs 4 to 5 months).

  (This yield of 23 kg/sq m / year using local Taiwanese variety of Tomato seeds - F1 seeds - still compares significantly less favourably to the 70 kg/sq m/ year productivity levels achieved in Holland using Dutch varieties of Tomato seeds)
- Labour Use – 4 workers per hectare. This also compares slightly less favourably to the 3.5 workers / hectare required for tomato cultivation in Holland – although labour costs in Taiwan is significantly lower than that in Holland.

The manager of the greenhouse indicated that while the capital cost of the CEA Greenhouse with the climate control system and infrastructure was very high, operationally they are slightly profitable and with yields still increasing over the last 3 years in operation, they expect to get a decent return on their investment.

Now we need to ask ourselves as agricultural practitioners in Malaysia… can we grow tomatoes in our humid tropical climate and achieve similar or higher productivity levels by adapting the growth protocols used by the Taiwanese and the Dutch?

Inside the Tomato greenhouse

Worker water-misting the Tomato vines to raise humidity levels.

Note the HVAC (Air Conditioning) vents below greenhouse roof

Air exchange large blower tubes with holes to exchange and distribute cold/warm air to control temperatures and humidity – as well as control CO_2/O_2 levels within the greenhouse.

Note horizontal fans hanging from ceiling below the shade netting framework to distribute warm air that rises up more evenly through the greenhouse.

Sulphur Heater inside greenhouse
– its turned on at midnight to control fungal infections

Power plant room with HVAC system (Air Conditioning system)

CEA Greenhouse Design Concepts for the tropics and sub-tropics

An optimum greenhouse design for vegetable growing under CEA Systems in the sub-tropics and tropics should function well in hot and humid/dry environment / climate which is characterized by a solar radiation sum of around 7 GJ/m^2 and high temperatures (27 to 36^oC) and humidity levels (> 95%).

The main elements of such a design would be a naturally ventilated greenhouse with large windows (0.5 m2 window area per m2 greenhouse ground surface) and insect nets to keep out pests. The greenhouse should be covered with a highly transparent plastic film cover that has high haze and is transparent for infra-red radiation. Furthermore, the greenhouse should be equipped with a fogging installation and a cooling (or sometimes heating) system as most plant species, for optimal growing, require optimization of growing temperature (and humidity) levels at the various growth phases. As established CEA Growing Protocols were developed for the temperate regions (that use heating systems), these protocols have to be modified for sub-tropical and tropical climes (that needs to use cooling systems). As such, to minimize the kilowatt energy use when designing and incorporating cooling systems, shade nettings (to absorb radiant energy) and adiabatic/evaporative cooling technologies should be used in concert with more direct energy using air-conditioning technologies. Alignment of greenhouses in an East-West direction would also help keep temperatures lower inside. This will all help in maximizing the viability of most temperate CEA system growing protocols adapted to the sub-tropics and tropics.

The yearly solar radiation sum in the tropics is over 7+ GJ (compared to 6GJ in Taiwan and 3.9 GJ in The Netherlands). As plant growth is largely determined by solar radiation, the potential crop yield for vegetable production in the rainforest tropics is higher than in both sub-tropical Taiwan and the temperate Netherlands. However, due to the higher radiation intensities in the humid rainforest tropics, the temperature and relative humidity in the greenhouse will be higher, which will reduce crop growth/yield. Hence the importance of light/temperature and humidity control measures in tropical CEA growing systems as described in more detail below:-

- **Ventilation and insect nets**

  A greenhouse for tropical climates should be equipped with a well-designed ventilation system to avoid excessive temperatures inside the greenhouse necessitating excessive power usage by cooling systems. As the power consumption of mechanical ventilation is high, natural ventilation is preferable – made more effective by high greenhouse roofing. The exhaust vents should be equipped with insect net to keep pests out. To provide sufficient ventilation capacity, even with insect nets, the surface area of the vents should be at least 0.5 m^2 per m^2 greenhouse ground surface. In that case, the temperature inside the greenhouse is close the outside temperature. (Natural ventilation is not able to decrease the temperature below the outside temperature level unless the intake air is pre-cooled. This would be possible if the intake air is run in underground in water saturated soils or drainage ditches to cool the air to below ambient temperatures prior to entering the greenhouses).

  Note: Most greenhouses use natural ventilation to remove hot air out of the greenhouse, as natural ventilation is a very efficient mechanism for air exchange if there is reliable wind outside – as would be the case in coastal areas. Only in warm climates with low wind speeds (such as in shielded valleys / hillslopes) would mechanical ventilation be favoured despite higher energy costs for running the ventilators. However, to mix the air inside the greenhouse in order to achieve a homogeneous climate throughout the whole area, horizontal mixing fans may be advisable.

• **Greenhouse Cover material and Shading screens**

A thick (UV resistant) plastic film that is diffuse and has a high transmission of light (>75%) can be used as a greenhouse cover material. It should also have a high transmission of infra-red radiation, which helps to reduce high greenhouse temperatures. The greenhouse cover should be complemented by shading screens to decrease inside greenhouse and crop temperatures during periods of high diurnal irradiation (particularly during mid-day periods). An external screen with a shading percentage of 30% should suffice - not limiting ventilation too much but still reduces the risk of crop damage by too much light.

Where crops native to the temperate climes require longer daylight for flowering (long day-length species), phyto-wavelength light systems (energy consuming) need to be installed.

• **Adiabatic / Evaporative Cooling**

Installing a fogging system with a net capacity of at least 300 g/m^2/hr will decrease the temperature inside the greenhouse during the hottest hours of the day and will contribute to a less stressed crop. A pad and fan system is not advisable because of the higher energy cost and inhomogeneous temperature distribution inside the greenhouse. If internal greenhouse humidity (and/or temperature) needs to be kept low, a solar-powered pump and water sprinkler system to wet the cover periodically to cool down the greenhouse on evaporation could be implemented. (Note: Fogging systems are not very effective in lowering temperatures under high humidity conditions. As a rough rule of the thumb, fogging and other adiabatic cooling systems can only lower temperatures upto a third of the difference between the prevailing wet and dry bulb temperature).

• **Cooling System (naturally cooled air intake; non-powered)**

If located in a riverine delta with high water tables and level terrains, it is possible to pre-cool air entering into the greenhouses *without* the use of energy. Intake air can be naturally pre-cooled to about 24 to 25^{o}C by running air intake pipes (of high conductivity) underground in water saturated soils or drainage canals (under natural vegetation cover) for suitable distances to allow for sufficient and efficient heat exchange. The setting up of a centralized Air Intake Infrastructure Network system to provide naturally pre-cooled air to all greenhouses in the CEA Zone would be the most cost efficient way to do this (and would also serve as a selling point to attract CEA Investors). Note that the existing river systems can perhaps be used to affect the heat transfer of the intake air. This has the advantage of minimizing the length of the canal and earthworks required.

Individual greenhouses can thereafter have the option of installing additional power-based (chiller) cooling systems on the branch pipes leading to the greenhouse/s to cool the intake air prior to it being pushed into the individual greenhouse/s. See below.

• **Cooling System (powered)**

A cooling system using power is recommended to achieve the optimal target temperatures for optimal growth of the specific crop – *after* all steps to minimize internal greenhouse temperatures are functional i.e. a combination of cover – shade – fogging - natural ventilation / pre-cool air intake systems.

To achieve internal greenhouse operating temperatures below 25^{o}C, the greenhouse has to be air-conditioned (i.e. by using power) sources either with fossil fuels or by renewable sources such as hydro or solar energy (or a combination of these). Off course cooling the greenhouse by means of hydro or solar energy is more environmentally sustainable (energy balance positive) and has low running costs.

Multi-System Integrated Cooling for Tropical Greenhouses

Greenhouse (GH) Environment	GH Cooling Design Feature	Variable controlled	Impact on GH Temp (°C)	Ambient Temp (°C)
				36 (ext temp)
External:	Greenhouse Cover (UV reduction roofing)	Incoming solar radiant energy	-1/2	34
	Evaporative Cooling (sprinklers)	Heat up of GH by solar energy	-3	31
External – Internal	Air Exchange (vents/blowers)	Temp & Humidity control	-1	30
Internal:	Shading (shade netting)	Temp reduction within GH	-3	27
	Fogging	Further Temp reduction within GH	-1	26
	Naturally Pre-Cooled Intake Air	Temp of intake air into GH	-2	24
	Air-Conditioning *-using power!*	Target Temp achievement for crop spp.	-3 to -7	**21 to 17**

Cost of Setting up and Operating Greenhouses

Capex cost

The capital cost of building a fully climate-controlled greenhouse that can achieve temperatures below 20°C in the tropics would be approximately USD 600/m2 (against USD 60/m2 for a normal greenhouse that can only achieve a minimum temperature of 24°C).

The overall breakdown for **greenhouse *without* Air-Conditioning** will be USD$ 60/m2 broken down as below:-

1. Greenhouse Structure - US$30 /m2
2. Shade/Ventilation/Fogging - US$ 25 /m2
3. Irrigation - US$ 5 /m2

The growing temperature achievable would be around 8-10deg Celsius reduction (from outside temperature) for this setup.

Greenhouse *with* Air-Conditioning (US$ 600/m2) could achieve temperatures as low as 15 deg. Celsius, but in order to retain such lows temperatures, it would be necessary to minimise the amount of sunlight or heat penetration into the greenhouse - thus affecting the photosynthesis process.
Such types of greenhouse would have facilities to simulate the growing condition with adjustment of lighting, humidity, temperature and etc.

Thus, to summarize, the approximate cost to build a 0.5 Ha Greenhouse (5000 m^2) would be:

- **Non-Air/Conditioned:** US$ 0.3 million or RM 0.9 million
- **Air/Conditioned:** US$ 3.0 million or RM 9.0 million

Opex cost

The operating costs of a greenhouse would be highly variable and dependent on the following variables:-

- Type of Greenhouse
- Temp Control (cooling) systems installed/used
- Crop Species grown and Growth Protocols followed, growing period etc.
- Cost of Energy inputs
- Cost of Water inputs
- Labour intensiveness / level of automation
- Post-Harvest Handling and Storage facilities

Post-Harvest Handling and Cold Storage Facilities for Fruits and Vegetables

While each CEA Cluster would have its own Post-Harvest Sorting and Storage facilities, perhaps specifically designed for the crop produce type from the individual cluster/s, additional large centralized facilities sited at the port would also be required to "hold" the produce pending loading on ships / airplanes as part of the logistics and distribution system. Given that high value horticultural crop produce has very short shelf life, minimizing the time to market is very critical.

Post-harvest deterioration of fruits and vegetables during storage depends largely on temperature. One way to slow down this change and so increase the length of time fruits and vegetables can be stored, is by lowering the temperature to an appropriate level. It must be remembered that if the temperature is too low the produce will be damaged and also that as soon as the produce leaves the cold store, deterioration starts again and often at a faster rate.

Temperature

All fruits and vegetables have a 'critical temperature' below which undesirable and irreversible reactions or 'chill damage' takes place. Carrots for example blacken and become soft, and the cell structure of potatoes is destroyed. The storage temperature always has to be above this critical temperature. One has to be careful that even though the thermostat is set at a temperature above the critical temperature, the thermostatic oscillation in temperature does not result in storage temperature falling below the critical temperature. Even 0.5°C below the critical temperature can result in chill damage.

Critical Storage Temperatures and Relative Humidities for various fruits and vegetables

Crop	**Critical Storage Temperature** °C	**Relative Humidity** %	**Max. Storage Time recommended** for Temperate countries (ASHRAE Handbook 1982)	**Max. Storage Time** in Cold Stores for Vegetables in Tropical Countries
Apple	**0 – 4**	**90 – 95**	2 – 6 m	
Beetroot	**0**	**95 – 99**		
Cabbage	**0**	**95 – 99**	5 – 6 m	2 m
Carrots	**0**	**98 – 99**	5 – 9 m	2 m
Cauliflower	**0**	**95**	2 – 4 w	1 w
Cucumber	**10 -13**	**90 – 95**		
Eggplant	**8 – 10**	**90 – 95**		
Lettuce	**1**	**95 – 99**		
Leeks	**0**	**95**	1 – 3 m	1 m
Oranges	**0 – 4**	**85 – 90**	3 – 4 m	
Pears	**0**	**90 – 95**	2 – 5 m	
Pumpkin	**10 – 13**	**70 – 75**		
Spinach	**0**	**95**	1 – 2 w	1 w
Tomatoes	**13 – 21**	**85 – 90**		

It can be seen from the table that there are basically three groups of fruit and vegetables:

- those stored at 0 - 4°C;
- those stored at 4 - 8°C; and
- those that require a storage temperature above 8°C.

It is often more convenient to concentrate on one of these groups.

Relative Humidity

For most produce, a high but not saturated, relative humidity is required, ex. 85 - 95%. The above table shows specific relative humidities for fruits and vegetables. There is always some moisture loss during cold storage but excessive moisture loss is a problem. It is essential that the relative humidity be kept above 85%.

This can be done by:-

- allowing the produce to reach storage temperature and then covering in plastic
- sprinkling the produce with water, this should be done before storage since if the vegetables are sprinkled during storage condensation occurs at the refrigeration unit.

Length of Storage

The above table also gives the maximum storage times recommended by various organisations. These recommendations are based on figures from Europe and America and are often for too long for small-scale stores in tropical countries for the following reasons:-

- It is often difficult to prevent delays between harvest and storage.
- The produce is often bruised during harvest and loading of the store.
- Transport can be bumpy and result in damage.
- The temperature of the retail outlets is far higher than for the retail outlets in Europe and America.

Incompatibilities in storing crop produce

If different produce is being stored in the same room, there is a risk of transfer of odours or ethylene (which impacts the ripening process). The table below shows the more important incompatibilities.

Table : Storage Compatibility Matrix of Fruits and Vegetables

	Apples	Bananas	Cabbage	Grapes	Oranges	Potatoes	Vegetables
Apples	-	N	SD	Y	Y	SD	Y
Bananas	N	-	N	Y	N	N	Y2
Cabbage	SD	Y	-	SD	N	SD	SD
Grapes	Y	Y	SD	-	Y	Y	Y
Oranges	Y	N	N	Y	-	Y	Y
Potatoes	SD	N	SD	Y	Y	-	Y
Vegetables	Y	Y	SD	Y	Y	Y	-

KEY: Y = No Cross-Action SD = Slight Danger BD = Big Danger N = Cross-Action will take place

The cold store should be kept very clean and the doors opened as little as possible.

Handling & Transport

Care needs to be taken during the unloading from the cold store and during transport. If the produce can be transported in the same crates they were stored in, handling and concomitant damage will be reduced.

(The more perishable crops often need to be marketed to end consumers within 10 days).

Packing system

A packing system is required so that the produce can be loaded and unloaded easily and safely. This can be a system using crates that can be stacked or a more complicated system using racks and trays. It is important that the crates are small enough to be moved easily when full of vegetables; are able to be easily and safely stacked; and are strong enough to hold the weight of the other crates. It is essential that the airflow is not restricted, therefore a two-foot gap should be left between the walls and the crates and three-foot gap left between the crates, the ceiling and refrigeration units.

The figure below shows the design of a crate that is suitable for cold stores. For small-scale cold storage systems, stackable crates are the most appropriate packing system.

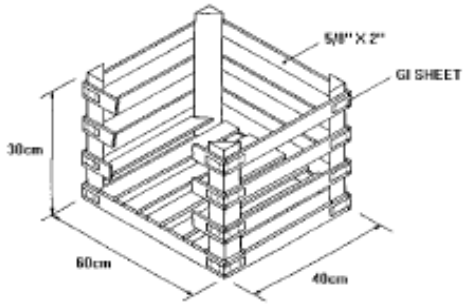


Figure: Crates used for storage & transport

Shelf life

The shelf life of the produce will not be as long as fresh produce but if the above recommendations are followed, the reduction in shelf life can be as little as 10%.

Food Security

A Food Safety Authority (FSA) usually under a government body can periodically inspect all CEA Greenhouses (and Aquaculture Ponds) as well as Post–Harvest Handling and Storage facilities to check inputs/outputs and operating conditions – in order to certify *quality* and *safety* standards are met and sustained. The *Codex Alimentarius*, which is a series of international standards for food and agricultural products, can be used as a reference guide. To this end, a Quality Control Lab operated by the FSA would need to be set up which can also provide other lab testing services (both quality control and agronomic) to GH crop growers.

