2022 FFTC-TARI-MJU Symposium
(FFTC-DFNet II: Tropical Fruit Project)

International Symposium on Trends and Opportunities of Displacement of Fruit Tree Production Areas under Climate Change

November 28-29, 2022

Hybrid Mode

Free registration at https://km.fftc.org.tw/workshop/17

Venue: Conference Center, FURAMA Hotel, Chiang Mai, Thailand
Webex Videoconference

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Welcome Message

Assoc. Prof. Apinun Suvarnaraksha, Ph.D.
Director of The Office of Agricultural
Research and Extension,
Maejo University

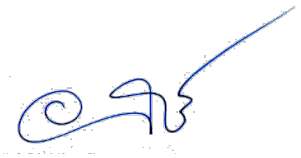
Dear Colleagues, friends, ladies, and gentlemen,

It is my great pleasure, and on behalf of the Maejo University, Thailand to welcome all of you, from Belgium, India, Indonesia, Japan, Nigeria, Philippines, Taiwan, Thailand and Vietnam, to participate in **The International Symposium on Trends and Opportunities of Displacement of Fruit Tree Production Areas under Climate Change**.

There will be plenty of knowledge enhancing activities such as key note speakers, conference, discussion and field trip in tropical fruit production. The study of tropical fruits is essential for food security, varieties of fruit, cultivation, processing, monetization and environment care. I hope these 2 days of our symposium would help all participants expand and share their knowledge for our future international cooperation e.g. research, staff mobilities, students exchanges, scholarships, and technology transfer.

Finally, wish you all success in carrying out the activities and maintain your strongly academic spirit.

All the best



Assoc. Prof. Apinun Suvarnaraksha, Ph.D.
Director of The Office of Agricultural Research and Extension,
Maejo University

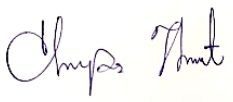
Preface

Asst. Prof. Chinnapan Thanarut, Ph.D.
Organizing Committee,
Faculty of Agricultural Production,
Maejo University

This is a great pleasure for me to welcome you to **The 2022 FFTC-TARI-MJU Symposium (FFTC-DFNet II: Tropical Fruit Project) - International Symposium on Trends and Opportunities of Displacement of Fruit Tree Production Areas under Climate Change** on November 28-29, 2022.

The event is part of collaboration with three-organizers; **FFTC:** Food and Fertilizer Technology Center for the Asian and Pacific Region, **TARI:** Taiwan Agricultural Research Institute – Fengshan Branch, and **MJU:** Maejo University (Faculty of Agricultural Production, Office of Agricultural Research and Extension, and International College). The aim of the symposium is to share and exchange information on how climate change has affected fruit production in Japan, Malaysia, Philippines, Taiwan, and Thailand, and share insights and experiences on the ways farmers, industry, and consumers have or will deal with these changes and challenges.

I hope this symposium can bring together with the collaboration, effective management, and dissemination of valued academic information for the better growth of Asian and Pacific region. Finally, a big thank you to all the staff who have given their best efforts to make this symposium a success.



Asst. Prof. Chinnapan Thanarut, Ph.D.
Organizing Committee,
Faculty of Agricultural Production,
Maejo University

Organizers

FFTC Food and Fertilizer Technology Center for the Asian and Pacific Region

TARI Fengshan Tropical Horticultural Experiment Branch, Taiwan Agricultural Research Institute, COA, Taiwan

MJU Maejo University (Faculty of Agricultural Production, The Office of Agricultural Research and Extension, and International College), Thailand

Objectives

- Share information on the ways climate change has affected fruit tree production and country experiences in coping with these challenges.
- Identify opportunities to manage these challenges, including fruit tree cultivation areas shift and production of non-traditional fruit crops or new varieties.
- Identify topics for future research, development, and collaboration.
- Visit recent developments of the fruit industry in northern Thailand.

Symposium Program

Day 1: November 28, 2022

Time (GMT+7)	Topics	Speaker
0900 – 0930	**Registration**	
0930 – 0945	**Opening** Opening/ welcome remarks Introduction of guests	**Dr. Su-San Chang** Director, FFTC, Taiwan **Dr. Hsueh-Shin Lin** Director General, TARI, Taiwan **Dr. Weerapon Thongma** President, MJU, Thailand
0945 – 0950	MoA Signing	**Dr. Wen-Li Lee** Director, TARI-Fengshan, Taiwan **Dr. Ruangchai Juwattanasomran** Dean, Faculty of Agricultural Production, MJU, Thailand
	Group photos	All participants
Session 1	**Moderator: Dr. Domingo E. Angeles** Professor, Institute of Crop Science, University of the Philippines Los Baños, the Philippines	
0950 – 1030 (30 +10 min)	Topic 1 Challenge and trend to produce Longan in Thailand	**Dr. Theeranuch Jaroenkit** Associate Dean, Associate Professor, Faculty of Agricultural Production, Maejo University, Thailand
1030 – 1100	**Coffee/Tea Break**	
1100 – 1140	Topic 2 Challenge and opportunity: The impact of climate change on fruit production	**Dr. Wen-Li Lee** Director, Fengshan Tropical Horticultural Experiment Branch, Taiwan Agricultural Research Institute, COA, Taiwan
1140 – 1220	Topic 3 Challenge and opportunity: The impact of climate change on fruit production in Malaysia	**Mr. Muhammad Afiq bin Tajol Ariffin** Senior Research Officer, Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), Malaysia
1220 – 1330	**Lunch Break**	
Session 2	**Moderator: Dr. Siriwat Sakhonwasee** Associate Professor, Faculty of Agricultural Production MJU, Thailand	

Time (GMT+7)	Topics	Speaker
1330 – 1400	Topic 4 Challenge and trend to produce grapes and temperate fruit in tropical areas	**Dr. Chinnapan Thanarut** Assistant Professor, Faculty of Agricultural Production, MJU, Thailand
1400 – 1430	Topic 5 Passion fruit and avocado production in Japan and the challenge of reducing chilling stress on them	**Dr. Tomohiro KONDO** Associate Professor, Laboratory of Tropical Agriculture, Kyoto University, Japan
1430 – 1500	Topic 6 Heavy rainfall has given rise to severe crop diseases caused by *Phytophthora* spp. in Taiwan - taking passion fruit as an example	**Dr. Jin-Hsing Huang** Associate Researcher, Plant Pathology Division, TARI, COA, Taiwan
1500 – 1530	**Coffee/Tea Break**	
Session 3	**Moderator: Dr. Orapin Saritnum** Assistant Professor, Faculty of Agricultural Production MJU, Thailand	
1530 - 1600	Topic 7 Climatic factors affecting yield and yield prediction of aromatic coconut	**Dr. Kietsuda Leungwila** Associate Professor, Horticulture, Kasetsart University, Thailand
1600 – 1630	Topic 8 Fruit production in the Philippines amidst climate change	**Dr. Domingo E. Angeles** Professor, Institute of Crop Science, University of the Philippines Los Baños, the Philippines
Session 4	**Moderator: Dr. Wen-Li Lee**, TARI, Taiwan	
1630 – 1720	**Panel Discussion and Recommendations:** Reallocation, displacement and growing new crops and/or varieties to overcome the challenges of climate change	Panelists: All speakers
1720 – 1730	**Closing Remarks**	**Dr. Su-San Chang** Director, FFTC, Taiwan **Dr. Hsueh-Shin Lin** Director General, TARI, Taiwan **Dr. Weerapon Thongma** President, MJU, Thailand
1830 – 2000	Welcome dinner	MJU, TARI, FFTC

