



Programme Book

MSPPC 2020

Emerging Trends of Plant Physiology in Changing Environment

17 – 18 November 2020

MSPP IN BRIEF

Malaysian Society of Plant Physiology (MSPP) is a professional scientific body dedicated towards promoting research and development in tropical plant biology. Inaugurated on 29th April 1989 (Registration No. 889 Wilayah Persekutuan) the Society was formalised with the purpose to encourage and promote the development of plant physiology as a pure and applied phase of botanical science. This may be accomplished by:

- The organisation of meetings, lectures, symposia, seminars, workshops, conferences, and related activities.
- The publication of matters pertaining to plant physiology and related topics.

To date, 27 volumes *Transactions of the Malaysian Society of Plant Physiology* and 12 volumes of *Journal of Tropical Plant Physiology* (JTPP) have been published. JTPP is published twice a year beginning 2018.



PERSATUAN FISILOGI TUMBUHAN MALAYSIA (MALAYSIAN SOCIETY OF PLANT PHYSIOLOGY)

Official address:
Locked Bag No. 282
UPM Post Office
43409 UPM Serdang
Selangor Darul Ehsan
Malaysia

Tel: +6(03)- 89537313/62797235
Fax: +6(03)- 89536153

E-mail: excomspp@mspp.org.my
Website: <http://www.mspp.org.my>

Table of Content

FOREWORD BY THE PATRON.....	6
FOREWORD BY THE PRESIDENT.....	7
FOREWORD BY THE CHAIRMAN.....	8
MSPPC 2020 ORGANISING COMMITTEE.....	9
MSPP EXECUTIVE COMMITTEE 2019-2021.....	10
PROGRAMME.....	12
KY01 Emerging Trends of Plant Physiology in Changing Environment.....	17
PL01 Seed Technology in Facing Environmental Changes.....	18
PL02 Exploiting Plant Physiology for Sustainable Development.....	18
IS01 Development of Rice for Tolerance to Multiple Abiotic Stresses Through Marker Assisted Breeding.....	19
IS02 Malaysia China Food Security Collaboration.....	20
IS03 Urban Farming Technology and Innovation for Food Security in Malaysia.....	20
IS04 Application of Postharvest Technology in Tropical Fruits.....	21
O01 <i>In vitro</i> Callus Induction and Plant Regeneration from Petiole Explants of <i>Tacca Integrifolia</i> , an Important Ornamental Herbal Plant.....	23
O02 <i>In vitro</i> Culture Establishment, Direct Organogenesis, and Acclimatization of <i>Zingiber officinale</i> Rosc. var. Bentong.....	23
O03 Controlling Hyperhydration in Micropropagation of <i>Ziziphus jujuba</i>	24
O04 Phenological Observation of Selected Tropical Timber Trees on Elevated CO ₂ Assessment through Free Air Carbon Dioxide Enrichment (FACE) Study in Tekam, Pahang.....	24
O05 Lemon Myrtle Essential Oils as Potential Botanical Pesticide against Bacterial Leaf Blight Disease (<i>Xanthomonas oryzae</i> pv. <i>oryzae</i>) in Paddy.....	25
O06 Physiological Responses and Root Profiles of <i>Melastoma malabathricum</i> Grown with Soil Amendments in Acidic Soil Condition.....	26
O07 Organic Amendments Influence Growth and Physiology of <i>Melastoma malabathricum</i> , a Slope Species.....	26
O08 Size and Area of Mesocarpic Cells of <i>Passiflora edulis</i> Sims. During Fruit Growth and Development.....	27
O09 Effects of Foliar Fertilizers on the Growth and Yield of Roselle (<i>Hibiscus sabdariffa</i> L.) on Bris Soil.....	27
O10 Growth and Yield Components of Sweet Corn (<i>Zea mays</i> L.), Okra (<i>Abelmoschus esculentus</i> L. Moench) Intercropping Pattern in Young Rubber Plantation.....	28
O11 Shade and NPK Fertilizer Enhanced Growth and Yield of <i>Agastache rugosa</i> (Fisch. & C.A.Mey.) Kuntze.....	28
O12 Cellular and Biochemical Differences in Seeds.....	29
O13 Effect of Packaging Materials on the Postharvest Quality of Winged Beans (<i>Psophocarpus tetragonolobus</i>).....	29
O14 The Production of Volatile Sulphur Compounds and Up-regulation of Methionine-γ-lyase in 'Musang King' and 'D24' Durian Ripening.....	30

O15	Impact of Drying Temperatures on the Stability of Antioxidant Activities and Phenolic Constituents of Leaf and Stem Extracts of <i>Moringa oleifera</i>	30
P01	The Effects of Different Types and Concentrations of Auxin on Root Induction of <i>Phyllanthus niruri</i> (Dukung Anak)..	32
P02	Gene Expression of <i>RBC</i> and <i>GLYK</i> in <i>Albizia saman</i> (Jacq.) Merr Under the Elevated Concentration of Carbon Dioxide.....	32
P03	Isolation of Genic Microsatellite Markers in <i>Mitragyna speciosa</i> (Ketum).....	33
P04	Establishment of <i>In vitro</i> Plantlets Production of White Dragon Fruit (<i>Hylocereus undatus</i>) using Nodal Segments... ..	33
P05	Development of Lateral Flow Immunoassay Against <i>Ralstonia solanacearum</i> Causing Banana Blood Disease (BDB) from Symptomatic and Asymptomatic Banana Plants.....	34
P06	Preliminary Study of <i>In vitro</i> Propagation on Highlands Species <i>Rhododendron jasminiflorum</i> var. <i>punctatum</i> from Cameron Highlands Montane Park (CHIMP)	34
P07	Effect of Auxins Singly and Combination with Cytokinins on Callus Induction of <i>Labisia pumila</i> var. <i>Alata</i>	35
P08	Survival of <i>Eusideroxylon zwageri</i> (Belian) Shoot-tips in Liquid Nitrogen Using Encapsulation-Dehydration Method.....	35
P09	Contained Evaluation and Agronomic Performance of Pioneer 4546 (P4546) Grain Corn in Transgenic Glasshouse Condition.....	36
P10	<i>In silico</i> Promoter Analysis of <i>ABP57</i> (Auxin Binding Protein 57), a Drought-Responsive Gene.....	36
P11	Preliminary Study on <i>In vitro</i> Propagation of <i>Intsia palembanica</i> (Merbau)	37
P12	Toxicity Evaluation of Chitosan Nanoparticles (CNP) and Chitosan Nanoparticles Loaded with Boron (CNP-B) using a Zebrafish Embryo Model	37
P13	HPLC Method for Mitragynine and 7-Hydroxymitragynine Determination in <i>Mitragyna speciosa</i>	38
P14	Study of Metabolite Variations in <i>Eurycoma longifolia</i> Roots Harvested at Different Age	38
P15	Development of Genic SSR Markers from Transcriptome Sequences of <i>Baeckea frutescens</i> (Cucur Atap) for Genetic Diversity Assessment	39
P16	Preparation and Characterization of Chitosan Nanoparticles Loaded with Boron (CNP-B).....	39
P17	Confined Field Evaluation of Transgenic Eksotika Papaya Against Papaya Dieback Disease	40
P18	Profiling of Terpene Synthase Genes in <i>Aquilaria malaccensis</i> Agarwood Induced using Different Conditions... ..	40
P19	Photosynthetic Performance of Ambient and Elevated CO ₂ MR263 Rice Seedling under Different Light Irradiance.. ..	41
20	The Effect of Water Deficit on Growth of Paddy MR 219 (<i>Oryza sativa</i>).....	41
P21	The Effect of Different Water Levels on the Growth and Yield of Rice (<i>Oryza sativa</i>)	42
P22	Meta-QTL Analysis Associated to Tolerance to Metal Toxicity in Rice (<i>Oryza sativa</i> L.).....	42
P23	Alluvial Soil and Pepper Gas Exchange Properties Enhancement with Fermented Juices, Biochar, and Compost.....	43
P24	The Photosynthesis, Transpiration and Water Use Efficiency of Selected Mangrove Species at Larut Matang Mangrove Forest, Malaysia.....	43
P25	Clonal Rootstock Variation of <i>Hevea brasiliensis</i> in Selected Physiological Traits Influence by Water Stress.....	44

P26	Effect of Haze on Fruit Development, Pigmentation, and Productivity of <i>Passiflora quadrangularis</i> L. (Giant Granadilla Passion Fruit).....	44
P27	Efficacy of Fungicides and Biofungicides in the Control of Leaf Blight and Fruit Rot on Indigenous Eggplant.....	45
P28	Revelation of <i>Pantoea</i> Species as a New Causative Agent of Rice Bacterial Leaf Blight Disease via Multilocus Sequencing Analysis (MLSA)	46
P29	Identification and Characterization of <i>Fusarium</i> spp. Causing Slow Decline Disease of Black Pepper (<i>Piper nigrum</i>) in Belaga and Betong Districts, Sarawak	46
P30	Development of a Loop-mediated Isothermal Amplification Method for the Rapid Detection of Banana Blood Disease (BDB).....	47
P31	Do Flower Strips Help in Increasing Beneficial Insects?	47
P32	Seeds Germination of an Urban Tree, <i>Xanthostemon chrysanthus</i> (F. Muell.) Benth. in Different Treatment of Sowing Media.....	48
P33	Variations in Banana Growth Development and Soil Nutrients Status During Vegetative Stages.....	48
P34	Vigour and Morphological Characteristics of Tropical Mango Seedling Rootstock cv. 'Telor'	49
P35	Shoot Vigour of 'Harumanis' Mango Grown under Rain-shelter and Greenhouse	49
P36	Effects of Light-Emitting Diodes (LEDs) and Transplanting Dates of Basil in Nutrient Film Technique (NFT)	50
P37	Preliminary Observation on the Effect of LED Lighting on Growth and Physiological Characteristics of Sweet Basil (<i>Ocimum basilicum</i>).....	50
P38	Preliminary Findings on Spatial and Temporal Pattern of Total Nitrogen after Rainfall Event	51
P39	A four-year Evaluation of the Growth Performance of <i>Acacia hybrid</i> Clones.....	51
P40	Nanofertilizer-Nitrogen, Phosphorus, and Potassium (NPK) Uptake by <i>Carica papaya</i> var. Sekaki Seedlings	52
P41	Growth, Yield Performance, and Phytochemical Content of Sweet Potato and Napier Grass Grown in Different Cropping Systems	53
P42	Malaysia Plant Red List: Rapid Assessment of Peat Swamp Forest in Pekan Forest Reserve, Southeast Pahang	53
P43	Growth Variations in the First-Generation of <i>Tectona grandis</i> (Teak) Progeny Test at Papulut Forest Reserve, Gerik, Perak, Malaysia.....	54
P44	Growth Performance of Tissue Culture Rubber (<i>Hevea brasiliensis</i>) Trees.....	54
P45	Effects of Different Rootstock Age on Grafting Success and Growth Performance of <i>Garcinia atroviridis</i>	55
P46	Mangosteen: Performance of Vegetative Growth in Three Locations	55
P47	Effects of Different Environmental Conditions on Stem Cuttings of <i>Strobilanthes crispus</i>	56
P48	Effect of Nitrogen, Phosphorus, and Potassium Availability on Adan Rice Planted in Lowland Area.....	56
P49	Effect of Paclobutrazol (PBZ) Application Induction on Vegetative, Reproductive growth, and Fruit Quality of Harumanis Mango in Greenhouse Conditions.....	57
P50	Performance of Different Forage Sorghum Varieties as Affected by Mechanised and Semi-mechanised Planting Density, and Harvest Cycle in Mineral Soil.....	57
P51	Paclobutrazol Application for Growth Performance and Flower Enhancement of Extrafloral Nectaried Plant <i>Turnera ulmifolia</i> (Turneraceae)	58

P52	Effect of Plant Growth-Promoting Rhizobacteria (PGPR) on Rice (<i>Oryza sativa</i> L.) Grown Under Drought Condition.....	59
P53	Effects of UV-C Irradiation on the Postharvest Quality of <i>Ficus carica</i> During Storage.....	59
P54	Effect of Postharvest Treatments on Storage Stability of Noni (<i>Morinda citrifolia</i> L.) Fruit	59
P55	Quantification of Primary Metabolites, Phenolics Content, and Antioxidant Properties of <i>Hydrocotyle bonariensis</i> and <i>Centella asiatica</i>	60
P56	Extending the Storage Life of Jackfruit at Sub-optimal Temperature Using Artificial Ripening	60
P57	Selection of Experimental Domain Factors using Two-level Factorial Design on Polyphenols, Phenolic Acids and Flavonoids Content of Lemon Peel (<i>Citrus limon</i>)	61
P58	Quality Aspect of Lowland Cauliflower During Storage.....	61
P59	Evaluation of Growth and Quality of Purple Red <i>Brassica</i> Influenced by Different LED Wavelengths in Indoor Vertical Farming	62
P60	Effects of LED Lights Exposure in Combination with Different Concentrations of Seaweed Extract in Reducing Chilling Injury Incidence on Pineapple (<i>Ananas comosus</i> L. cv. Morris)	62
P61	The Effect of Different Concentrations of Gibberellin in Developing Parthenocarpic Chili (<i>Capsicum annuum</i> L.).....	63
P62	Comparison of Seed Germination under Different Aerobic Rice Cultivation System	63
P63	Seed Quality of Chilli (<i>Capsicum annuum</i>) var. Kulai as Affected by Biopolymer Coating.....	64
P64	Evaluation of Sorghum Seed Viability using Tetrazolium Test.....	65
P65	High Quality Cultivars for the Establishment of Herbal Integrated Farming.....	65
P66	Responses of Seed Germination and Seedling Growth to Seed Priming in <i>Moringa oleifera</i>	66
P67	Seed Quality of Papaya Lines Selected for Tolerance to Papaya Ring Spot Virus Disease.....	66
P68	Growth Assessment of Mesta (<i>Garcinia mangostana</i> L.) Seedlings on Different Growing Media	67
P69	Cryopreservation of <i>In vitro</i> -Grown Taro (<i>Colocasia esculenta</i>) Apical Meristem Using a Droplet-Vitrification PVS3 Technique.....	67
P70	Pre-evaluation on Growth, Yield and Chemical Constituents of Four Selected Herbal Species from Breeding Plot Located at Felcra Nasarudin, Sri Iskandar, Perak.....	68
P71	Environmental Stress on Selected Aerobic Seed Quality During Seed Development.....	68
P72	Fruit Ripeness Effect on the Characteristics, Germination, and Desiccation Tolerance of <i>Syzygium myrtifolium</i> Seeds.....	69
P73	Effect of Seed Priming Treatments on Seed Quality of Tomato (<i>Solanum lycopersicum</i>)	69
P74	Yield Performance of Ulam Tenggek Burung in Pilot Scale	70
	ACKNOWLEDGEMENTS	71

FOREWORD BY THE PATRON

MALAYSIAN SOCIETY OF PLANT PHYSIOLOGY



Assalamualaikum Wm Wb and Salam Sejahtera

It gives me great pleasure to extend a warm welcome to all presenters and participants to the 30th Malaysian Society of Plant Physiology Conference (MSPPC 2020). As the health and safety of everyone is our paramount concern during this COVID-19 pandemic, we shift our conference this year through the virtual communication (webinar) to replace the annual in-person event.

We hope that this meeting will provide a foundation for our understanding on the uncertainties as well as resilience of plants in their survival in multiple environmental changes and also offer viable strategies for the enhancement of adaptive measures in future climate change. Plants which are tolerant to these environmental changes would be important targets for future endeavours in ensuring continuous food supply and sustainable ecosystem.

I believe that this gathering of professional plant scientists from various agencies of different expertise would be able to provide a useful integrated knowledge in plant ecophysiology while aiming for improved and sustainable plant production. Thus, experts in plant physiology, plant ecology, agronomy and biotechnology are encouraged to provide and exchange ideas, techniques, and actions in mitigating environmental problems, as well as ensuring sustainable production for the whole ecosystem.

Finally, I would like to express my sincere gratitude to the MSPPC 2020 organising committee for their hard work and commitment in making this conference a great success. Congratulations!

Prof. Dato' Dr. Mohd Fauzi Hj. Ramlan

Patron of MSPP



FOREWORD BY THE PRESIDENT

MALAYSIAN SOCIETY OF PLANT PHYSIOLOGY



Assalamualaikum Wm Wb and Salam Sejahtera

It is a great pleasure for me to welcome all participants to the 30th Malaysian Society of Plant Physiology Conference (MSPPC 2020). On behalf of the society, I would like to extend our gratitude to Prof. Dato' Dr. Mohd Fauzi Hj. Ramlan, Patron of MSPP, for his willingness to officiate the conference. This year, the conference is organised as webinar due to COVID-19 pandemic. Alhamdulillah, we received a great support from the participants. We appreciate your presence at this difficult time.

The theme of the MSPPC 2020, "Emerging Trends of Plant Physiology in Changing Environment" is highly pertinent in the present situation where changing environment has unfavourable consequences not only on plants but also us as the end users. The roles of various experts in plant science are vital in formulating applicable approaches for future research in facing a challenging environment.

I would like to thank our invited speakers for their willingness to share their thoughts and experiences for the benefit of the participants. I would also like to use this opportunity to express my appreciation to the Executive and MSPPC 2020 Committees who have put their valuable efforts to make MSPP a vigorous and vibrant society. Finally, I wish all of you an enjoyable and fruitful deliberation throughout the conference.

Thank you.

Dr. Ahmad Nazarudin Mohd Roseli

President of MSPP



FOREWORD BY THE CHAIRMAN

MALAYSIAN SOCIETY OF PLANT PHYSIOLOGY



Assalamualaikum Wm Wb and Salam Sejahtera

It is my great pleasure to welcome you to the 30th Malaysian Society of Plant Physiology Conference held this year through this virtual platform due to the current COVID-19 pandemic. Even in this time of uncertainties, we believe that we should proceed with our annual event and we are thankful that it is taking place as usual, albeit being conducted virtually.

The theme “Emerging Trends of Plant Physiology in Changing Environment” was chosen mainly to address the various advances that have been undertaken in maintaining plant yield in uncertain conditions that the world is in at the moment. While originally the matter was related to the climate change and global warming, the theme of the conference is even more fitting now with the COVID-19 situation where there is a grave concern worldwide regarding plant production and food security.

As plant scientists, we should play pivotal role in alleviating this condition. It is high time that we expand our circle of researchers and involve more researchers so that we can achieve this target in a short period of time. I hope that this annual conference continues to provide an avenue where not only important intellectual breakthroughs are presented, but new ideas and practical solutions are also shared. From this conference, we also wish that these important findings will eventually be published in our journal, Journal of Tropical Plant Physiology (JTPP).

Last but not least, I would like to express my sincere appreciation to the organising committee for their tireless efforts and unwavering commitment in making this conference a success. I also wish that all the participants will have an enjoyable conference with productive discussions even while we are gathered virtually.

Thank you for your participation.