The FSA would also ensure traceability systems are in place and that all crop produce meet GlobalGAP (formerly known as EurepGAP) standards.

Halal Certification - The FSA can also be empowered by JAKIM to award Halal certifications where required based on Islamic guidelines and criteria.

The above certifications would give tangible assurance and meaning to any branding and branding campaign on any crop produce.

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Potential Crops Suitable for Greenhouse Cultivation

When assessing plant species suitability for CEA Greenhouse cultivation systems, we need to look at the optimum or native growth climate conditions for the plant species. The use of CEA Greenhouses allows for an economically efficient (and environmentally friendly) crop production system which capitalizes on a sites natural water and solar resource - and perhaps also sustainable hydro-sourced energy - to achieve good crop yields and predictability of production, high product quality, high food safety and good ratio of benefit and costs.

Below are the potential crop species potentially possible/suitable for growing in CEA Greenhouses in the tropics.

CEA Greenhouse Cropping Systems Temperatures that need to be achieved for optimal crop growth (in the tropics)

Category	Crop Species	Scientific / Latin name	CEA Cultivation / AgroTech System used	Country CEA practiced in	Non-CEA Agro-Climatic requirements
Vegetables					
Leafy	Asparagus	Asparragus officinalis	Fertigation		Cold Climate 13 - 19°C
	Leek	Allium spp.	Hydroponic/fertigation		Cold Climate 13 - 19°C
	Cauliflower	Brassica oleracea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 16°C
	Endive	Cichorium endivia	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Parsley	Petroselinum crispum	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Chard	Beta vulgaris *cicla*	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Coriander	Coriandrum sativum	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Artichoke	Cynara scolymus	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Celery	Apium graveolens	Hydroponic/fertigation		Cold Climate 15 - 16°C
	Cabbage	Brassica oleracea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Broccoli	Brassica oleracea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Kailan	Brassica oleracea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Chinese Cabbage	Brassica rafa	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Lettuce	Lactuca sativa	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Spinach	Spinacia oleracea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Green Mustard	Brassica juncea	Hydroponic/fertigation	Taiwan	Cold Climate 15 - 18°C
	Brussels Sprouts	Brassica oleracea	Hydroponic/fertigation		Cold Climate 15 - 18°C
	Rhubarb	Rheum rhabarbarum	Hydroponic/fertigation		Cold Climate 15 - 18°C
	Watercress	Nasturtium officinale	Hydroponic/Aquaponic		Cold Climate 15 - 18°C
	Water Spinach	Ipomoea aquatica	Hydroponic/fertigation	Taiwan	Tropics
Non-Leafy	Onion	Allium cepa	Hydroponic/fertigation	Taiwan	Cold Climate 13 - 19°C
	Garlic	Allium sativum	Fertigation		Cold Climate 13 - 19°C
	Potato small tuber	Solanum tuberosum	Aeroponic	Taiwan	Cold Climate 15 - 16°C

Category	Crop Species	Scientific / Latin name	CEA Cultivation / AgroTech System used	Country CEA practiced in	Non-CEA Agro-Climatic requirements
	Turnip	Brassica rapa	Fertigation		Cold Climate 15 - 16°C
	Carrot	Daucus carota	Fertigation		Cold Climate 15 - 16°C
	Beetroot	Beta vulgaris	Fertigation		Cold Climate 15 - 18°C
	Radish	Raphanus sativus	Fertigation		Cold Climate 15 - 18°C
	Chilli Pepper	Capsicum annuum	Hydroponic/fertigation	Taiwan	Warm temperate >21°C
	Eggplant	Solanum melongena	Hydroponic/Fertigation		Warm temperate >21°C
	Tomatoes	Solanum lycopersicum	Hydroponic/fertigation	Taiwan, Japan	Warm temperate 18 - 27°C
	Cucumber	Cucumis sativus	Hydroponic/fertigation	Taiwan	Warm temperate 18 - 27°C
	Green pepper	Capsicum annuum	Hydroponic/fertigation	Taiwan	Warm temperate 18 - 27°C
	Sweet corn	Zea mays	Fertigation		Warm temperate 18 - 27°C
	Dry bean	Phaseolus vulgaris	Fertigation		Warm temperate 18 - 27°C
	Lima bean	Phaseolus_lunatus	Fertigation		Warm temperate 18 - 27°C
	Bell pepper	Capsicum annuum	Hydroponic/Fertigation		Warm temperate 18 - 27°C
	Mushrooms				
Fruits	Mango	Mangifera indica	Fertigation	Japan, Taiwan	Warm climate
	Melon	Cucumis melo	Fertigation	Taiwan	Warm temperate 18 - 27°C
	Watermelon	Citrullus lanatus	Fertigation	Taiwan	Warm temperate >21°C
	Figs	Ficus carica	Fertigation	Japan	Temperate-Tropical hi-land
	Strawberry	Fragaria	Hydroponic/fertigation		Temperate
	Apples	Malus domestica	Fertigation		Temperate
	Oranges	Citrus sinensis	Fertigation		Temperate
Ornament-als	Orchids	Orchidaceae	Fertigation	Taiwan	Tropical lo-land
	Flowers various spp.		Fertigation	China, Taiwan	Sub-Tropics
	Tulips	Tulipa spp.	Fertigation	Netherlands	Sub-Tropics

The above identified species already have their individual established CEA Growing Protocols in the countries they are currently grown in – mainly the sub-tropical/temperate countries and regions of Taiwan and the Netherlands.

In addition to these identified species, other species native to the sub-tropics / temperate regions could possibly be cultivated in CEA systems in the tropics to export to other tropical regions/countries at premium prices – in addition to benefitting from lower storage and transport costs and lower cost of production ex-farm (from mainly lower energy input costs). Note that the crops identified as "Temperate" and "Cold Climate" in the above listings – are all currently being imported into Malaysia and other tropical countries from the northern latitudes.

Tenha Organic Farm

Date visited: 17 Nov 2016
By Gan Tee Jin

Tenha Organic Farm, at 16 ha of land, is the largest organic farm in Tainan County. It was established in 2005, leasing its land from the giant state-run Taiwan Sugar Corporation (Taisuco).

They focus on leafy vegetables, with 40 varieties planted. Production, which has been steadily rising has reached a capacity of 35 tonnes per month. Ten greenhouses were added in 2013, making a total of 70, with each being 100 m^2. However, the severe typhoon in 2016, one of the worst in years, damaged many green houses and incapacitating a third of output.

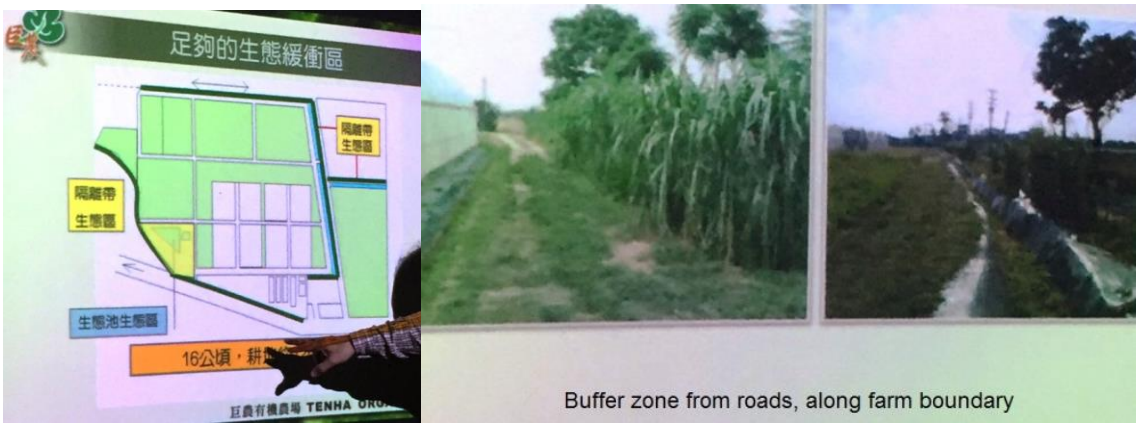

Typhoon damaged greenhouse with vegetables growing on soil beds.

Tenha has its own packaging facilities, and distributes its produce in refrigerated lorries to retailers' shelves in two days, so that customers can expect their vegetables to maintain their freshness for another five days. This is a longer shelf life than vegetables from other producers who do not have as efficient a packaging and distribution system.

Own brand packaging

Some of their higher value vegetables are exported to Macau and Singapore, with a Michelin-starred restaurant in the latter buying its baby corns.

To meet organic certification standards, they had to set aside 4 ha (or 25% of its land) along its boundary as a buffer zone from roads. This buffer zone is planted with trees, and the Taiwan government pays farmers for doing so, with spot checks to verify compliance. To be truly organic, two certificates are required - one for farming practices and another certification for packaging and distribution. The advisor to Tenha, Dr Zhou, also advises Yongling Shanlin Organic Farm which is set up by one of Taiwan's wealthiest men, Terry Guo Tai-ming, the founder of Foxconn. The Yongling farm is 7-8 times the size of Tenha, with much more modern facilities.



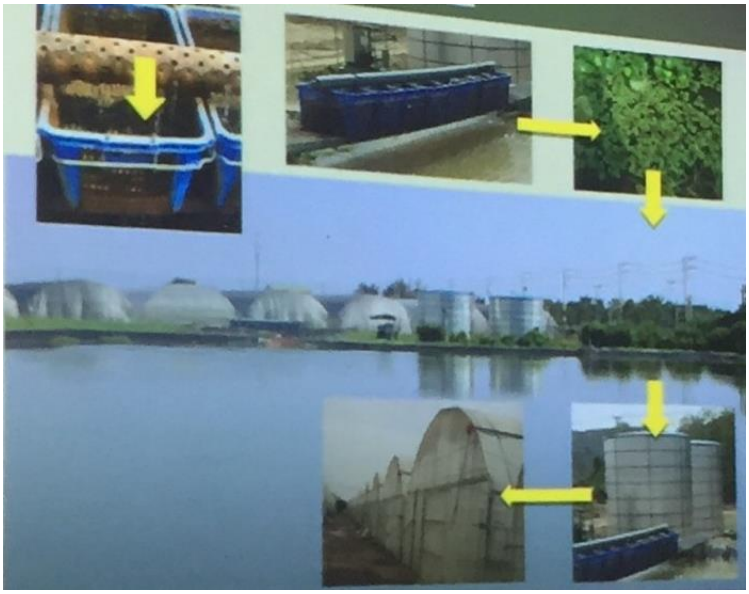
Farm Plan & Layout

Organic Certification labels

Soil quality is an important criterion in organic farming. The land, which was previously cultivated by Taisuco using conventional methods, had 0.4% organic matter in its soils when Tenha's lease started. Gradually, organic farming practices built up soil organic matter to 2%, resulting in significantly higher yields compared to the early years. Nonetheless, yields are only a third of conventional farming; in spite of premium selling prices of 2-3x conventional produce, profitability is still less than non-organic farms.

Crop rotation, inter-cropping and allowing lands to lie fallow are practised to maintain soil quality. Tenha must submit soil samples, taken at up to 1.5m depth, to an accredited laboratory to analyse for various nutrient content, and pesticide levels. Authorities also make random checks to verify compliance. No pesticide, no growth hormone, no GMO, no chemical fertilisers are allowed.

The farm relies on well water, which is high in iron content. This inorganic form of iron is not healthy for consumption, so the water is purified before being used in the farm. Part of this purification relies on a biological process.



Water recycling system

Pest & Disease control

Several natural predator insects were identified to control pests, and examples of these are shown in the accompanying photographs. When pests are detected, the right predators are released to the site(s) affected. These predators are found in the field somewhere, and trans-located to the affected site to ensure the pest problem is addressed without delay. With an abundance of food, both pests and predators are not uncommon in the fields.

Chickens and ducks are used to rehabilitate greenhouses in preparation for the next planting. They not only eat the harmful worms in the soil, but also clear remnant vegetables and grasses as shown in the photos below. These chickens are moved from one greenhouse to another where their services are needed, and it was most amusing to watch the video of them rushing with gusto to the next destination - they seemed to know exactly where to go without missing a beat! This integrated approach enables Tenha to also market organically grown chickens and eggs for sale. Similarly, organically reared geese are used in the open spaces to control grass and weed growth.

Ducks and Chickens used to keep weeds down – as well as to supply organically produced eggs!

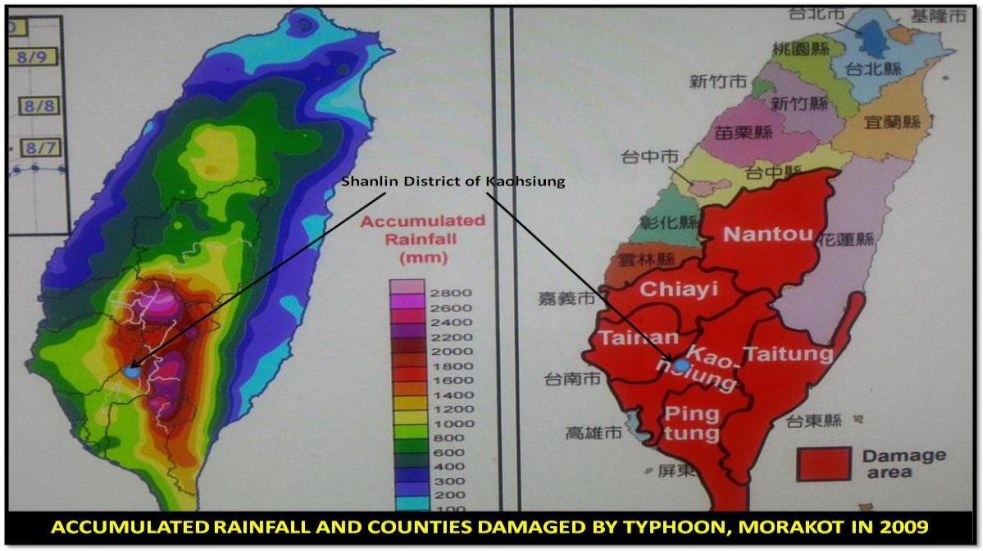
Yonglin Shanlin Organic Farm

Date visited: 19 Nov 2016
By Chee Chuan Chai

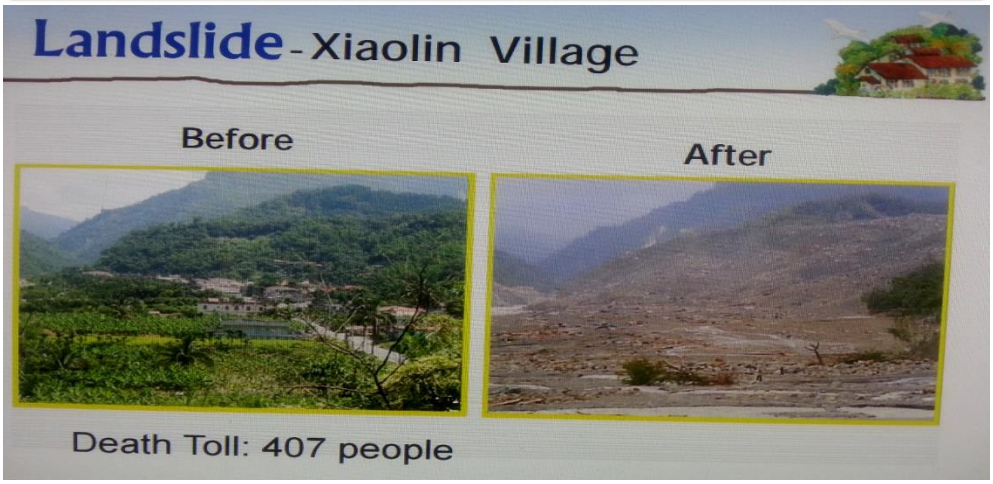
1. BACKGROUND

1.1 Typhoon Morakot that struck in 8 August 2009 had caused serious damage to many farming communities of six counties in southern Taiwan.