Field Trip Program

Day 2 – November 29, 2022

Time	Topics	Responsible
0730 – 0830	• Pick up at Furama Hotel • Bus trip to Maejo University	International College and Faculty of Agricultural Production
0830 – 0930	• Visit off-season grape, persimmon, and pear production at the Division of Pomology	Dr. Chinnapan Thanarut
0930 – 1000	• Bus trip to Home of Cowboy Farm, MJU	International College
1000 – 1015	• Coffee break at Home of Cowboy Farm	International College and Faculty of Agricultural Production

1015 – 1200	• Visit mango and longan farms at the Home of Cowboy Farm
	  ○ Off-season production technology
	  ○ Drone technology
		Dr. Surachai Salirat

1200 – 1300	• Lunch at the Home of Cowboy Farm	International College and Faculty of Agricultural Production
1300 – 1400	• Bus trip to Uraiwan Organic Farm, Maetang District	International College and Faculty of Agricultural Production

1400 – 1600	• Visit Uraiwan Organic Farm
	  ○ Organic pomelo, grapefruit, mulberry, cacao, lemon
	  ○ Coffee break
	  ○ Intensive management of mango and longan production
		Mr. Jack Kavin

1600 – 1730	• Leave for Furama Hotel	International College

Abstracts

Challenge and Trend to Produce Longan in Thailand

Theeranuch Jaroenkit* and Pawin Manochai
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Abstract

Thailand is the biggest exporter of longan in the world even though the planting area is second to the Republic of China. In Thailand, longan planting areas are located mainly in the northern region. The planting area in year 2021 was about 265,000 ha whereas the production was 1,200,804 ton and the average yield was about 5.4 t/ha. Besides the tropics which the weather is suitable for tropical and sub-tropical fruit production, the suitable technology for flower induction and quality-longan production are also available for all farmers across the country. Consequently, longan production in Thailand is available year-round. On-season longan is usually available during July to August and the rest of the year it is considered as off-season longan. In previous time, off-season longans were lower than 1% in year 2000 but it has been increasing to be about fifty percent since 2015. The most important factor for this successful off-season production was the technology of flower induction that has been researched and reported in Maejo University since 1999. Not only the flower induction technology, but pruning technique, a method of enhancing fruit size, along with postharvest technology strengthen productivity. Thailand subsequently became a top producer of longan in the world. However, the effect of climate change e.g., drought during year 2013-2014 and 2019-2020 or flooding in year 2011 and 2022 had an impact on longan production in some specific area. Therefore, research topics on fruit tree adaptations or physiological responses to purposely reduce a food loss in the future are essential and hopefully they would be gained more attention by agricultural researchers.

Keywords: Longan, Off-season, Production trend

Challenge and Opportunity: The Impact of Climate Change on Fruit Production in Taiwan

Wen-Li, Lee, Hsin-Hsiu Fang, Kuo-Dung Chiou

Abstract

Fruit trees are an important crop their proportion can reach 40% of the total output value of crop production (Taiwan). According to that it take times for set up an orchard and not easy to modified after established. Climate changes have a huge impact on fruit production cause by fruit trees growth is closely linked to climate change, which can have deleterious effects such as abiotic and biotic stresses. With the increase of temperature in recent years, drought, heavy rain fall, unexpecting raining, disease and pest occurrence change, there is a huge pressure on fruit production. Compared with field crops, the impact of climate change on fruit trees may be greater. Short-term crops grow quickly, the status of field changes rapidly. It is easy to use cultivation methods to adapt to or avoid unsuitable environmental factors. Fruit trees are long term crops, climate changes can seriously affect in different growth stage, such as reduced flowering, poor pollination, premature or delayed fruit ripening, reduced yield, pale fruit color, fruit sunburned, reduced total soluble solid (TTS) content. According to that the growth and development of fruit trees are the result of the interaction between environmental factors and genotypes. Each fruit has a different reaction on temperature variation and climate change. Meanwhile, fruit trees are long term growth, the orchard is not easy to change its state, and various mitigation measures are not easy to implement. Therefore, predicting near future climate patterns, adopting new technologies to mitigate the impact of climate change, integrating cropping techniques, selecting those varieties adapted to envelopment change, and even adopting a fruit tree production on control environment is the key to overcoming the impact of climate change on fruit production. In this article, we will discuss the impacts and opportunity of climate change on fruit tree production and various strategies to overcome.

Keywords: Climate Change, Fruit Production, Strategy, Opportunity

Challenge and Opportunity: The Impact of Climate Change on Fruit Production in Malaysia

Muhammad Afiq Tajol Ariffin*, Mohd Aziz Rashid, Mohammad Hariz Abdul Rahman, Mohd Fairuz Md Suptian, Fahimee Jaapar, Mohd Shukri Mat Ali @ Ibrahim, Suhana Safari, Nor Hazlina Mat Sa'at, and Zulhazmi Sayuti
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Abstract

Extreme weather events as a consequence of global climate change result in more occurrence of high temperature stress or heat waves in plants and significant decline in many crop productions. The incidents of high temperature up to 40.10℃ were frequently recorded at northern Peninsular Malaysia with Agro-ecological Zone 1, regions with a clear and regular dry season annually. Fruit crops such as famous *'Harumanis'* mango, durian, papaya and many others that are cultivated within this region were reported to experienced reduction in yield productivity, especially during extreme dry season. The optimum temperature range for optimal growth and yield productions of many tropical fruits is between 21 °C and 33 °C, and high temperature causes the morphological, physiological and developmental changes incidents. During the reproductive stage, heat stress also cause reduction in pollen viability and disrupts the completion of pollination, pollen tube growth, fertilization; and embryo and endosperm development that result in low fruit-setting, flower drop and reduced yield. In 2020, dry spell occurred in the Northern part of Malaysia similar to 2016 that caused the export of '*Harumanis*' mangoes to be halted due to 60% reduction in productivity. As more and intensified extreme climatic events including heat waves are anticipated in the future, more research is conducted to develop adaptation strategies against detrimental effects of high temperature stress on fruit crops. Malaysian Agricultural Research and Development Institute (MARDI) is leading a research entitled 'The Development of Adaptation and Mitigation Technologies for the Sustainability of Fruits, Vegetables and Livestock under Climate Change Scenarios' from 2021 - 2025. This project aims to develop strategies to overcome the impact of climate change through the development of adaptation and mitigation technologies. Current projects include the study of the effects of simulation of heat wave (38^{o}C) on papaya and corn within climate-controlled room. Preliminary observation showed that at high temperature, hermaphrodite papaya cultivar has tendency to form functional male flowers with poorly developed and non-functional female parts, high frequency of flower drop and low fruit productivity. It also caused higher rate of abnormal cobs, low kernel set and low cob yield in corn. The potential of the use of micronutrients and chemical element to improve pollen viability, pollen tube growth and fruit-setting is currently investigated with some promising results.