Assoc. Prof. Dr. Roohaida Othman

Chairman of MSPPC 2020



MSPPC 2020 ORGANISING COMMITTEE

Chairman

Assoc. Prof. Dr. Roohaida Othman (UKM)

Vice Chairman

Dr. Ahmad Nazarudin Mohd Roseli (FRIM)

Secretariat

Dr. Mohd Hakiman Mansor (UPM)
Dr. Puteri Edaroyati Megat Wahab (UPM)

Finance

Assoc. Prof. Dr. Che Radziah Che Mohd Zain (UKM)
Dr. Martini Mohammad Yusoff (UPM)

Social and Publicity

Dr. Farah Fazwa Md Ariff (FRIM)
Dr. Noor Liyana Sukiran (UKM)
Mr. Mohd Saifuldullah Abd Wahid (FRIM)

Scientific and Technical

Dr. Nor Mayati Che Husin (MRB)
Prof. Dr. Normaniza Osman (UM)
Assoc. Prof. Dr. Roohaida Othman (UKM)
Assoc. Prof. Dr. Tsan Fui Ying (UiTM)
Dr. Ahmad Nazarudin Mohd Roseli (FRIM)
Dr. Siti Aishah Hassan (UPM ALUMNA)
Dr. Siti Hajar Ahmad (UPM ALUMNA)
Dr. Lok Eng Hai (FRIM ALUMNUS)
Dr. Zamri Ishak (MARDI ALUMNUS)
Dr. Rogayah Sekeli (MARDI)
Dr. Martini Mohammad Yusoff (UPM)
Dr. Noor Liyana Sukiran (UKM)
Dr. Noorliana Mohd. Zan (MRB)
Mr. Nazrul Hisham Nazaruddin (MARDI)

MSPP EXECUTIVE COMMITTEE 2019-2021

PATRON	<ul style="list-style-type: none"> • Prof. Dato' Dr. Mohd Fauzi Hj. Ramlan
PRESIDENT	<ul style="list-style-type: none"> • Dr. Ahmad Nazarudin Mohd Roseli
IMMEDIATE PAST PRESIDENT	<ul style="list-style-type: none"> • Assoc. Prof. Dr. Tsan Fui Ying
VICE PRESIDENT	<ul style="list-style-type: none"> • Assoc. Prof. Dr. Roohaida Othman
SECRETARY	<ul style="list-style-type: none"> • Dr. Rogayah Sekeli
ASST. SECRETARY	<ul style="list-style-type: none"> • Dr. Nor Mayati Che Husin
TREASURER	<ul style="list-style-type: none"> • Assoc. Prof. Dr. Che Radziah Che Mohd Zain
COMMITTEE MEMBERS	<ul style="list-style-type: none"> • Prof. Dr. Normaniza Osman • Dr. Martini Mohammad Yusoff • Dr. Mohd Hakiman Mansor • Nazrul Hisham Nazaruddin



MSPPC 2020 WEBINAR PROGRAMME

WEBINAR

MSPPC 2020

PROGRAMME

30th Malaysian Society of Plant Physiology Conference
Emerging Trends of Plant Physiology in Changing Environment

17 and 18 November 2020

Tuesday 17 November 2020

0800– 0900 Welcoming Remarks:
Assoc. Prof. Dr. Roohaida Othman
Chairman of MSPPC 2020

Opening Address:
YBhg. Prof. Dato' Dr. Mohd Fauzi Hj. Ramlan
Patron of Malaysian Society of Plant Physiology

0900 – 1000 Keynote Address:
Chairperson: Assoc. Prof. Dr. Roohaida Othman
(Universiti Kebangsaan Malaysia)

Emerging Trends of Plant Physiology in Changing Environment
Dr. Elizabeth Philip
(Ministry of Energy and Natural Resources, Malaysia)

1000 – 1040 Plenary 1:
Chairperson: Dr. Zamri Ishak
(Malaysian Agricultural Research and Development Institute Alumnus)

Seed Technology in Facing Environmental Changes
Prof. Dr. Uma Rani Sinniah
(Universiti Putra Malaysia)

1040 – 1110 e-Poster Session I (P01-P15)

Session I: Biotechnology and Nanotechnology
Chairperson: Dr. Khalisanni Khalid
(Malaysian Agricultural Research and Development Institute)

1110-1140 Invited Speaker 1:
 Development of Rice for Tolerance to Multiple Abiotic Stresses Through Marker Assisted Breeding
Noraziyah A. A. S., Mohd Ikmal A., and Waitul Fifika A.
(Universiti Kebangsaan Malaysia)

1140-1205 *In vitro* Callus Induction and Plant Regeneration from Petiole Explants of *Tacca integrifolia*, an Important Ornamental Herb Plant
Mohd-Zulhilmi M., and Shermarl W.
 (Kasetsart University, Thailand)

1205-1230 *In vitro* Culture Establishment, Direct Organogenesis and Acclimatization of *Zingiber officinale* Rosc. var. Bentong
Nisar A. Z., Hawa Z. E. J., and Hakiman M.
 (Universiti Putra Malaysia)

1230-1255 Controlling Hyperhydration in Micropropagation of *Ziziphus jujuba*
Perera N. I., Sinniah U. R., Shairul Izan R., Abdullah T. L., and Hakiman M.
 (Universiti Putra Malaysia)

1255-1400 e-Poster Session II (P16-P36)

Session II: Ecophysiology, Stress Biology and Pest Management

Chairperson: Dr. Martini Mohammad Yusoff
 (Universiti Putra Malaysia)

1400 -1425 Phenological Observation of Selected Tropical Timber Trees on Elevated CO₂ Assessment Through Free Air Carbon Dioxide Enrichment (FACE) Study in Tekam, Pahang
Nadiyah Salmi N., Nashatul Zaimah N. A., Nor Rashidah M., Noraliza A., Nor Asmah H., Azian M., and Nik Norafida N. A.
 (Forest Research Institute Malaysia)

1425 - 1450 Lemon Myrtle Essential Oils as Potential Botanical Pesticide Against Bacterial Leaf Blight Disease (*Xanthomonas oryzae* pv. *oryzae*) in Paddy
Hazalina Z., Norhayu A., Dzolkhifli O., Siti Izera I., and Noor Azlina M.
 (Malaysian Agricultural Research and Development Institute)

1450 - 1515 Study on Interaction Between Physiological Responses and Root Profile of *Melastoma malabathricum* Grown with Soil Amendments in Acidic Soil Condition
Lili Syahani R., Normaniza O., Rosazlin A., Jamilah Syafawati Y., and Siti Nur Zahira O.
 (Universiti Malaya)

1515 - 1540 Organic Amendments Influence Growth and Physiology of the Slope Species *Melastoma malabathricum*
Wan Nurul Atiqah W. M., Chai L. L., Rosazlin A., and Normaniza O.
 (Universiti Malaya)

1540 - 1610 Invited Speaker 2:
 Malaysia China Food Security Collaboration
Vincent W. W. S.
 (Malaysia Innovation Hub)

1610 - 1710 Plenary 2:
Chairperson: Assoc. Prof. Dr. Tsan Fui Ying
(Universiti Teknologi MARA)

Exploiting Plant Physiology for Sustainable Development
Prof. Dr. Ian Dodd
(University of Lancaster, United Kingdom)

Wednesday 18 November 2020

Session III: Plant Growth and Development
Chairperson: Dr. Puteri Edaroyati Megat Wahab
(Universiti Putra Malaysia)

0900 - 0930 Invited Speaker 3:
 Urban Farming Technology and Innovation for Food Security in Malaysia
Zulhazmi S., Johari S., Masnira M. Y., and Puteri Aminatulhawa M. A.
(Malaysian Agricultural Research and Development Institute)

0930 -0955 Size and Area of Mesocarpic Cell of *Passiflora edulis* Sims. During Fruit Growth and Development
Shahidah M. N., and Phebe D.
(Universiti Putra Malaysia)

0955 - 1020 Effects of Foliar Fertilizers on the Growth and Yield of Roselle (*Hibiscus sabdariffa* L.) on Bris Soil
Norhayati Y., and Goo C. Y.
(Universiti Malaysia Terengganu)

1020 -1100 e-Poster Session III (P37-P51)

1100 -1125 Evaluation of Growth and Yield Components of Sweet Corn (*Zea mays* L.) - Okra (*Abelmoschus esculentus* L. Moench) Intercropping Patterns in Young Rubber Plantation
Shampazuraini S., Martini M. Y., Mohd-Fauzi R., and Zulkefly S.
(Universiti Putra Malaysia)

1125 -1150 Shade and NPK Fertilizer Enhanced Growth and Yield of *Agastache rugosa* (Fisch. & C.A.Mey.) Kuntze
Khairul Azree R., Puteri Edaroyati M. W., and Azizah M.
(Universiti Putra Malaysia)

1150 -1215 Cellular and Biochemical Differences in Seeds
Mohamad Azril Hafis M. N., and Tsan F. Y.
(Universiti Teknologi MARA)

1215 -1240 Elite Scientific Instruments MSPP Online Slides Show
Muhammad Zulfadzli Z.

1240 – 1400 e-Poster Session IV (P52-P75)

Session IV: Postharvest Technology and Quality Control

*Chairperson: Dr. Wan Zaliha Wan Sembok
(Universiti Malaysia Terengganu)*

1400 - 1430 Invited Speaker 4:
Application of Postharvest Technology in Tropical Fruits
*Phebe D., Nuratika Tamimi S. M., Balasundram G., Maizan Izni A. M., Bokhary Z., Amin M., and Salumiah M.
(Universiti Putra Malaysia)*

1430 - 1455 Effect of Packaging Materials on the Postharvest Quality of Winged Beans (*Psophocarpus tetragonolobus*)
*Nor Elliza T., and Nur Syahirah A. R.
(Universiti Malaysia Sabah)*

1455 - 1520 The Production of Volatile Sulfur Compounds and Up-regulation of Methionine-γ-lyase in 'Musang King' and 'D24' During Durian Ripening
*Azizah M., Tan X. Y., Phebe D., Mohd Sabri P. D., Leona-Daniela J. D., and Benjamin L. Y. C.
(Universiti Putra Malaysia)*

1520 – 1545 Impact of Drying Temperatures on the Stability of Antioxidant Activities and Phenolic Constituents of Leaf and Stem Extracts of *Moringa oleifera*
*Saliu A. A., Azizah M., and Hakiman M.
(Universiti Putra Malaysia)*

1545 – 1610 Kahoot

1610 – 1640 Poster Competition Results and Winner's Presentation

1640 – 1700 Closing Speech
Dr. Ahmad Nazarudin Mohd. Roseli
President of MSPP

The background of the slide is a close-up photograph of a wood grain, showing concentric rings of various shades of brown, tan, and black. A solid red rectangular box is positioned in the upper-left quadrant, containing white text. To the right of the red box, the background transitions into a solid blue-grey color.

Speakers:

Keynote

Plenary 1 & 2

Invited 1- 4

ABSTRACTS: KEYNOTE PAPER

KY01 Emerging Trends of Plant Physiology in Changing Environment

Elizabeth P.

Ministry of Energy and Natural Resources, Wisma Sumber Asli, No. 25 Persiaran Perdana, Presint 4, 62574 Putrajaya, Malaysia.

**Email: philip@ketsa.gov.my*

ABSTRACTS: PLENARY PAPERS

PL01 Seed Technology in Facing Environmental Changes

Sinniah U. R.

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

**Email: umarani@upm.edu.my*

“Controlling the seeds controls the world” is a quote with very deep meaning. Seeds and planting materials are the farmers most essential input and in the form of plant genetic resources “the plant breeders” most important raw material for manipulation to enhance yield, adaptability, or nutritional value. One tiny seed can produce a million seeds in single plant, a time capsule with many secrets and wonders of plants embedded in the seeds; basically it is the source of life. Its significance becomes more important as agriculture today faces many challenges, on account of climate change, global warming, and high food grain prices. The global seed market size is estimated to be valued at USD 59.3 billion in 2020 and it is expected to escalate to USD 80.9 billion by 2025, indicating its importance. In Malaysia, the government is looking towards modernizing the agriculture sector particularly in the area of food production. This noble intention has to be strongly supported by the presence of good quality seeds which is the primary starting point for successful crop production. To date, Malaysia is still importing much of its seed required for food production. “Quality seed does not cost, it pays”. In view of the above, controlling the seeds *via* understanding its physiology, biochemistry, requirements for germination and storage are necessary, particularly with the challenges faced due to environmental or climate change. This paper will discuss on the important concepts in seed development and maturation, germination and dormancy, seed storage and highlight advancement in seed related technologies incorporating priming, pelleting and coating which can enhance the performance of the seeds. The impact of new science and technology on production of seed will be discussed.

PL02 Exploiting Plant Physiology for Sustainable Development

Dodd I.

Lancaster Environment Centre, Lancaster University, LA1 4YQ, United Kingdom.

**Email: I.Dodd@lancaster.ac.uk*

Plant physiology seeks to understand how plants develop, grow, and interact with their physical, chemical and biological environment¹. While this is an important intellectual endeavour, most research funding requires that researchers demonstrate how this knowledge can be applied to enhance crop yields. While the last 50 years have seen spectacular successes in boosting crop yields in some parts of the world by planting improved varieties and using scarce resources (such as irrigation water and chemical fertilisers), there are concerns that these advances have not benefited all nations. Moreover, some of these successes have incurred environmental costs such as soil erosion and depletion of finite water resources. I will provide case studies from two current projects that fall under the banner of “sustainable development”, that aim to exploit plant physiological knowledge to design irrigation techniques that use less water while maintaining crop yields. Ensuring that farmers want to, and are able to, apply these techniques is an increasingly important role for the plant physiologist.

ABSTRACTS: INVITED PAPERS

IS01 Development of Rice for Tolerance to Multiple Abiotic Stresses Through Marker Assisted Breeding

Noraziyah A. A. S.*, Mohd Ikmal A., and Waitul Fifika A.

Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM), 43600 Bangi, Selangor, Malaysia.

*Email: nora_aziz@ukm.edu.my

Rice (*Oryza sativa*) is the staple food for more than 90% of the Asian's population. As the population growth rate in Asia is likely to grow at 1.3% per annum, rice production should be increased by at least 13% in 2030 to meet the estimated demand. In Malaysia, the current self-sufficiency level (SSL) on rice is around 70% despite the various types of subsidies provided by the government. The remaining 30% has been imported from other rice-producing countries such as Vietnam, Thailand and Pakistan. High dependency on import can cause a major threat to the country's social, economic and political stability. However, to achieve 100% rice SSL it is not an easy task due to several issues such as limited land to grow more rice, limited resources, high production cost, and increasing severity of abiotic and biotic stresses due to climate change. Climate change-induced abiotic stresses (such as drought, submergence, salinity, nutrient deficiencies and heavy metals) adversely affecting rice growth and productivity. Malaysia's rice varieties though high-yielding, are highly susceptible to abiotic stresses. Thus, developing high-yielding rice varieties that can withstand abiotic stress through a breeding program is a sustainable and viable option for improving productivity, reducing farmers' risks and bringing marginal land into use. Selection of parental lines and breeding method is crucial to ensure the effectiveness of a breeding program. Rice germplasm which includes traditional varieties, landraces and wild relatives serve as main genetic sources for abiotic stress tolerance. Conventional breeding seems to be an effective way to develop new rice cultivars; however, it is tedious and highly dependent on subjective evaluation and empirical selection by the breeder. The pressure is higher when it involves multiple stresses. As compared to conventional breeding, marker-assisted breeding (MAB) and mutational breeding are more useful and effective to produce new plant varieties that are tolerant to these abiotic stresses in a shorter time. By using MAB, beneficial alleles from traditional varieties, landraces, and wild relatives can be introgressed to develop climate-ready rice varieties. Molecular markers mainly microsatellite and single-nucleotide polymorphism have been applied to locate genes and quantitative trait loci (QTLs) linked to the various traits of interest on rice chromosomes. Information about genes and QTLs linked to abiotic stress-tolerance are important, where this information can be used by plant breeders to develop promising breeding lines. Research at International Rice Research Institute since the last 15 years has led to the identification of major QTLs such as *qDTY_{1.1}*, *qDTY_{2.2}*, *qDTY_{3.1}*, *qDTY_{6.1}*, and *qDTY_{12.1}* for drought-tolerance, *Submergence 1 (Sub1)* for submergence tolerance, and *Saltol* and *SKC1* for salinity tolerance. Some of these QTLs have been used in MAB programs in Malaysia to improve abiotic stress tolerance. Through these breeding programs, several promising high yielding and abiotic stress-tolerant lines were identified, and few were registered. Although the introgression of these QTLs through MAB has been suggested as a fast-track and effective approach for abiotic stress improvement of mega rice varieties, the target QTL must have a large and consistent effect on yield for MAB to be worthwhile. Also, understanding the effects of the QTLs, their combinations, and interactions in providing single or multiple abiotic stresses tolerance are also crucial.

IS02 Malaysia China Food Security Collaboration

Vincent W. W. S.

Malaysia Innovation Hub, Suite 19.01, Level 19, The Gardens North Tower, Mid Valley City, Lingkaran Syed Putra, 59200 Kuala Lumpur, Malaysia.

**Email: wongwaisang@gmail.com*

Malaysia have set up the Cabinet Committee on Food Security comprising of experts on food production, economists, and social scientists. However international collaboration was not part of the agenda, and the objective of this presentation is to propose a collaboration with China, with their proven record of food security through the use of the latest technologies and innovations plus the proper management, product marketing and supply chain distribution throughout the country. With China's new economic policy of twin circulation, ie domestic consumption and international trade, as announced by their President Xi Jinping, great opportunities can be created for our Malaysian agriculture and aquaculture sector. Products from Malaysia ranging from specialty rice, oil, seafood, and marine products will have immediate access to the China's vast domestic market. With the China ASEAN Technology Transfer Center to be set up here in Kuala Lumpur, Malaysia can have access to the full range of innovative products and services ranging from Smart Agriculture, Product Development and Distribution systems, Cold Chain Logistics, Big Data and its application as well as the latest innovations in satellites and Unmanned Aerial Vehicles and Drones. Through the China One Belt One Road initiative, many countries in ASEAN including Indonesia, Cambodia, Laos, Thailand, Myanmar, Philippines and even Brunei have collaborated with China and have increased their food productivity and improved their food security positioning. Malaysia is the last country in ASEAN yet to have official technology collaboration and food security collaboration with China. In this Post Covid recovery era, we need the latest technologies and economic model to enable our agriculture sector to move forward. China can provide such assistance on a G to G basis and we can assist to engage with the relevant China authorities to move this proposal to fruition for the well-being of our people.

IS03 Urban Farming Technology and Innovation for Food Security in Malaysia

Zulhazmi S.*, Johari S., Masnira M. Y., and Puteri Aminatulhawa M. A.

Horticulture Research Centre, Malaysian Agricultural Research and Development Institute, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

**Email: zulhaz@mardi.gov.my*

Rapid urbanization around the world has resulted in the rural-to-urban migration for better economic opportunities, which increases the urban population by 70%. Global food demand is projected to rise with the increase in the world population from 7.7 billion to 9.2 billion in 2050. Hence, similar trend is also expected in the growth of urban population. In Malaysia, good economic growth caused an increase in population from 31.1 million in 2015 to 33.8 million in 2020. In order to accommodate the rapid urbanization, some suburban agricultural lands have been converted to residential area, and this led to a decline in food production area in Malaysia. Availability of agricultural land has decreased by 0.66% as recorded in 2017. In addition, the water resource for agricultural purposes also reduces, due to the competition with the urban residential and industry use. The decline in agriculture lands and resources in urban and suburban areas limits the capacity of traditional food production method to meet the growing food demand of urban dwellers. Creativity and technology are two important elements to ensure continuity of food production in urban areas. Resource efficiency is among the most important things that need to be emphasized for maximum production with minimal resource utilization. In recent years, there have been rapid development of technologies to meet the suitability of agriculture activities in urban areas. This was catalyzed by the growing interest in farming and production of their own food among urban dwellers. Landless and tiered cultivations are among the popular planting concepts for urban farmers. MARDI as a research agency has developed several innovations for urban

community agricultural use. Among others are self-watering systems for community farming and verticle planting systems in a controlled environment using artificial lighting (LED). The verticle planting system can produce vegetables of 5-10 times higher yields as compared to the conventional production system. Through R&D, the environment (light, temperature, plant nutrition and humidity) as well as physiological factors were taken into consideration for the production of high quality and yield of crops. Since it was introduced in 2014, urban agriculture in Malaysia has undergone transformation towards a more modern, advanced and sophisticated approach. Apart from using sensors to control and determine crop requirement factors, Internet of Thing (IoT) applications have been incorporated in urban farming for more efficient monitoring system. This paper will present MARDI's experience in implementing the development of urban agricultural innovation, the development of vertical planting systems and the future prospects of national food crop production.