1.2 Following the tragedy, the Central and Local Governments had facilitated the implementation of reconstruction plans, including the provision of suitable land and infrastructure to assist more than 3,000 victims affected by the typhoon. In addition, the Foxconn Technology Group invested TWD500million through the Yonglin Foundation to set up and operate the Yonglin Shanlin Organic Farm to provide jobs to the victims - a beautiful example of public-private sector partnership in rebuilding a destroyed community!



ACCUMULATED RAINFALL AND COUNTIES DAMAGED BY TYPHOON, MORAKOT IN 2009



1.3 Reconstruction works started in September 2009 in line with the approved framework of aided community reconstruction starting with the establishment and operation of an organic farm from 2009 to 2016 prior to moving into a self-sustaining business phase. At the same time, work on community reconstruction would continue for the physical and spiritual well-being of the local residents and also preservation of their indigenous culture. Further plans are also included for the development of locally featured industry along BOPT model to promote employment.

1.4 The visit to Yonglin Shanlin Organic Farm on 19th November 2016 was an opportunity for participants of the Agricultural Study Tour in Taiwan organised by MEOA to see progress made since work started in September 2009 and hear plans to make this project a viable eco-friendly agricultural business by year 2021.

2. LOCATION

2.1 Yonglin Shanlin Organic Farm is located in Takao around 57 kilometres by road from Kaohsiung City travelling north-east, passing through well cultivated plains including Ch'ishan known for its banana production since early years.

3. ESTABLISHMENT AND OPERATION

3.1 With the approval of the development plan and allocation of suitable land, work started in September 2009 to establish a model organic farm, initially employing 95 participants with priority given to the typhoon victims and selected interested individuals.

3.2 In line with the objective to develop an eco-friendly organic farm, only locally available materials such as timber, river stones etc. were used for the construction of buildings, roads, drains etc. Water supply from nearby highlands was pumped into the farm reservoir for domestic and farm use. Where possible, the water is recycled for further farm use.

3.3 The farm area became arable two years after work started. Out of 54ha allocated, 50ha were certified suitable for organic farming with a total of 38ha already planted up with organic crop so far. Another 7ha of low lying lands with surface water were planted with organic rice while 105 greenhouses were constructed over 3.5ha in the more fertile areas. Other crops were planted in other open areas depending on soil suitability. The farm area would later be increased as and when necessary.

3.4 High value organic vegetables and other crops are planted in greenhouses for better growth control and to prevent pest problems. Intercropping and crop rotation is also practised to maintain crop quality through minimising buildup of pest and disease.

3.5 With experience and improved techniques over time, the total harvest from the organic farm improved from a first-year harvest of 37 tons per year in 2012 to 79 tons per year last year (in 2015).

3.6 Operations at the organic farm start right from production and sourcing of high quality planting materials, crop growing and maintenance, harvesting, sorting, and finally marketing and distribution to local and international markets. Internet marketing of farm produce is also being carried out. Farm by-products are also utilised to recycle back as compost, animal feed etc.

105 GREEN HOUSES CONSTRUCTED ON 3.5HA. PLOT

GENERAL VIEW OF OPEN AREA PLANTING AT THE ORGANIC FARM

ORGANIC VEGETABLES PLANTED IN OPEN AREAS WITH DRIP IRRIGATION

PACKAGING OF FARM PRODUCE FOR DISTRIBUTION TO LOCAL AND INTERNATIONAL MARKET

4. MANPOWER DEVELOPMENT AND PROMOTION

4.1 Manpower development and training is an ongoing process to keep abreast with the latest technologies available for the organic farm to become even more sustainable - done through employment of well trained personnel and skilled workers to produce high quality farm produce for higher profitability as this project moves into a totally commercial phase starting this year (2016).

4.2 Training is done by experienced and specialised trainers available both at the farm centre and from relevant government departments and selected private sectors.
Emphasis is not only on farming technology and profits but also to give due consideration to preservation of environment and well-being of the farming community and this includes the peoples' spiritual recovery and preservation of indigenous culture.

4.3 Priority in project participation is given to typhoon victims and interested individuals to be trained for the Yonglin Shanlin Organic Farm. Some trained individuals leave the centre to work on their own farms with the option to sell their farm produce to the centre for sorting, packaging and marketing. The training program is ongoing with 400 trainees having been trained so far with 100 undergoing training at time of our visit.

4.4 A marketing company has been employed to establish product branding and a designer company to sort out product packaging.

4.5 Trainers and selected trainees also participate in international shows to promote products from the organic farm.

4.6 Field tours are also conducted at the farm to promote eco-farming to interested parties including local and overseas study groups.

5. COMMUNITY RECONSTRUCTION AND AGRO-TOURISM

5.1 In line with the Reconstruction Plan, the various Yonglin Shanlin Organic farm businesses will further be developed into a fully locally integrated industry sector to attract the younger generation to stay back to work and prosper their own respective regions/locality.

5.2 Community reconstruction would continue to improve the quality of life and well-being of the residents allowing them to live in a healthy and environmentally friendly villages and townships.

5.3 Eventually the project is expected to grow into popular agro-tourism and holiday destinations taking advantage of attractive local attractions such as hot-springs, organically produced vegetables and fruits, a healthy living environment inhabited by happy and friendly people.

6. CONCLUSION

6.1 Based on information obtained during the briefing given during the study tour from 13th to 20th November 2016 to various agricultural production units, there is no shortage of expertise in Taiwan for the Yonglin Shanlin Agricultural Farm to establish its eco-friendly organic farm successfully in line with the approved community reconstruction plan - not only to restore the well-being of the residents but also to move further towards development of a model rural agro-industry to promote jobs and prosperity of the local population.

6.2 Foxconn, a huge corporation renowned for manufacturing of various electronic products including Apple iPhones, lends not only financial support, but also its vast network of business contacts to ensure efficient and effective distribution of farm produce. This distribution network, which is open to independent organic farmers who formerly trained at Yonglin, helps to ensure that they can earn a decent income from farming organically.

6.3 With the available expertise and support of the government, it will not be difficult for this project to move further towards making this locality into an eco-friendly holiday destination taking advantage of local attractions such as hot-springs, organically grown fruits and vegetables with pleasant, friendly and happy residents.

VISIT TO YONGLIN SHANLIN AGRICULTURAL PARK ON 19TH. NOVEMBER 2016

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Dayi Agritech Co., Ltd.

11/18/2016

About Dayi Agritech - by Boey Huey Shen

Dayi Agritech Co., Ltd. was established in Taiwan Pingtung Agricultural Biotechnology Park in 2012. Being a subsidiary of Dahan Horticulture Dev. Co. with over 20 years of experience in the industry has given Dayi Agritech an edge specifically in the plant substrate and biofertilizer industry.

Dayi Agritech Co., Ltd.

ABOUT DAYI AGRITECH - BY BOEY HUEY SHEN

| COMPANY PROFILE

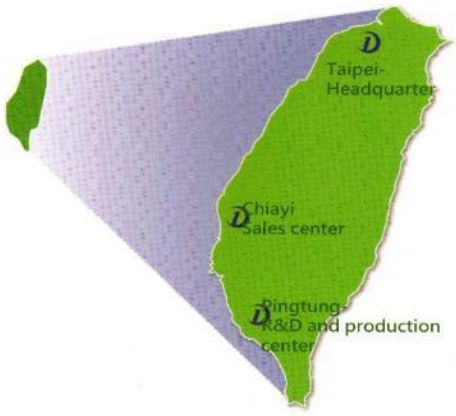
Dayi Agritech Co. Ltd. was established in **Taiwan Pingtung Agriculture Biotechnology Park** in 2012. Being a subsidiary of Dahan Horticulture Dev. Co., Dayi Agritech is formed with a solid foundation from over 20 years of stable development in China. It is currently one of the most advanced fertilizer and substrate production centres in Asia due to its expertise and advanced manufacturing in biofertilizers and substrates.

To ensure the quality of the manufactured products, Dayi Agritech has set up a professional laboratory for physical and chemical analysis. Currently Dayi Agritech is a certified ISO9001 and ISO14001 company and is endorsed by The Taiwan Council of Agriculture.

Dayi Agritech caters to the international markets while trading mainly in Taiwan and China.

It operates at three main locations in Taiwan namely:

- Taipei (Headquarters),
- Chiayi (Sales Center) and
- Pingtung (R&D and Production Center).



The company has an in-depth penetration in the China market with 4 farms and over 6 sales offices around Mainland China.

Due to its core principles of delivering quality products to its customers, Dayi Agritech works hand-in-hand with planters and growers to ensure they are up to date with the market demands.

Dayi Agritech also collaborates with the Taiwan government and academic institutions to enhance R&D efforts in producing better and higher quality products. Such collaborations include the Kaohsiung District Agricultural Research and Extension Station, Taoyuan District Agricultural Research and

Extension Station and the Horticulture Department of National Chung Hsing University.

In Dayi Agritech, ensuring product quality is the main priority.

Thus, the company has taken necessary measures to ensure that the manufactured products are of high quality standards:-

- Dayi specialists visit local factory to supervise the manufacture of raw materials periodically.
- Only raw materials with RHP certification is chosen.
- In accordance with ISO 9001 quality management system, each batch of raw material will be checked by the in-house laboratory.

- In-house R&D facilities.
- Product stability and efficiency is confirmed with repeated trials.
- Tried-and-tested products to ensure successful plant production.

- Computerized management.
- Continuous production to ensure no hiccups in supply chain.
- Automatic packaging of products.

- Each batch will be sampled and kept for traceability.
- Products are analyzed for physical/chemical characteristics.

Peat

- High quality peat materials from Baltic Sea and Irish.
- High pore volume with a favorable pore size distribution.
- Structural stability over time.
- Buffering against shifts.
- Free of pests and pathogens.

Coco coir

- Procedures for safe materials : Aging→Washing→Drying
- Buffered quality is available.
- Recyclable, eco friendly product.
- Free of pests and pathogens.

As plants of various varieties have different substrate and nutrient requirements, a wide variety of substrates and raw materials are available. All of the raw materials are RHP certified to ensure substrates are safe for horticulture activities.

Substrates produced by Dayi Agritech is highly flexible and has a wide range of applications from soil-amendment to soil-mix.

SANXING GREEN ONION FARM

(Yilan County)

Visited 13 November 2016

by Dr Kam Suan Pheng and Jacqueline Foo

The visit by MEOA members to the green onion farm was at a site located near the town of Sanxing in Yilan county, in the north-east of Taiwan.

1 MEOA Members examining the Green Onion fields near Sanxing town in Yilan county

Green Onion, known variously as 'spring onion' and 'scallion', is a symbol for prosperity, good luck, and intelligence in local culture. The Taiwanese word for 'spring onion' is pronounced *cang*, the same sound as that for 'prosperity', while the Mandarin Chinese for 'scallion', *cong*, is the same as that for 'intelligence'.

The green onion is widely used in Chinese cooking for flavouring, and the green onions grown around Sanxing township are prized for their sweet and fragrant flavour that is mildly peppery yet not overly spicy, derived from a long white stem filled with a juicy and sugary glycogen. They are also valued for their texture - tender fibers that give a pleasing crunch. The ideal length of the white stem is between 18cm and 21cm.

Sanxing is located in the western-most corner of a 300-square-kilometer alluvial plain, open to the sea on the eastern side and surrounded by a crescent of mountain ranges on the other three sides supplying fresh mountain water for irrigation. Blue-green fields of green onion stretch as far as the eye can see. The area is environmentally suited to the growing of green onions, with exposure to the sea on one side and a cool westerly wind coming off the mountains, cloud cover which protects from direct exposure to the sun, and a large diurnal temperature range that causes dew formation in the mornings. The area receives high rainfall, so the green onions are planted on high bunds to avoid 'wet feet'. The bunds are mulched with a thick blanket of dried rice stalks which keeps the soil cool in summer, conserves heat in

the winter, and also prevents many types of weed. The deep mulch presumably produces the distinctive long white lower part (about 15 cm) filled with juicy and sugary glycogen that is much prized and fetches high prices. Apparently, the taste and flavour of the green onion is influenced by the type of fertilizer and nutritional supplements used.

In the Sanxing area, green onions are propagated not from seed as in south Taiwan, but from stalks of already cultivated green onions which are transferred into planting holes made in the rice-stalk mulch using a special implement. After three months, each stalk has branched into a bunch of eight and is ready for harvesting.

The harvest is sent to the sales/delivery centre run by the local farmers' cooperative association, from where it is sent on to those supermarkets or wholesalers that have signed annual contracts with the local farmers' association to buy a set amount of the farmers' produce per season. This arrangement guarantees a stable source of income to green onion farmers who see themselves facing higher risks as compared with ordinary green vegetable farmers, whose planting cycles are one month as compared to the three months faced by green onion farmers.

Three rounds of harvest per year is the norm, with one crop every three months and a month in between to prepare the field for replanting. Alternatively, the green onion can also be grown in rotation with rice, when the bunds are removed to form paddies. This could be a good practice to break the pest and disease cycle, particularly when green onions are susceptible to 20 types of pests, and are therefore difficult to grow organically.

The normal wholesale price for green onion is NTD200/kg, and could go as high as NTD1500/kg in the wake of a severe typhoon, as happened recently.

The farm that we visited was called '*Nong Fu Qing Chong Ti Yan Nong Chang*' (or 'Farmers' Green Onion Experience Farm'). In our itinerary, it was listed as an 'organic' green onion farm, but its organic practices were not highlighted for our group – or perhaps we did not ask the correct questions about the farm's organic practices. It is not only an operating farm growing green onion, but like several other farms in Sanxing, it is also run as an agro-tourism facility and hosts busloads of local and foreign tourists. Visitors are first given the hands-on experience of making their own green onion pancakes, seated at long tables with lumps of dough, rolling pins, bottles of oil and bowls of chopped green onion. Having rolled out the dough, sprinkled on the green onion and folded the dough over, visitors then take their pancakes to communal griddles manned by farm staff who fry the pancakes, after which they are handed back to the waiting visitors who can enjoy the fruits of their labour spiced up with chili sauce.

Members making their own green onion pancakes - chopped green onion sprouts wrapped in rolled dough.

Getting the pancakes fried.

Stomachs filled, visitors are next organized to don conical straw hats and appropriately sized wellington boots provided by the farm, before being marched out to the fields for an explanation on the cultivation of spring onions - and the chance to pull out stalks of green onion, some for planting in a planting hole, others to take back to the buildings for washing in a concrete tank (together with the wellington boots) and placing on racks, before departure from the facility. We noticed a roofed-over area near the entrance with fuel-efficient stoves, where visitors can presumably enjoy a meal in the evenings, possibly another hands-on experience.

Members taking a tour of the onion fields - and also harvesting some onion shoots!

As we left Sanxing to return to Taipei, our guide pointed out to us the grand bungalows that had sprung up as weekend homes for the affluent from Taipei. With access from and back to Taipei greatly shortened upon the completion of the tunnel through the mountains a few years ago, the price of farmland in Yilan County – particularly around Sanxing - has shot up in consonance with the demand for land to build weekend homes, so much so that new laws and regulations have been brought in to retain agricultural land for farming purposes.

Most of us were not aware that the distillery for Taiwan's famous and acclaimed single malt whiskey, Kavalan, was very close to Sanxing township. Had we but known, we would surely have asked Professor Ng to include a visit to the distillery in our itinerary. But it was not to be: we had to rush back to Taipei for our visit to 101 Taipei, so the Kavalan Distillery will have to be on the itinerary for our next visit to Taiwan.

Kumquat Production in Yilan

Yilan-Lanyang Kumquat Production Cooperative

Visited 13 November 2016
By Gan Tee Jin

This farmer cooperative in Yilan county, not far from Jiaoxi township, is just about an hour's drive south-east from Taipei - the route was considerably shortened by three hours when the 12.9 km long tunnel through the Hsuehshan (Snow Mountain) Range was opened in 2006.

A silver-haired senior Mr Li, who has extensive knowledge of agriculture and marketing and who returned to Yilan County upon "retirement" to become an advisor to this cooperative involved in Kumkuat, gave us a half hour oral background of the Kumquat industry before showing us his field plantings.