Keywords: Heat wave, Crop yield, Fruit quality, Physiological performance, Mitigation method

Challenge and Trend to Produce Grapes and Temperate Fruit in Tropical Areas Change from a Crisis into an Opportunity under Climate Change

Chinnapan Thanarut

Division of Pomology, Faculty of Agricultural Production, Maejo University

Abstract

The temperate zone fruit tree, cold temperature, is very important for growth, flowering, and productivity. From theory, the optimum temperature for growth is 19-25 °C, 16-25 °C for flower bud development, and 7.2 °C for at least 100 hours. for Beak dormancy or bud beak. Thailand can grow some varieties that require low temperatures for 100-300 hours. After accumulating the number of chilling hours. Flower and leaf buds of temperate zone fruit still dormancy. Until the average temperature rises to more than 15 °C, the flower buds, and leaf buds beak and continues to develop.

In Thailand, Temperate zone fruit grown as of the year 2021, has a planting area of approximately 2,166.6 ha. Grapes are the first planted in Thailand. Expected to be imported since the reign of King Rama 5, Grapes began to be planted seriously by an imported grapevine from California, United States in 2493 and from Europe in 2497, which can grow satisfactory results. Since then, grape cultivation in Thailand has become more widespread in the central, north, northeast, and western region respectively. by planting both table grapes (fresh eating grapes) and wine grapes. And in 1982 brought new varieties to be researched in the area of Royal Project Foundation, and most of them are seedless grapes. In 2021, there are 1,408.8 ha of grape-growing areas, divided into 768.8 ha of wine grapes and 832 ha of table grapes, accounting for 65.0% of all temperate zone fruit. The average yield is about 7,500 kg/ha, the average farmer price is 40 baht for wine and 60 baht for table grapes.

In 1969, the Royal Project Foundation brought temperate zone fruit trees. to tested on high land which can produce good yields in the season and then in 2011 began to be planted for testing at the Division of Pomology, Faculty of Agricultural Production, Maejo University, which has a height of 300 meters above sea level, the average minimum temperature is 13 °C, the average maximum temperature is 39 °C. It was found that can grow well, due to hot weather and can produce both in and off-season, can also produce all year round by using the chemical for break dormancy such as hydrogen cyanamide to replace the chilling requirements, and using cytokinin mixed with boric acid to induce flower bud formation in the off-season.

At present, the temperate zone fruit planting area has been expanded to various areas of Thailand. The planting area such as persimmon 314.4 ha (19.7%), Japanese apricot 122.8 ha (5.7%), plum 115.1 ha (5.3%), peach & nectarine 66.8 ha (3.1%), kiwifruit 6.3 ha (0.3%), pear 5.0 ha (0.3%), and other (fig, mulberry, raspberry, and blackberry) 7.1 ha. (0.5%) respectively, an average yield of 4,183.8 kg/ha and average price of 90 baht/kg.

Keywords: Temperate fruit in Thailand, Temperate fruit area

Passion Fruit and Avocado Production in Japan and the Challenge of Reducing Chilling Stress on Them

Tomohiro Kondo

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Abstract

Physiological disorders in fruit crops at Japan due to global warming have been increasingly reported; peel puffing and low acid content in citrus, inferior peel coloration in grape, poor bud brake in peach and so on. Replacing current fruit crops with more heat-tolerant ones is thought to be one of a solution. Thus, in warm temperate zones, where now evergreen fruit crops, such as citrus and loquat, are mainly cultivated, introducing subtropical fruit crops should be the solution. And so, in southwestern Japan, passion fruits and avocados have recently been increasingly cultivated in open fields because they have a relatively high tolerance to cold compared to other subtropical fruit crops. In Japan, the cultivation method for passion fruit as an annual crop have been established, planting to open field at Apr. to May and harvested at Aug. to Sep, and so the cultivation area has been increasing. Avocado have been reported to survive and bear fruits in some areas where the minimum temperature is below freezing, though commercial orchard still be limited. Both passion fruit and avocado are promising crop, but plant injury, low fruit quality and low fruit set percentage due to chilling stress have been also reported, thus the cultivation methods for decreasing chilling stress is now demanded. Recently, shading and H_2S application have been reported to enhance vegetative growth and photosynthetic rate and reduce chilling injury. And then, adaption these findings to cultivation methods is demanded.

Keywords: Global warming, Hydrogen sulfide, Low temperature, Shade, Sub-tropical fruit

Heavy Rainfall has Given Rise to Severe Crop Diseases Caused by *Phytophthora* spp. in Taiwan, Taking Passion Fruit as an Example

J.-H. Huang

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Abstract

Climate change has led to a significant increase in the frequency of extreme weather events. In Taiwan, the frequency of heavy rainfall has increased significantly and has caused various crop diseases; most of them were caused by *Phytophthora* spp., leading to root rot, crown rot, leaf blight, dieback, fruit and flower rot, and even death of plants. These common crop diseases are passion fruit Phytophthora blight (pathogens: *P. palmivora* and *P. nicotianae*), Phytophthora bud and leaf blight, fruit brown rot, and foot and root rot of citrus (major pathogens: *P. citrophthora*, *P. palmivora*, *P. nicotianae*), Phytophthora leaf blight, and fruit and root rot of papaya (pathogens: *P. palmivora* and *P. nicotianae*), Phytophthora heart rot of pineapple (major pathogen: *P. nicotianae*), Welsh onion Phytophthora blight (pathogen: *P. nicotianae*), cucurbit Phytophthora blight (pathogens: *P. melonis* and *P. capcisi*), orchid Phytophthora blight (pathogens: *P. palmivora* and *P. nicotianae*). In recent years, passion fruit Phytophthora blight caused by *P. nicotianae* resulted in severe yield loss after heavy rainfall in Taiwan. The causal pathogens could infect leaves, fruits, tendrils, and sometimes stems and roots, causing leaf blight, leaf and fruit dropping, and even the death of plants. Pathogens in field soil are the most important inoculum sources. They could produce zoospores in the free water on the soil surface after the resting spores immerse in water in the soil for more than 24 hours under heavy rainfall and spread to the upper parts of the plants by rain splash. Passion fruit cultivars with Phytophthora blight resistance could be used as rootstock to prevent the scion from foot and root rot. Several fungicides and low-risk materials with control potential were screened by pot cultivation tests in the greenhouse. Field trial results show that the regular application of phosphite weeks before the rainy season or/and the precise application of fungicides before and during the rainy season could significantly reduce the disease severity. Furthermore, applying Bordeaux mixture on the soil surface days before raining season, plus the chemical usage mentioned above, could greatly reduce disease severity and reduce the yield loss of passion fruit caused by the disease.