IS04 Application of Postharvest Technology in Tropical Fruits

Phebe D.*, Nuratika Tamimi S. M., Balasundram G., Maizan Izni A. M., Bokhary Z., Amin M., and Salumiah M.

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: phebe@upm.edu.my

Food insecurity has been addressed since a decade ago, but it has been particularly critical during COVID-19 pandemic when logistic and distribution industries fail to operate as routine schedules. This leads to a challenge for distributor to retain quality of fresh horticultural produces while waiting for distribution. Therefore, the objective of this paper was to address application of postharvest technologies in tropical fruits to prolong postharvest life and retain quality. Ultraviolet-C is a kind of physical treatment to kill microorganism without leaving deleterious residues to consumers and environment. It is able to suppress crown rot diseases, retain postharvest quality and antioxidant capacity of Berangan banana during fruit ripening. It is also able to inhibit conidial germination and sporulation of *Colletotrichum gloeosporioides* on Chok Anan mango. Hydrocooling is another kind of physical treatment by dipping produces in cold water for certain period of time. It is able to retain quality of sweet corn for longer period as compared to control. Hydrocooling at ½ cooling time can preserve cell wall structure of rockmelon fruit and retains fruit quality during storage. Hot water treatment is also a kind of physical treatment where hot water is used to sterilize fruit surface. By dipping Berangan banana fruit in hot water of 50°C for 20 min, anthracnose was controlled, while ripening process was slowed down and eventually led to shelf life extension. Similarly, hot water treatment at 55°C for 5 min reduced postharvest disease in Chok Anan mango. In conclusion, with these postharvest technologies, the postharvest life of fresh tropical fruits is able to prolong.



ABSTRACTS ORAL PRESENTATION

ABSTRACTS: ORAL PAPERS

001 *In vitro* Callus Induction and Plant Regeneration from Petiole Explants of *Tacca Integrifolia*, an Important Ornamental Herbal Plant

Mohd Zulhilmi M.^{1,2*}, and Shermarl W.²

¹Department of Horticulture, Faculty of Agriculture, Kasetsart University, Lat Yao, Chatuchak, 10900 Bangkok, Thailand.

²Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: zulhilmisrol@gmail.com

Callus induction and indirect organogenesis protocol were developed using leaf and petiole explants of *Tacca integrifolia* on MS medium supplemented with different plant growth regulators. For callus induction, MS medium with 6-benzylaminopurine (BAP) alone or in combination with α -naphthalene acetic acid (NAA) was used. High efficiency (100%) callus induction was obtained in petiole than leaf explant at concentration of 1 mg/L BAP and 0.3 mg/L NAA. In leaf explant, maximum callus induction capabilities were obtained at concentrations of 1 mg/L BAP with 0.1 mg/L NAA and 1 mg/L BAP and 0.3 mg/L NAA, with 73.4% frequency of induction of compact callus. The shoots from induced callus of petiole and leaf explants were transferred on MS medium fortified with different concentrations of BAP (0 - 5 mg/L). The highest mean number of shoots per explant was initiated in MS medium supplemented with 3 mg/L BAP, which produced seven shoots per explant. Scalp was induced at the basal end of developing shoot of the explants after six-week inoculation where MS medium supplemented with 4 mg/L BAP resulted in scalp formation of 93.3%. Root emergence was observed within 15 - 20 days in root induction media fortified with various concentrations of NAA (0 - to 0.5 mg/L) and 20 - 25 days in MS medium supplemented with various concentrations (0 - 0.5 mg/L) of indole-3-butyric acid (IBA). Therefore, an application of 0.3 mg/L of IBA is recommended when producing a large number of healthy roots. The results of the present study on *in vitro* propagation of *T. integrifolia* are important for the mass production of plantlets.

002 *In vitro* Culture Establishment, Direct Organogenesis, and Acclimatization of *Zingiber officinale* Rosc. var. Bentong

Nisar A. Z.^{1,2}, Hawa Z. E. J.¹, and Hakiman M.^{1,3*}

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Department of Horticulture, Faculty of Plant Sciences, Afghanistan National Agricultural Sciences and Technology University, Kandahar, Afghanistan.

³Laboratory of Sustainable Resources Management, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Bentong ginger (*Zingiber officinale* Rosc.) is herbaceous, monocotyledon plant from the Zingiberaceae family. It is the most popular cultivar of ginger in Malaysia. The poor flowering and seed formation of ginger caused it to hinder its breeding. It is proliferated through its rhizome, and the underground rhizomes are exposed to different kinds of pathogens. Since these pathogens are readily spreading through the conventional propagation methods, it is crucial to develop a micropropagation protocol to produce disease-free planting materials of Bentong ginger commercially. Therefore, this study was conducted to investigate the effects of Clorox® on explant surface sterilisation, plant growth regulators on shoots multiplication and rooting, and finally, different potting media were evaluated for the *ex vitro* acclimatisation of Bentong ginger. Rhizome sprouted buds were effectively sterilised in 70% Clorox® (5.25% NaOCl) for 30 minutes by obtaining 75% contamination-free explants, which were successfully established at 83.60% survival rate in the culture medium. MS medium supplemented by 10 μ M of zeatin and 2.5 μ M NAA was the best combination for shoot multiplication that produced 6.7 shoots per explant after six weeks of culture. Roots were spontaneously induced with the multiplication stage, and they were further developed by adding 5 - 7.5 μ M NAA to the culture medium. *In vitro* derived plantlets of Bentong ginger were successfully acclimatised in a growing media made of soil + coco peat + vermiculite (1:1:1) by controlling their transpiration by covering with

transparent polyethylene bags for two weeks. After four weeks of acclimatisation, 94.8% of the *in vitro* raised plantlets were survived in the *ex vitro* conditions. The acclimatised plantlets were successfully established with a 100% survival rate under 50% black shade net. In conclusion, the present study's outcome can be adopted for large-scale production of Bentong ginger's disease-free planting.

003 Controlling Hyperhydration in Micropropagation of *Ziziphus jujuba*

Narmada I. P.^{1,2}, Sinniah U. R.¹, Shairul Izan R.¹, Abdullah T. L.¹, and Hakiman M.^{1,3*}

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Fruit Crop Research and Development Institute, Department of Agriculture, Sri Lanka.

³Laboratory of Sustainable Resources Management, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Ziziphus jujuba is a well-known medicinal fruit plant, also called Chinese dates or red dates. The fruits are highly nutritious and enriched with numbers of antioxidants. Like many other woody plants, micropropagation was a challenge for jujube as it is vulnerable to hyperhydration under *in vitro* conditions. The hyperhydration symptoms are characterized as a glass-like or water-soaked translucent appearance caused by excess water uptake. This has leads to physiological malformation, including poor lignification, reduced mechanical strength, low vascular development, and abnormal stomatal development. By addressing underlying causes, the effectiveness of micropropagation can be improved. Four different basal media (woody plant medium -WPM, Murashige and skoog -MS, $\frac{3}{4}$ strength of MS, Driver and Kuniyaki Walnut medium - DKW) and two types of gelling materials (agar and phytigel) were evaluated. Parameters monitored includes the appearance of hyperhydration symptoms, hyperhydration intensity, shoot length, and leaf chlorophyll content. The WPM showed the least hyperhydration symptoms, while severe symptoms were observed in MS compared to other basal media tested. Hyperhydration intensity was observed higher in phytigel when comparing to the shoots raised in agar. The maximum shoot length was recorded in WPM and MS media with 3.6 and 3.7 cm, respectively. There were no significant differences in shoot length cultured on phytigel and agar. The WPM with agar was the best combination that showed the least hyperhydration symptoms in *in vitro* shoots. Healthy fully expanded leaves were observed. It also showed a significantly higher leaf chlorophyll content (0.8 mg/g fresh weight) as compared to other treatment combinations evaluated.

004 Phenological Observation of Selected Tropical Timber Trees on Elevated CO₂ Assessment through Free Air Carbon Dioxide Enrichment (FACE) Study in Tekam, Pahang

Nadiah Salmi N.^{1*}, Nashatul Zaimah N. A.¹, Nor Rashidah M.¹, Noraliza A.¹, Nor Asmah H.¹, Azian M.², and Nik Norafida N. A.²

¹Forestry Biotechnology Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong Selangor, Malaysia.

²Forestry and Environment Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong Selangor, Malaysia.

*Email: nadiah@frim.gov.my

Forest ecosystems are generally regarded as carbon absorption and storage areas, to stabilize carbon dioxide (CO₂) gas concentration in the atmosphere. For this reason, forests have crucial role in mitigation and adaptation to climate change. Free air CO₂ enrichment (FACE) facility located in Tekam, Pahang allows phenological observation of the effects of elevated CO₂ on tropical timber trees and under natural forest conditions. Phenology involves monitoring and observing plant biological development including flower formation, fruiting and external environmental factors that influenced it's physiological traits. Data from selected mother trees were monitored in the 25 m x 25 m large-scale FACE experiments (480–650 ppm). From the study, we found that the flowering and fruiting frequency of selected trees in FACE located area

were more responsive to elevated CO₂ at initial years of observation. However, longer exposure to elevated CO₂ resulted in trees expressing down-regulated or acclimated traits which also largely depending on the species. The initial results from 3 years observation in this study provide plausible trend on how tropical timber trees in their native environments and field-grown crops will respond to a rising atmospheric CO₂. Data collection in this study has contributes to a more comprehensive understanding on the adaptation of the tropical forest ecosystem to an increase of atmospheric CO₂.

005 Lemon Myrtle Essential Oils as Potential Botanical Pesticide against Bacterial Leaf Blight Disease (*Xanthomonas oryzae* pv. *oryzae*) in Paddy

Hazalina Z.^{1,2*}, Norhayu A.², Dzolkhifli O.², Siti Izera I.², and Noor Azlina M.¹

¹Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Head Quarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

²Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Malaysia.

*Email: hazalina@mardi.gov.my

Rice (*Oryza sativa*) has been cultivated since ancient times and it is the most important staple food worldwide, especially in East Asia, Southeast Asia, South Asia, the Middle East and the West Indies. However, rice production is facing serious constraints from diseases mainly caused by bacteria, viruses, or fungi. As an example, bacterial leaf blight is caused by *Xanthomonas oryzae* pv. *oryzae*, which is one of the most serious diseases of rice. Yield loss due to bacterial leaf blight can be as much as 70% when susceptible varieties are grown, in environments favourable to the disease. The current practice uses chemical copper-based pesticide to control the diseases. There are concerns that frequent applications of copper-based pesticide have led to the emergence of copper-resistant strains in agriculture raising doubts on the long-term sustainability of agricultural production. Copper based pesticide also have adverse effects on the environment and biodiversity, such as contamination of soil and groundwater, with significant impact on soil biota. There is a need to use environmentally safe approaches to overcome the loss of grain yield in rice due to this disease. Active compound from plant especially essential oils, have been demonstrated to possess potent antibacterial, antifungal, insecticidal and nematocidal activity. Therefore, this study on the effect of seven essential oils against *Xanthomonas oryzae* pv *oryzae* growth was initiated by performing *in vitro* screening via filter disc diffusion assay on peptone sucrose agar (PSA). Lemon myrtle (*Backhousia citriodora*) essential oil showed strong antimicrobial activity against Xoo with the highest inhibition zones of 39.0±1.0 mm in diameter. The minimum bactericidal concentration (MBC) of lemon myrtle essential oil was also determined by dilution methods and found to be 0.075% (v/v). Based on its antibacterial performance, lemon myrtle essential oil was selected to be further characterised by GC-MS to identify its phytochemical compounds. Geranial (43.63%) and neral (40.04%) were identified to be the major compounds in lemon myrtle while the minor compounds were eugenol, isocitral-E, geraniol, mentha-2,8-dien-1-ol, citronellal and linalool. The trace compounds that were 1.0% or less were pinene-α, camphene, pinene-β, cineole, myrcene, terpinene-γ, pulegone, terpinen-4-ol, shyobunol, piperitone, copaene- α, caryophyllene-ε and cadinene-γ. The metabolite profiling obtained provided the important information on the compounds responsible for the activity of lemon myrtle and can be further exploited for future applications.

006 Physiological Responses and Root Profiles of *Melastoma malabathricum* Grown with Soil Amendments in Acidic Soil Condition

Rusli L. S.^{1,2*}, Osman N.^{1*}, Abdullah R.¹, Yaacob J. S.^{1,3}, and Omar S. N. Z.¹

¹Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia.

²Faculty of Applied Sciences, Universiti Teknologi MARA Cawangan Negeri Sembilan Kampus Kuala Pilah, 72000 Negeri Sembilan, Malaysia.

³Centre for Research in Biotechnology for Agriculture (CEBAR), Universiti Malaya, 50603 Kuala Lumpur, Malaysia.

*Email: sva180073@siswa.um.edu.my, normaniza@um.edu.my

Soil acidification which affects soil nutrient availability is one of the major constraints to crop productivity. Soil acidity prevents the elongation of root that interferes the physiological processes in the plant. The shallow root produced with the poor performances of the plants contributes to the soil erosion problems. Liming has been used for decades in the agricultural sector for the amelioration of acid soils, but it is claimed to cause soil pollution. A common approach to enhancing fertility is the implementation of soil amendments. Soil amendments are known to change the physicochemical properties of soils and bioavailability of plant nutrients, thus enhancing plant growth. Hence, compost as an alternative method which is often nutrient-enriched and has fertiliser retaining ability was introduced recently to improve soil fertility. This study aimed to assess the interaction between physiological responses and root profiles of *M. malabathricum* as affected by compost, ground magnesium limestone, combined treatment of compost and ground magnesium liming grown on acidic soil condition. Compost was significantly higher in the rate of photosynthesis and water use efficiency. Compost also showed highest in root volume and root diameter compared to other treatments. Correlation analysis showed that the root diameter and root volume of *M. malabathricum* grown with all amendments were positively correlated with the physiological responses. In conclusion, the use of compost alone was deemed adequate for it showed good effects on plant physiological performances as well as root profiles. Hence, the preliminary results of this study highlight the potential use of compost as a promising solution to the growth and development of plants, especially those grown on unfavourable condition like low pH.

007 Organic Amendments Influence Growth and Physiology of *Melastoma malabathricum*, a Slope Species

Wan Nurul Atiqah W. M., Chai Li, L., Rosazlin A., and Normaniza O.*

Institute of Biological Sciences, Faculty of Science, Universiti Malaya, 50603 Kuala Lumpur, Malaysia.

*Email: normaniza@um.edu.my

Organic amendments have the potential to improve plant growth and physiological performance, but this effect is minimally explored in Malaysian slope species. In this experiment, the effects of three organic amendments (20 t ha⁻¹ biochar, compost, or vermicompost) versus inorganic fertiliser were investigated on *Melastoma malabathricum* growth and physiological responses in a slope experiment to determine the best amendment to support the species development. After nine months, vermicompost treatment increased the stem diameter by 114% compared to 71% in control but insignificant in difference compared to inorganic fertiliser, showing potential for substitution. Among all organic amendments, only vermicompost resulted in greater fresh above-ground biomass in *M. malabathricum* ($p < 0.05$). Vermicompost also increased relative chlorophyll content and photosynthetic rate by 68% and 32%, respectively. Similarly, both stomatal conductance and transpiration rate in vermicompost treated plants were improved by more than 100% compared to control, which were probably because of greater stomatal opening induced by phytohormones originating from the amendment. Contrasting trends were found in physiological responses of *M. malabathricum* in biochar treatments, where all parameters except relative chlorophyll content were lower than control. Therefore, it is deduced that vermicompost probably the most suitable organic amendment for improving *M. malabathricum* growth and physiological performance on slope conditions.

008 Size and Area of Mesocarpic Cells of *Passiflora edulis* Sims. During Fruit Growth and Development

Shahidah M.N., and Phebe D.*

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: phebe@upm.edu.my

Passion fruit (*Passiflora edulis* Sims.) is one of important commodities in Malaysia that being cultivated for both domestic and export purposes. Fruit size is an important criterion for commercialization, especially in rating the fruit quality. It is hypothetically suggested that the fruit size of *P. edulis* is regulated by the number and cell sizes during growth and development. To test this hypothesis, the changes in cell area, diameter and cell numbers during fruit development were analysed. Naturally, pollinated fruit were collected weekly from 7 days to 63 days after pollination (DAP). The mesocarp cell of fruit was subjected into microscopic observation using scanning electron microscope (SEM). Cell area, diameter and cell size were analyzed using the ImageJ software. It was observed that rapid increase of cell area and diameter occurred during 7 to 21 DAP and slowed down during 28 until 63 DAP. The cell number was stagnant during 7 to 14 DAP before a rapid proliferation during 21 to 42 DAP. These results showed that the cell diameter and area were highly correlated with the final fruit size.

009 Effects of Foliar Fertilizers on the Growth and Yield of Roselle (*Hibiscus sabdariffa* L.) on Bris Soil

Norhayati Y.^{1,2*}, and Goo C. Y.¹

¹Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia.

²Biological Security and Sustainability Research Interest Group (BioSes), Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia.

*Email: yatiyusuf@umt.edu.my

Roselle (*Hibiscus sabdariffa* L.) calyxes contain huge number of antioxidants, used worldwide in hot and cold beverages, as flavoring agent and herbal medicine. With the highly adaptable with all ranges of soils; Roselle can be potentially planted at Beach Ridges Interspersed with Swales (BRIS) soil which is regarded as a problematic soil in Malaysia. The aim of this study was to determine the effect of foliar fertilizer on the growth and yield as well as the anthocyanin, carotenoids, chlorophyll, and ascorbic acid contents in Roselle (UKMR-2) on BRIS soil. The VITA-Grow foliar fertilizer was applied at different time intervals which are every 0, 2, 3, 6 and 8 weeks. The growth parameters were measured every three weeks. The yields which were amount, weight, size, and biochemical contents of matured fruits were determined. The highest plant height, stem diameter, calyx's size, ascorbic acid, carotenoids, and chlorophyll contents were obtained at six weeks interval of foliar application. Surprisingly, control plant had the highest number of calyxes, calyx's fresh and dry weights as well as anthocyanin content. However, foliar application was only significantly affected the calyx's length and diameter as well as carotenoids content compared to control plant. Above results indicated that foliar application is not significantly affected the growth and yield of Roselle plant.

010 Growth and Yield Components of Sweet Corn (*Zea mays* L.), Okra (*Abelmoschus esculentus* L. Moench) Intercropping Pattern in Young Rubber Plantation

Shampazuraini S., Martini M. Y.*, Mohd Fauzi R., and Zulkefly S.

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: martini@upm.edu.my

A field study was conducted at MINI Research Station of Malaysia Rubber Board, Jasin, Malacca and located at Latitude 2° 18' 60.00" N and Longitude 102° 25' 59.99" E. The aim of this study was to evaluate the growth and yield of sweet corn and okra (Lady's finger) intercropping with two years old young rubber stands. This study was conducted using a complete randomized block design (CRBD) consisting of three replications. The crop ratio treatments comprises: T1 (20% okra + 80% sweet corn + rubber), T2 (50% okra + 50% sweet corn + rubber), T3 (80% okra + 20% sweet corn + rubber), T4 (100% okra + rubber) and T5 (100% sweet corn + rubber). The results obtained showed no significant difference in sweet corn plant height and number of leaves plant⁻¹ by intercropping with okra. However, the number of marketable cobs, cob yield and biomass yield were significantly ($P < 0.05$) affected in the cropping pattern in the T5 treatment using only one single crop, sweet corn. However, number of okra fresh pods per plant, length and diameter of a fresh pod, weight per pod as well as fresh pod yield per hectare were significantly ($P < 0.05$) reduced when okra was intercropped with sweet corn for all treatments. Hence, sweet corn, okra, and intercropping pattern of 20% okra + 80% sweet corn + rubber is recommended in young rubber plantation instead of using a sole cropping of sweet corn or okra.