Kumquat growing came from China about 250 years ago, but no one he has spoken to really knows why Yilan County, in the north-east coast of Taiwan, was chosen for this purpose. Today, about 280 ha out of Taiwan's 300 ha of kumquat orchards are in this area. The average size of each orchard is only 0.1 ha, and many are operated by ageing farmers of around 70 years old.

In 1841 during the Chin Dynasty, an expert from China was despatched to teach the local farmers how to preserve the fruits to overcome widespread spoilage. Thereafter the industry expanded. Another growth spurt occurred after 1864, when a Traditional Chinese Medicine (TCM) doctor developed it into a medication for sore throats - this medicinal purpose is still recognised today. Later, a son of this TCM doctor developed kumquat from being an "agricultural" product into a "commercial" or "traded" one. It was not quite clear what Mr Li meant by "commercial" product.

When Japan colonised Taiwan (1895 till the end of WW II in 1945), the third and fourth generation farmers took advantage of the free movement of goods to sell their produce in Japan. Given the good quality of Yilan kumquats, they did well.

The industry suffered a setback during WW II as it was regarded as not essential to the war effort. The decline continued after the war, as the government under Generalissimo Chiang Kai-shek was more intent on retaking China than nation building. Things started looking up when Chiang Ching-kuo, who succeeded his father as President in 1978, encouraged more economic development in the mid-80s while shifting emphasis away from retaking China.

Demand picked up in the 1980s due to improved transport infrastructure and increased tourism. With a limited market size in Taiwan, the industry looked to exports for growth. However, the lack of quality made this difficult as most farmers catered to the processing market, where price was low. Mr Li encouraged them to raise their quality standards and to move to the fresh fruit segment for higher prices and margins. However, he encountered a lot of resistance from ageing farmers.

Finally, he convinced Mr Lin Ting-cai, who now runs the cooperative we visited, to go organic and harvest the fruits by cutting their stalks rather than by plucking (the latter is cheaper and not as acceptable for the processing market). Gradually, others followed suit. In this painstaking way, the price of kumquats rose from NT$8/kg (process fruits) in 2001 to NT$120/kg (wholesale price for organic, fresh fruits) presently. But there's still room for improvement as high-grade kumquats from Japan retail for NT$1000/kg.

At the price of NT$120/kg, farmers are able to earn annual gross income of NT$2 million or more per hectare. That's like 15 times what we get from oil palm! However, the road to success was not easy. To produce good organic fruits, Mr Li emphasised that a farmer had to rehabilitate the soil first, then

improve the health of the kumquat trees before being able to have good quality crop. The transformation required patience and perseverance.

Mr Lin Ting-cai, who looks much younger than his mid-sixties age, showed us around the kumquat orchard which is set on hill terrain.

At the Kumquat Orchard - Lin Ting-cai explaining its cultivation

Two varieties of Kumkuat are grown:-

- the local **Taiwan variety** (*oval* in shape), and the
- the imported **Japanese variety** (*rounde*r in shape, less tangy and sweeter).

Tasting the difference between the Taiwan and Japanese varieties of kumkuat fruit

Their organic fertilizers are mainly from on-farm compost; pest and disease management rely on organic formulations in solution form applied via sprinklers.

During harvest season, they supplement their workforce with the unemployed, who earn NT$170-180 (US$5.35 - 5.66) an hour, inclusive of a NT$50 per hour top up provided by the government. We learnt that government support for agriculture also includes R&D funding. At this co-op, we saw data loggers that collect weather readings, and an experimental plot where they simulate the effects of higher temperature (climate change) by covering a couple of trees with plastic sheets.

Data logger installed near trees to record micro-climate

The section for the export market was covered by netting to protect against fruit flies. A scented trap was installed to mop up any flies that managed to slip pass. An inspection of the trap revealed one dead fly inside, there since six months ago! The first-year yield of this government-funded trial was not affected by the netting, implying that pollination is not impeded.


Trees producing fruit for the export market were covered by netting

At the end of the visit, we were treated to a cold and very refreshing drink of kumquat juice and fresh garden salads dressed with… kumquat! And the salads actually tasted good with it.

More information is available at http://go2taiwan.net/monthly_selection.php?sqno=86, a site which promotes tourism in Taiwan. Apparently, the tunnel through the Hsuehshan Range has led to an influx of tourists and weekenders from Taipei to Yilan.

Some Info on Kumquat …

Kumquats have been called "the little gems of the citrus family". They were included in the genus *Citrus* until about 1915 when Dr. Walter T. Swingle set them apart in the genus *Fortunella,* which embraces six Asiatic species. The common name, which has been spelled cumquat, or comquot, means "gold orange" in China – where they are believed to have originated.

Kumquats (*Citrus margarita and japonica*) are a group of small fruit-bearing trees in the flowering plant family Rutaceae. They were previously classified as forming the now historical genus *Fortunella*.

The edible fruit closely resembles that of the Orange (*Citrus sinensis*), but it is much smaller, being approximately the size and shape of a large olive. Kumquat is a fairly cold-hardy citrus.

In Taiwan, both the Taiwanese or Oval kumquat *(Fortunella margarita)* and the Japanese or Round kumquat *(Fortunella. japonica)* is cultivated.

Description

The kumquat tree is slow-growing, shrubby, compact, 8 to 15 ft (2.4-4.5 m) tall, the branches light-green and angled when young, thornless or with a few spines. The apparently simple leaves are alternate, lanceolate, 1 1/4 to 3 3/8 in (3.25-8.6 cm) long, finely toothed from the apex to the middle, dark-green, glossy above, lighter beneath. Sweetly fragrant, 5-parted, white flowers are borne singly or 1 to 4 together in the leaf axils. The fruit is oval-oblong or round, 5/8 to 1 1/2 in (1.6-4 cm) wide; peel is golden-yellow to reddish-orange, with large, conspicuous oil glands, fleshy, thick, tightly clinging, edible, the outer layer spicy, the inner layer sweet; the pulp is scant, in 3 to 6 segments, not very juicy, acid to sub-acid; contains small, pointed seeds or sometimes none; they are green within.

Taiwanese (Nagami) or Oval kumquat *(Fortunella margarita)* (left); and Japanese (Marumi) or Round kumquat *(Fortunella. japonica)* (right).

Origin and Distribution

The kumquat plant is native to South Asia and the Asia-Pacific region. The earliest historical reference to kumquats appears in literature of China in the 12th century. They have long been cultivated in India, Japan, Taiwan, the Philippines, and SE Asia. They were introduced to Europe in 1846 by Robert Fortune, collector for the London Horticultural Society, and shortly thereafter into North America.

Climate

Robert Fortune reported that the Taiwanese or 'Nagami' kumquat required a hot summer, ranging from 80º to 100º F (26.67º-37.78º C), but could withstand 10 to 15 degrees of frost without injury. It grows in the tea regions of China where the climate is too cold for other citrus fruits, even the Satsuma orange. The trees differ also from other Citrus species in that they enter into a period of winter dormancy so profound that they will remain through several weeks of subsequent warm weather without putting out new shoots or blossoms. Despite their ability to survive low temperatures, as in the vicinity of San Francisco, California, the kumquat trees grow better and produce larger and sweeter fruits in warmer regions.

Propagation

Kumquats are rarely grown from seed as they do not do well on their own roots. In China and Japan, they are grafted onto the trifoliate orange (*Poncirus trifoliata*). This has been found the best rootstock for kumquats in northern Florida and California and for dwarfing for pot culture. Sour orange and grapefruit are suitable rootstocks for southern Florida. Rough lemon is unsatisfactory in moist soils and tends to be too vigorous for the slow-growing kumquats.

Culture

In orchard plantings, kumquats on trifoliate orange can be set 8 to 12 ft (2.4-3.65 m) apart, or they may be spaced at 5 ft (1.5 m) in hedged rows 12 ft (3.65 m) apart. For pot culture, they must be dwarfed; must not be allowed to become pot-bound, and need faithful watering to avoid dehydration and also need regular feeding.

Harvesting

For the fresh fruit market, it has been customary to clip the fruits individually with 2 or 3 leaves attached to the stem. For decorating gift packs of other citrus fruits, or for use as table decorations, leafy branches bearing several fruits are clipped. This practice has been common in Florida but in cooler California the tree is not sufficiently vigorous to stand much depletion.

Keeping Quality

Because of the thick peel, the kumquat has good keeping quality and stands handling and shipment well.

Pests and Diseases

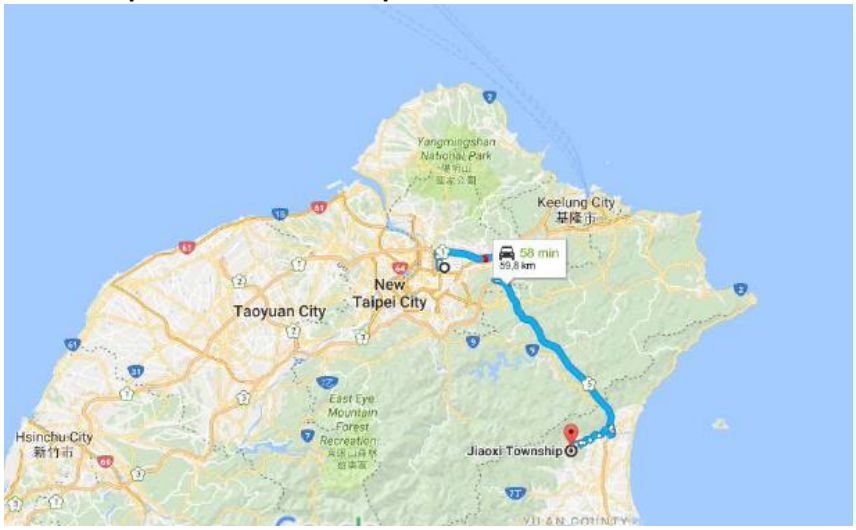
Potted kumquats are subject to mealybug infestations. Dooryard and orchard trees may be attacked by most of the common citrus pests. They are highly resistant or even immune to citrus canker. The following diseases are recorded by the Florida Department of Agriculture as observed on kumquats: scab *(Elsinoë fawcetti* and its conidial stage, *Sphaceloma fawcetti;* algal leaf spot, or green scurf *(Cephaleuros virescens);* greasy spot *(Cercospora citri-grisea);* anthracnose (*Colletotrichum gloeosporioides);* fruit rot, melanose (Diaporthe *citri);* stem-end rot and gummosis *(Physalospora rhodina).*

Food Uses

Fresh kumquats, especially the 'Meiwa', can be eaten raw, whole. For preserving, they should be left until they lose some of their moisture and acquire richer flavour. The fruits are easily preserved whole in sugar syrup. Canned kumquats are exported from Taiwan and often served as dessert in Chinese restaurants. For candying, the fruits are soaked in hot water with baking soda, next day cut open and cooked briefly each day for 3 days in heavy syrup, then dried and sugared. Kumquats are excellent for making marmalade, either alone or half-and-half with calamondins. The fruit may be pickled by merely packing in jars of water, vinegar, and salt, partially sealing for 4 to 5 days, changing the brine, sealing and letting stand for 6 to 8 weeks. To make sweet pickles, halved fruits are boiled until tender, drained, boiled again in a mixture of corn syrup, vinegar, water and sugar, with added cloves and cinnamon, and then baked until the product is thick and transparent. Kumquat sauce is made by cooking chopped, seeded fruits with honey, orange juice, salt and butter.

Source: Wikipedia, Purdue Univ. Agriculture

Route: Taipei to Jiaoxi Township



Kaita Agriculture Farm on "King Guava"

Kaohsiung

Date visited: 19 Nov 2016
By Tan Chee Lan & Sanjay Vohrah

A gigantic tray of freshly cut succulent King Guava and chilled bottles of drinking water pleasantly welcomed MEOA members on arrival at the Guava farm.

Prof Ng introduced the farmer (and host) who stood beside members relishing the guavas. After welcoming us, our host apologetically explained that the succulent porous crunchy guava served was not as sweet because in September 2016, a typhoon had hit Taiwan. The guava trees required time to recover from the adverse effects of the typhoon.

Profile of Guava cultivation at Kaita Agriculture Farm

The area of the King Guava orchard visited was 1.5 hectares. The ground appeared arid. About 1cm diameter tubes for drip irrigation & fertilizing.

The guava plants were planted 4.5 ft. (1.5m) apart on ridges (as the plants would not survive in water-logged conditions). To keep the ground around the plants clean, the fallen leaves were cleared and swept into the furrows.

As equipment and man tramped over the leaves, the mulching leaves would effectively function as a nutrient source to the guava plants. The furrows eased the cultivators' walk along for wrapping fruits (when ping-pong sized), and for harvesting, pruning operations etc. The plants were regularly pruned and maintained at about 4.5 ft height. (1.5m).

The width between two ridges (with a sandwiched furrow) measured about 15 ft. (5m). The grafted plants would start fruiting in about 18 months. No fruiting agent is required. The trees were well fertilized with organic fertilizer once a year and a monthly booster of NPK15:15:15 at an average of 500gm per tree. During the dry season, the plants were watered every 15 days via drip irrigation.

Flower pollination and pest management

As the bees pollinate the flowers, very light pesticide would be used, if at all.
To overcome pests, the fruits (when about 3cm in diameter) were manually wrapped.

In cool Taiwan, there are fewer pest issues - unwrapped fruits would sometimes have brown holes and or a "slight string" of brown lines caused by pests. However, the more serious pest attacks would be on the leaves.

Workforce

A total of 4 workers were engaged in the 1.5 hectares guava orchard.
The per day hours of work was not fixed. Farmer's response to clarification was: "per day one can work 5 hours or 10 hours or not at all". (Presumably family members work together).

Commercially Planting Guava

As some of the plants were 7 generations old, and the trees were not uniform in age, the farmer was unable to answer the question on the yield per tree in his orchard. Nonetheless, it can be calculated using the following variables:-

- the guava plants would mature in 3 years.
- a mature plant would yield 60kg guava per year.
- there would be 800 trees planted on one hectare.

At harvest, the fully matured Taiwan Giant Guava could weigh as much as about 2 kg per fruit!
(Note that the seedless guava and the pink core guava could not fruit in Taiwan because of the cool climate. A warmer climate would be required). Even the leaves of the guava plant could be boiled or dried, simmer in hot water to drink as tonic for the diabetic.

Taisuco

Phalaenopsis operation (in Tainan)

Orchid breeding and mass propagation

Visited 16 November 2016
By

About TAISUCO

Taisuco (the short form for Taiwan Sugar Company) is a government owned corporation with a large land bank allocation that has diversified out of its original involvement in the sugar business and is now involved in multiple sectors of the economy via various business divisions as follows:-

- Sugar Business
- **Agriculture Business** (involved in Phalaenopsis orchid production)
- Biotechnology Business
- Livestock Business
- Hypermarket Business
- Petroleum Business
- Marketing Business
- Leisure Business

We visited Taisuco's Phalaenopsis (orchid) operations in Tainan which comes under Taisuco's Agriculture business division.

Agriculture business division

Taisuco's Agriculture Business division that we visited to see their Phalaenopsis (orchid) operations was in Tainan.

While their Agriculture Business division has 7 Greenhouses nationwide with a total area of 303,000 m^2, the operation in Tainan is a Phalaenopsis Breeding and Propagation Centre with a Greenhouse sized at 5,500m^2

Taisuco was the first company in Taiwan that industrialized Orchid Nurseries having begun this activity in 1987. It currently has more than twelve (12) hectares of automated environment-controlled greenhouses. The Phalaenopsis culture area of this division is >5% of Taiwan total Phalaenopsis culture area. 90% of the Phalaenopsis produced is meant to export.

(There are also overseas branches - in USA (since 2000) and in Canada (since 1996), covering a total of 61,360m^2 which produce only pot flowers).

Breeding and Propagation Unit

The Breeding and Propagation Unit we visited in Tainan covers a total of 3,800m^2

The Greenhouse facilities at the unit includes a Clean Room (class-1000), 140 sets of production laminar flow trays, and an orchid Virus Detection Center.

The facility produces 6,000,000 healthy mericlones annually.


Some of the various varieties of Phalaenopsis

Research Unit

The Research unit uses Tissue Culture techniques to come up with new Phalaenopsis varieties.