Keywords: Oomycetes, Flooding, Disease, Integrated control

Climatic Factors Affecting Yield and Yield Prediction of Aromatic Coconut

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Abstract

Aromatic coconut's export value is the fourth highest among all Thai fruit crops. However, there are some periods during the year when the coconut supply does not meet the high demand. This research project aimed to determine climatic factors causing the coconut yield fluctuation and to predict the yields in advance for precision aromatic coconut farming. The study from five aromatic coconut orchards in Ratchaburi and Nakhon Pathom provinces collected from 2019-2022 showed that fruit drop in rainy season caused the lesser production in the summer. However, rainfall, air temperature and humidity had no effect on stigma receptivity, amount of nectar, nectar sugar concentration, anther dehiscence and pollen viability of coconut flowers. Numbers of anthophiles and pollinators had positive correlation with relative humidity, but negative correlation with light intensity. Stingless bee tended to reduce coconut fruit drop in rainy season. Stepwise multiple linear regression revealed that the weather condition data of the past year provided the most accurate prediction of coconut yield with r_C = 0.77. Air and soil temperatures were important variables for the prediction. Artificial neuron network analysis provided a prediction equation with discrepancy between actual and predicted values of 18%. Multivariate time series analysis, harmonic regression and dynamic Bayesian networks generated equations that could predict yield seven months in advance (with 95% confidence interval) based on temperature, relative humidity, and amount of rainfall from the previous three months together with number of inflorescences and number of female flowers.

Keywords: Rainfall, Stigma receptivity, Pollen viability, Anthophiles, Stepwise multiple linear regression, Dynamic Bayesian networks

Fruit Production in the Philippines amidst Climate Change

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Abstract

Global warming due to anthropogenic activities and natural causes results in climate change. The 0.85°C increase in global temperature from 1880-2012 has brought extreme climatic events worldwide. For a vulnerable country like the Philippines, climate change is manifested with a 0.65°C increase in temperature from 1951-2010, erratic climatic pattern, increase wet season precipitation, decrease dry season precipitation, prolonged drought, and disastrous typhoons.

The long term increase in temperature locally fails to significantly correlate with yield particularly in banana. The more pronounced adverse effect of climate change on fruit production lies on the changing weather patterns which resulted in low yield due slower/faster growth rates, poor flowering and fruit set, high pest infestation, early fruit maturation, poor postharvest quality, and untimely availability of fruits. Changing climate which makes dry season drier, and wet season wetter, compromises land productivity devoted to fruit crops. Changes in growing environment requires the use of resilient crops and/or modification of the environmental conditions, the latter being more expensive in the long run. Resilient crops during the dry season include mango, cashew, wax apple, Java plum and ciruela, sapodilla among others. Sites with plenty of rain, but with good drainage and without strong typhoon are suitable for Canarium, jackfruit, banana, pineapple, papaya among others. Tolerant crops to typhoons of moderate intensity include Canarium, mango, citrus, guava, sapodilla, breadfruit, and mangosteen, Strategies to respond to changing climate effects on fruit production include adoption of adaptation and mitigation measures, good fruit production practices such as multistorey cropping and appropriate nutrient, water, pests, and canopy management through pruning, adoption of smart fruit production system, and a review of existing land use to ensure its suitability and sustainability for fruit crop production.

Climate change is inevitable. As such fruit production in the midst of climate change should be streamlined with local climate change adaptation, and disaster risk reduction plans. It should also form part of the agriculture and fishery modernization plan of the Department of Agriculture. Consulting with the stakeholders, a roadmap to address climate change as it affects production should be developed and used as basis for an integrated and comprehensive research and development plan.

Keywords: Resilient crops, Land use, Smart agriculture

Curriculum Vitae of Speakers

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1995-1999 Ph.D. (Horticulture) Univ. of Hawaii at Manoa, USA
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Selected Publications:

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Educational Background
Doctor degree, National Pingtung University of Science and Technology, Taiwan. 2012/7.
Master degree, National Taiwan University, Taiwan. 1997/6.
Bachelor degree, Chinese Cultural University, Taiwan. 1992/6.

Work Experience
Director of the Fengshan Tropical Horticultural Experiment Branch, Taiwan Agricultural Research Institute (TARI) (2019.07-present)

Associate Researcher and Director of Fruit Tree Department of Fengshan Tropical Horticultural Experiment Branch, Taiwan Agricultural Research Institute (TARI) (2009.06~2019.07)

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Assistant of Fruit Tree Department, Fengshan Tropical Horticultural Experiment Branch, Taiwan Agricultural Research Institute (TARI) (1997~2001)

Assistant of Molecular Genetics Laboratory, Department of Agronomy, Taiwan Agricultural Research Institute (TARI) (1994-1995)

Convenor of Breeding Group, Council of Agriculture (COA), Executive Yuan, Taiwan. (2020.01- present)

Executive Secretary of the Fruit Tree Promotion Group, Council of Agriculture (COA), Executive Yuan, Taiwan. (2011.01~2014.07)

Convenor of the Papaya Technical Service Team, Council of Agriculture (COA), Executive Yuan, Taiwan. (2008.01~2019.07)

Convenor of the Mango Technical Service Team, Council of Agriculture (COA), Executive Yuan, Taiwan. (2009.01~2019.07)

Executive Secretary of 2015 International Symposium on GA3 Tropical Fruits (Guava, Wax Apple, Pineapple and Sugar Apple), International Society for Horticultural Science (ISHS), Kaohsiung, Taiwan

Convenor of I International Symposium on Tropical Plant Breeding, International Society for Horticultural Science (ISHS), Cairns, Australia, 2016

Academic Committee Member of XII International Mango Symposium, International Society for Horticultural Science (ISHS), Guangxi, China, 2017

The 55th Honorary board member of the Taiwan Horticultural Society (2021.02 - present)

The 54th and 53th board members of Taiwan Horticultural Society (2017.02-2020.03)

The 15th board Member of Taiwan Agricultural Exchange Association (2020.01-2020.12)

Board Member of Known-You Social Welfare Foundation (2022.03 - present)

Award

The 43rd National Top Ten Outstanding Agricultural Experts, Taiwan (2019)

Outstanding Alumni of the Department of Horticulture and Landscape Studies, National Taiwan University, Taiwan (2019)

Outstanding Alumni of Pingtung University of Science and Technology, Taiwan (2018)

Award of International Society for Horticultural Science (ISHS) (2016)

Career Award of Taiwan Society for Horticultural Society (2016)

Academic Achievement Award of Taiwan Seed Society (2008)

Research Award of National Science and Technology Council, Taiwan (1997)

Research Expertise

Pomology, especially papaya, passion fruit and mango
Biotechnology, including plant tissue culture

Dr. Muhammad Afiq Bin Tajol Ariffin
Senior Research Officer
Horticulture Research Centre
Malaysian Agricultural Research and Development Institute (MARDI)
Malaysia

AREAS OF EXPERTISE

Agriculture science; Conventional Plant Breeding; Plant Genetic; Molecular Biology

EDUCATIONAL DETAILS

a. M. Sc. (Management of Plant Genetic Resources), Universiti Kebangsaan Malaysia (UKM), 2012
b. Bsc. (Hons) (Resource Biotechnology), Universiti Malaysia Sarawak (UNIMAS), 2009

WORKING EXPERIENCE

i. MARDI Senior Research Officer (2016 – Present)

Currently doing research on durian, mango, and watermelon on development of new variety

ii. MARDI Research Officer (2011 – 2015)

Conducted research on development of new guava, wax apple, and starfruit variety

iii. Green World Genetics, Plant Breeder (2011)

Assisted on tomato, bell pepper, chili, cucumber, sweet corn, and rockmelon hybrid seed production and evaluation.