011 Shade and NPK Fertilizer Enhanced Growth and Yield of *Agastache rugosa* (Fisch. & C.A.Mey.) Kuntze

Khairul Azree R., Puteri Edaroyati M. W.*, and Azizah M.

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: putri@upm.edu.my

Agastache rugosa (Fisch. & C.A.Mey.) Kuntze or Korean mint is an herbaceous perennial eminent for its purple spiked flowers. Versatile and exotic, *A. rugosa* makes a valuable addition to any landscape and interiorscape. In recent years, *A. rugosa* has received much attention because of purported anticancer, anti-HIV, antibacterial, antifungal and antidepressant activities besides other health benefits. *Agastache rugosa* mixed with other herbal medicines is also a promising candidate for treating symptoms in COVID-19 patients. Though newly introduced, Malaysia has a potential for commercial cultivation of *A. rugosa*. There is currently no official recommendation in literature for shading and fertilizing; some farmers use the recommendations of *A. foeniculum*, which, as *A. rugosa*, belong to the Lamiaceae family. Thus, the goal of this study is to investigate the growth, biomass distribution, and physiological responses of *A. rugosa* under varying shade and NPK rates. By understanding the growth pattern, we can find the optimum macronutrient level for higher biomass yield. Plants were grown under two shade levels (0% and 50%), and four NPK rates (80, 160, 240 and 320 kg ha⁻¹) in a nested design. NPK rates were nested within each shade level in RCBD with four replications. Urea, TSP and MOP were used as sources of nutrients. Leaf gas exchange of fully expanded leaves were measured by using a portable photosynthesis instrument (LI-COR 6800, LI-COR Incorporated, Lincoln, Nebraska, USA). Data were analyzed by general linear model, polynomial regression, and Fisher's LSD test ($P < 0.05$). Shading significantly affected plant height, internode length, stem diameter, root shoot ratio, leaf mass ratio, leaf area ratio, specific leaf area and leaf area index of *A. rugosa*. Non shaded plants had higher transpiration rate and stomatal conductance. Applying NPK fertilizer enhanced leaf, stem and root dry mass, total leaf area and chlorophyll a. Chlorophyll b, chlorophyll a/b ratio, total chlorophyll and carotenoid content did not differ between shade and NPK treatment. However, interaction between shade and NPK

levels affected net photosynthetic rate and carboxylation efficiency. As for the recommendation the growing of *A. rugosa* under non shaded conditions and applying 240 kg/ha NPK can enhance its growth and yield.

012 Cellular and Biochemical Differences in Seeds

Mohamad Azril Hafis M. N., and Tsan F. Y.*

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin, 77300 Merlimau, Melaka, Malaysia.

*Email: tsanfuiying@uitm.edu.my

Tolerance to desiccation in seeds is important for storage, genetic preservation, and minimization of space. The seed response towards desiccation process is classified into three types based on storage behavior. They are the recalcitrant, orthodox, and intermediate seeds. Orthodox seed that naturally survives desiccation undergoes maturation drying that causes reduced vacuole volume followed by metabolic shutdown and sometimes, de-differentiation. This situation causes oxidative stress due to imbalance between reactive oxygen species and antioxidant enzyme but the amount of sugar and protein in the desiccating seed is able to act as a protective mechanism to prevent damage of the seed. Unlike orthodox seed, recalcitrant seed is developed and shed at high moisture content which makes it remain metabolically active. This seed does not undergo maturation drying at the end of seed development. Thus, it becomes sensitive to the postharvest desiccation. Recalcitrant seed also has some amount of sugars and proteins, but they cannot act as a protective mechanism. Intermediate seed is a seed that is more tolerant to desiccation than recalcitrant seed but does not survive low temperature and extreme desiccation levels.

013 Effect of Packaging Materials on the Postharvest Quality of Winged Beans (*Psophocarpus tetragonolobus*)

Nor Elliza T.*, and Nur Syahirah A. R.

Faculty of Sustainable Agriculture, UMS Sandakan Campus, 90000 Sandakan, Sabah, Malaysia.

*Email: ellizatajadin@ums.edu.my

A study was conducted to determine the effect of packaging materials on the postharvest quality of winged beans, *Psophocarpus tetragonolobus*. A factorial experiment was conducted with four packaging materials and four storage days, in a completely randomised design with four replications. The beans were packed in perforated polyethylene (PE) bags, banana leaf and printed newsprint paper in addition to without packaging as a control. The beans were subsequently kept at 5 ± 2 °C in the refrigerator. The postharvest quality characteristics were measured at four days interval from 0 days until 12 days of storage. Weight loss, firmness, hue colour value and ascorbic acid and chlorophyll contents were significantly influenced by the packaging materials, storage days and their interactions. Except for weight loss, the firmness, hue and both ascorbic acid and chlorophyll contents of winged beans seemed to decrease as the storage days increased. As compared to control, the winged beans packed with perforated PE bags have higher firmness, hue, ascorbic acid content and chlorophyll content and a lower percentage of weight loss. It can be concluded that in the storage of winged beans, the use of perforated PE bags improved moisture retention while allowing carbon dioxide from respiration to escape from the bags, thus maintaining the postharvest quality. The perforated PE bags had an excellent ability to protect the beans from overexposure to carbon dioxide, which hastened deterioration and shortened produce shelf life.

014 The Production of Volatile Sulphur Compounds and Up-regulation of Methionine- γ -lyase in 'Musang King' and 'D24' Durian Ripening

Azizah M.^{1*}, Tan X.Y.¹, Phebe D.¹, Mohd Sabri P.D.², Leona Daniela J.D.³, and Benjamin L. Y. C.⁴

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Department of Food Science, Faculty of Science and Food Technology, 43400 UPM Serdang, Selangor, Malaysia.

³Agronomic Selection, Sime Darby Plantation Technology Centre Sdn. Bhd., UPM-MTDC Technology Centre III, Universiti Putra Malaysia, Lebu Silikon, 43400 UPM Serdang, Selangor, Malaysia.

⁴Advanced Biotechnology and Breeding Centre, Malaysian Palm Oil Board, 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia.

*Email: azizahm@upm.edu.my

Durian (*Durio zibethinus* L.) is an edible tropical fruit known as the 'King of Fruits' in many countries, especially Malaysia. The aim of the present work was to characterize the composition of volatile organic compounds (VOCs) in 'Musang King' and 'D24' durian fruits. The composition of VOCs in both durians demonstrated that 'D24' had almost equal ratio between volatile sulphur compounds (VSCs) and volatile esters compounds (VECs). However, 'Musang King' showed higher VECs which was more than 80%. It was found that the number of VSCs in 'D24' was 57% higher than those detected in 'Musang King'. Diethyl trisulfide was found in both durians; however, it was higher in 'D24'. Characterization of the proteins associated with the production of VSCs were performed by proteomic analysis. The results indicated that the methionine- γ -lyase was present in both 'Musang King' and 'D24'. The relative abundance of methionine- γ -lyase was also four folds higher in 'D24' as compared to the 'Musang King'. These results provide the information of VSCs in durian aroma which lead to the consumer preference and the protein that controlling the regulation of VSCs in durian.

015 Impact of Drying Temperatures on the Stability of Antioxidant Activities and Phenolic Constituents of Leaf and Stem Extracts of *Moringa oleifera*

Saliu A. A.¹, Azizah M.¹, and Hakiman M.^{1,2*}

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Laboratory of Sustainable Resources Management, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Moringa oleifera (Lam.) from the family Moringaceae has been considered one of the most useful trees globally. This is because of potential in traditional medicine, including infectious diseases, cardiovascular, gastrointestinal, hematological, antibacterial, diabetes, and various skin disorders. Studies have shown that the plant is chemically composed of bioactive compounds and exhibits pharmacological properties, making it an effective antimicrobial agent. It is rich in vitamins, minerals, and other essential phytochemicals. It has been evaluated for its high antioxidant activities in all parts of the plant. The production of antioxidant and phenolic constituents is not stable; it tends to fluctuate for various reasons. This study was conducted to determine the impact of three oven drying temperatures 40, 50, and 60°C on the antioxidant activities and phenolic constituents of leaf and stem extracts of *Moringa oleifera*. The highest total phenolic, polyphenol, and flavonoid contents were exhibited by the leaf extract dried at 40°C with 206.33 mg GAE/g, 202.27 mg GAE/g, and 89.95 mg RE/g, respectively. However, the stem extract showed the highest concentration of total phenolic acids, polyphenol, and flavonoids in the sample dried at 60°C with 122.19 mg GAE/g, 134 mg GAE/g, and 130 mg RE/g, respectively. In conclusion, *Moringa oleifera* leaf and stem exhibited relatively high amounts of bioactive compounds at different temperatures. Therefore, further studies of different drying methods are needed for optimization and comparison with the current study.



ABSTRACTS POSTER PRESENTATION

ABSTRACTS: POSTER PAPERS

P01 The Effects of Different Types and Concentrations of Auxin on Root Induction of *Phyllanthus niruri* (Dukung Anak)

Anis S. A.¹, Azizah M.¹, and Hakiman M.^{1,2} *

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Laboratory of Sustainable Resources Management, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Phyllanthus niruri or Dukung Anak, commonly known as Gale of Stone, is an herbaceous medically potent plant belonging to the family Phyllanthaceae. It has been distributed in tropical countries, including Malaysia. It has been used traditionally to treat various ailments such as diabetes, jaundice, flu, and cough. It possesses numerous medicinal properties such as anti-tumor, anti-carcinogenic, and a remedy for hepatitis B viral infection. Overexploitation of this species has resulted in large-scale destruction of this plant from natural habitat. Thus, this study was proposed to solve the problem by using *in vitro* technology approach. Application of different rooting hormones (auxin); indole-3-butyric acid (IBA), 1-naphthalene acetic acid (NAA), and indole-3-acetic acid (IAA) at different concentrations (0, 1.25, 2.5, and 5.0 μ M) induced the adventitious root of explants. All the parameters, which are number of roots, root length, and number of leaves, showed significant responses towards the treatment application with $P < 0.05$. Treatment of 2.5 μ M IBA showed the highest number of roots with the most extended root length. Meanwhile, 2.5 μ M NAA resulted in the highest number of leaves. In conclusion, different types of auxin and its concentrations have shown a significant response to *P. niruri*. A complimentary study on this plant acclimatization will be carried out to evaluate explants' survival in *ex vitro* conditions.

P02 Gene Expression of *RBC* and *GLYK* in *Albizia saman* (Jacq.) Merr Under the Elevated Concentration of Carbon Dioxide

Che Radziah C. M. Z.^{1,3*}, Fathurrahman F.⁴, Nizam M. S.^{1,3}, and Wan Juliana W. A.^{2,3}

¹Department of Biological Sciences and Biotechnology, ²Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

³Institute of Climate Change, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

⁴Department of Agrotechnology, Faculty of Agriculture, Universitas Islam Riau, Pekanbaru, 28284 Indonesia.

*Email: cradziah@ukm.edu.my

Global climate change caused by the increase of carbon dioxide (CO₂) in the atmosphere has happened since the industrial revolution and the increased of economics growth. CO₂ concentrations continue to rise, including in Malaysia, whereby in 2015, the rate was exceeded 400 ppm. Malaysia announced its commitment to reduce greenhouse gases (GHG), or CO₂, in 2020 by 40%. One of the ways to reduce CO₂ is to plant the trees that can absorb the CO₂ efficiently. *Albizia saman* (Jacq.) Merr was reported to be able to absorb a high concentration of CO₂. The objective of this research was to investigate the response of *A. saman* plants to elevated CO₂ in term of gene expression. The gene expression related to photosynthesis such as rubisco (*RBC*) and D-glycerate 3-kinase (*GLYK*) genes has been studied. *A. saman* was grown in a greenhouse under two conditions of CO₂ concentration (400 and 800 ppm). The analysis of quantitative PCR (qPCR) showed increased levels of *RBC* expression by 16-fold, while *GLYK* showed a one-fold decrease in the expression level in the treated plants. From the analysis, it was suggested that *A. saman* has been able to absorb carbon dioxide effectively. Therefore, it is recommended that *A. saman* be widely cultivated in Malaysia in conjunction with Malaysia's commitment to reduce CO₂ levels by 2020.

P03 Isolation of Genic Microsatellite Markers in *Mitragyna speciosa* (Ketum)

Lee C. T., Nurul Farhanah M. R., Norlana Izzati, Hazwani Humaira Z.*, Nur Nabilah A., Kevin K. S. N., Ng C. H. Z., Tnah L. H., Norlia B., and Lee S. L.

Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

*Email: hazwani@frim.gov.my

Mitragyna speciosa (Rubiaceae) is an important medicinal plant valued for its stimulatory or mood enhancer and analgesic effect. We developed 29 genic microsatellite markers in *M. speciosa* using next-generation sequencing approach. Leaf transcriptome data generated through Illumina paired-end sequencing were mined for microsatellites. A total of 29 microsatellite markers were isolated and characterised based on 32 ketum individuals collected from FRIM Research Station at Jengka, Pahang, of which 21 were polymorphic. Due to the narrow gene pool sampled, most of the polymorphic loci yielded only two to three alleles. The highest number of alleles ($A = 6$) was observed in locus *MspT29*. The mean observed heterozygosity and expected heterozygosity were comparable, $H_o = 0.436$ and $H_e = 0.439$. The eight monomorphic loci might exhibit allelic variation when samples from different locations are genotyped. With the increasing reports on the medicinal properties of ketum, there is a need to carry out conservation genetic study in this medicinal plant species along with other improvement programmes. The transcriptomic microsatellite markers developed will facilitate such endeavours.

P04 Establishment of *In vitro* Plantlets Production of White Dragon Fruit (*Hylocereus undatus*) using Nodal Segments

Jessica I. J. A.^{1*}, Nurul Fitriyani M.¹, Noorasmah S.¹, and Sreeramanan S.²

¹Department of Crop Science, Faculty of Agricultural Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, Nyabau Road, P.O. Box 396, 97008 Bintulu, Sarawak, Malaysia.

²School of Biological Sciences, Universiti Sains Malaysia (USM), Georgetown, 11800, Penang Malaysia.

*Email: jessica@upm.edu.my

White pitahaya with its scientific name *Hylocereus undatus* that comes from the botanical family of *Cactaceae* has been getting popularity because of its health benefits. In Malaysia, it is called 'buah naga' which means dragon fruit. This fruit has been getting a lot attention by fruit growers because it has high commercial value and rich in antioxidants. This study aimed to establish multiple plantlets of *H. undatus* through *in vitro* micropropagation from nodal segments from *in vitro* germinated seeds. Through micropropagation, *H. undatus* can be commercialized, increase in quality and shelf life of the fruits. Hence the current research was conducted to select the optimized media component and its effect on growth index of the nodal segments. The shoot formation of *in vitro* nodal segments was assessed based on the following parameters such as different explant sizes (3-4 mm and 5-6 mm), Murashige and Skoog medium strength ($\frac{1}{2}$ MS, 1 MS and 2 MS media), sucrose concentration (0, 10, 20, 30 and 40 mg/L) and shooting hormone; 6-Benzylaminopurine (BAP) concentration (0, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mg/L). Results indicated that optimal *in vitro* plantlet of *H. undatus* obtained with highest growth index (2.06 ± 0.17) with explant size of 5-6 mm cultured on 2 strength MS medium supplemented with 30 mg/L of sucrose and 2.5 mg/L 6-benzylaminopurine (BAP).

P05 Development of Lateral Flow Immunoassay Against *Ralstonia solanacearum* Causing Banana Blood Disease (BDB) from Symptomatic and Asymptomatic Banana Plants

Mohd Afendy A. T.^{1*}, Nor Fazmimi N. A.¹, Khairul Anuar S.², Nur Sulastri J.³, Siti Noraini B.¹, Farah Farhanah H.³, Zulaikha M.³, and Adlin Azlina A. K.¹

¹Biotechnology and Nanotechnology Research Centre, ²Engineering Research Centre, ³Horticulture Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: fendy@mardi.gov.my

Banana blood disease (BDB) has caused a serious threat to the banana industry in Malaysia. The disease is caused by *Ralstonia solanacearum* phylotype IV. The bacterium forms an irregular round, creamy colonies with red centres when cultured on Kelman's tetrazolium chloride (TZC) medium. The present study was performed to develop lateral flow immunoassay (LFIA) against *R. solanacearum*. The detection of the LFIA strip was made possible using the polyclonal antibodies raised against *R. solanacearum* and immunised in New Zealand White rabbit. It is used as the capture antibodies striped as the test line on the nitrocellulose membrane. The detector reagents consist of the respective anti-*R. solanacearum* polyclonal antibodies conjugated with 40 nm gold nanoparticles sprayed onto fibre-glass conjugate pad. The assembled LFIA strip was then tested on *R. solanacearum* culture and field samples consisting of the pseudostem, petioles and leaves of the visibly asymptomatic and symptomatic banana plant. Visible test line signal could be observed from the positive culture as well as from some of the samples of the banana plants. This preliminary development of LFIA strip shows a promising result for the rapid detection of BDB especially very helpful in diagnosing those asymptomatic banana plants without undergoing conventional culture process.

P06 Preliminary Study of *In vitro* Propagation on Highlands Species *Rhododendron jasminiflorum* var. *punctatum* from Cameron Highlands Montane Park (CHIMP)

Mohd Saifuldullah A. W.*¹, Nor Hasnida H., Nazirah A., Muhd Fuad Y., Norsiha A., Rozidah K., Rohani A., Nurliyana A. L., and Ahmad Fathul Ilmi A. Z.

Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: saifuldullah@frim.gov.my

Rhododendron jasminiflorum var. *punctatum* is a native plant species in Cameron Highlands which belongs to the Ericaceae family. This flower species can be found in widespread open space areas above 900 meters from sea level. Besides, this shrub may live up to 2.5 meters in height; have white pinkish flowers with open umbels and consists of 3 to 5 elliptic leaves arranged in pseudo whorls. The objective of this study was to develop a tissue culture protocol for the *R. jasminiflorum* highland species. The plantlets obtained will be used as the planting stock materials for the Cameron Highlands Mountain Park (CHiMP) in the effort of establishing a garden of rhododendron to become a new attraction of tourist spot in Parit Falls Recreational Forest. In this study, two types of sterilization techniques were applied on explants, which are vegetative parts and seeds. For the young shoots, single and double surface sterilization methods were applied; however, clean culture was not obtained after three weeks. On the other hand, surface sterilization of the *R. jasminiflorum* seeds explants succeed in clean culture obtained using only one method which is 70% of ethanol for 2 min followed by 50% of clorox® for 20 min. The culture produced will be subjected to shoot multiplication.