The Virus control department is tasked with ensuring that all products are screened and virus free so that they are certified clean for export. RT-PCR virus screening by biochip is done during propagation process. However, they are slowly shifting to use commercial off-the-shelve rapid virus detection kits - a more economical alternative.

The Process of Mericlone Production

The process of mass production of Phalaenopsis via tissue culture is as follows:-

1. Selection of excellent plants to source explants
2. 1st virus screening
3. Spike node cutting (to obtain explant)
4. Culture of node explant
5. Transfer of culture into Mother Flask
6. Multiplication of culture in Mother Flask
7. 2nd virus screening
8. Move to Subculture Flask
9. Move to in-vitro Planting and 3rd virus screening

The important parameters that need to be controlled at various stages of the whole process are:

- Temperature
- Light Intensity
- Humidity

Product Sales & Markets

The Phalaenopsis plants produced in Taiwan mainly to cater for the Japan, USA, Canada and Europe markets, while overseas production is mainly for their local markets.

The Oncidium cut flowers are mainly for Japan (>90%) and the Taiwan local market only.

The orchid flower product ranges from cut flower, flask flower, young potted plants (4.5cm, 7.5cm, 10.5cm and custom size), and blooming plants.

Over the years, the unit has chalked up the following achievements to its credit:

- More than 100 crosses made
- More than 500 varieties carrying "Taisuco" brand has been registered in RHS
- More than 200 awards in many international orchid exhibitions since 1990

Taisuco Phalaenopsis varieties

Cultural Practices for Phalaenopsis when in pots (inside or outside greenhouse)

Managing (Inducing/Suppressing) Flowering

Temperature plays an important role in Phalaenopsis flowering. Generally, 64 °F night temperature and 77 °F day temperature are ideal temperature settings for forcing flowering of most Phalaenopsis varieties in the greenhouse. (Higher temperatures suppress flowering and in commercial greenhouse production, temperatures are kept high to supress flowering till the plant has grown sufficiently and has reached the right size). Uniform spike initiation can be expected in 4-6 weeks from cold temperature exposure, and the plants will be ready for sale in another 3 months with one to two flowers open. Time required may vary, depending on variety and plant condition.

After spike initiation, the time needed for the first flower to open can be manipulated - hasten it by increasing the temperature or delay it by lowering the temperature (depending on when market needs it). However, increasing the temperature will run the risk of getting fewer bud counts (and it definitely incurs additional energy cost), while lowering the temperature might run a risk of bud drop caused by the cold.

Light is also an important factor in determining flower quality. Higher light intensities will give better flowering quality as long as the light does not reach the level of burning the leaves or increase the temperature in the greenhouse too much.

Orchid Care

Phalaenopsis, commonly referred to as the "Moth Orchid," are considered one of the easiest orchids to grow in the home. The long-lasting flowers bloom in together at the same time for up to three months. While the flowering season may vary, the plants can bloom more than once during the year. Phalaenopsis have become one of the most popular varieties of orchids due to their easy care and delicately poised vibrant floral formations.

Optimal Temperature
Day 70 -90°F; Night 60 -70°F.

Watering
Every 5-7 days if growing in bark or every 10 days if growing in sphagnum moss. Keep evenly moist. Avoid wet foliage at night.

Light
Moderate indirect light. No direct sun.

Fertilizer use
Twice a month, less in winter.

Humidity
Phalaenopsis enjoys moist air. About 55-75% humidity is ideal. Humidity can be increased by placing the plant over a tray of water with some pebbles or rocks etc. to raise the pot above the water.

Repotting
Plants should be repotted every other year. Since Phalaenopsis grow upwards, they can be repotted into the same sized pot. Medium grade fir bark works well with the base of the bottom leaf at the surface of the medium. Water is sparingly used until new roots have established.

SUNPRIDE

Phalaenopsis Orchid

Breeding & Production

ROYAL BASE CORPORATION

(Taiwan)

www.sunprideflora.com

ROYAL BASE CORPORATION

A company specializing in Phalaenopsis orchid variety breeding, production, and marketing & sales under the brand name "SUNPRIDE"
(http://www.sunprideflora.com/Video.aspx).

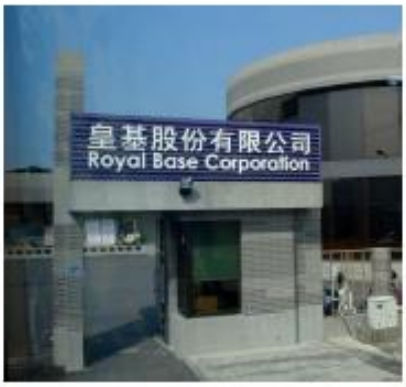
Main Products: Phalaenopsis tissue culture (flask plants), young plants, flowering plants and cut flowers.

The Royal Base Group (estb 2003) has its headquarters in Taipei which manages global sales and marketing of Phalaenopsis orchids, as well as two mass production sites:-

- The one located in Chuanghua (Taichung county) in Taiwan does breeding, tissue culture lab, young plant production and new products development.
- The other, named Apollo Farm and located in Dalat, Vietnam, is responsible for cut flower and young plant production (http://www.apolloflora.com/EN_about.asp).

The company has also established a Branch office in the US in 2007.

The Royal Base Group is the first and only corporation in Asia to have received all three certificates - MPS-ABC, MPS-GAP, and MPS-Quality – in recognition of operating its businesses in an environmentally and socially responsible manner.



ROYAL BASE CORPORATION

Phalaenopsis orchid production - "Sunpride"

http://www.sunprideflora.com/Video.aspx

Specializes in Phalaenopsis orchid production across the value chain from breeding to production to sales and marketing domestically and globally.

Flowering plants

Cut flowers

Young plants

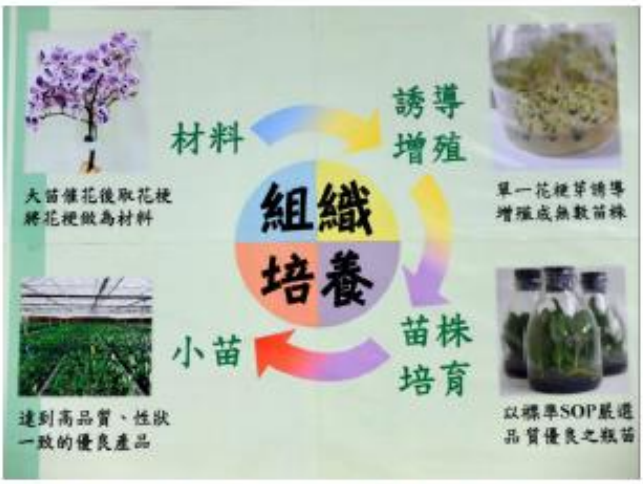
Tissue-cultured plantlets

TISSUE CULTURE FOR MASS PRODUCTION

Mass production of the orchid plants is done using tissue culture techniques.

Plant tissue culture is a collection of techniques to grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. Plant tissue culture is widely used to produce clones of a plant in a method known as micropropagation.

Tissue cultures are initiated using spikes with active meristem tissue.



Phalaenopsis orchid propagation is through auxiliary shoot multiplication that is conducted within a strictly controlled laboratory system.

ORCHID BREEDING

Average of 300 new varieties produced by breeders each year.

New varieties are selected for:-

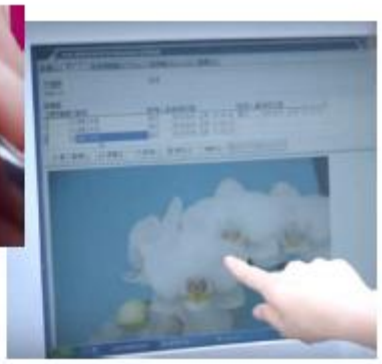
- aesthetics
- ability to withstand long transportation period (free from bud-dropping problems)
- long vase life

While having a large collection of varieties of varying colours, patterns and sizes, its breeding program focuses on the midi-size Phalaenopsis varieties that are suitable for home and office spaces and as gifts.

Detailed data on each variety is captured in customized computer programs.

Breeding strategy

Breeding process



Computerized data documentation

TC Production Process

The company carries out tissue culture using high-class facilities within a strictly controlled laboratory process system to ensure well-scheduled bulk production of healthy, virus-free Phalaenopsis plantlets with low mutation rates.

In order to produce good quality Phalaenopsis flask plants, certain procedures are strictly and carefully performed for quality control and assurance.

(For contract-based tissue culture production, the company provides a production schedule according to customers' request 6 months after receiving the spikes and numbers of sub-culture cycles are also determined to ensure production quality and quantity).

THE TC PRODUCTION PROCESS

STEPS INVOLVED

The process of mass production of Phalaenopsis via tissue culture is as follows:-

- Selection of excellent plants to source explants
- 1st virus screening
- Spike node cutting (to obtain explant)
- Culture of node explant
- Transfer of culture into Mother Flask
- Multiplication of culture in Mother Flask
- 2nd virus screening
- Move to Subculture Flask
- Move to in-vitro Planting and 3rd virus screening

The important parameters that need to be controlled at various stages of the whole process are:

- Temperature
- Light Intensity
- Humidity

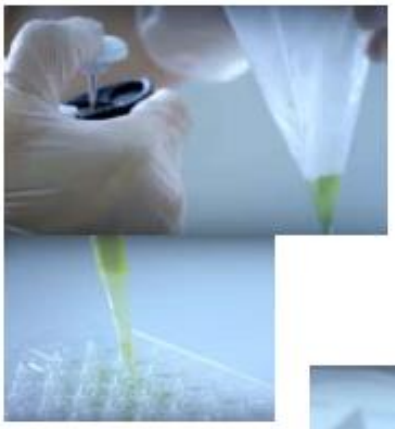
Strict Mother Plant Selection

Proper selection of mother plants for tissue culture propagation is emphasized, the plants are being strictly selected by their flower, leaf, and overall plant appearances for good characteristics and without mutation.

- Furthermore, the plants are tested by ELISA and RT-PCR for virus free material.
- The mother plants are renewed with new plants regularly for the material vitality.

VIRUS INSPECTION & DETECTION

...utilizing RT-PCR and ELISA lab procedures



Healthy Plant Production

Every spike of the mother plants is tested by virus detection individually.

During the first stage (initiation of explants, establishment of mother plant from meristem of nodes in spikes), two types of RT-PCR virus testing are performed - for ORSV and CymMV virus detection.

After the material is determined clean and virus free, it can be used in tissue culture propagation.

Virus detection screen will be implemented again at the last stage (stage before acclimation) of tissue culture propagation for guaranteed delivery of virus free healthy flasks.

MEDIUM PREPARATION

Preparation of stable medium with specific plant hormone concentrations for each variety is carried out in high-volume medium mixers.


High volume medium mixers

Stainless steel mixing container with paddle stirrer

MEDIUM PREPARATION (Dispensing)

Dispensing of the plant growth medium into culture bottles is automated.

Automatic medium dispensing machine into flasks

AUTOCLAVING

High-volume autoclaves are used for sterilizing the culture bottles containing the growth medium, as well as sterilizing the cutting utensils.

High volume autoclaves can accommodate customized bottle racks

Cutting utensils are autoclaved as well

WASHING & STORAGE AREA

The washing and storage area has automated bottle washing machines and ovens (besides storage space and trolleys customized to accommodate the trays of culture bottles).

Bottle washing machines

... similar to that produced by Yih Shyang Agro-machinery & Automation factory in Chiayi

Washing area

Customized trolleys

PREPARATION FOR ENTERING THE CLEAN AREAS

Staff follow strict measures to change into clean attire, scrub their hands and arms and go through an air curtain in the buffer area before entering the clean areas where the cutting and bottling of the plant tissues are carried out, which are maintained at 99.9% germ-free.

Lockers for laboratory staff

Buffer area with air vents

TRANSFER ROOM has 50 laminar flow cabinets

The transfer room is where the plant tissue / cultures are successively separated for multiplication under clean conditions. The cutting is carried out in laminar flow cabinets with one trained staff per station.
With 50 laminar flow cabinets, the production of TC plantlets is about 2 million per year.
This works out to be 166,667 plantlets per month, or 6410 plantlets per day (assuming 26 working days per month),
or 128 plantlets per worker (assuming 50 workers using all available laminar flow cabinets) per 8-hour working day (without shift work)

Staff wear caps, masks and covered shoes

CUTTING & CULTURING

Sterilized stainless steel utensils are used for cutting

Limited Sub-Culture Cycles

When the Phalaenopsis chromosomes are experiencing fast multiplication during mitosis (i.e. cells dividing multiple times), incomplete division can easily occur and result in mutations.

Limiting sub-culture cycles in combined with stable culture medium can prevent mutation. As such, for true to type propagation, each meristem material is limited to 10 sub-culture cycles. The mutation threshold is set at 10%.

Culture bottles are made of glass for better light transmission and are narrow necked for reducing exposure to contaminants

BARCODING FOR TRACEABILITY

Barcode System

To avoid confusion of the varieties, a barcode system is used throughout the whole tissue culture production process.

From the reading of the barcodes during the operation process, the operator can ensure the labels on first stage bottles match with last stage bottles.

Barcodes used for identifying

- variety,
- cutting
- cycle, operator,
- date,
- etc.

Barcode information is captured for documentation

CULTURE ROOM

The culture bottles containing the plant tissue are kept in air-conditioned culture rooms with regulated temperature and lighting conditions.

Floor-to-ceiling, broad racks, with arrays of dual fluorescent lights

Greenhouse Climate Control System

The greenhouse is equipped with the automated Priva environmental control system, a drip irrigation system, and a hydraulically-driven moveable container tray system to move plant batches through different climate control zones.

- **Temperature**
  - During cultivation stage, the temperature is:
    - set at **25°C or above** during 1.7" and 2.5" pots stages.
    - maintained at **27°C or above** for the 3.5" pots stage
  - in order to prevent the plants from early spike induction (which would progress to premature flowering)
  - [To initiate flowering, drop temperature below 22 to 24oC].

- **Light Intensity**
  - In order to produce young plants with strong healthy leaves, with light-green and yellow-green leaf color, each stage is subjected to a particular light intensity.
    - For 1.7" and 2.5", the light intensity for de-flasked young plants is between 3,000 to 5,000 lux according to the young plant condition. After a period, it will increase to 5,000 to 8,000 lux (PAR 100 – 150 umol/m2.s.)
    - For 3.5" pots, the light intensity will be around 8,000 to 20,000 lux (PAR 150-350 umole/m2.s.)

- **Relative Humidity**
  - The Relative Humidity in the greenhouse during daytime can be as low as 50%. Phalaenopsis belongs to the CAM plant family with the characteristics of stomata close during the day time and open at night time. The plant is not affected by low humidity in the greenhouse during the day.
  - At night, the Relative Humidity needs to be controlled between 70-80% as this benefits the plant growth and disease control.

- **Watering (Irrigation)**
  - The automatic irrigation system improves irrigation efficiency and ensures even water distribution to the plants. Irrigation frequency is based on the climate and plant growth condition. Watering is carried out every 7 to 10 days. At initial cultivation period, medium is recommended to be slightly wet - not damp. It is advisable to apply less dosage during each watering but to water multiple times to enhance root induction.

GREENHOUSE FACILITY

The grow-out facility at the Chunghua site comprises 1.7 ha of 6m high glass greenhouse with Dutch environmental control system (by Priva) that monitors internal and external climate and optimizes the greenhouse environment for Phalaenopsis growth while being energy efficient.

Retractable shades

Accordion roof windows

Fully automated environmental monitoring and control

GREENHOUSE INTERIOR

ACCLIMITIZATION

The TC plantlets that are ready for planting are brought out into the acclimatization area adjoining the greenhouses and allowed time to adjust to higher temperature conditions outside the culture room.

The subsequent planting process and duration depends on the product to be sold, whether as:

- flask plants,
- young plants,
- flowering plants or
- cut flowers.

POTTING PLANTS

Successive **potting** is done at three stages, using 1.7", 2.5" and 3.5" diameter pots:-

- During 1.7" stage, only sphagnum moss is used to preserve moisture and for root initial development.
- For the 2.5" and 3.5" stages when the roots are already developed into a strong root system, too much moisture can damage the root system. Therefore, bark with good air ventilation and water drainage is used, and is mixed with small sphagnum moss pieces to maintain moisture and fertilizer.