PUBLICATIONS

Shahril, A. R., Nor Helwa, E. N. A., Siti Norhayati, I., Muhammad Fairuz, M. Y., **Muhammad Afiq, T. A.**, Zul Helmey, M. S., Muhammad Hafiz, M. H., Khairun Hisam, N., Mohd Asrul, S., and Nrozihan, A. 2019. Assessment of diversity and population structure of mango (*Mangifera indica* L.) germplasm based on microsatellite (SSR) markers. *Australian Journal of Crop Science,* 13(02): 315-320.

Azi Azeyanty, J., Adibah, A. B., Salwa, S., Ahmed, E., **Muhammad Afiq, T. A**., and Siddhartha, P. 2022. CTAB Method to Isolate DNA from silica-dried frond tissues of several tree fern species from Peninsular Malaysia. *Central Asis and The Caucasus*, 23(1): 1797-1802.

Ab Razak, S., Nor Azman, N. H. E., and **Tajol Ariffin, M. A.** 2020. Identification of true to type and open pollinated progenies of polyembryonic *Mangifera indica* cv. Harumanis using microsatellite markers. 2020. *Journal of Applied Horticulture,* 22(2): 122-126.

Sharil, A. R., **Muhammad Afiq, T. A.**, Sharifah Munirah, S. M., Nor Helwa, E. N. A., Mohd Azhar, H. 2020. Microsatellite markers for the molecular characterization of potentially commercial mango (*Mangifera indica*) progenies. *Malays. Appl. Biol.* 49(3): 81-85.

Muhammad Afiq, T. A., Ulia, I., Musanif, G., Norzila, G., Salehudin, M. R., Mohd Ridzuan, M. D., Siti Aishah, H., Nur Aisyah, A., Razali, M., Mohd Shukri, M. A. I., Nor Hazlina, M. S., and Johari, S. 2022. Effects of pollen from different durian clones on MDUR 88 durian fruit setting. *Buletin Teknologi MARDI,* 30: 179-185.

Hartinee, AB., Zuraida, A. R., Muhammad Hafiz, M. H., Mohd Ridzuan, M. D., Wan Mahfuzah, W. I., Zul Helmey, M. S.,**Muhammad Afiq, T. A.**, Nor Dalila, N. D., Mohd Asrul, S., and Ahmad Hafiz, B. 2018. Potential of commercial fig cultivation in Malaysia. *Buletin Teknologi MARDI,* 14: 57-68.

Muhammad Afiq, T. A., Mohd Musanif, G., Ahmad Norhisyam, A., Salehudin, M. R., Nur Azlin, R., Siti Aisyah, A., Wan Mahfuzah, W. I., Mohd Asrul, S., Razali, M., Rozlaily, Z., and Pauziah, M. 2019. Preliminary study of paternal effect on the characters of 'Musang King' durian (*Durio zibethinus* L.) fruit from cross-pollination. *Trasaction of Persatuan Genetik Malaysia,* 10: 61-65.

Muhammad Afiq, T. A., Mohd Asrul, S., Salehudin, M. R., Ullia, I., Razali, M., Johari, S. and Musanif, G. 2018. A preliminary study on self-incompatibility and the need of cross pollination on 'Musang King' durian (*Durio zibethinus* L.) for fruiting. *Transaction of Persatuan Genetik Malaysia,* 8: 35-

Muhammad Afiq, T. A., and Abd Rahman, M. 2016. Study on floral biology and fruit set in mango accessions for breeding program. *Transaction of Persatuan Genetik Malaysia*, 1: 1-3.

Muhammad Afiq, T. A., Mohd Azhar, H., Mohd Asrul, S., Nor Dalila, N. D., and Johari, S. 2016. Study onf fruit quality of variants of *Mangifera indica* L. var. 'Chok Anan' at MARDI. *Transaction of Persatuan Genetik Malaysia,* 3: 183-185.

Asif, M. J., **Ariffin, M. A. T.,** Yit, M., Wong, M., Abdullah, M. Z., Muhammad, N., Ratnam, W., 2015. Utilization of STMS markers to verify admixture in clonal progenies of *Acacia* mapping populations and relabeling using assignment tests. *Journal of Forest Science,* 61 (5): 200-209.

Dr. Chinnapan Thanarut
Assistant Professor
Faculty of Agricultural Production
Maejo University
Chiang Mai, Thailand

1. Academic Background

Educational qualification	Year of Graduation:	Institution:	Country:
B. A. T. (Bachelor Agri. Technology) Pomology	1989	Maejo University	Thailand
Ms.C. (Horticulture)	1996	Chiang Mai University	Thailand
Ph.D. (Horticulture	2010	Nation Chung Hsing University	Taiwan

2. Specialization:

Plant Propagations
Off Season of grapes and temperate zone fruits in tropics and subtropics
Pot plant productions
Plant propagation technique

3. Responsibilities:

Teaching of Temperate zone fruit, Citrus production, Fruit industry, Research and experimental design, Plant micro technique, and Contest judging fruits
Research, development and promotion subtropical and temperate fruit production such as Grape, Passion fruit, Plum, Peach, Pear, Persimmon, Mulberry, Fig, Kiwifruit, and Hormone for flower induction of fruit tree.
Coordinate of grape and small fruits research and development for the farmer and grower.
Consultant grapes and pomology of company in Thailand.

4. Publications:

Thanarut, C., K. Suthikul, and Y. S. Yang. 2005. Guava Production in Thailand. Proceedings of a Symposium on Guava Industry and Development in Taiwan. p. 9-21.

Thanarut, C., K. Suthikul, and Y. S. Yang. 2005. Wax-apple Production in Thailand. Proceedings of a Symposium on Wax-apple Industry and Development in Taiwan. p. 8-26.

Thanarut, C. and Y. S. Yang. 2006. Papaya Production in Thailand. Proceedings of a Symposium on Papaya Industry and Development in Taiwan. p. 40-50.

Thanarut, C. and Y. S. Yang. 2006 Indian Jujube Production in Thailand. Proceedings of a Symposium on Indian Jujube Industry and Development in Taiwan. p. 9-15.

Thanarut, C., W. Suthon, and Y. S. Yang. 2007 Lychee Production in Thailand. Proceedings of a Symposium on Lychee Industry and Development in Taiwan. p. 13-34.