P07 Effect of Auxins Singly and Combination with Cytokinins on Callus Induction of *Labisia pumila* var. *Alata*

Najhah M. Y.¹, Jaafar, H. Z. E.¹, Nakasha J. J.¹, and Hakiman M.^{1,2*}

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

²Laboratory of Sustainable Resources Management, Institute of Tropical Forestry and Forest Products, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Labisia pumila, known widely as Kacip Fatimah, is an herbaceous plant that grows widely in the shade of the tropical forest floor. Malaysian, mainly women, use this plant as traditional medicine, especially as postpartum medication. From previous research, *L. pumila* was proven to contain high flavonoids, phenolic, and other phytochemicals. Since the discovery of its medicinal values, *L. pumila* was sought after, and high demand for its raw materials can be seen in the market. However, the source for this herb in natural habitat is decreasing because of its slow growth rate. Hence, plant tissue culture technique facilitates large-scale production to increase the supply and to ensure this plant did not face extinction. The study was conducted to investigate the effect of different types and concentrations of auxin singly and in combination with cytokinins towards callus induction of *Labisia pumila* var. *alata*. Leaves explant from 8 weeks old of *in vitro* plantlets were cultured onto different 2,4-Dichlorophenoxyacetic acid (2,4-D) and picloram concentrations. Treatment with 0.5 mg/L of 2,4-D produced the highest callus induction percentage (60%) with greenish and compact callus texture. 0.5 mg/L of 2,4-D and 1 mg/L of picloram were then combined with 0.25 mg/L and 0.5 mg/L of different types of cytokinin, respectively. Results showed that 0.5 mg/L of 2,4-D with zeatin produced the optimal percentage for callus induction (100%) with yellowish to greenish and compact texture of callus.

P08 Survival of *Eusideroxylon zwageri* (Belian) Shoot-tips in Liquid Nitrogen Using Encapsulation-Dehydration Method

Nashatul Zaimah N. A.*, Rosdi K., Nor Asmah H., Noraliza A., Nadiah Salmi N., Nor Rashidah M., Muhammad Alif D., and Fadzlina Z.

Forest Biotechnology Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: nashatul@frim.gov.my

This study aimed to evaluate a preservation technique for *Eusideroxylon zwageri* shoot-tips using encapsulation-dehydration method. This method involves surface sterilization, shoot-tips pre-cultured process for 16 hours in Murashige & Skoog (MS) medium, containing 0.3 M sucrose, encapsulated in 2% (w/v) sodium alginate and 0.1 M calcium chloride and followed by dehydration for about six hours using silica gel. Cryopreservation was performed by using direct plunging into liquid nitrogen where the samples were stored for one day. The samples were then thawed at a 40°C water bath and cultured using MS and WPM (Woody Plant Medium). Results obtained showed that viability of encapsulated *E. zwageri* shoot-tips was higher when cultured on WPM than in MS medium. Coincidentally, there are also shorter dehydration period with high viability rates in using WPM as compared to MS medium.

P09 Contained Evaluation and Agronomic Performance of Pioneer 4546 (P4546) Grain Corn in Transgenic Glasshouse Condition

Nazrul Hisham N., Rogayah S.*, Amin Asyraf T., Wee C.Y., Zaifulfarizal Z., Mohamad Naim Z., and Sanimah S.

Biotechnology and Nanotechnology Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: lynn@mardi.gov.my

Malaysia relies heavily on imported grain corn (*Zea mays* L.) for animal feed, including genetically modified (GM) corn. It is therefore planned and proposed to plant selected GM corn cultivars in Malaysia, with the objective of reducing the dependence of imported grain corn on animal feed, which in turn contributes to the national food sovereignty. In compliance to the Biosafety Act 2007, preliminary studies of the intended GM corn need to be carried out in a controlled and contained environment before any field release. Therefore, *Z. mays* cv. P4546 was planted to evaluate the suitability of the transgenic glasshouse condition for the planting of grain corn before the arrival of the GM seeds. A total of 500 polybags with measurement of 20 inches x 20 inches were prepared using soils originated from Seberang Perai, Penang. Each polybag was planted with two seeds for germination, and after 14 days of planting, the rate of germination of both and single seeds was 85% and 10%, respectively, while the remaining failed to germinate. Only one plantlet was allowed to grow in each polybag. When the plant starts flowering, manual pollination was applied by dusting over the pollen from the tassels to the emerging silks at each ear. To achieve maximum fertilisation rate, the pollen from 100 donor plants was also supplemented to the samples. Subsequently, the fitness was assessed by counting seeds per ear, and the results showed that 14.7% of the ears had full seed, 63.6% of the ears had less seed, and 21.7% of the ears had no seed. The mean of the fruit length, the fruit weight, and the fruit weight without husk were approximately 28.03 cm, 98.97 g and 77.07 g, respectively. The results indicated that the current technique should be improvised to suit the limitation of the contained environment in order to achieve at least 90% ears with full seed. Further evaluation is currently conducted by reducing the sample size to 300 plants to increase the efficiency of manual pollination.

P10 *In silico* Promoter Analysis of ABP57 (Auxin Binding Protein 57), a Drought-Responsive Gene

Farah Afiqah B., and Noor Liyana S.*

Department of Biological Sciences and Biotechnology, Faculty Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

*Email: liyana@ukm.edu.my

Auxin Binding Protein 57 (ABP57) encodes an auxin-binding protein in rice, and its overexpression in rice and *Arabidopsis* had increased the plants' tolerance to drought conditions. It suggests that *ABP57* possessed a function in drought stress response. The promoter region of *ABP57* was analysed *in silico* to understand the regulation of *ABP57* expression. About 1 kb of the upstream region was used to identify the *cis*-acting element in the *ABP57* promoter. Several motifs involved in stress response such as DRE (dehydration-responsive element), ABRE (abscisic acid-responsive element) and EREBP (ethylene-responsive binding protein) were identified. The binding sites of transcription factor (TF) such as WRKY, MYB, bZIP and NAC were also present in the *ABP57* promoter. These results suggest that these TFs may regulate *Abp57* during drought stress. However, more studies are needed to determine the interaction between the TFs and *ABP57*.

P11 Preliminary Study on *In vitro* Propagation of *Intsia palembanica* (Merbau)

Nor Rashidah M.*, Nashatul Zaimah N. A., Nadiyah Salmi N., Nor Asmah H., Noraliza A., Fadzlinah Z., and Muhammad Alif Daniel M. S.

Biotechnology Programme, Forestry Biotechnology Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: norrashidah@frim.gov.my

Intsia palembanica, or commonly known as Merbau (Malacca teak), is one of the tallest trees in the tropical region, and it is capable of towering up to 50 m in height. In 2019, Merbau is officially named as Malaysia's national tree. This preliminary study was conducted to fill in gaps on its *in vitro* propagation method to achieve better survival rates of clean explants. A few regimes of sterilisation of the mature seeds from the wild were conducted to ensure a better survival rate. Two different surface sterilisation methods have been tested, which showed that pre-sterilisation of all forms of explants using 0.1% Benomyl for 30 min increased the number of clean survival explants. Simple cleaning using Chlorox® solution was not enough to control fungal and bacterial contamination. Based on the percentage of contamination and response, the best method for surface sterilisation of *I. palembanica* was 70% of Chlorox®, which produced more than 90% clean cultures. Nodal segments explants from the *in vitro* germinated seeds were further tested on two different basal media for *I. palembanica* optimum growth. Half strength of Woody Plant Media ($\frac{1}{2}$ WPM) produced healthier rooted plantlets in terms of size and colour of shoots and leaves compared to half strength of Murashige and Skoog media ($\frac{1}{2}$ MS). However, further study is needed to establish an efficient, effective, and reproducible protocol for the tissue culture of *I. palembanica* explants obtained from the open field.

P12 Toxicity Evaluation of Chitosan Nanoparticles (CNP) and Chitosan Nanoparticles Loaded with Boron (CNP-B) using a Zebrafish Embryo Model

Nur Sabrina W.^{1*}, **Nor Suzaida M. N.¹**, Ruqayyah Ainul B.², Noor Azlina M.¹, Norliza A. B.¹, and Mas Jaffri M.²

¹Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Headquarters, 43400 Serdang, Malaysia.

²Department of Cell and Molecular Biology, Faculty of Biotechnology and Biomolecular Sciences, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: nsabrina@mardi.gov.my

In a previous study, boron (B) has successfully been encapsulated in chitosan nanoparticles (CNP) through ionic gelation. Although chitosan nanoparticles are biodegradable and are considered safe, there is still risk that the applied fertilizer formulation with CNP-B may enter the environment and cause detrimental effect to the surroundings. In this study, the toxicity of chitosan nanoparticles (CNP) and chitosan nanoparticles loaded with boron (CNP-B) were evaluated using a zebrafish embryo model. Effects of CNP and CNP-B on zebrafish embryo survival rate, hatching rate, heart rate and their developmental condition were analysed throughout the incubation periods starting from 0 to 120 hours of post exposure (hpe). It was found that both, chitosan nanoparticle (CNP) and boron-chitosan nanoparticle (CNP-B), were highly toxic towards the zebrafish embryos with LC₅₀ value of 2.3% (v/v) and 4.6% (v/v), respectively. There was no significant difference on the heart rate of zebrafish larvae (96 hpe) as compared to untreated embryos after being exposed to CNP and CNP-B at concentration of <5%. In addition, there were no teratogenicity or delayed hatching effects on the zebrafish embryonic development with CNP and CNP-B at concentration of <5%. The present results highlight the need to assess health risk and potential environmental effect of newly developed nanoparticles.

P13 HPLC Method for Mitragynine and 7-Hydroxymitragynine Determination in *Mitragyna speciosa*

Norliana Izzati M. R.^{1,2*}, Fauziah A.¹, Ling S. K.¹, Lee S. L.¹, Kevin Ng K. S.¹, Ng C. H.¹, Ng C. L.², Goh H. H.², and Lee C. T.¹

¹Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

²Institute of Systems Biology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

*Email: norlianaizzatimr@gmail.com

Kratom (*Mitragyna speciosa*) belongs to the coffee family, Rubiaceae. It is a medicinal plant indigenous to Southeast Asia. Kratom leaf has been used as a traditional remedy for treating fever and muscle ache. *Mitragyna speciosa* has many medicinal properties, with opioid-like, analgesic and antitussive effects, among others. The main pharmacologically active compounds found in kratom are mitragynine (MG) and 7-hydroxymitragynine (7-OH). Both compounds are reported to exhibit opioid-like activity, with 7-OH being significantly more potent. We report here a high performance liquid chromatography (HPLC) method for MG and 7-OH determination in *M. speciosa*. The chromatographic separation was conducted with the duration of 25 min using Kinetex EVO C18 column, with gradient mobile phase of ammonium bicarbonate buffer (pH 9.5) and acetonitrile at the flow rate of 1mL/min. The method was optimized with the calibration range of 1µg/mL - 500µg/mL for MG, and 0.1µg/mL - 25µg/mL for 7-OH. The detection of MG and 7-OH at 226nm showed retention time at 16 and 12 min, respectively.

P14 Study of Metabolite Variations in *Eurycoma longifolia* Roots Harvested at Different Age

Nur Nabilah A.^{1*}, Kamalrul Azlan A.², Norlia B.¹, Nor Hasnida H.¹, and Nazirah A.¹

¹Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

²Metabolomics Laboratory, Institute of Systems Biology (INBIOSIS), Universiti Kebangsaan Malaysia (UKM), 43600 Bangi, Selangor, Malaysia.

*Email: nabilah@frim.gov.my

Eurycoma longifolia is a well-known medicinal plant with pharmacological effects and important bioactive compounds such as alkaloids and quassinoids. The suitable age of harvesting *E. longifolia* root for commercial use is relatively unclear and could influence the overall bioactive compounds present in the plant. In this study, non-targeted liquid chromatography mass spectrometer (LC-MS) and multivariate analyses (MVA) were performed to determine the chemical constituent of aqueous extract of 1-, 4- and 11-year-old *E. longifolia* matured roots as well as 3-month-old *E. longifolia* hairy root (HR) culture. Unsupervised principle component analysis (PCA) and supervised partial least square discriminant analysis (PLSDA) were applied to evaluate metabolic similarities and differences in *E. longifolia* roots and hairy root in response to different harvesting age. A total of 31 significant metabolites with variable importance in projection (VIP) value exceeding 1 (VIP ≥ 1) were identified and considered as candidate marker compounds which contribute to the separation trends between the samples. Additionally, the results revealed that putatively identified quassinoids were significantly higher in 1-, 4- and 11-year-old *E. longifolia* roots whereas putative canthin-6-one alkaloids were abundantly present in 3-month-old *E. longifolia* hairy root (HR). The finding highlighted that different harvesting age led to metabolite variations in *E. longifolia*.

P15 Development of Genic SSR Markers from Transcriptome Sequences of *Baeckea frutescens* (Cucur Atap) for Genetic Diversity Assessment

Nur Nabilah A.*, Lee C. T., Nurul Farhanah Z., Lee S. L., Kevin Ng K. S. N., Ng C. H., and Tnah L. H.

Genetics Laboratory, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: nabilah@frim.gov.my

Baeckea frutescens, locally known as Cucur Atap, is a medicinal plant of the family Myrtaceae and subfamily Myrtoideae. It has been widely used in traditional medicine and has great potential for pharmaceutical utilisation due to its anti-inflammatory, antimicrobial, antimalarial and antioxidant properties. The increasing demand of *B. frutescens* herbal medicinal products has led to its over-exploitation. Therefore, it is crucial to gather the genetics information of *B. frutescens* in order to formulate conservation and breeding programmes for this species. In this study, a total of 26 polymorphic simple sequence repeat (SSR) markers have been developed in *B. frutescens* based on the leaf transcriptome sequence data obtained using next generation sequencing (NGS) technology. These markers were evaluated using 32 individuals from FRIM Research Station in Setiu. The mean number of alleles was two and the average expected (H_E) and observed heterozygosity (H_O) were 0.484 and 0.900, respectively. Cluster analysis revealed high genetic similarity among the individuals, whereby many of them were of the same clones. It is essential to examine more individuals from other populations for better understanding of the genetic diversity of this useful medicinal plant.

P16 Preparation and Characterization of Chitosan Nanoparticles Loaded with Boron (CNP-B)

Nur Sabrina W.^{1*}, Nor Suzaida M. N.¹, Ruqayyah A. B.², Nur Balqis Z.², Mohd Azhar H.¹, Noor Azlina M.¹, Norliza A. B.¹, and Mas Jaffri M.²

¹Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

²Department of Cell and Molecular Biology, Faculty of Biotechnology and Bimolecular Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: nsabrina@mardi.gov.my

Although micronutrients are needed in small quantities, they play vital roles in development of plants. Among the micronutrients needed, boron (B) is the most important micronutrient for papaya as it affects both yield and quality of the fruit. Deficiency of micronutrients including boron arise in particular environments and where plants receive insufficient care. In the last few years, researchers have examined the potential of nanotechnology to improve fertilizer use efficiency. The objectives of this study are to optimize the preparation of chitosan nanoparticles loaded with boron (CNP-B) and to characterize the produced CNP-B. It is presupposed that encapsulation of boron in chitosan nanoparticles will allow for the micronutrient to be released in a sustained manner. Optimizations of the factors determining the size distribution and stability of the CNP-B prepared through ionic gelation was carried out. The CNP-B formed instantly when polyanionic sodium tripolyphosphate (TPP) is added to readily mixed chitosan-boron solution; and showed an increase in particle size compare to unloaded chitosan nanoparticles (CNP). It was determined that the optimum ratio for chitosan:TPP:boron is 2.4:1:1 with 0.5% chitosan (pH5), 0.7% TPP (pH2) and boron concentration 0.08%. This ratio allows for the size of the chitosan nanoparticles with encapsulated boron to be below 200 nm with a low polydispersity index and an encapsulation efficiency of 15%. TEM images showed that the single or aggregated nanoparticles have nearly spherical shape, smooth surface with their size being below 200 nm. FTIR analysis suggest the formation of chitosan nanoparticles and the incorporation of boron into the chitosan nanoparticles were successful. *In-vitro* studies was also conducted to determine the boron release profile from chitosan nanoparticles at room temperature for 120hours. The release of boron was found to be linear from 0h to 120h indicating a sustained-release of boron encapsulated in chitosan nanoparticles. Additionally, *in vitro* cellular uptake of CNP and CNP-B were studied using fluorescein isothiocyanate (FITC)-tagged CNP and CNP-B. The fluorescent microscopic images of the treated leaves showed intensely illuminated lamina compared to the FITC

treated control set. Overall, this study provides preliminary results in developing a strategy for sustain released of micronutrients in field.

P17 Confined Field Evaluation of Transgenic Eksotika Papaya Against Papaya Dieback Disease

Rogayah S.^{1*}, Nazrul Hisham N.¹, Amin Asyraf T.¹, Mat Amin N.¹, Chien-Yeong W.¹, Nora'ini A.², Zaifulfarizal Z.¹, Sanimah S.¹, and Sarip J.³

¹Biotechnology and Nanotechnology Research Centre, ²Industrial Crops Research Centre, ³Horticulture Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: lynn@mardi.gov.my

The papaya dieback disease (PDD) has caused a major hiccup in the Malaysian papaya industry and *Erwinia mallotivora* has been identified as the causative pathogen of the disease. To rejuvenate the papaya industry as well as to improve papaya export, effective disease prevention strategies are imperative to curb the spread of the pathogen. An alternative strategy by using genetic engineering approach was embarked to develop transgenic papaya plants that can silence the quorum sensing (QS) system of the bacterial pathogen during infection. Hence, by quenching the QS system, it is hypothesized that the infection and proliferation of *E. mallotivora* in the papaya plants could be prevented. Two *acyl-homoserine lactone lactonase (AHL lactonase)* genes, *aiiA*-SP24 and *aiiA*-CHB37, were successfully isolated from *Bacillus cereus* and *Bacillus thuringiensis*, respectively, characterised and functionally validated to have the ability to specifically disrupt the QS in *E. mallotivora*. These lactonase genes were then introduced into papaya genome to overexpress these genes in the genetically modified papaya plants. Preliminary screening results in contained environment under Transgenic Glasshouse indicated that there was a considerable delay in disease development for several transgenic papaya lines. Therefore, further evaluation through confined field trial was initiated. The transgenic lines overexpressing the *aiiA* genes have been challenged against *E. mallotivora*. Interestingly, a few potential lines were observed to be able to resist the disease up to 40 days after infection (DPI). The disease severity score from each plant was assessed based on the scale of 0 (not infected) to 5 (severely infected, which leads to plant death). The most potential transgenic line having a scored 1 disease severity (very localised water soak at sites of infection), though it had been 35-DPI after the infection occurred, and eventually, recovered completely at 40-DPI. In addition to this, three more potential transgenic lines were scored at stage 3 at 40-DPI, which indicated an enlarged water-soaked in the main stem while the apical shoot remained healthy. Meanwhile, all control plants were severely infected at Stage 5 and died as early as 14-DPI. This work on genetic engineered papaya plants offers a promising and astounding outcome; nevertheless, more confined field screenings will be conducted for further validations.

P18 Profiling of Terpene Synthase Genes in *Aquilaria malaccensis* Agarwood Induced using Different Conditions

Farah Adibah A. K.¹, Kamalrul Azlan A.², and Roohaida O.^{1,2*}

¹Department of Biological Science and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.

²Institute of Systems Biology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.

* Email: roohaida@ukm.edu.my

Aquilaria spp. are among the most expensive trees in the world due to their ability to form agarwood upon wounding. These trees produce secondary metabolites including terpenes as a defence mechanism, which are mostly sesquiterpenes. This group of terpenes are responsible for the distinctive odour of agarwood which makes it a highly sought after ingredient in the fragrance and food industries as well as in religious ritual products. The surging demand in agarwood has prompted the development of various artificial induction methods which were found to stimulate agarwood formation with different aromas. Hence the enzymes

involved in the production of these metabolites will also vary. To understand the changes in the gene expression of terpene synthase genes during different induction conditions, this study aimed to analyse the transcriptome profiles of trees that have been given different induction treatments. Transcriptome profiles were obtained using RNAs extracted from *Aquilaria malaccensis* trees that produce agarwood as a result of injury due to natural phenomenon or induced using artificial methods. The RNAs were sequenced and assembled, followed by sequence comparison with several databases for gene identification. The relative abundance of each unigene in the *A. malaccensis* trees was determined using differentially expressed gene (DEG) analysis. The results were in line with the metabolite profiles of the trees induced using different conditions. The transcriptome data contribute towards increasing knowledge on this economically important tree which may have impact on the industry as a whole.