Potting mix machine

Fertilizer used is Peters 20-20-20 All Purpose fertilizer with extra iron, calcium, magnesium, and boron.
The fertilizer concentration is adjusted for different growth stages:

- During 1.7" stage, low concentration of fertilizers is applied with 40 to 50 ppm nitrogen to enhance root system development
- After transplanting into2.5" pots, the nitrogen concentration is increase to 70 to100 ppm
- At the 3.5" pot stage, the nitrogen concentration is increased to 150 to 200 ppm

The company is also a distributor for these two substrates imported from New Zealand.

Pine Bark substrate

Sphagnum Moss substrate

DELICATE PACKAGING

Delicate packaging is done and strict temperature control maintained during shipping - cooling to tropical countries, heating to temperate countries.

Young plants

Flowering plants

Cut flowers

DISPATCHING

Dispatch is carried out following a strict schedule and a well-built logistics networking.

Cultural Practices for Phalaenopsis when in pots

(inside or outside greenhouse or in buildings)

Managing (Inducing/Supressing) Flowering

- Temperature plays an important role in Phalaenopsis flowering. Generally, 64 °F night temperature and 77 °F day temperature are ideal temperature settings for forcing flowering of most Phalaenopsis varieties in the greenhouse. (Higher temperatures supress flowering and in commercial greenhouse production, temperatures are kept high to suppress flowering till the plant has grown sufficiently and has reached the right size). Uniform spike initiation can be expected in 4-6 weeks, and the plants will be ready for sale in another 3 months with one to two flowers open. Time required may vary, depending on variety and plant condition.

- After spike initiation, the time needed for the first flower to open can be manipulated - hasten it by increasing the temperature or delay it by lowering the temperature (depending on when market needs it). However, increasing the temperature will run the risk of getting fewer bud counts (and it definitely incurs additional energy cost), while lowering the temperature might run a risk of bud drop caused by the cold.

- Light is also an important factor in determining flower quality. Higher light intensities will give better flowering quality as long as the light does not reach the level of burning the leaves or increase the temperature in the greenhouse too much.

Optimal Care of Mature Orchids

Orchid Care

Phalaenopsis, commonly referred to as the "Moth Orchid," are considered one of the easiest orchids to grow in the home. The long-lasting flowers bloom in together at the same time for up to three months.

- While the flowering season may vary, the plants can bloom more than once during the year. Phalaenopsis have become one of the most popular varieties of orchids due to their easy care and delicately poised vibrant floral formations.

- **Optimal Temperature**
  Day 70 -90°F; Night 60 -70°F.

- **Watering**
  Every 5-7 days if growing in bark or every 10 days if growing in sphagnum moss. Keep evenly moist. Avoid wet foliage at night.

- **Light**
  Moderate indirect light. No direct sun.

- **Fertilizer use**
  Twice a month, less in winter.

- **Humidity**
  Phalaenopsis enjoys moist air. About 55-75% humidity is ideal. Humidity can be increased by placing the plant over a tray of water with some pebbles or rocks etc. to raise the pot above the water.

Repotting
Plants should be repotted every other year. Since Phalaenopsis grow upwards, they can be repotted into the same sized pot. A medium grade fir bark works well with the base of the bottom leaf at the surface of the medium. Water sparingly used until new roots have established.

Thank you !

ROYAL BASE CORPORATION
(Taiwan)

www.sunprideflora.com

VISIT TO SHINING BLACK FUNGUS FARM

Date visited: 16 Nov 2016

By Ong Soo Cheng

Shining Organic Black Fungus Farm is located at No. 28, Xikuo Village, Zongpu Township, Chiayi County 606.

Zongpu Township is an excellent black fungus production area in South Taiwan which produces 70 – 80% of **Taiwan Black Fungus** (Auricularia polytriche). The favorable sub-tropical climate, with high humidity and good rainfall coupled with diligent agriculture entrepreneurship and strong government support are contributing factors to the success story of black fungus cultivation in Zongpu Township.

We arrived at Shining Farm at 1.00 pm and the farm's owner was ready to receive us at the entrance. The owner, Mr. Chuang in his late thirties, is a second-generation farm owner who inherited what was a very traditional farm started by his father. A diligent and enterprising agriculturist, he has managed to transform the traditional farm into a sizable commercial organic black fungus production centre.

The farm we visited was one of the 6 facilities owned. Daily production of wet fungus from the 6 farms total 6000 kg with centralized processing done at the centre that we were visiting.

We were taken immediately for a tour of the farm by Mr Chuang who briefed us on its operations.

The briefing is summarized as below:-

1. **Preparation of Substrate**

   Just like mushroom, preparation of substrate is the first step in black fungus cultivation. Substrate is make up of sawdust, soy and barley meal with shell fish derived materials added as N source.

   Sawdust from Acacia Mangium is left to decompose for a year before being used to mix with soy and barley meal for bag filling.

2. **Bag Filling**

   Bag filling is done by semi-automatic machine which can bag up to 10,000 pieces of 30 x 12 cm Ø clear polypropylene bag per day. Four (4) workers sitting beside the semi-automated machine are busy filling the bags, insertion of small plastic plugs, bag tying, arranging the bags in trays and loading the trays of bags 9onto movable racks/carts.

3. **Sterilization And Inoculation**

   Filled bags on movable racks / carts are sterilized in chamber at 121º C for 12 hours to kill whatever microbes in the substrate. Sterilize bags are kept in cooling room, to be inoculated with the spawn of black fungus when the temperature has gone down to 10 - 15ºC. Inoculated bag is also commonly called space bag by local farmers.

4. **Growing / Cultivation**

   The growing shed is constructed with cement floor and metal roofing sheet support by metal posts. Black UV resistant fabric netting is used as side cover, allowing very little light penetration and providing the necessary dark environment required for fungus growing. Another layer of canvas is used to regulate the temperature of the growing shed. Together with watering system

installed inside and outside the shed, temperature is maintained at 20-25º C while humidity is kept at 70-80%. Temperature determines the growth rate while humidity controls the quality of the fungus produced.

Inoculated space bags are arranged on metal rack for spawning. Spawning is a process where the thread like white filaments spread to colonize the substrate in the bag. This process takes about 1 1/2 - 2 months to complete. After successful colonization, the bags are cut at the top end for the emergence of primordial. It takes about 5-7 days for primordial to emerge. This primordials grow rapidly to mature fungus within 15 – 20 days in summer. It may take up to 30 days during Winter due to the cooler climate. Each space bag can produce up to 4 flushes over the growing cycle of about 5 months.

5. Harvesting / Sorting / Packing

Harvested black fungus are sorted at the sorting yard where the workers sit o low stools, pick up the fungus, trim the stems and separate the fungus according to size.

6. Final Products

Organic black fungus from Shining Farm is ISO 9001 and CAS certified. It has a readily market in fresh form which fetches NTD 70-100 per kg. Any excess is sun dried and sells at NTD 500 per kg. At the conversion rate from wet to dry of 15:1, wet organic fungus commands a very high premium. The latest addition is production of black fungus drink which is marketed as a health drink under the well-known name of Good Moni.

7. Waste Recycling

Spend substrate is separated from bag, make into compost as organic fertilizer for orchids and vegetables farming.

Shining Farm is a very efficient and productive organic black fungus production enterprise. High yields, good quality, direct marketing and a tie up with agrotourism, contributed an annual revenue of more than NTD 100 million. With 40 workers on the payroll, each contributes up to NTD3.0 million in revenue per year. (USD 1 = NTD 30.12)

Note: *This write up is based on site visit and briefing by farm owner. It may differ from information obtained from other sources. 08/12/2016*

Agricultural Machinery Manufacturers

IE-IE Co. Ltd. and Yih Shyang Co. Ltd.

Visited 14 & 16 November 2016
By Leslie Ong

IE-IE Co. Ltd. - cultivation and soil preparation machine manufacturer

On our second day of the MEOA Taiwan Agriculture Tour, we visited IE-IE Corporation in Taipei, a company that focuses on agri-machinery manufacturing (cultivation and gardening machines).
The company was founded in 1970 where it began by distributing and maintaining Japanese agriculture machines (e.g. Kubota, Mitsubishi). By 1998, IE-IE Corporation had developed its own factory and were designing its own agricultural machines under its in-house "NINCHINO" brand. Over the years, the company has invested heavily into R&D for their products and have also looked to broaden their market presence. Their efforts proved fruitful as by 2015, IE-IE Corporation recorded overseas sales surpassing 50% of total sales volume. Currently, their products can be found across SE Asia, China, Europe, and the United States, to name a few.

During the visit, we toured their factory which focuses on metalworks and assembly of the various agricultural machines within their portfolio. The NINCHINO agricultural machines are primarily designed for cultivation and are hand-operated. There are a few function-specific machines including a cultivator for ginger plantations and a hand-held cement mixer. Targeting small to medium farms, all products are marketed based on their portability and ease-of-use, and have benefited from IE-IE Corporation's investment into designing a hardy gearbox.

Parts Assembly area at the factory

The cultivators serve various functions including banking, weeding, ploughing, soil loosening, tiling and furrowing. NINCHINO offers a range of agricultural machines differing in engine size, functional capabilities and various accessories (e.g. paddy field wheels, weeding wheels) to suit the user's needs. With a single machine, a user can cultivate between 1 to 3 acres of land.
For more information, please visit www.ietw.com.tw

A NINCHINO cultivator

Various types of NINCHINO cultivation and soil preparation machines

Yih Shang Co. Ltd.

Our fourth day of the MEOA Taiwan Agriculture tour started with a visit to Yih Shang Corporation, a company with over 40 years of experience in developing machines for rice farming and over 20 years of experience for vegetable farming. The company has also worked with Malaysian rice companies for over 10 years.

The main types of agri-machines developed by this company has sought to automate two main processes:-

- seed sowing into pot-trays and
- in-field planting of seedlings from the pot-trays

Automated seed sowing machine

A novel approach to sowing seeds, the automated machine works on a conveyor belt system which carries (shallow) pot-trays along various stages before depositing the finished sowed seed trays for collection.

A brief overview of the steps involved:-

1. Pot-trays are stacked and placed onto the machine
2. Machine fills each tray with soil, levels the soil, and creates indents for the seeds
3. To place the seeds, individual needles pick up the seeds from an attached tray using suction, before depositing it into the pot-trays
4. The next stop along the conveyor system involves levelling the soil again to cover each seed
5. Water is administered to the pot-trays
6. Completed (seeded) trays are stacked in groups of five and are removed from the end of the conveyor system

Within an hour, approximately 3,000 trays can be sowed, with each pot-tray holding 128 'pots' in an 8 × 16 grid format.

The automated seed sowing machine can be used to sow a variety of seeds (seed types/sizes) due to the interchangeability of the needles used – a total of 10 different needle gauges are available; and customisation is also available for different pot-tray configurations.

Hydroponics seed sowing

In a similar fashion, a modified version of the seed sowing machine is used to deposit seeds into hydroponics foam pads (instead of pot-trays). The unit is substantially smaller compared to the non-hydroponics counterpart, but it can sow 160 foam pads within an hour, which each pad housing 96 seeds.

Tissue culture flask washer (for use in Tissue Culture plant production systems)

Another machine was tailored to clean the interior of tissue culture flasks. Acting like a domestic dishwasher, tissue culture flasks are placed in trays (20 flasks per tray) which enter the machine. The machine flips the tray over onto various brushes which enter and clean the interior of the flasks. A total of 120 trays of flasks can be cleaned using the machine within an hour.

In-field Planter machine

We were also shown a working demonstration of an automated in-field planting machine.

The machine requires three personnel to operate, namely, a driver and two personnel to manually load the seedlings from the pot-trays into the machine's feeder. With this set-up, the machine can plant four rows of seedlings whilst driving due to the automated planting 'spike' which pierces the soil and drops a pre-loaded seedling.

A brief overview of the steps includes:-

1. Pot-trays are stacked on a rack towards the back of the machine
2. Two personnel extract the seedlings from the pot-trays and place them into 'cups' attached to the machine
3. The seedlings automatically drop from the 'cups' into the planting 'spikes'
4. The planting 'spikes' pierce the soil and deposit a seedling
5. Water is administered to the plant from two on-board tanks

Overall, it was interesting to see the various machines efficiently designed to tackle what would be labour-intensive tasks.

Automated seed sowing machine

Pot-trays being filled with soil

Seeds selected by needles using suction and planted into soil-filled pot-trays to germinate

In-field Planting machine

In-field Planter

Seedlings being transferred from planter pot-trays into the ‘cups’ of the planter machine

The Planter machine drops the seedlings into/on the ground - in 4 rows

Automated Tissue culture flask washer (front & back) - another product the factory also makes!

Aquaculture – Tilapia breeding and cultivation

Yihua **Aquaculture Farm** *(Tainan)*

Visited 17 November 2016
By Amit Guha

Yihua http://www.ty2.com.tw/en/en.html

Yihua is a Tilapia breeder farm. It produces the following tilapia fry types for sales to commercial aquaculture farms (locally and overseas):-

- Single-Sex tilapia fry,
- Native Black tilapia fry,
- Red tilapia fry and
- Transgenic Black tilapia fry

The company was founded in 1969 by Yi-hua, who while still active in the business, it is now run by his son Michael.

Founder Yi-hua with a new breed of Tilapia bred to survive in brackish water.
It has a different shape from the traditional tilapia (larger and flatter in shape) and is marketed as Asian Bass!

Prior to visiting the ponds, Michael informed that the Food and Agriculture Organization (FAO) estimates that by 2030, the world's average consumption of fish products will rise from 16.7 kg to 19 to 20 kg per person per year. Therefore, the industry in Taiwan needs to increase the added value of the Taiwan Snapper (localized Tilapia variety) in following this industry growth and development trend.

Tilapias growing in aerated ponds

In Aquaculture, the main emphasis is on water quality management – as a good water quality environment will not promote diseases.

Ideal Water Conditions for the local Tilapia (called Taiwan Snapper):

- Water Temp: 24 – 35 ^{o}C
- pH: 6.8-8.5
- D-O_2: > 5ppm
- NH_3 < 0.05 ppm

However, the "wuguo" variety (a specially bred Taiwan tilapia) fish that Yihua produces can tolerate a more extreme range of water conditions:

- Water Temp: 16-35 ^{o}C
- pH: 5-11
- D-O_2: min 1ppm
- NH_3: max tolerable is 2.4ppm

Therefore, the locally bred "wuguo" Taiwan Snapper (tilapia) variety can tolerate more adverse water conditions including colder temperatures and more unclean waters.

About a month before the "Cheng Ming" festival after Chinese New Year (Cheng Ming is in March most of the time), water temperatures in South Taiwan reach 25^{o}C which will lead to fry hatchings. Breeder farmers (such as at Yihua) will then harvest the fries and sell to downstream farmer growers after a sorting and screening (quality control check) process. The fries are sold in polypropylene cold-resistant bags where the temperature is controlled at about 20 ^{o}C and pure oxygen added into the bag. Each bag can fit 20K fries.
The downstream growers who buy the fries from Yihua will grow the fish in their own ponds and on reaching maturity will market the fish to retailers/consumers.

Diseases of the Taiwan Snapper

Streptococcus:

- A wide range of this class of bacteria develops well at high water temperatures.
- Causes red blood cell destruction, internal organ bleeding, intestinal disease, and festering in Taiwan Snapper.
- Dead fish will cause massive infection.

Rickettsia:

- Often outbreeds during low water temperatures.
- Causes loss of appetite; fin base and anus turn red; skin, grill ulcer and protruded eyes.
- Anatomically, visible shows the spleen, kidney, liver, gills, ovaries appearing with grey nodules.

About 10 years ago, Chiayi University Professor Zhang Wenxing had developed a drug to stimulate high resistance to streptococcal breed of bacterial infections of Tilapia.
Yihua farms now regularly "immunize" their breeder fish with this drug.