Thanarut, C., Chen, C. C., and Yang, Y. S. 2010. Effects of Streptomycin, GA_3 and CPPU on Seedlessness and Berry Quality in 'Kyoho' and 'Honey Red' Grapes. Hort. NCHU.

Thanarut, C., C. C. Chen, and Y. S. Yang. 2010. Effects of Streptomycin, on Pollen Tube Growth and Seedless Berry Induction in 'Kyoho' Grapes. J. Taiwan Soc. Hort. Sci.

Thanarut, C., P. N. Nan and S. Natip. 2012. Effects of GA_3 and CPPU on Berry Quality in 'Beauty Seedless' and 'Flame Seedless' Grapes. Research Journal of Royal Project Foundation. p. 96-105.

Thanarut, C. and P. Chaiyasit 2013. Study of All Year Round Production of 'Pakchong No. 1 and 'Holland' Papaya by Shoots Training on the Structure. Research Journal of Royal Project Foundation. P. 73-83.

Thanarut, C., P. Pasopa and P. Chaiyasit 2014. Study on Quantity and Quality of Mango by Canopy Training System and Bearing Shoots Control. Research Journal of Royal Project Foundation. P. 363-368.

Thanarut, C. and Y. S. Yang. 2014. Studies on the Mechanism of Seedless ana Seedlessness in 'Kyoho' (*Vitis vinifera* L. x *Vitis labruscana* bailey) grapes Induced by Streptomycin Acta Hort. 1059 : 205-212.

Thanarut, C and J. C. Ko. 2015. Guave, Wax apple, Sugar Apple and Pineapple Production in Thailand. International Symposium on GA3 Tropical Fruit ZGuava, Wax apple Pineapple and Sugar Apple). Actar Hort. 1166. 7-13.

Thanarut, C. and Y. S. Yang. (2014) Studies on the Mechanism of Seedless ana Seedlessness in 'Kyoho' (*Vitis vinifera* L. x *Vitis labruscana* bailey) grapes Induced by Streptomycin Acta Hort. 1059:205-212.

Lo, Q. T., P. Pooprompan, S. Sakhonwasee, and C. Thanarut. 2015. Effects of Atonik and Plant Growth Regulators on Berry Quality of 'Beauty Seedless' Grape. The 36th National Graduate Research Conference., Maejo University, Chiang Mai, Thailand. p. 184-194.

Chao-Jen Wang, Chinnapan Thanarut, Pei-Lun Sun, and Wen-Hsin Chung.2020. Colonization of human opportunistic Fusarium oxysporum (HOFo) isolates in tomato and cucumber tissues assessed by a specific molecular marker. PLOS ONE. 1-15. https://doi.org/10.1371/journal. pone.0234517. June 12, 2020.

Jui-Ching Ko, Chung-Ruey Yen, Chinnapan Thanarut, and Sang-Han Tsai. 2022. Reproductive Growth and Berry Quality of 'Pione' and 'Muscat Bailey A' Grapes in Thailand. J. International Cooperation and Development Fimd. 17 (1) 1-12.

Sheng-Chi Chu, Kuo-His Lin Tsung-Chun Lin, Chinnapan Thanarut, and Wen-Hsin Chung. 2022. Sensitivity of *Colletotrichum gloeosporioides* species complex (CGSC) isolated from Strawberry in Taiwan to benzimidazole and stobilurin. Journal of Pesticide Science 47(4), 1-12.

Dr. Tomohiro Kondo
Associate Professor
Laboratory of Tropical Agriculture,
Graduate School of Agriculture, Kyoto University, Kyoto, Japan

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Academic background

2020 – Present
Graduate School of Agriculture, Kyoto University, Associate Professor
2015-2020
Faculty of Regional Innovation, University of Miyazaki, Associate Professor
2014-2015
Graduate School of Agriculture and Life Sciences, The University of Tokyo, Research fellow
2013-2014
Graduate School of Agriculture and Life Sciences, Kyoto University, Research fellow

Selected publications

Since my student days, main research interest has been the physiological response of tropical and subtropical fruits such as passion fruit and mango. Recently, I have researched about reducing chilling stress on subtropical fruits.

Kondo, T., and Morizono, H. (2022). Effects of drought stress on flower number in 'Summer Queen' passion fruit. Hort. J. 91: 448-452.
Kondo, T., Ikazaki, K., Koala, J., and Takenaka, K. (2022). Effects of porous material and irrigation frequency on the survival rate and vegetative growth in mango seedling at Burkina Faso. Trop. Agr. Develop. 66: 89-94.
Jinzenji, Y., Kondo, T., and Higuchi, H. (2022). Effects of sodium hydrosulfide on physiological responses in a salt-tolerant soybean genotype 'AGS313' under saline conditions. Ecology Journal. 4: 79-89.
Kondo, T. (2021). Effect of sodium hydrosulfide, a hydrogen sulfide donor, application on vegetative growth in passion fruit under chilling stress. Trop. Agr. Develop. 65: 54-57.
Kondo, T. and Honsho, C. (2018). Effect of shade on low temperature damage in 'Bacon' avocado (Persea americana). Trop. Agr. Develop. 62: 132-135.

Dr. Jin-Hsing Huang
Associate Researcher
Taiwan Agricultural Research Institute, COA
Taichung, Taiwan

Education:

Ph. D. (2013) in Plant Pathology, National Chung Hsing University
M. S. (1993) in Plant Pathology, National Chung Hsing University
B. S. (1991) in Plant Pathology, National Chung Hsing University

Experience:

1. Associate Researcher in Taiwan Agriculture Research Institute (TARI)
2. Agricultural expert for diplomatic allies (2016-2018)
3. Ten Best Agricultural Specialist of Taiwan (2016)
4. Visiting scientist of USDA APHIS (2014)
5. 2014 Exemplary civil servant
6. 2013 Outstanding contribution award of TARI
7. 2012 Business Contribution Award of Chinese Sustainable Agriculture Association
8. 2011 Hundred Best Managers (in Manager Magazine)
9. 2010 Best presentation in Annual Meeting of Mycological Society of Taiwan

Specialties:

1. Biology of Oomycetes
2. Climate change and Plant diseases caused by Phytophthora
3. Diseases of greenhouse crops
4. Integrated control of crop pests

Dr.Kietsuda Luengwilai
Associate Professor
Department of Horticulture
Faculty of Agriculture at Kamphaeng Saen
Kasetsart University
Nakhon Pathom, Thailand

Education

1996-2000	B.Sc. (Agriculture). Kasetsart University, Bangkok, Thailand.
2003-2005	M.Sc. (Horticulture and Agronomy). University of California, Davis, USA.
2005-2010	Ph.D. (Plant Biology). University of California, Davis, USA.

Research Interests

I am interested in the postharvest biology of fresh commodities especially vegetables and fruit. My primary focus is on understanding in chilling injury of pineapple fruit, carotenoid metabolism of papaya and pummelo fruits, the volatile regulation of essential oil accumulation in holy basil leaves. My current researches have focused on preharvest factors affecting yield and quality of young aromatic coconuts and durian ripening.