P19 Photosynthetic Performance of Ambient and Elevated CO₂ MR263 Rice Seedling under Different Light Irradiance

Azzami Adam M. M.^{1*}, Muhammad Nazmin Y.², Mashitah J.², Muhammad Naim Fadzli A. R.³, and Fleming A.⁴

¹Technology Commercialization and Business Centre, MARDI Parit, Perak, Malaysia.

²Department of Crop Science, Universiti Putra Malaysia, 43400 Serdang Selangor, Malaysia.

³Paddy and Rice Research Centre, MARDI Seberang Perai, 32800 Seberang Perai, Pulau Pinang, Malaysia.

⁴Department of Animal and Plant Sciences, The University of Sheffield, United Kingdom.

*Email: azzami@mardi.gov.my

Elevated CO₂ (eCO₂) has been used for many years to increase photosynthetic performance and yield in high-value crops grown in glasshouses. Increasing CO₂ levels in general decrease photorespiration and increase photosynthesis thus resulting in overall higher yield and plant performance. In this project, we studied and investigated the photosynthetic performance of eCO₂ MR263 rice seedlings compared to those grown at the ambient condition when being measured at different irradiance levels (400, 1000, and 1600 $\mu\text{mol photon m}^{-2} \text{ s}^{-1}$). Seedlings were grown in ambient (400 ppm) and elevated CO₂ chamber (600-800 ppm) for about four weeks. Fully expanded rice leaf number five was used for gas exchange and fluorescence measurements. Results showed that eCO₂ treatment had significantly increased the assimilation rate (A), intrinsic water use efficiency (iWUE), quantum yield of PSII electron transport (ΦPSII), electron transport rate (ETR), the quantum yield of CO₂ assimilation (ΦCO_2), and photochemical quenching (qP) under different light level (400, 1000, and 1600 $\mu\text{mol photon m}^{-2} \text{ s}^{-1}$). Interestingly the stomatal conductance (gs), and non-photochemical quenching (NPQ) values for eCO₂ were significantly lower than aCO₂. The finding suggested a general physiological improvement for rice grown under elevated CO₂ which could be potentially exploited for novel agronomic practice that improves grain and yield quality.

20 The Effect of Water Deficit on Growth of Paddy MR 219 (*Oryza sativa*)

Heary Azween A., and Wan Natasya W. A.*

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Jasin Campus, 77300 Merlimau, Melaka, Malaysia.

*Email: natasyaahmed@uitm.edu.my

A study was carried out to evaluate the response of paddy MR 219 (*Oryza sativa*) towards various condition of water deficits. Initially, the study was conducted at the Greenhouse 6, UiTM Melaka Jasin Campus, Faculty of Plantation and Agrotechnology. However, it has been redirected on 18th March 2020 from enclosed greenhouse to outdoor condition at the balcony of B-6-2 Condominium Pelangi, Sentul, Kuala Lumpur due to Coronavirus (COVID-19) pandemic. The experiment was set up with four treatments and four replications in a Completely Randomized Design (CRD) for a total of sixteen pots in a plot. The treatments used in this study were T0 = continuous flooding, T1 = field capacity at panicle stage, T2 = field capacity at flowering stage, and T3 =

saturated condition. Growth parameters such as plant height, number of tillers, and flag leaf width were measured at 15, 30, 45, 60, 75, and 90 days after sowing. The results revealed that, saturated condition was significantly pronounced to affect number of tillers and flag leaf width except for plant height of paddy MR 219. It was observed that the inconsistency of water depth for flooding affected by evaporation losses during warm weather may influenced the plant height.

P21 The Effect of Different Water Levels on the Growth and Yield of Rice (*Oryza sativa*)

Norfatin Atikah J., Noraida M. R.*, and Heary Azween A.

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA (Melaka) Jasin Campus, 77300 Merlimau, Melaka, Malaysia.

*Email: noraida96@uitm.edu.my

Water condition is one of the main concerns in rice production. It is estimated that over 75% of the world's rice is produced using continuous flooding practice. The purpose of this study was to investigate the effect of different water levels on paddy growth and yield. There are four water levels tested in this study namely, T0 (1 cm), T1 (3 cm), T2 (6 cm), and T3 (9 cm) in order to find the best water level effect on the paddy growth performance and yield compared to the common water level application. The water levels were replicated five times in a Completely Randomized Design (CRD). The collected parameters were plant height, number of tillers, number of leaves, relative chlorophyll content, number of panicles, and fresh and dry weight. Data obtained were subjected to One-Way ANOVA using Minitab software. The results showed that there was no significant difference between the water levels on the rice growth and yield. These results suggested that saturation up to 1 cm flooding water do not affect rice production and growth. Therefore, it was able to sustain the rice growth production.

P22 Meta-QTL Analysis Associated to Tolerance to Metal Toxicity in Rice (*Oryza sativa* L.)

Kalaivani N.*, and Nur Izyan K.

Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43000 UKM Bangi, Selangor, Malaysia.

*Email: vani@ukm.edu.my

Oryza sativa or rice is a staple food for most people around the world. In Malaysia, rice is a major food source and an economic source for Malaysians. Around 700 thousand hectares of land in Malaysia is used for paddy cultivation and the figure is expected to increase in the future in line with the increasing population of Malaysia. However, rice is vulnerable to the threat of abiotic stress, especially soil-borne stresses such as heavy metal toxicity. Metal toxicity is caused by human activities such as mining and iron smelting and negatively affects rice in terms of physiology as well as grain yield. Thus, the production of varieties that are tolerant to metal toxicity is able to curb the negative effects. The purpose of this study was to produce a consensus map related to tolerance to metal toxicity by conducting meta-analysis, to determine QTL "hotspot" area by collecting QTL data related to tolerance against metal toxicity and to identify key genes in against this stress via functional analysis. The methods include bibliographic search, meta analysis and also functional analysis. The results showed that meta-QTL 6.4 contained QTLs related to namely aluminium, iron and cadmium toxicity tolerance. This QTL has 5 QTLs namely qSDW6.3, qPH6, qCRE6, qMRL6 and qALSRL6. Through the functional analysis, there were three biological functions most commonly found, namely metal binding sites, transporter activity and oxidative stress signaling. These three biological functions are directly related to the properties of tolerance to the toxicity of heavy metals in rice. Thus, the information obtained is useful in breeding efforts to produce new rice varieties that are tolerant to metal toxicity as this regions carry multiple resistance to metal toxicity and makes the effort of breeding for multiple stress tolerant lines more efficient as it will reduce the time taken to produce rice varieties that are tolerant to aluminium, iron and cadmium.

This research was conducted under DCP-2017-004/1, which was awarded by UKM.

P23 Alluvial Soil and Pepper Gas Exchange Properties Enhancement with Fermented Juices, Biochar, and Compost

Kevin M. T. S.^{1*}, Ahmed Osumanu H.^{2,3,4}, Yuen K. C.¹, Sing L. P.¹, Mercer Z. J. A.¹, and Mohd Effendi W.⁵

¹Research and Development Division, Malaysian Pepper Board, 93916 Kuching, Sarawak, Malaysia.

²Department of Crop Science, Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia (UPM), Bintulu Campus, 97008 Bintulu, Sarawak, Malaysia.

³Institute of Tropical Agriculture and Food Security (ITAFoS), Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia.

⁴Institut of Ekosains Borneo, Universiti Putra Malaysia (UPM), Bintulu Campus, 97008 Bintulu, Sarawak, Malaysia.

⁵Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.

*Email: kevinmuyang@mpb.gov.my

The continuous and intensive use of chemical fertilizers in agriculture causes soil deterioration. Alluvial soils are considered fertile soils but their continued use without proper management or nutrients replenishment is an unsustainable practice. Chemical fertilizer, though a first choice of farmers to replenish soil nutrients, causes harm to the soil. This 20-month study evaluated the selected properties of an alluvial soil as well as pepper gas exchange characteristics after applying organic amendments in a black pepper smallholder farm. There were five treatments each replicated five times in a randomized complete block design. The treatments included biochar, fermented plant and fruit juices, compost, and conventional chemical fertilizer. The results showed that soils with the combined application of fermented juices, biochar, and compost were significantly better in soil physical (lower soil bulk densities and higher soil porosities) and chemical (better TOC) properties. The fermented juices incorporated with biochar and compost had favorable effects on the foliar chlorophyll concentration, NDVI, and gas exchange rates such as photosynthesis, stomatal conductance, and transpiration. Also, pepper foliar chlorophyll, NDVI, and photosynthesis rate were negatively correlated with soil total N in which these physiological traits of pepper decreased with increasing soil N. Based on these results, a combination of organic amendments is the best choice compared with the individual amendments or chemical fertilizer to sustain soil health.

P24 The Photosynthesis, Transpiration and Water Use Efficiency of Selected Mangrove Species at Larut Matang Mangrove Forest, Malaysia.

Marryanna L.*, Mohd Ghazali H., Azian M., Tariq Mubarak H., Hafizi M. J., and Nurul Aqilah M. R.

Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

*Email: marryanna@frim.gov.my

The plant needs water for its physiological processes including photosynthesis. Water used in photosynthesis will be released to the atmosphere by transpiration processes. The ratio of photosynthesis and transpiration in the plant explains the water use efficiency (WUE) of the plant. Mangrove plant filtrates saline water and transpires fresh water into the air. These processes are useful in cloud formation and source for rainwater. Therefore, mangrove plays an important role in maintaining the water cycle. The study on transpiration and water use efficiency of mangrove species is still lacking. Information on the hydrological characteristic of the mangrove plant related to its physiology traits is often neglected. Therefore, this study has been undertaken to fill in the gap of information as a value-added conservation effort of mangrove. This information is also important to clarify gas exchanges at the different forest ecosystem levels. Such studies have been conducted to clarify gas exchanges in dipterocarp forest but less has been done for mangrove forest species. Therefore, this study aims to provide fundamental data on transpiration and WUE of mangrove forest species. The observation was conducted in the morning and afternoon using Li6400XT on *Rhizophora apiculata* (*bakau minyak*) and *Rhizophora mucronata* (*bakau kurap*). This paper, therefore, reports the preliminary result of the observation in selected mangrove species at Larut Matang mangrove forest, Perak, Malaysia. The photosynthesis of *R. apiculata* was $9.41 \mu\text{mol m}^{-2} \text{s}^{-1}$ in the morning and increased to $13.07 \mu\text{mol m}^{-2} \text{s}^{-1}$ in the

afternoon. However, there was not much difference between the morning and afternoon observations in *R. mucronata* ($13.01 \mu\text{mol m}^{-2} \text{s}^{-1}$ in the morning and $12.19 \mu\text{mol m}^{-2} \text{s}^{-1}$ in the afternoon). The transpiration rates were much higher for *R. apiculata* compared to *R. mucronata* in both observations. WUE of the *R. mucronata* was higher compared to *R. apiculata* in both observations. Generally, *R. mucronata* had higher rate of photosynthesis and WUE. However, the WUE was high in *R. apiculata* during morning and afternoon observation.

P25 Clonal Rootstock Variation of *Hevea brasiliensis* in Selected Physiological Traits Influence by Water Stress

Noorliana M. Z.*

Latex Harvesting Technologies and Physiology, Production Development Division, RRIM Research Station of Sg Buloh, Malaysian Rubber Board, 47000 Sungai Buloh, Selangor, Malaysia.

*Email: noorliana@lgm.gov.my

Water stress will be one of the most critical environmental factors that will affect crop productivity in the coming years. These prolonged water stress conditions will have adverse effects on the growth and physiological conditions of plants. Since, *Hevea brasiliensis* uses the budding propagation method, selection of a good rootstock is therefore crucial to evaluate for withstand ability under water stress condition. In this study, four clonal rootstocks (RRIM 2002, RRIM 2020, RRIM 2023 and RRIM 2024) were observed for their intrinsic tolerance to water stress conditions. Two to three whorls of polybags plants ($n=4$) were grown in glasshouse condition and subjected to two water treatments: 1) well-watered and 2) water stress by withholding irrigation for 14 days. Physiological traits (chlorophyll pigments, membrane stability, epicuticular wax content, chlorophyll fluorescence) and leaf water status by measuring relative water content were observed. Fourteen days after water stress, the four rootstocks had significantly decreased leaf relative water content and showed clonal rootstock variation in preserving the cell membranes stability as supported by significant lower membrane Injury index. The least affected was observed in RRIM 2023, exhibiting the highest membrane stability and lowest membrane injury relative to RRIM 2020 that was found to be severely affected. A similar result was shown by a higher epicuticular wax content, chlorophyll b and total chlorophyll of RRIM 2023 as compared with RRIM 2020, despite no significant interaction between clone and water treatments. Hence, membrane stability supported by epicuticular wax content and chlorophyll pigments revealed variation in clonal rootstock; RRIM 2023 was more likely to endure water stress than RRIM 2024, RRIM 2002 and RRIM 2020. Perhaps, the significant parameters could be a basis for developing a simple and fast glasshouse screening methods aiding the selection of drought tolerance rootstock.

P26 Effect of Haze on Fruit Development, Pigmentation, and Productivity of *Passiflora quadrangularis* L. (Giant Granadilla Passion Fruit)

Nur Shahirah S.¹, Halifah Afiza I.¹, Shiamala Devi R.^{1,2*}, Noorasmah S.^{1,2}, Japar Sidik B.³, and Muta Harah Z.⁴

¹Department of Crop Science, Faculty of Agriculture Science and Forestry, Universiti Putra Malaysia Bintulu Campus, 97008 Bintulu, Sarawak, Malaysia.

²Institute Ekosains Borneo, Universiti Putra Malaysia Bintulu Campus, 97008 Bintulu, Sarawak, Malaysia.

³Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

⁴Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*Email: shiamala@upm.edu.my

Air pollution has become a major environmental issue facing the world today due rapid increase in industrialization and anthropogenic activities. The potential direct effect of haze on the fruit development, pigmentation and productivity of *Passiflora quadrangularis* was investigated during the haze event in July to October 2019 at passion fruit farm in Universiti Putra Malaysia Campus Bintulu, Sarawak. Uncontrolled forest and peat field fires and agricultural burning in Indonesia and Borneo which produces transboundary smoke

haze that causes deterioration in the local air quality. The haze was moderate level with Air pollution index (API) reading between 52-81 (moderate API) in August 2019 coinciding with the first flowering season for *P. quadrangularis*. The pollution index increased to a high of 110-146 API (Unhealthy) prolong for 14 days in September 2019 was concurrent with the major blooming of this species. This value was however decreased in October 2019 to 34-55 API (good to moderate API) and this was coinciding with the period of the fruiting. Simultaneously, August to September 2019 was the driest months with temperature and rainfall ranged were 94.8-158.0 mm and 26.6-27.8°C, respectively. Based on the observation, this non-native *Passiflora* species managed to survive and initiated good sets of flowers and fruits during this haze period. *Passiflora quadrangularis* exhibited more flower buds during the haze phenomenon however successful rate of fruits development was 68% (October to November 2019) compared to those of the second and third cycle of fruiting in December 2019-January 2020 (81%) and February-March 2020 (86%), respectively. During the heavy haze time in September 2019, the successfully pollinated flowers resulted in an irregular fruit shape considered to be "dumbbell" compared with the normal fruit shape is oblong-ovoid. This abnormality was not recorded during the third fruiting cycles in February 2020 onward till present. Commonly, ripened fruits of *P. quadrangularis* fruits were in yellowish green. Unlike other passion fruit, this species does not produce pigmentation of purple, yellow or orange upon ripening. However, the fruits that being produced during this haze events, developed purple pigmentation on their exocarp. Meanwhile, yield of the *P. quadrangularis* also showed 21% reduction (October to November 2019) which was (4517.25 kg ha⁻¹) compared to the potential yield (February-March 2020) which was 9590.34 kg ha⁻¹. Smaller fruit size was yielded during the haze period (770.0-1352.0 g) compared to the normal fruit size of (1224.0-2760.0 g). In conclusion, it is anticipated that a longer duration of severe level of haze at flowering, fruiting and ripening stages will probably have greater effects on plant physiological performance and yield of the fruits. *Passiflora quadrangularis* may also could be used as a model plant for biomonitoring the air pollution as it is sensitive to particular air pollutants and show specific responses to pollutants effects.

P27 Efficacy of Fungicides and Biofungicides in the Control of Leaf Blight and Fruit Rot on Indigenous Eggplant

Aminah M.¹, Nurin Izzati M. Z.¹, Umikalsum M. B.¹, Razean Haireen M. R.¹, Siti Noor Aishikin A. H.¹, Nurul Ammar Illani J.¹, and Norhadijah A.²

¹Program Kawalan Biologi, Pusat Penyelidikan Agrobiodiversiti dan Persekitaran, Ibu Pejabat MARDI, Persiaran MARDI UPM, 43400 Serdang, Selangor, Malaysia.

²Program Kawalan Biologi, Pusat Penyelidikan Agrobiodiversiti dan Persekitaran, MARDI Klang, 41400 Klang, Selangor Malaysia.

*Email: aminah@mardi.gov.my

Field studies have been conducted at MARDI Serdang, Selangor to evaluate the efficacy of commercially available fungicides and biofungicides to control of diseases on indigenous eggplant (terung telunjuk). Leaf blight and fruit rot were the major diseases caused by the fungus *Phomopsis vexans*. Two (2) fungicides (a.i copper hydroxide and azoxystrobin) and four (4) biofungicides (garlic oil, Bacillus Care, Tricho Care and Plant Protect) were tested. Based on all treatments, the results show that commercial fungicide (copper hydroxide) treatment shows the highest percentage of disease protection over control (54%). The next effective treatment and found on par were fungicide with active ingredient azoxystrobin and biofungicide based trichoderma sp. (Tricho Care). Efficacy of biofungicides such as garlic oil, Bacillus care, and plant protect have been found to be ineffective in controlling leaf blight disease on indigenous eggplants. However, fruit rot infection was reduced by 90% with treatment using garlic oil at the fruiting stage in comparison to other treatments. Therefore, the study suggested that fungicide with active ingredient copper hydroxide effectively control leaf blight disease. Meanwhile, the use of plant based biofungicide (garlic oil) successfully controlled fruit rot disease of indigenous eggplant.

P28 Revelation of *Pantoea* Species as a New Causative Agent of Rice Bacterial Leaf Blight Disease via Multilocus Sequencing Analysis (MLSA)

Ibrahim R.¹, Ismail S.I.¹, Ina-Salwany M.Y.², and Zulperi D.^{1*}

¹Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

²Laboratory of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: dzarifah@upm.edu.my

Bacterial leaf blight is an important bacterial disease in rice (*Oryza sativa*), caused by *Xanthomonas oryzae* pv. *oryzae* with yellow straw-coloured leaves and lesions symptoms. However, recent studies have shown that rice samples continually screened negative for *X. oryzae* pv. *oryzae* and yet several *Pantoea* species have been linked to the disease incidence. Four isolates were collected from Research Plot in Jitra, Kedah as well as in Sungai Besar and Sekinchan, Selangor. Identification of the bacterial isolates was carried out via phenotypic characterization and pathogenicity test before proceed to molecular identification via Multilocus Sequencing Analysis (MLSA). Morphological observation, biochemical and pathogenicity tests showed the characteristics of pathogenic *Pantoea* species for all isolates. For MLSA, *atpD* and *infB* gene fragments were amplified at ~657 and ~615 bp, respectively. Single *atpD* and *infB* phylogenetic tree analyses revealed that isolates MF1 and MF5 were of 99% and 90% bootstrap values to *Pantoea stewartii* subspecies *indologenes* reference strains PNA 14-12, PNA 03-3, BCC099 and LMG2630 (GenBank Accession Nos.: MF771256, MF771251, EF988853 and EF988906). Meanwhile, isolates PA1 and PA12 were of 75% and 89% bootstrap values to *Pantoea ananatis* reference strains F508, B2Y, AMG322 and En26 (GenBank Accession Nos.: KT203515, KU679910, KT429233 and KT429241). Conclusively, MLSA revealed that both *Pantoea* species are new causative agent for the rice bacterial leaf blight disease.