Fish being injected with drugs to stimulate disease resistance

Fish being checked for disease

SWOT Analysis of Taiwan's Tilapia Aquaculture Industry

Strengths:

- Taiwan is currently 2nd in the world in terms of export value - its aquaculture production is only 3% of the world's total, but export value is 10% of the global export value.
- Taiwan has mastered the art of fish breeding - Taiwan is currently breeding high quality Taiwan Snapper.
- Matured and professional breeding and development skill - high food conversion rate and increased disease resistance, with top notch "all male" fries breeding skill and techniques.
- Excellent aquatic processing technology and production system – has gained a reputable track record to support marketing efforts. Also, has enhanced the food safety and product quality processes.
- "Taiwan Snapper" brand establishment for locally bred Tilapia: The creation of high-quality image in the world, particularly in the United States which is an important importer. It has become one of the fish species used in Japanese sashimi.

Weaknesses:

- Limited production capacity in Taiwan.
  - At present, Taiwan's Snapper species get the highest yield in Taiwan's aquaculture industry. But Taiwan's farming area is limited, and therefore significant increase in production is difficult.
- High cost of production and conservative management.
  - Compared with China and South East Asian countries, Taiwan's land and labour costs are high, and each household farming area is small. Also, funds are not concentrated, and so the scale of operation is limited.

Opportunities:

- Reduction in global marine fish reserves - but the global demand for fish continues to increase.
- Consumers are increasingly receptive to Taiwan's Snapper - and consumers in Europe, United States and the Middle East love its advantage of being easy to cook.
- Most other countries are just beginning to emphasize on their production and marketing track record. This favours strong product quality control procedures to expand the market for the Taiwanese Snapper.

Threats:

- Aquaculture has a low barrier of entry - Taiwan Snapper's strong adaptability to the environment, ease of breeding and rapid growth are also the criteria considered by developing countries and therefore much sought after. Therefore, competitors are increasing.

- China and South-East Asia have lower costs - their production had increased tremendously.
- Taiwanese entrepreneurs ventured into China and South-East Asia and directly helped to improve their technical knowledge levels and transferred this farming technology.
- The standard of drug residue testing has increased – this has led to increasingly strict standards of food export and as such, the increase of testing items and the increase in breeding costs.

Yihua - *Taiwan Tilapia and Unisexual Tilapia Breeder Fish Farm*
Operator:

Michael
T (06) 783-3989
E ficus1121@hotmail.com

LIANG KAO ECO-AQUACULTURE FARM

(in Tainan County)

Visited 13 November 2016

by Jacqueline Foo

This is a family-run aquaculture farm of 5.73 Hectares, with 13 ponds used for the rearing of Eel (in 5 ponds covering 2.5 Hectares), Hybrid Tilapia or "Taiwanese Snapper" (in 5 ponds of area 2.2 Hectares), and mixed rearing of Whiteleg Shrimp and Milk Fish (*Chanos chanos*) (in 3 ponds covering 1.03 Hectares).

Signboard at aquaculture farm entrance

Layout Plan of aquaculture ponds at the farm

Non-pond areas of the farm are utilized for a rustic-looking exhibition hall show-casing numerous information posters on hundreds of species of fish, while a small area fronting the main access road serves as a restaurant, with the owner's wife and daughters cooking and serving home-style cooked dishes.

Initially, integrated farming of fish and vegetables was attempted, but the farming of vegetables was dropped due to problems with pests and diseases, and the owners decided to focus solely on aquaculture.

The farm employs 10 workers, and annually harvests approximately 50 Metric Tons of Eel, Tilapia, Whiteleg Shrimp and Milk Fish.

It prides itself on its eco-friendly aquaculture practices, which involve:

- using pelleted fish feed, and *kangkung* grown in the ponds to feed Tilapia when the fish density is lower;
- restraint in using chemicals for disease control unless absolutely necessary, when only government-approved chemicals are used;
- manual weeding to avoid the use of herbicides.

The farm can boast a number of certifications such as ISO 22000, Taiwan Good Aquaculture Practice (TGAP), SQF 1000 (Safe Quality Food) certification awarded by the SQF Institute, and certification by the Aquaculture Stewardship Council (ASC) – the global standard for responsible and sustainable aquaculture, which so far has been awarded to only 24 farms in the world.

Eels

The Eel is a fresh water fish that is active at night. Of the four (4) eel species, the Japanese eel (*Auguilla japonica*), with a dark dorsal fin (top, facing water surface) and white ventral fin (facing downwards), also known as "white eel", is most suited for Taiwan growing conditions and enjoys a good market in Japan (as *unagi*).

This freshwater Eel spawns in the sea and migrates into fresh water to complete adulthood. It then migrates out of fresh water back to the sea to its spawning area. After spawning, it dies. The Eel is famous among the various species of fish as a "long distance traveller", swimming over 5,000 kilometers from the fresh water area where it grows into an adult to reach its spawning grounds in the ocean.

As breeding in captivity of this Eel species is not yet established, eel fry is collected from the wild in the sea off the Yilan area (north-eastern Taiwan). The fry's are available for about a month from the winter solstice. Collected fry are transferred to the ponds and grown out for one (1) year to marketable size of 200-300 g/fish (or 4 fish/kg). They are fed on pellets specially formulated for eels. The age of an eel can be measured by the number of rings on its scales, with one ring denoting one year of age.

Eels are harvested by concentrating the fish in a net drawn to the pond's edge and, with the use of suction pumps, sucking the eels into a clean-water holding area where they are hand-selected for size and packed for export.

Pond hygiene is practised every 12-18 months when the pond is drained. The pond mud may be retrieved and used as fertilizer for algae culture, and the soil in the pond is allowed to dry out.

Prof. Ng educating members on the technical aspect of aquaculture

One of the aquaculture ponds at the farm

Hybrid Tilapia

The hybridization of Oreochromis spp. with Tilapia spp. has produced the 'Taiwanese Snapper" or "Taiwan Tilapia", an improved version of the "Ng Kok Fish" or Cichlidae (originating from Africa) which was brought in from Singapore in 1946 by two gentlemen - Ng Chen Fei and Kok Kai Chang - and named after the both of them.

Research and development conducted at the National Chiayi University has produced disease-resistant tilapia strains by identifying and introducing the gene for resistance to the common diseases to which Tilapia are most susceptible, and using external stimuli for gene expression rather than by genetic engineering. As this species has a strong immune system, adapts easily to most environments and is omnivorous, it is one of the most popular types of fish for farming,

Taiwanese snapper or Taiwan Tilapia can only spawn in warm water with temperatures above 20°C. The spawning season is from March to November every year, with April to September being the most active period. Stocking density averages 10,000-15,000 fingerlings in a 30meter x 30meter pond. Single stocking takes place in March/April, resulting in multiple harvests throughout the year. Shrimp are introduced into the ponds to scavenge and keep the pond bottom clean.

The Taiwan Tilapia grows quickly and enjoys a high rate of propagation. It reaches a marketable size of 300-400 grams in 6 months, but is often reared until it reaches larger sizes, with 12-month-old fish averaging 800-1,000 grams, and 18-month-old fish averaging 1,200-1,500 grams.

In order to catch the fish, the net is cast in the pond and gradually pulled into a rectangle shape with the fish caught in the net. The fish are then placed in plastic pails before being transferred onto trucks for weighing, after which they are kept alive in tanks with ice and oxygen, and transported by truck to wholesalers or process factories according to the sizes specified by the buyers.

Whiteleg Shrimp

The scientific name for this species of shrimp is *Litopenaeus vannamei***.** It is also commonly known as "Pacific whiteleg shrimp". It originates from the eastern Pacific (off El Salvador, Guatemala, extending from the Mexican state of Sonora as far south as northern Peru), and has been introduced as a culture species into Southeast Asia as an alternative to the Tiger Shrimp (*Penaeus monodon*) that increasingly faces disease problems (particularly the while spot syndrome virus) under culture. Farming of Whiteleg Shrimp has overtaken Tiger Shrimp production in China, Taiwan Province of China and Thailand, due to a number of favourable factors, particularly the availability of the Specific Pathogen Free (SPF) and the Specific Pathogen Resistant (SPR) brood stock. However, due to fears over importation of exotic diseases, many Asian countries have been reluctant to promote farming of *L. vannamei*, so that its culture remains officially confined to experimental testing only in Cambodia, India, Malaysia, Myanmar and the Philippines.

In nature, a brackish-water shrimp in its adult stage, this species is increasingly farmed in freshwater conditions (as in this farm), due to their ability to tolerate wide fluctuations in salinity and different water conditions, making them more resilient. They are also omnivorous.

For farming purposes, Whiteleg Shrimp is stocked at a density of 400,000-1,500,000 shrimp per hectare of pond surface area, with water depth kept at 1.5-2.0 meter, and with a 10cm-deep layer of soil at the bottom of the pond. Feeding with prawn feed takes place 2 to 4 times a day: feeding 4 times a day results in the shrimp growing 1.6 to 1.8 times faster as compared to feeding twice a day. Feeding duration is kept to 1-1.5 hours. Whiteleg Shrimp grow to about 9-12 grams over 2 months in summer, and 8-10 grams over 2 months in winter. Weight increase per week is 2 grams. They are harvested by scooping them out in nets.

Shrimp farming requirements are more stringent than for fish farming, and extra precaution has to be taken with water temperatures and disease prevention. Prior to stocking, the ponds have to be

thoroughly dried out and disinfected, and during farming, water quality, stocking density and feeding have to be carefully monitored and balanced.

Milk Fish

Milk Fish (scientific name *Chanos chanos)* is also commonly known as "Sea Grass Fish" and "Peaceful Fish". It is found in off-shore tropical marine waters, particularly South Taiwan, the Philippines and Indonesia, with other Asian countries now farming Milk Fish.

The nutritional benefits and uses of Milk Fish are manifold, and this may account for its recent upsurge in popularity as a fish to be farmed. The fish head is rich in vitamins and collagen which can improve the firmness of human skin. The skin of the fish is rich in vitamins A and B1, which can improve human eyesight. The fish flesh is a rich source of easily digested protein, and contains iron which helps prevent anemia, and zinc which helps wounds to heal quickly, thus preventing scarring. Fish oil from the Milk Fish contains EPA and DHA which help to reduce cholesterol and prevent heart disease, and assists in brain development. The fish stomach is rich in fish oil suitable for young and old alike.

As it is a tropical fish, the Milk Fish cannot withstand extreme cold temperatures and die in large quantities if the pond water temperature drops too low. The fry are captured naturally, placed in a Milk Fish nursery, and imported into Taiwan for farm rearing. The production period is from April until January of the following year, with the most active period being from May to November. After 8 months, the fry will have grown to a market-acceptable size and weight. Milk Fish have to attain the age of 5 years and the weight of 5 kg before they become spawning adults.

The Milk Fish is harvested in the ponds using seines. Fish snagged in the seines have scratches on the body and are usually used for processing, while those scooped up in the nets can be sold in the market for culinary purposes.

Exhibition Hall and Restaurant

As mentioned above, part of the area is covered by a simple building which houses an exhibition hall with numerous posters and exhibits of the various types of fish to be found off the coast of Taiwan.

Our group enjoyed an excellent lunch of several home-style dishes, including the produce from the ponds, cooked by the wife of the owner, and served with the help of their comely daughters.

From pond to table – a fine Tilapia for our lunch

1 Group Picture with farm owner and family

Ornamental Marine Fish Export Business

(Taikong Corp. – Pintung Packing Branch) www.tkfish.com.tw

Date visited: 18 Nov 2016

By Sanjay Vohrah

Background

Taikong Corp was established in 1977 as an **ornamental marine fish export business**. To their credit, they were the first and only manufacturer in Taiwan to obtain both ISO9001 and ISO14001. In 2001, they produced the world's first fully fluorescent transgenic fish (code name: TK-1), which till today is the pride of their research.

In 2007, they built the largest ornamental fish stock and shipping centre and started exporting ornamental shrimps, freshwater fishes, marine fishes and aquarium plants.

Fish breeding tanks

Some of the new fish types bred:

Mpimbwe blue frontosa

Albino heckelii

Tread-finned cichlid

With almost 40 years of experience, they endeavour to continue serving their customers better.

Nature of Business:-

1) Main business is trading of fish livestock, developing new species (TK-1, which is regretfully banned from trading worldwide as well as in Taiwan for now).
2) Trading in the complete range of aquatic pet accessories including water conditioner, fish nursing products, plant growers, feeds, nutrition and aquarium accessories under the brand Azoo.
3) Trading in other aquatic species such as jelly fish, frogs, tortoises, shrimps and aquatic plants

Location of visit:-

Taikong Corp, Pingtung Branch
No. 41, Nong Ke Road,
Dehe Village,
Changjhih Township,
Pingtung County 908,
Taiwan.

The facility we visited is within the Pingtung Agricultural Biotechnology Park. The centre houses the facilities used in the final stage of preparing the fishes and other livestock for export. As we were there well after all the stocks had left, we were left to witness the balance (excess supplies) still on site.

The stages were clarified by Ms. Judy from Taikong with the flow chart below:-

Stage 1: Collection of Fish Stocks

The stock is delivered from both the in-house and sub-contracted (cooperative) farms at about 4.00am. As the fishes arrive in bulk, a hot day can be a challenge in terms of fish mortality. Hence, they have to be transported before the sun rises.

Stage 2: Quality Inspection

Here the life stock goes through the first Quality Inspection (QI) which include correctly identifying the species, size, quantity and fish health according to what was ordered.

Stage 3: Nursing / Quarantine

In this stage, Quarantine by species is done under the supervision of the Veterinary Department. This enables smooth transition through the necessary department clearance at the respective client's countries.

Stage 4: Inspection

Prior to packing, the stock is inspected a second time to ensure that the fishes are is the same excellent health condition in which they arrived and are double checked that their specifications are as per customer's request - especially in appearance and size.

Stage 5: Packing for Markets

The fishes are packed according to the market it is going to. They can be packed either in bulk for local delivery or in plastic bags with pure oxygen pumped in for export. The oxygen supplied gives them a minimum of 72 hours from packing to delivery to the respective customers.

Taikong endeavours to ensure delivery within the stipulated time though their experiments have shown that some species can last longer than 72 hours in these bags. The maximum number of fishes per pack varies by species metabolic rates and size. (To illustrate the point should the TK-1 species be placed into a pack, they can pack as many as 2400 fishes in a pack).

Ice packs or heat packs are added to the boxes containing the packs of fishes according to the receiving country's climatic condition at point of receipt. Should the weather be warm, cool packs are added; likewise, in the event the weather is expected to be cold, warm packs are added. The idea of adding cold/hot packs is to maintain the water temperature at between 22 and 25 °C. This is the generally accepted temperature for most of the livestock handled.

Our host shared with us that the preferred freshwater fish species are African and South American Cichlids given their very beautiful appearance and hardy characteristics. In fact, this species was used to create the famed Flowerhorn species that took the ornamental fish market by storm a few years back. As Taikong has a long history of researching, breeding and cross breeding fishes, they have the ability to balance the demand and supplies well. For this species with their long track record they have little problems in breeding to meet the demand.

Our host shared that in the past, a saltwater aquarium was restricted for a person of wealth status; However, in recent times it has spread to all levels of society with interest in salt water fishes as children are captivated by the fantasy from the cartoon Finding Nemo and its recent sequel, Finding Dory. Taikong has successfully bred this species in high density environments. Given the unique sexual orientation of this species it is an achievement. Their farms and sub contract farms are capable of handling this breeding in high density environments and it has enabled Taikong to preserve the natural environment by avoiding over harvesting and destruction of the corals of their natural habitat and the ocean ecology.

At point of packing, salinity of the water is in the range between 24.8 to 30 ppt. A quick test from one the tanks which contained the Maroon clown fish (Nemo) read 26.1ppt. Similar to the freshwater fishes, the temperature of the water is kept between 22 and 25°C.

Stage 6: Export

The products are easily packed into the boxes with are subsequently shipped to the respective customers.

TAIWAN FU SHRIMP (Taikong Corp.)

Date visited: 18 Nov 2016
By Daniel Tan

The Taikong Corp based in the Pingtung County has an ornamental fish division. In its 40 years of experience, Taikong has built a rather well known and large ornamental fish division including producing the world's first Transgenic Fish, TK-1 (Fully Fluorescent).

The Taiwan Fu Shrimp division of Taikong developed a wide variety of ornamental fish and shrimps for export to Europe and Asia.