Publications

Luengwilai, K., Yu, J., Jiménez, R. C., Thitisaksakul, M., Vega, A., Dong, S. and Beckles, D. M. 2022. Ectopic Expression of Arabidopsis thaliana zDof1. 3 in Tomato (*Solanum lycopersicum* L.) Is Associated with Improved Greenhouse Productivity and Enhanced Carbon and Nitrogen Use. International Journal of Molecular Sciences, 23(19), 11229.

Sangsoy, K., Beckles, D. M., Terdwongworakul, A., and **Luengwilai, K**. 2022. Discriminating pineapple batches for susceptibility to postharvest internal browning. Scientia Horticulturae, 300, 111069.

Wongpraneekul, A., Havananda, T. and **Luengwilai, K.** 2022. Variation in aroma level of holy basil (*Ocimum tenuiflorum* L.) leaves is related to volatile composition, but not trichome characteristics. Journal of Applied Research on Medicinal and Aromatic Plants, 100347.

Kaewjumpol, G., Srisamlee, S., Beckles, D. M. and **Luengwilai, K.** 2021. Enzymatic Browning in Banana Blossoms and Techniques for Its Reduction. Horticulturae, 7(10), 373.

Nukuntornprakit, O., **Luengwilai, K.** and Siriphanich, J., 2020. Chilling injury in pineapple fruit is related to mitochondrial antioxidative metabolism. Postharvest Biology and Technology, 170, p.111330.

Meas, S., **Luengwilai, K**. and Thongket, T. 2020 . Enhancing growth and phytochemicals of two amaranth microgreens by LEDs light irradiation. Scientia Horticulturae, 265, 109204.

Krisanapook, K., P. Anusornpornpong, T. Havananda, and **K. Luengwilai**. 2019. Inflorescence and flower development in Thai aromatic coconut. Journal of Applied Horticulture 21, 1: 3-12.

Buaban, P., D. M. Beckles, O. Mongkolporn, and K. **Luengwilai.** 2019. Lycopene Accumulation in Pummelo (*Citrus Maxima* [Burm.] Merr.) Is Influenced by Growing Temperature. International Journal of Fruit Science, 1-15.

Havananda, T., and **K. Luengwilai**. 2019. Variation in floral antioxidant activities and phytochemical properties among butterfly pea (*Clitoria ternatea* L.) germplasm.Genetic Resources and Crop Evolution. 66; 645–658.

Luengwilai, K., D. M. Beckles, U. Roessner, D. A. Dias, V. Lui, and J. Siriphanich. 2018. Identification of physiological changes and key metabolites coincident with postharvest internal browning of pineapple (*Ananas comosus* L.) fruit. Postharvest Biology and Technology. 137: 56-65.

Kamonwan S., O. Mongkolpornb, W. Imsabaia and **K. Luengwilai.** 2017**.** Papaya carotenoids increased in Oxisols soils. Agriculture and Natural Resources. 51: 253-261.

Luengwilai, K., D. M. Beckles, and J. Siriphanich. 2016. Postharvest internal browning of pineapple fruit originates at the phloem. Journal of Plant Physiology 202: 121-133**.**

Luengwilai, K., D. M. Beckles, O. Pluemjit, and J. Siriphanich, 2014. Postharvest quality and storage life of 'Makapuno' coconut (*Cocos nucifera* L.). Scientia Horticulturae 175: 105-110.

Beckles D. M., N. Hong, L. Stamova, and K. **Luengwilai.** 2012. "Biochemical factors contributing to tomato fruit sugar content: a review". Fruits, 67 , pp 49-64.

Luengwilai, K., D. M. Beckles, and M. Saltveit. 2012. "Chilling-injury of harvested tomato (Solanum lycopersicum L.) cv. Micro-Tom fruit is reduced by temperature pre-treatments." Postharvest Biology and Technology 63(1): 123-128.

Luengwilai, K., M. Saltveit, and D. M. Beckles. 2012. "Metabolite content of harvested Micro-Tom tomato (Solanum lycopersicum L.) fruit is altered by chilling and protective heat-shock treatments as shown by GC-MS metabolic profiling." Postharvest Biology and Technology 63(1): 116-122.

Luengwilai, K., O. E. Fiehn and D. M. Beckles. 2010. Comparison of leaf and fruit metabolism in two tomato (*Solanum lycopersicum* L.) genotypes varying in total soluble solids. Journal of Agricultural and Food Chemistry. 58(22):11790-11800.

Luengwilai, K. and D. M. Beckles. 2010. Climacteric ethylene is not essential for initiating chilling injury in tomato (*Solanum lycopersicum*) cv. Ailsa Craig. Journal of Stored Products and Postharvest Research. Vol. 1(1), pp. 1 – 8.

Luengwilai, K., K. Tananuwong, C. F. Shoemaker and D. M. Beckles. 2010. Starch molecular structure shows little association with fruit physiology and starch metabolism in tomato. Journal of Agricultural and Food Chemistry. 58, 1275-1282.

Luengwilai, K. and D. M. Beckles. 2009. Starch granules in tomato fruit show a complex pattern of degradation. Journal of Agricultural and Food Chemistry. 57, 8480-8487.

Luengwilai, K and D. M. Beckles. 2009. Structural investigations and morphology of tomato fruit starch. Journal of Agricultural and Food Chemistry. 57, 282-291.

Defilippi, B.G., D. Manriquez, K. **Luengwilai**, and M. Gonzalez-Aguero. 2009. Aroma volatiles: biosynthesis and mechanisms of modulation during fruit ripening. Advances in Botanical research. 50, 1-37.

Luengwilai, K., K. Sukjamsai and A. A. Kader. 2007. Responses of 'Clemenules Clementine' and 'W. Murcott' mandarins to low oxygen atmospheres. Postharvest Biology and Technology. 44, 48-54.

Dr. Domingo E. Angeles
Retired Professor
Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines Los Banos, Laguna, Philippines

Education:

Post-doctoral, University of Georgia Athens, Georgia, USA, Oct. '88- July '89
Post-doctoral, University of Hawaii, Oahu, Hawaii, USA, Aug-Sept 1989
Ph D, University of the Philippines Los Banos, major in Horticulture, minor in Soil Science, 1988
MS, University of the Philippines Los Banos, major in Horticulture, 1981
BSA, University of the Philippines Los Banos, College of Agriculture, major in Horticulture 198

Work experience

1. Member, Technical Panel on Agricultural Education, Commission of Higher Education, Manila Philippines, June 2020-date.
2. Chair, Fertilizer Policy and Technical Advisory Committee of Fertilizer and Pesticide Authority, Manila, Philippines.
3. Chair, UPLB Interdisciplinary Studies Center on Food and Nutrition Security, UPLB College, Laguna, Philippines 2013 to 2019.
4. Dean, College of Agriculture, University of the Philippines Los Banos, College, Laguna, Philippines, 2008-June 2015.
5. Associate Dean, College of Agriculture University of the Philippines Los Banos College, Laguna, Philippines, July 4, 1999 to July 2002.
6. Chairman, Department of Horticulture, College of Agriculture, University of the Philippines. Los Baños College, Laguna, Philippines, May 1991 to Dec. 1997.
7. Program Chair, Diploma in Agriculture Program, University of the Philippines Open University, College, Laguna, Philippines, July 4, 1999 to Dec 2001.
8. Professor 12, Institute of Crop Science, UP Los Banos College, Laguna, Philippines

Specialization

Plant physiologist with sufficient experience in plant nutrition and crop production. He has also a good background in plant propagation, postharvest physiology, cropping system and organic agriculture.