P29 Identification and Characterization of *Fusarium* spp. Causing Slow Decline Disease of Black Pepper (*Piper nigrum*) in Belaga and Betong Districts, Sarawak

Fatin Noratigah S., and Min K. Y.*

Department of Crop Science, Faculty of Agricultural Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.

*Email: yeemink@upm.edu.my

The 'King of Spices', black pepper (*Piper nigrum* L.) is the most commonly used spice due to its pungent aroma and flavour. Malaysia is the eighth largest world black pepper producer, generating an export revenue of RM 145.6 million in 2019 due to the rising demand of black pepper in the food and beverage, cosmetic and pharmaceutical industries. Black pepper is extensively cultivated in Sarawak contributing nearly 98% of the country's production. Nevertheless, production in Sarawak is hampered by slow decline disease caused by *Fusarium* spp. which has resulted in a 30% reduction in annual production. Thus, the objectives of this study were to isolate *Fusarium* spp. from symptomatic black pepper plants, and to characterise *Fusarium* isolates using morphological characteristics and phylogenetic analysis. *Fusarium* isolates were collected from the roots of diseased black pepper plants located in Belaga and Betong Districts, Sarawak. Morphological characteristics were used to tentatively identify the isolates and species confirmation was done based on translation elongation factor 1 alpha (EF1-alpha) sequence analysis. *Fusarium* species was identified based on closest match of *Basic Local Alignment Search Tool* (BLAST) search against three databases, namely NCBI GenBank, *Fusarium* MLST and *Fusarium*-ID databases. A total of 22 *Fusarium* isolates were found in this study. Among these, three *Fusarium* species were identified, namely *F. solani* (81.8%), *F. oxysporum* (13.6%) and *F. proliferatum* (4.6%). *Fusarium* species produced distinguished mycelium growth pattern and pigmentation on potato dextrose agar (PDA). The colour of the isolate pigmentations varied from pale yellow to pink to violet. Isolates changed their macromorphological characteristics when cultured on the sporulation-promoting carnation leaf agar (CLA). Macroconidia, microconidia and chlamydospores were found in all three *Fusarium* species. Morphological variations in septa number, apical and basal cell of macroconidia were found among

Fusarium species. Morphological features and molecular data were sufficient to support species identification, however phylogenetic tree based on EF1-alpha sequences was able to distinguish closely related isolates within a species. From neighbour-joining tree generated from EF1-alpha sequences, isolates of the same species were clustered in the same clades. Intraspecies variation was detected in isolates of *F. solani* where the main clade can be divided into sub-clades I and II. These findings are important in the formulation of effective disease management strategies including the breeding of resistant black pepper cultivars and identification of antagonistic biological control agents.

P30 Development of a Loop-mediated Isothermal Amplification Method for the Rapid Detection of Banana Blood Disease (BDB)

Lau H. Y.^{1*}, Norliza A. B., Rafidah B., and Sohana R.

Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), Persiaran MARDI-UPM, 43400 Serdang, Malaysia.

*Email: hylau@mardi.gov.my

Banana cultivation in Malaysia covers nearly 17% of the total fruit hectareage at about 28,000 ha. However, the production of banana decreased since 2007 due to banana blood disease (BDB). In this study, we have developed a rapid diagnostic method which is reliable, sensitive and specific for the detection of BDB in banana using unique and specific sequences from the BDB pathogen. Primers for LAMP were designed to amplify the A2-HR MARDI chromosome of *Ralstonia syzygii* subs. *celebensis*. The sensitivity of the assay was evaluated using DNA extracted from local isolates of *R. syzygii* subs. *celebensis*, while the assay specificity was determined using DNA extracted from *Fusarium oxysporum* pv. *cubense* and *Ralstonia solanacearum*. The detection limit of this LAMP assay is 0.005 ng of *R. syzygii* subs. *celebensis* genomic DNA and no crossed reaction was observed on *F. oxysporum* pv. *cubense* and *R. solanacearum*. Further evaluation of this assay using bacteria inoculated samples and real samples from banana fields were carried out. The method had successfully differentiated the diseased samples from healthy samples.

P31 Do Flower Strips Help in Increasing Beneficial Insects?

Nurin Izzati M. Z.^{1*}, Siti Noor Aishikin A. H.¹, Saiful Zaimi J.¹, Rosliza J.¹, Mohd Shahidan S.¹, Zul Helmy M. S.², Mohd Shukri M. A.³, and Aimi Athirah A.⁴

¹Agrobiodiversity and Environment Research Centre, ²Horticulture Research Centre, ³Industrial Crop Research Centre, ⁴Socio Economic, Market Intelligence and Agribusiness Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: nurin.izzati@mardi.gov.my

Mangifera is a common genus found in Malaysia. Pests and diseases are a major problem for *Mangifera* crops in Malaysia. Full dependence on chemical pesticides to control pests is not advisable due to the high costs and also adverse impacts on the environment and human health. Thus, a holistic approach that emphasises pest management and integrated pest management may contribute to fruit production development. The establishment of flowers strip is an alternative method that can be used in the management of environmentally friendly pests in agriculture. This concept involves cultural practices such as vegetation management in habitat manipulation that works to increase the presence of beneficial insects consisting of predatory insects and parasitoids at the same time to help control biological pests. Considering this potential, a year-long study was conducted in selected seasons (i.e., flowering, fruiting and off-season) to see the effect of flowering vegetation on beneficial insect distribution as well as pesticide population in the kuini (*Mangifera odorata*) field at MARDI Station Sintok, Kedah. Based on the ANOVA analysis, there was a significant difference ($p > 0.05$) in the presence of beneficial insects for the entire season on the treatment plot compared to the control plot. Therefore, cultivation of flowering plants in the area around the fruit farms was found to help increase the presence of

beneficial insects (predators, parasitoids and pollinators) compared to pest, which would help reduce the damage caused by pest attacks on kuini fruit production. A comprehensive study should be undertaken to strengthen the evidence and convince farmers that this method can reduce pests and diseases and is beneficial to environmental and human health.

P32 Seeds Germination of an Urban Tree, *Xanthostemon chrysanthus* (F. Muell.) Benth. in Different Treatment of Sowing Media

Ahmad Nazarudin M. R.^{1*}, Nur'Ain Syafiqah N. Z.², Siti Salwana H.³, Rosfarizal K.¹, and Abdul Razak S.³

¹Forestry and Environment Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

²Faculty of Agriculture, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia.

³Forestry Biotechnology Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: nazarudin@frim.gov.my

Xanthostemon chrysanthus (golden penda) belongs to the family of Myrtaceae. The species is locally known as jambu kuning and native to tropical northern Australia, New Caledonia, New Guinea, Indonesia, and the Philippines. It is a medium-sized tree and always preferred for urban planting due to its bright yellow in florescence. In landscaping, it can be used as screening plant, specimen plant, or to beautify roadsides, residential areas and parks. A single fruit of *X. chrysanthus* measures 10–12 mm in diameter, rounded in shape and woody, containing 50–100 tiny seeds. Although the seeds are produced abundantly, there is no scientific evidence on the germinating ability has been reported. Thus, an experiment under nursery condition was carried out to assess the germinating ability of the seeds in six different sowing media, namely 100% top soil (M1), 100% sand (M2), mixture of top soil and sand (1:1) (M3), mixture of top soil and sand (1:2) (M4), mixture of top soil and sand (2:1) (M5), and mixture of top soil, compost and sand (3:2:1) (M6). The first germinated seeds were evidenced at 11 days after sowing regardless of the sowing media. The germination percentages were vigorously increased from day 11 to day 18 after sowing and then reduced gradually with time. At 50 days after sowing, the highest germination percentage was recorded in M5 (52%), while the lowest germination percentage was in M2 (9%). At this stage, seeds sown in M5 showed a better growth performance as compared to that of other media. This study recommends M5 as a most suitable sowing media for germinating the seeds of *X. chrysanthus*.

P33 Variations in Banana Growth Development and Soil Nutrients Status During Vegetative Stages

Deniel S.¹, Izzah A. H.¹, Phebe D.², Nurulhikma M. I.³, Norliza A. B.⁴, and Wan Asrina W. Y.^{1*}

¹Department of Crop Science, Faculty of Agriculture Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.

²Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

³School of Biosciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

⁴Biotechnology & Nanotechnology Research Centre, Malaysian Agricultural Research & Development Institute (MARDI), Persiaran MARDI-UPM, 43300 Serdang, Selangor, Malaysia.

*Email: asrina@upm.edu.my

Vegetative stage is one of the crucial parts in whole banana cultivation process. This study aimed to investigate the banana (*Musa acuminata* cv. Berangan and *Musa acuminata* cv. Tanduk) growth development and soil nutrients status during vegetative stages. The experiment was organized in a randomized complete block design, while selected soil chemical properties were determined before planting and after six months of cultivation. The following vegetative characteristics were measured monthly: pseudostem height and size, leaf area, chlorophyll content and number of functional leaves. Selected soil chemical properties determined were soil pH, total N, available P and exchangeable K. During the first six months, a significant increase in soil pH

was observed, which might in relative to liming effect application before planting. A significant response was also noticeable in soil available P, total N and exchangeable K. A two-fold increase in soil total N and exchangeable K after six months of growing period might be attributed by application of NPK fertilizer. Chlorophyll content was significantly difference only at 90 and 150 days after planting (DAP) between banana varieties. As the DAP increased, banana pseudostem size was markedly increased from 30 to 150 DAP, while pseudostem height was only found significantly difference at 90 DAP. The leaf area between banana varieties was observed significantly difference at 30, 60, 150 and 180 DAP, while no significant difference was detected at 90 and 120 DAP. Number of functional leaves was found statistically significant at 60 and 150 DAP. Further research up to reproductive stage is needed to explore the optimal management practices for improving banana yield production in respective of Malaysia agroclimatic condition.

P34 Vigour and Morphological Characteristics of Tropical Mango Seedling Rootstock cv. 'Telor'

Abdullah F.^{1*}, and Tengku Maamun T. A. M.²

¹Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI) Sintok, 06050 Bukit Kayu Hitam, Kedah, Malaysia.

²Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI) Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

**Email: fadhil@mardi.gov.my*

The physiological understanding of seed germination is of a great significance for the improvement of quality of planting materials. Therefore, we conducted an observation on vigour and morphological characteristics of standard mango seedlings rootstock cv. 'Telor' in the nursery stage at MARDI Sintok, Kedah. The seedlings of 'Telor' cultivar were collected during fruiting season and sown in the sandy seedbed. After a month, the number of emerged shoots per seed and the overall germination were recorded. The morphological characteristics such as height (cm), stem diameter (mm) and the number of leaves were also recorded after all the seedlings were fully germinated. Germination of mango seedlings rootstock showed high germination rates with range 91 to 95%. The proportion of multiple plantlets per seed contributed the highest percentage of germination (60%) as compared to single plantlet per seed (40%). The seedlings of mango cv. 'Telor' rootstock can produce three to five plantlets per seed. Mostly, the single or the first plantlet that is emerging from the seed is more vigorous compared to other plantlets. Variable in plantlets size was also found from the germinated seeds of mango rootstock cv. 'Telor'. Our observation showed that the first plantlet had greater height, stem diameter and the number of leaves. Overall, the germinated plantlets showed a huge variation in terms of their growth and vigour.

P35 Shoot Vigour of 'Harumanis' Mango Grown under Rain-shelter and Greenhouse

Abdullah F.^{1*}, and Tengku Maamun T. A. M.²

¹Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), MARDI Sintok, 06050 Bukit Kayu Hitam, Kedah, Malaysia.

²Horticulture Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), MARDI Headquarters, P.O. Box 12301, General Post Office, 50774 Kuala Lumpur, Malaysia.

**Email: fadhil@mardi.gov.my*

Currently, new orchard management is introduced by planting 'Harumanis' cultivar under greenhouse or rain-shelter. However, it is believed that by modifying the growth condition may alter the morphology and/or physiology of the trees, because generally 'Harumanis' mango is grown in the open area. Therefore, a preliminary observation was conducted to study the effect of growing condition on the shoot vigour of 'Harumanis' mango. Grafted 'Harumanis' mango trees managed under standard agronomic practices were planted under different growing conditions (i.e. rain-shelter and greenhouse) and the trees planted in the open

area was subjected as control trees. After pruning season, the shoots of 'Harumanis' mango were left grown approximately a month. Data of shoot morphology such as length (cm), shoot diameter converted to cross-sectional area (ShCA) and leaves number per shoot, fresh (g) and dry weight (g) of shoots were taken and recorded at the full stage of shoot development. The results showed that the length and ShCA of shoots of 'Harumanis' mango were significantly longer and larger when planted under rain-shelter and greenhouse as compared to the open area but not for the leaves number per shoot. These preliminary results indicate that the growth of 'Harumanis' shoots from trees planted under greenhouse or rain-shelter are highly vigorous as compared to the trees planted in the open area. The possible factors that may affect the vigour of 'Harumanis' shoots planted under these growing conditions will be discussed.

P36 Effects of Light-Emitting Diodes (LEDs) and Transplanting Dates of Basil in Nutrient Film Technique (NFT)

Halimah H.^{1*}, Izyani R.¹, Mohmmad Abid A.², and Nur Syafini G.²

¹Industry Crop Research Centre, Persiaran MARDI-UPM, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

²Horticulture Research Centre, Persiaran MARDI-UPM, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: hallyhalimahhashim@gmail.com

Basil (*Occimum* sp.) is among the most popular fresh culinary herbs. However, there is a lack of knowledge on the characterization of the effects of Nutrient Film Technique (NFT) system on yield of produced basil. Our objectives were to quantify productivity and characterize growth of basil grown in NFT system with different Light-Emitting Diodes (LED) exposure and different transplanting dates. Seedlings were transplanted into NFT system with different seedling transplanting dates of 22, 18 and 14 days and under three different light LED exposures of fluorescent light: 70 red: 30 blue, 60 red: 30 blue: 10 green). The plants were harvested at 6 weeks after transplanting and basil plants of each treatment plot were used to determine plant height, diameter, internode length, number of nodes, number of leaves, total leaf area, fresh and dry weight, root fresh and dry weight and yield. There was no significant interaction between transplanting dates and LED exposure in the NFT system. Among the transplanting dates significant effects were shown on number of leaves, total leaf area, shoot fresh and dry weight and root fresh and dry weight. The overall shoot and root fresh weight per plant were highest at 18 days after transplanting at 61.24 and 31.05 g, respectively compared with 22 and 14 days after transplanting. All parameters were not significantly affected by different LED exposures. Differences in yield between culture systems may have resulted from differences in nutrient supply and availability for plant uptake. Transplant of large seedling plugs to NFT system was not shown to increase space-use efficiency after transplant without compromising yield, likely because root zone factors limited growth during seedling production. The best results were obtained at 18 days after transplanting and at LED exposure of 70 red: 30 blue.

P37 Preliminary Observation on the Effect of LED Lighting on Growth and Physiological Characteristics of Sweet Basil (*Ocimum basilicum*)

Izyani R.^{1*}, Halimah H.¹, and Mohamad Abid A.²

¹Industrial Crop Research Centre, MARDI, 43400 Serdang, Selangor, Malaysia.

²Horticulture Research Centre, MARDI, 43400 Serdang, Selangor, Malaysia.

*Email: izyani@mardi.gov.my

A preliminary study to evaluate the effect of light emitting diode (LEDs) lighting on growth, biomass, and physiological characteristics of sweet basil (*Ocimum basilicum*) was carried out in Plant Factory LED laboratory, MARDI Serdang. The experiment was laid out using split plot arrangement consisting of three different LED lighting and 3 replications. The seedlings were grown for 21 days and then transplanted to nutrient film technique system equipped with LED lighting for 45 days. Three LED light treatments tested were full spectrum (control), red blue (RB; 80% red: 20% blue) and red blue

green (RBG; 70% red: 15% blue: 15% green) with a 10 hours photoperiod. Results from the experiment showed that the growth of basil were affected significantly by various LED lighting treatment. Combination of LED RB and LED RBG significantly induced higher growth parameters such as plant height, number of leaves, leaf width and leaf area, girth, internode length, number of internode, leaf fresh weight, leaf area and biomass partitioning of all plant parts as compared to control. This LED treatment also showed the same trend in term of physiological characteristics and relative chlorophyll content of sweet basil plants where the photosynthetic rate, stomatal conductance, transpiration rate and chlorophyll content were increased for basil planted under LED RB and RBG as compared to the control. This result indicated that red, blue and green LED light is suitable and essential to enhance growth, photosynthesis and chlorophyll content of sweet basil.

P38 Preliminary Findings on Spatial and Temporal Pattern of Total Nitrogen after Rainfall Event

Izzah A. H., and Wan Asrina W. Y.*

Department of Crop Science, Faculty of Agricultural Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.

*Email: asrina@upm.edu.my

Sufficient N uptake by black pepper is crucial to promote the formation of fleshy catkin of berries. However, N is easily transported during rainfall particularly when the farm is lacked in implying land conservation practices. This study was conducted to determine the rainfall effect on N movement on black pepper farm located in Bintulu, Sarawak, Malaysia. About 120 soil samples (0 to 20 cm depth) were collected throughout 5 rainfall events in October 2018, analysed and quantify by AutoAnalyzer 3, and modelled using ordinary Kriging methods to check their spatial and temporal variation. Results showed that N movement was deeply affected by farmer management and soil texture (sand particle) by exhibiting moderate coefficient of variation (10.19% to 33.52%). Moreover, spatial, and temporal N movement have indicated ineffectiveness of land conservation through direct planting on bare soil surface, and unprecedented of terracing on >20o slope with an evidence of strong spatial dependence ranged from 0.21 to 3.78. The N movement process was accelerated with the help of rainfall intensity (13.80 mm hr⁻¹) on 2nd sampling time (0.5623 g kg⁻¹ to 2.2449 g kg⁻¹). Ineffective fertilizer application of 100 g/vine as broadcasting about eight hours before rainfall has affect N movement on sampling time no. 5 with high rainfall volume (44.70 mm). The N movement has affected N uptake by showing a sign of yellowish colour on leaf, defoliation, and reduce potential berries production. Therefore, it is crucial to establish cover crop such as legume to reduce N movement and provide N fixation in the soil-plant system. Few ways to maximise nutrients uptake for a better crop growth such as monitoring weather forecast, and foliar spray can be followed to reduce N hunger by crop.

P39 A four-year Evaluation of the Growth Performance of *Acacia hybrid* Clones

Keeren S. R., Mohd Zaki A., Nor Fadilah W.*, Siti Salwana H., and Ahmad Fauzi M. S.

Plant Improvement Programme of Forest Biotechnology Division, Forest Research Institute Malaysia (FRIM), Kepong 52109, Selangor, Malaysia.

Email: norfadilah@frim.gov.my

Acacia auriculiformis and *Acacia mangium* are native trees of Papua New Guinea and Indonesia. These trees are cross pollinated to produce a hybrid that grows faster than those of its parent trees. Moreover, this *Acacia* hybrid is also more resistant to diseases, namely Ceratocystis that causes heart rot disease, a major issue affecting *Acacia* plantations in Malaysia. Thus, *Acacia* hybrid is an ideal species that can be planted in forest plantations. To achieve this, there needs to be a continuous supply of good quality planting material. Thus, this study was undertaken with the objective of determining the best progeny clone to produce *Acacia* hybrid planting materials. The survivability and growth performance of *Acacia* hybrid clones were evaluated in a four-year field trial at Bintulu, Sarawak. A total of 86 *Acacia* hybrid clones were used in this study, with a planting distance of 3 x 3 m. After four years of planting, progeny clone W105 recorded the highest height at 18.5 ± 1.01

m. This was closely followed by the W060 progeny clone, which recorded a total height of 18.2 m, and had the highest height after one year of planting, at 4.9 m. After three years of planting, W053 progeny clone recorded the highest height at 16.7 ± 0.55 m. Similar to good height growth performance, the progeny clone W060 recorded the highest diameter at breast height after two years of planting (9.5 cm), three years of planting (14.3 cm) and four years of planting (17.7 cm). Thus, the progeny clone W060 shows potential to be used as future planting materials for Acacia hybrid plantations. Further continuous evaluation is required in later years to assess both quantitative and qualitative parameters for all progenies.