The shrimp division that we visited is rather sophisticated. Only 7 visitors were allowed into the elaborate establishment so as not to upset the "comfort zone" those fussy, puny, mingy, milky shrimps were accustomed to. (Both hands were thoroughly sanitized and both shoes were dusted on sticky mats to completely eliminate any possible lurking microbes that might harm those delicate - and hopefully delicious - crustaceans).

Aquarium racks with various species of ornamental fishes and shrimps

The sanitized room contains countless tanks containing miniature shrimps from elaborate multi cross breeding of Japanese/Taiwanese origin. Cute, colourful, gregarious specks (no larger than small ikan bilis) were busily gorging on homemade high protein fish food containing anthocyanins and extract of banana peels. These shrimps were fed twice daily and were kept in freshwater of pH 6 to 7.2 at 25°C and TDS (Total Dissolved Solids) of less than 105 ppm.

Ornamental Shrimp – Red King Kong!

A good cross breeding produced a striking red speck shrimp, appropriately known as Red King Kong (Red for sure but he is no King Kong as I needed to put on my reading glasses to spot him feeding with his mates at the bottom of the tank) sells for USD20/- each. This makes the Penang prawn mee that we eat seem cheap!

Google tells me that shrimps are egg bearers. A female shrimp protects her eggs externally between the legs, cleans them occasionally, and 7 to 10 juveniles survive from each batch. The females are bigger than the males and they reproduce every month. The juveniles reach maturity in 5 to 6 months.

Hybrids of new colour are not easily evolved and usually take more than 3 years to have a new variety after extensive selective breeding of specific species.

Their competitors are other breeders in Taiwan, Germany and Indonesia.

Advanced Green Biotechnology

Manufacturer of Microbial Enzymes, Insecticides, Pesticides & fertilisers

Figure 1: A group photo of the participants and the representatives from Advanced Green Biotechnology

Introduction

Advanced Green Biotechnology Inc. was founded in 2002, and went through an incubation program of Chung Hsing University as a bio-fertilizer company. Over the years, it has evolved into a Bio-Fertilizer & Bio-Pesticide company with well-equipped and award-winning research labs. It aims to serve the agricultural sector by promoting sustainable agricultural practices, and at the same time, to play a role in reducing environmental pollution.

We were told that the company's current development goals are:

- To develop **Bio-Pesticides** & **Bio-Fertilizers** (and get permits for their usage);
- To produce effective **Inhibition Enzymes** for
    1. Panama disease found in Banana's worldwide;
    2. Bacterial Wilt found in Solanaceae spp. plants;
    3. *Ganoderma boninense* found in Oil Palm (*Elaeis guineensis*) in South-East Asia;
- To develop **Organic Animal Feeds** for Livestock and Aquarium species;
- To develop secondary **Metabolic Extracts** technology & its products;

Being a biotechnology company, it has been in compliance of Good Laboratory Practice by establishing a good systematic production plant for their bio-products & have undertaken large scaled OEM & ODM demanded by their local and overseas clients. As a part of their marketing expansion plan, they

wish to form strategic partnerships with agri-biotech companies in China and ASEAN countries in marketing their products.

During our visit, we were briefed on the production of bio-fertilizers and bio-pesticides and shown the labs and production plant (Figure 2) with its various production machines (costs about USD 17K/unit).

Figure 2: Overview of their microbial production plant

It's worth noting that a producing microbial products is a multi-step process, essentially composed of microbe strain selection, cultivation of the micro-orgs, multiplication via fermentation, liquid microbes separation, dried freezing, crushing & packaging in an ISO certified production environment.

It was a fruitful visit and many of our members bought packages of BM to try on their oil palms.

For those of you would like to find out more about this company. You may visit www.agbt.com.tw or email agbt@agbt.com.tw.

Products by Advanced Green Biotech

Bio-Pesticides

Vigor-BM Bacillus mycoides

Vigor-BM is an environmentally friendly **microbial pesticide (fungicide)**. It can produce DMDS and Nitrite to kill soil-borne pathogens, such as Fusarium spp. & Rhizoctonia spp. It also induces plant resistance to other pathogens. Moreover, it can effectively alleviate the continuous cropping obstacles caused by these two major soil-borne diseases.

Vigor BM contains a beneficial microorganism that is common and ubiquitous in soils. Containing endospore-forming bacterium, It is highly resistant to heat and desiccation, thus a longer shelf life. In addition to the long-term viability of endospores, Vigor BM also exists as endophytic microorganism that induces resistance in plant itself.

The speaker (Vivian Chen, R&D Specialist) mentioned a Malaysian company was trying to use symbiotic Bacillus mycoides to cure Ganoderma infection in Oil Palm. However, it would only work with prevention, not cure. It works best in nursery stage but the resistance will not last forever in the plant (i.e. constant application is advised).

Vigor-MA Metarhizium anisopliae

Vigor-MA is an environmentally friendly **microbial insecticide**. *Metarhizium anisopliae* is a kind of fungi which has great potential for the biological control of pests. Upon contact with an

insect, spores would form, & hyphae would penetrate the insect's body, & would eventually kill the insect. Its conidia would stick to the surface of insect larvae, leading to the death of the larva when it germinates. *Metarhizium anisopliae* is safe for humans and applicable to organic farming and gardening.

This product is most suited to be used for terminating lepidoptera (e.g. Cotton Cutworm, Beet Armyworm, Plutella xylostella, Cotton Bollworm, etc), Coleoptera (e.g. Xylotrupes Gideon, Plenomus Canalieulates Falder), Elateridae, & Orthoptera (e.g Locust, etc.)

Vigor-BS Bacillus subtilis

Vigor-BS is a Gram-positive, catalase-positive bacterium commonly found in soil. A round of highly concentrated application could improve soil microenvironment in the root circle, increase absorption and utility of nutrients and reduce the incidence of air-borne diseases.

Bio-Fertilizers

Fert P: Phosphate Solubilizing Bacteria

Fert P contains the phosphate solubilizing bacteria ***Bacillus pumillus, Bacillus subtilius, Bacillus safensis.*** Bacillus safensis can secrete organic acids to convert non-available phosphates in the soil into plant available phosphates i.e. P that can be absorbed by plant roots.

A large proportion of soluble inorganic phosphorus added to soils is in a insoluble form, whereby plant roots are incapable of absorbing. Fert. P's phosphate-solubilizing bacteria plays a critical role in dissolving insoluble phosphorus in P-deficient soil so that a better nutrient uptake would promote faster plant development.

Fert-Root Associators: Glomus fasciculatus

Plant Root Mycorrhiza - forms external hyphae to help host plants to absorb nutrients (Phosphorus).

Arbuscular mycorrhizal fungi (AMF) are fungi-plant associations where the fungi produce arbuscules, hyphae and vesicles *both inside and outside* the roots. Spores are formed both in soil and roots. The external hyphae help host plants by directly absorbing inorganic nutrients (P and other macro-nutrients as well as some micro-nutrients) and move them into the roots of the plants. In addition to stimulating plant growth, it serves to increase the plants resistance to disease and drought, raise the transplant survival rate and decrease the demand for chemical fertilizers and pesticides.

Eco-KOmpo - Compost Inoculant

Eco-KOmpo Compost Inoculant No. 1 contains bacteria and key elements of bacteria multiplication. It helps to accelerate the decomposition of organic substances and putrefaction of compost.

Eco-Odlex – Odour remover Inoculant

Eco-Odlex Active Admixture No.1 contains natural enzymes and high/concentrated levels of natural live microorganisms and applies only safe micro-organisms as allowed by the environmental protection bureau. This product has been used to eliminate odour in toilets and the kitchen, clean up septic tanks, decompose organic substance in slaughter houses, junkyard, compost yards, and decompose excretion of pets and poultry to keep the environment clean and fresh.

YIHUA

Taiwan Tilapia Fish Breeding Farm

益華台灣鯛魚苗繁殖場

Yihua "Taiwan Snapper" fish nursery

Tilapia Fish Pond

- Aerated Ponds

臺灣鯛魚苗的繁殖
Taiwan Snapper – breeding fries

Founder Yi Hua – with a breeding Taiwan Snapper

為什麼叫臺灣鯛?
What is Taiwan Snapper?

- 吳郭魚的由來 The Origin of "Wuguo" fish.
- 吳郭魚的演進 Evolution of Wuguo fish.
- 福壽魚與單性魚苗 Flowerhorn and single sex fries
- 臺灣鯛的創立 Emergence of the Taiwan Snapper
- 臺灣鯛的進步與未來 Progress of Taiwan Snapper and its future

Industry SWOT Analysis

分析

- **SWOT** Analysis …
  - Strengths
  - Weaknesses
  - Opportunities
  - Threats

Strengths

Strengths (優勢):

- 出口值世界第二：養殖產量雖僅全球 **3%** 但出口值占全球**10%** 。
- Taiwan is 2nd in the world in terms of export value - aquaculture production is only 3% of the worlds total, but export value is 10% of the global export value.
- 掌握優良品種：台灣目前養殖的優質台灣鯛。
- 育種技術純熟：換肉率高與抗病率的提升，並建立超雄性養殖技術。
- Matured and professional breeding skill - high food conversion rate and increased disease resistance, with top notch "all male" fries breeding skill and techniques. Taiwan has mastered the art of fish breeding - Taiwan is currently breeding high quality Taiwan Snapper.
- 優良的水產加工技術與產銷履歷的推動：提升了食品安全與產品品質。
- Excellent aquatic processing technology and production system - has gained reputable track record to support marketing efforts. Has enhanced the food safety and product quality processes.
- 台灣鯛品牌的建 :立：於全球創造高品質形象，美國為重要進口國，亦是日本生魚片的使用魚種之一。
- "Taiwan Snapper" brand establishment: The creation of high-quality image in the world, especially the United States which is an important importer. It has become one of the fish species used in Japanese sashimi.

Weaknesses

Weaknesses (劣勢):

- 產量增加幅度受限：目前台灣鯛養殖為養殖漁業產量最高的魚種，但台灣養殖面積有限，產量增加有所難度。
- Limited production capacity.
  - At present, Taiwan's Snapper species get the highest yield in Taiwan's aquaculture industry. But Taiwan's farming area is limited, therefore increase in production is difficult.
- 生產成本高，經營形式保守：相較於中國與東南亞各國，台灣土地與勞工成本高，且每戶養殖面積小，資金不集中，經營規模受限。
- High cost of production and conservative management.
  - Compared with China and Southeast Asian countries, Taiwan's land and labour costs are high, and each household farming area is small. Also, funds are not concentrated, so scale of operation is limited.

Opportunities

Opportunities (機會):

- 海洋捕撈資源的減少，但全球對於魚貨需求持續的增加。
- Reduction in global marine fish reserves, but the global demand for fish continues to increase.
- 消費者對於台灣鯛的接受度逐漸提高，且便於烹煮的優勢受到歐美與中東消費者的喜愛。
- Consumers are increasingly receptive to Taiwan's Snapper - and consumers in Europe, United States and the Middle East love its advantage of being easy to cook.
- 大部分國家開始重視產銷履歷，有利具品管程序之產品拓展市場。
- Most countries have just begun emphasizing production and marketing track record. This is favourable to product quality control procedures to expand the market.

Threats

Threats (威脅):

- 養殖競爭門檻低，臺灣鯛對環境適應力強，繁殖及生長快速，易於養殖，是開發中國家投入發展的標的，競爭者日益增多。
- Aquaculture has a low barrier of entry: Taiwan Snapper's strong adaptability to the environment, ease of breeding and rapid growth; are the criteria considered by developing countries and sought for. Therefore, competitors are increasing.
- 中國與東南亞養殖成本低，產量大大增加。
- China and South East Asia have lower costs - their production has increased tremendously.
- 台商至中國與東南亞發展，帶動其技術水準提升使養殖技術的外流。
- Taiwan entrepreneurs ventured to China and South East Asia, and directly helped to improve their technical and knowledge level and transferred this farming technology.
- 藥物殘留檢驗標準的提高，導致食品出口的標準日趨嚴格，檢測項目的增加，提高了養殖成本。
- The standard of drug residue testing has increased – has led to increasingly strict standards of food export and as such, the increase of testing items and the increase in breeding costs.

台灣鯛的未來

依據聯合國糧農組織(FAO)估計: 2030年,全世界的平均魚類產品消耗量,將由現今每人每年16.7公斤,上升到每人每年19~20公斤.

According to Food and Agriculture Organization (FAO) estimates ...

by 2030, the world's average consumption of fish products will increase from 16.7 kg to 19 - 20 kg per person per year.

所以: Therefore:

- 提高台灣鯛的附加價值 increase added value of Taiwan Snapper
- 順應趨勢發展 follow the development trend

魚苗 Fries

魚苗分類 Fries Classification

- 土種:黑公.粉母

Local breed: black male, pink female

內銷市場
Internal market

- 單性魚苗:台灣鯛魚苗

single sex fries: Taiwan Snapper fries

國內外.全世界
National and International markets
條凍.魚片.其他加工
Frozen, fillet, other processing

魚苗繁殖與捕撈

Fry Breeding and Harvesting

約清明前一個月當水溫達到25度就會有魚苗孵化

About a month before "Cheng Ming" (Cheng Ming is in March most of the time), water temperatures reach 25°C which will lead to fry hatchings.

業者進行捕撈與蓄養即可販賣給下游養殖戶

The breeder farmer will harvest the fries and sell to downstream farmer growers.

魚苗作業流程

Fries Processing Procedures

台灣鯛與疾病

Taiwan Snapper and its diseases

養殖首重水質的管理，水質環境良好甚疾病無由產生

In Aquaculture, the main emphasis is on water quality management - good water quality environment will not promote diseases.

臺灣鯛最適當的範圍為水溫:

Ideal Water Conditions for the original Taiwan Snapper (Tilapia) :

- 度 Water Temp: 24 – 35 ℃
- 酸 pH: 6.8-8.5
- 溶氧 D-O_2: > 5ppm
- NH_3 < 0.05 ppm

但吳郭魚所能容忍的惡劣水質範圍如下

However, the locally bred "wuguo" (tilapia) fish can tolerate a wider range of water conditions:

- 度 Water Temp : 16-35 ℃
- 酸 pH: 5-11
- 溶氧 D-O_2: min 1ppm
- NH_3: max tolerable is 2.4 ppm

可見臺灣鯛為一種對惡劣環境容忍度極高的魚類，

Therefore, the local Taiwan Snapper (tilapia) variety is a species that can tolerate well adverse conditions.

臺灣鯛的疾病

Diseases of Taiwan Snapper

1. 鏈球菌:廣域性的細菌.好發於高水溫期.於台灣鯛身上易造成紅血球破壞.內臟出血敗壞.腸道疾病.魚體潰爛.魚隻死亡後會造成大規模感染

Streptococcus:

- A wide range of this class of bacteria develops well at high water temperatures.
- Causes red blood cell destruction, internal organ bleeding, intestinal disease, and festering in Taiwan Snapper.
- Dead fish will cause massive infection.

2. 立克次體:常發生於低水溫期.食慾減退.鰭基部、肛門變紅.皮膚、鰭出現潰瘍.凸眼，解剖可見脾臟、腎臟、肝、鰓、卵巢出現灰白色結節

Rickettsia:

- Often outbreeds during low water temperatures.
- Causes loss of appetite; fin base and anus turn red; skin, grill ulcer and protruded eyes.
- Anatomically, visible shows the spleen, kidney, liver, gills, ovaries appearing with grey nodules.

疾病防治

Disease Prevention

- 本場以於10年前聘請嘉義大學張文興教授進行針對鏈球菌的高抗病力魚種實驗
- 10 years ago, we engaged Chiayi University Professor Zhang Wenxing to experiment on high resistance to streptococcal breed.
- 實驗以結束並取得良好成果
- Experiment ended with good result

- 實驗分為:抵抗鏈球菌的基因與攻毒實驗
- The experiment was divided into:
  - Streptococcus resistance gene and
  - infective challenge experiment

注射藥物進行刺激

Injection of drugs to stimulate resistance

種魚篩選

Fish Screening

養殖漁業與文化:數魚苗

Aquaculture fisheries and culture: counting of fry

YIHUA

YIHUA

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