Membership to organizations

I served as officer and member of international organizations and professional organizations on agricultural education, fruit industry, crop science, local agricultural association. This includes Global Confederation for Higher education in Agriculture, Asian Association for Agriculture Colleges and Universities, Philippine Fruit Association, Philippine Association of Agriculturist, Crop Science Society of the Philippines, and Gamma Sigma Delta Honor Society of Agriculture, National Research Council of the Philippines.

Teaching

As Professor of Crop Science, I mentored PhD, MS and undergraduate students and spearheaded the development and institution of curricular programs which include among others BS Agriculture major in Landscape Agroforestry, BS Agriculture major in Agricultural System, and BS Agribiotechnology program in the College of Agriculture and Food Science with major in Crop Biotechnology, Animal Biotechnology, Crop Protection Biotechnology and Food Biotechnology. I implemented the Excellence in Education program in our College aimed at improving the quality of teaching and learning that will increase the number of students graduating on time, increase the number of honor students, reduce the number of students getting failing grades, reduce the number of students shifting to other courses and increase the teaching performance of teachers. To my credit I was bestowed the Achievement Award in Teaching by the Philippine Fruit Association, Achievement Award in Teaching by the Crop Science Society of the Philippines and the One UP Professorial Chair Award on Teaching by UP system.

Research

I conducted a range of research in the field of propagation, flowering, postharvest handling, plant nutrition, cropping system and production of fruit crops, and sweet sorghum. My research resulted to development of technology and significant information which include but not limited to the following: correction of lumpy fruit problem in papaya by boron application, flower induction of mango using calcium nitrate, flower induction of pineapple using low dose of ethrel, sampling protocol for pili using tissue analysis, water footprint for banana and pineapple, nano fertilizer application protocol for banana, critical sap nitrate for quick test of pineapple and banana, diagnosis and recommendation integrated system for banana and pineapple, and production practices for sweet sorghum for bioethanol production. Through this research, and in collaboration with other professors, I co-authored two books titled “Royal Fruits in the Tropics” which earned the Best Book awards from National Academy of Science and Technology, and “Sweet Sorghum as Feedstock: A milestone for Bioethanol Fuel”. I also published several journal articles on crop nutrition, production and flowering, chapters of books, several proceeding papers, policy papers and popular articles.

Extension/Professional service

I organized training programs on fruit production and nursery management and served as resource person on various fields of pomology. I also organized national and international conferences on food security and served as consultant for several clients on agriculture planning, farm planning and development, and production of fruit crops.

Background Information of Field Trip

Division of Pomology
Faculty of Agricultural Production, Maejo University
Sansai District, Chiang Mai, Thailand

There is the learning center in fruit tree belongs to the Division of Pomology, Program in Horticulture, Faculty of Agricultural Production, Maejo University. The production of various types of fruit trees were show in the tropical, subtropical, and temperate fruit trees such as mango, guava, lychee, longan, grapes, persimmon, etc. It focuses on using modern science to increase productivity both in and out of season. Learn how to reproduce fruit trees using new technologies. And the use of technology to preserve the produce after harvest. Most of them are focused on the fruit trees of Thailand's economy.

Home of Cowboy Farm
University Farm, Maejo University
Sansai District, Chiang Mai, Thailand

University Farm, namely Home of Cowboy Farm, is an enterprise agency located in Maejo University. Starting with the resolution of the University Council on September 24, 2006, it was considered and approved in principle to establish the University Farm Bureau by merging similar university projects in this department, such as the Ban Pong Development Project due to the Royal Charter, the Agricultural Park and University Farm Project, Phrao District, the Eco-Tourism Development Center, etc. Entrepreneurship begins from preparation of various inputs, maintenance in the agricultural system, use of microorganisms and herbal extracts for pest control and control, as well as the harvest. Packaging or processing of products, marketing management for sale, which is a turnkey farming operation. It is an agricultural learning resource in the north of the country. To visit mango and longan farms at the Home of Cowboy Farm, focus on the off-season production technology and Drone technology.

Maejo University is also the oldest agricultural university. It is necessary to act as an example to students and the public. Especially, students studying agriculture need to know. It is necessary to be practical in order to go out and become a qualified entrepreneur in the future, or to go out and be the manager of your own farm or company. It is necessary to have an internship until you know all about planning, production, post-harvest processes, processing, and marketing. The establishment of a university farm is therefore specifically in line with the university's mission. Universities with studies in agriculture and beyond.

Uraiwan Organic Farm
Maetang District, Chiang Mai, Thailand

Uraiwan's Organics Chiang Mai, the largest and highest quality organic farm which is located in the northern part of Thailand and has an area of more than 130 rai. There is situated at an altitude of 500 meters, the farm enjoys the typical Northern Thailand climate with a hot rainy season from May through October and a dry season from November to April. During winter in January, the night temperature can go down to 10 degrees Celsius. With the ideal temperature to grow fruits and vegetables in Chiang Mai; Uraiwan's Organic Farm can offer wide ranges of vegetables during the cool and dry season, moreover, Uraiwan's Organic Farm offers the finest selection of fruits during the hot and rainy season.

Uraiwan's Organic Farm is a local producer of over 50 kinds of organically grown premium products since 2012 which is certified by the International Federation of Organic Agriculture Movements (IFOAM) and EU (CE). Everything in Uraiwan's Organic Farm including the wide range of vegetables, aromatic herbs and selection of seasonal fruits is 100% organic using purely organic farming methods. Uraiwan's Organic Farm grows robust crops without using any persistent pesticides, chemical toxic or any GMOs. They are building up soil with natural inputs and managing weeds and pests through cultivation, biological controls and diverse crop rotations. The balanced of the soil results in healthy crops with proving to be good-tasting, nutritious, and more health promoting. Uraiwan's Organic Farm also owns a company called, Natural Agriculture which is primarily active in the manufacturing of organic compost and organic fertilizer and operates with sustainable development principles; so Uraiwan's Organic Farm has very good fundamentals in the organic background. Consumers can rest assured that any products from Uraiwan's Organic Farm are at the top quality of organic products. Uraiwan's Organic Farm view organic production as a means to work with the environment and maintain the balance of their ecosystem, agriculture plays important role in Thailand but only a few farmers tend to care for our environment. As producer and consumer, together we can create the wave to make a difference for our planet. In this program, we are focus on the Intensive management of mango and longan production. The products, especially in organic fruits, such as pomelo, grapefruit, lemon, mulberry, and cacao are waiting to try, switching to organic products are recommended for the long term in health, taste and freshness.