P40 Nanofertilizer-Nitrogen, Phosphorus, and Potassium (NPK) Uptake by *Carica papaya* var. Sekaki Seedlings

Khalisanni K., Mohammad Najib O. G., and Hartinee A.

Malaysian Agricultural Research and Development Institute (MARDI), MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: sanni@mardi.gov.my

Plant growth and development depend largely on the combination and convergence of accessible mineral nutrients in the plant. Fertiliser elements such as N, P and K are the most important macronutrient that play a significant role in physiological and biochemical responses, for example for photosynthesis and agronomic development characteristics. Nanofertilisers are known for their large surface area and particle size which is less than the pore size of leaves and allows the entrance of nutrients into the plant tissue. As a strategy to minimise the nutrients of macroelement losses in the soil, nitrogen (N), phosphorus (P) and potassium (K) ion sources have been modified through the process of micellar catalysis using ionic surfactant as a carrier. *Carica papaya* var Sekaki was treated with a newly developed colloidal nanofertiliser, commercial nanofertiliser (Khazra) and commercial NPK fertiliser for its growth in a shaded environment for 2 months. Colloidal NPK nanofertilisers at optimised concentrations of 0.05, 0.09 and 0.1 M (T1, T2 and T3), Khazra commercial nanofertilisers (T4) and NPK 15:15:15 (T5) as control were sprayed every two weeks. From this study, the top fully expanded leaf samples were harvested and washed with deionised water at 70 °C for 72 hours every 2 weeks after transplantation. Different nanofertiliser treatment did not have significant effects on the nutrient content of the leaves. The nutrient compositions reported in this study were found in healthy leaf tissues of different plant species in the normal range. The concentration of total N ions in leaves was not significantly affected by different treatments. As expected, the concentration of P increased after week 2 for all treatment of fertilisers with no significant difference between treatments since 75 % of P was required during the early stage of cereal production in the first 5 to 6 weeks after emergence of crop. Therefore, the colloidal NPK nanofertiliser modified by micellization was an important measure in improving *C. papaya* development by focussing on the seedling stage, while minimising environmental impacts. The papaya leaf content of K at seedling stage showed that K was continuously taken up throughout 8 weeks of treatment at a constant rate in all treatments with no significant difference. Treatment with 0.1 M nanofertiliser resulted in 3.547% of K from week 2 to week 4 which was in line with previous study where 3.5% of K was required for papaya growth at the vegetative stage. The results obtained from this study provide information on how to improve effective nutrient uptake in plants.

P41 Growth, Yield Performance, and Phytochemical Content of Sweet Potato and Napier Grass Grown in Different Cropping Systems

Nur Anisaqilah A.¹, Martini M. Y.^{1*}, Shokri J.², and Shampazuraini S.³

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

²Department of Animal Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

³Faculty of Plantation and Agrotechnology, UiTM Melaka, Jasin Campus, 77300 Merlimau, Melaka, Malaysia.

*Email: martinimy@upm.edu.my

The present study was conducted to evaluate the growth, yield performance and phytochemical content of sweet potato and Napier grass due to different cropping systems. The sweet potato var. Bukit Naga and Napier grass var. Pakchong-1 tall and Kobe dwarf was evaluated in sole cropping and intercropping systems. The treatments comprised five cropping systems namely sole cropping of sweet potato, sole cropping of tall Napier, sole cropping of dwarf Napier, intercropping of sweet potato with tall Napier and intercropping of sweet potato with dwarf Napier arranged in Randomized Complete Block Design with three replications. Growth and yield measurements of sweet potato and Napier grass, physiological characteristics and phytochemical content of sweet potato tubers were taken. Sole cropping of sweet potato produced the highest yield production of sweet potato at 817.63 kg/ha and intercropping of sweet potato with tall Napier grass produced high yield of Napier grass at 32,160 kg/ha. Furthermore, land equivalent ratio for intercropping of sweet potato and tall Napier grass was 2.10, which indicated that the growing of sweet potato and tall Napier grass together was more efficient per unit area than the two crops grown separately. Moreover, the intercropping of sweet potato with dwarf Napier produced tubers of high total phenolic content at 23.79 mg GAE/g. The results obtained are very useful in the future direction of their production programmes.

P42 Malaysia Plant Red List: Rapid Assessment of Peat Swamp Forest in Pekan Forest Reserve, Southeast Pahang

Mohd Afzanizam M.^{1*}, Elizabeth P.², and Azian M.³

Climate Change and Forestry Program, Forestry and Environment Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: mohdafzanizam@frim.gov.my

The International Union for Conservation of Nature (IUCN) Red List criteria are a globally accepted method to assess species vulnerability and extinction risks. Most countries are adapting these criteria for domestic use; hence Malaysia Plant Red List was developed and adopted. There are nine 'threatened' category to indicate its severity and vulnerability. Based on flora inventory, 95 out of 462 individuals are categorized as 'threatened' according to criterion by IUCN Red List and Malaysia Plant Red List. Forest stand for stocking density, tree basal area, and tree volume were 95 stems ha⁻¹, 14.64 m² ha⁻¹ and 212.37 m³ha⁻¹, respectively. This contributes to almost one-fifth or 20% of peat swamp species are red listed. List of taxa categorized as threatened in Pekan Forest Reserve Pahang (Compartment 75) are as follows; two Critically Endangered (CR) species namely *Gonystylus bancanus* (Ramin melawis) and *Shorea platycarpa* (Meranti paya); five Vulnerable (VU) species namely *Tetramerista glabra* (Punah), *Ctenolophon parvifolius* (Mertas), *Sandoricum beccarianum* (Sentul), *Santiria rubiginosa* (Kedondong kerantai) (var. *latipetiolata*), *Dacryodes macrocarpa* (Kedondong matahari) and *Horsfieldia crassifolia* (Penarahan); four Near Threatened (NT) species namely *Aglaiia rubiginosa* (Bekak), *Planchonella maingayi* (Nyatoh nangka merah); *Shorea leprosula* (Meranti tembaga) and *Myristica lowiana* (Penarah arang gambut). Out of three threatened categories, only Critically Endangered (CR) and Vulnerable (VU) were critically discussed in this paper as Near Threatened (NT) are not included, however, should raise concern, awareness and urgent needs for conservation.

P43 Growth Variations in the First-Generation of *Tectona grandis* (Teak) Progeny Test at Papulut Forest Reserve, Gerik, Perak, Malaysia

Nor Fadilah W.^{1*}, Mohd Zaki A.¹, Keeren S.¹, Mohamad Lokmal N.¹, and Muhammad Asri L.²

¹Plant Improvement Programme, Forest Biotechnology Division, Forest Research Institute Malaysia (FRIM), Kepong 52109, Selangor, Malaysia.

²Forest Plantation Programme, Forest Biotechnology Division, Forest Research Institute Malaysia (FRIM), 52109 Kepong, Selangor, Malaysia.

*Email: norfadilah@frim.gov.my

Tectona grandis is highly prized all over the world for its renowned wood qualities. Even though *T. grandis* has been introduced in Malaysia since the 1950s, there is very limited teak plantation can be found, especially in Peninsular Malaysia. Mainly, the reason is it's difficult to obtain high-quality planting materials since *T. grandis* is an exotic species. Therefore, to provide high-quality planting materials that can grow optimally, the breeding strategy of this species has to be planned carefully. We reported here was a progeny trial study of *T. grandis* which has been established since 2002. The trial plot was established with a total of 29 selected families based on superior plus trees characteristics from a resource stand located at FRIM's research station (SPF) Mata Ayer, Perlis. The trial plot was laid out in Randomized Complete Block Design (RCBD) with eight blocks and four progenies per family. Thus, making a total of 928 progenies were planted with the distances of 4 m × 3 m, making the total plot areas amounting to 1.2 ha. Growth data such as total height (HT), clear bole height (CBH) and diameter at breast height (DBH) were collected every year. This paper will be discussing the variations in the growth performances at the age of 14 years old. Assessment by Analysis of Variance (ANOVA) showed that there was a highly significant difference with $p < 0.05$ observed in the CBH and DBH traits. However, the HT trait showed non-significant variation among the 29 families. Further analysis by Tukey Post Hoc test showed that there were seven families significantly have the highest CBH (family R5, B83, R3, B74, T0, B78 and R6), whereas no distinct variations observed from the DBH trait. Furthermore, the ordinal ranking (summary of all the three growth traits) showed that the top five families were; T5, R3, B78, B83 and R5. Findings from this progeny trial have led to the establishment of clonal trial plots in 2014. There were three research plots have been established at Perlis, Kelantan, and Melaka, and currently, growth data are still being collected to assess the potential clones that can grow optimally at different environmental conditions.

P44 Growth Performance of Tissue Culture Rubber (*Hevea brasiliensis*) Trees

Nor Mayati C. H.^{*}, Ahmad Shukri Hadafi I., and Abdul Razak A.

Genetic Resources and Improvement Unit, Production Development Division, RRI Experimental Station, Malaysian Rubber Board, 47000 Sg. Buloh, Selangor, Malaysia.

*Email: normayati@lgm.gov.my

Tissue cultured parent rubber trees were produced in the early 2000 and transplanted after four years old. They were located at Field 118, Pelepah Division, RRI Research Station, Kota Tinggi (SPKT), Johor. Total acreage is about 0.64 ha and with a planting distance of 6.09m x 3.65m. It is situated near to the main road and planted within the main rubber stands. Transplanting was carried out in phases depending on the survival rates. The clonal mother trees selected were RRIM2025 (15 trees), GL1 (40 trees) and RRIM600 (29 trees) which were initially transplanted in March 2004 while bud grafted, RRIM2025V1 clone was transplanted in April 2004 (78 trees) and June 2004 (132 trees). The conventional bud grafted, RRIM2025NB (22 trees) clone was also used as a control. Annual growth and other parameters measured include bole volume, height, and girth for four consecutive years. Results obtained showed that tissue culture clonal materials of RRIM2025 outperformed all others. However, the older clones in RRIM600MP, RRIM600V1 and GL1 do not performed well although there were higher total height growth and wood volume recorded. Hence, due to bigger tree trunk growth and other physical desirable timber characteristics in RRIM2025, this clone serve it breeding purpose as a latex timber clone.

P45 Effects of Different Rootstock Age on Grafting Success and Growth Performance of *Garcinia atroviridis*

Nurhazwani M.^{1*}, Saifuddin I.², and Muhammad Syakir B.¹

¹Industrial Crop Research Centre, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

²Agrobiodiversity and Environment Research Centre, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: wanie@mardi.gov.my

Garcinia atroviridis or commonly known as asam gelugor is an underutilized fruit. There is lack of prioritised research on this species. As Asam gelugor trees are mostly raised from seeds, these seedlings usually produce (about 70 per cent) male trees which do not bear fruits. In order, to maintain the genetic characters from the propagated variety, a vegetative propagation method using grafting is used. This will ensure rapid multiplication and production of female planting materials. However, the success of grafting must depend on various factors such as environment, grafting methods, time, age and type of rootstocks used. This suitable grafting technique must be developed to meet increasing demand for planting materials of this fruit. As such, a study was conducted to determine the effects of using two different rootstock ages and to evaluate the growth of *Garcinia atroviridis* using Complete Randomised Block Design (CRBD). Results obtained showed that there was no significant difference in percentage of survival in 12 (85%) and 18 (90%) months age rootstocks. However, similar results were also observed on the number of new leaves after 30 days. At 60 days after grafted, the highest mean number of leaves (7.25) was produced by 18 months of age rootstock and the lowest mean number of leaves (3.00) produced by 12 months age rootstock. Based on growth performance using top wedge grafting, the 18 months rootstock is strongly recommended when propagating *Garcinia atroviridis*.

P46 Mangosteen: Performance of Vegetative Growth in Three Locations

Salehudin M. R.^{1*}, Ab Kahar S.², Hartinee A.¹, Razali M.², Mohd Fairuz N.³, Adnan K.¹, Mohd Ismail M. K.³, Zalina E.³, Mohd Apandi S.³, and Rais H.¹

¹ MARDI Sintok, 06050 Bukit Kayu Hitam, Kedah, Malaysia

² MARDI Ibu Pejabat, Persiaran Mardi - Upm, 43400 Serdang, Selangor, Malaysia.

³ MARDI Jerangau, 21820 Ajil, Terengganu, Malaysia.

*Email: salehudin@mardi.gov.my

Mangosteen is deemed as queen of fruit with long juvenility period before it starts fruiting. It is prominently planted in the east coast region as it prefers high humidity and rainfall. This study determined the growth of mangosteen in 3 locations i.e, MARDI Jerangau, MARDI Sintok and MARDI Serdang. Vegetative growth of mangosteen (variant mesta) was recorded every 4 months from day of planting. Soil types for Mardi Jerangau, MARDI Sintok and MARDI Serdang are clay loam, silty clay loam and loam, respectively. pH for each location is 4.57, 4.01 and 4.88, respectively. MARDI Jerangau received around 4255 mm while MARDI Serdang received 2576 mm and MARDI Sintok had around 1670mm of precipitation per year. MARDI Jerangau received most of its rainfall starting from October to January and least in February to May due to ending of Northeast Monsoon while MARDI Sintok had scattered drought season with least rainfall in February, March and August. During these periods, it is crucial to supply water to plants with irrigation system and prolong shading. After planting, mangosteen in MARDI Sintok had the best vegetative growth in terms of height increment (4.4 cm month⁻¹) as compared to those in MARDI Jerangau and MARDI Serdang (3.53 cm month⁻¹ and 3.29 cm month⁻¹, respectively).

P47 Effects of Different Environmental Conditions on Stem Cuttings of *Strobilanthes crispus*

Syafiqah Nabilah S. B.*, Norhayati S., Farah Fazwa M. A., and Mastitah M. T.

Herb and Tree Improvement Branch, Forestry Biotechnology Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

*Email: syafiqah@frim.gov.my

Strobilanthes crispus (L) Bremek is a medicinal plant that being traditionally used to treat hyperucemia that lead to kidney stone and gout. It is commonly known as 'pokok pecah beling' in Malaysia and it belongs to the family Acanthacea. Previous studies found that this medicinal plant is rich in antioxidants, vitamins, and minerals. The extracts of *S. crispus* displayed a very strong inhibitory activity towards xanthine oxidase enzyme. Xanthine oxidase (XO) is an important enzyme catalyzing hydroxylation of hypoxanthine to xanthine and then xanthine to uric acid which is excreted by kidneys. Looking at the potential medicinal value, it is necessity for plant breeder to come out with high quality planting materials of this species for industrial usage. Whereas the propagation technique plays an important role to ensure sustainable high quality raw materials. Therefore, this study was aimed to identify the suitable condition for growing the stem cuttings of *S. crispus*. Two different rooting media such as M1-soil: sand (2:1) and M2-soil:sand (1:1) were tested and the stem cuttings were grown in two different environment (i. green house; ii. enclosed growing chamber). The survival rate of the cuttings was recorded weekly whilst the rooting performances were measured at week 4. Cuttings grown in T1-soil: sand (2:1) shows 100% survival rate and rooting percentage at green house condition whereas cuttings grown in enclosed growing chamber gradually reduce survival rate after two weeks of cuttings. Therefore, this study suggests the stem cuttings of *S. crispus* should be grown in M1-soil: sand (2:1) growing media at green house condition. The findings from this study is essential for breeders and herbal propagators for mass production of *S. crispus* in future.

P48 Effect of Nitrogen, Phosphorus, and Potassium Availability on Adan Rice Planted in Lowland Area

Izzah A. H., Adibah M. A., and **Wan Asrina W. Y.***

Department of Crop Science, Faculty of Agricultural Science and Forestry, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia.

*Email: asrina@upm.edu.my

Adan rice is Sarawak's local variety and cultivated for home consumption with characteristics of small grain, pleasant taste, and fine texture which cultivated on rainy season (October to April). To sustain rice production and soil quality, some farmers practise crop rotational with baby corn during offseason. The objective was to determine effect of NPK availability on Adan rice grown under lowland conditions. A study was conducted on a hectare of rice field in Kuala Tatau, Bintulu, Sarawak on rainy season (2017 to 2018) by collecting soil samples (0 to 20 cm depth) at three rice stages (vegetative, reproductive, and ripening), four plots, and four subplots and analysed for soil N, P, and K concentrations using wet digestion, Bray and Kurtz's, and double acid methods. The results indicated that there were significant differences in N ($2369.70 \text{ mgkg}^{-1}$) and K (68.19 mgkg^{-1}) concentrations at reproductive and vegetative stages, respectively. The main reason attributed to these findings is due to residual effect of corn stalk left by the farmers during an early establishment of rice vegetative phase (42 DAP) has improved K availability. Urea (46%N) and NPK Red (17:3:25:2 MgO + TE) applications ultimately has elevated N concentration during reproductive stage (90 DAP). Plot #3 shown greater P (4.46 mgkg^{-1}) and K concentration (54.53 mgkg^{-1}) and sub plot A reported greater K concentration (55.14 mgkg^{-1}). The variation of NPK availability caused by delaying fertilization at reproductive stage and by avoiding fertilization at vegetative phase, has created nutrient starvation during tillering and affect panicle initiation and flowering.

P49 Effect of Paclobutrazol (PBZ) Application Induction on Vegetative, Reproductive growth, and Fruit Quality of Harumanis Mango in Greenhouse Conditions

Zul Helmey M. S.^{1*}, Muhamad Hafiz M. H.¹, Wan Mahfuzah W. I.¹, Shaidatul Azdawiyah A. T.², Mohd Aziz R.², Mohd Farid A. F.¹, Muhamad Izzat Z.¹, Siti Aishah H.¹, and Siti Afiah J.³

¹Horticulture Research Centre, MARDI Sintok, 06050, Bukit Kayu Hitam, Kedah, Malaysia.

²Agrobiodiversity and Environment Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400, Serdang, Selangor, Malaysia.

³Department of Crop Science, Faculty of Agriculture, 43400, UPM Serdang, Selangor, Malaysia.

*Email: zulhelmey@mardi.gov.my

Paclobutrazol (PBZ) is a growth regulator used to control vegetative growth, stimulating the reproductive capacity for seasonal or biennial bearing fruit crops. In the recent years, many reports showed that application of PBZ by soil drenching or foliar spray to mango trees can cause reduction in vegetative growth and stimulate flowering. The application of flower induction is one of the key factors that may influence the growth, yield and the quality of the mango trees. Therefore, this study was demonstrated with the objective to determine the application and rate of PBZ to induced vegetative, reproductive growth and fruit quality of Harumanis trees in greenhouse conditions. The experimental layout was Completely Randomized Design (CRD) with 4 treatments, each with 3 replications. Paclobutrazol was applied to 22 months old Harumanis trees as T1- no induction (control), T2- (soil drenching- 2000 ppm PBZ), T3- (foliar spray 1000 ppm PBZ) and T4- (soil drenching- 2000 ppm PBZ) plus (foliar spray 1000 ppm PBZ). The data obtained was analyzed using ANOVA in SAS software (Version 9, SAS Institute Inc. Cary, North Carolina, USA) and differences between treatment means were compared using Duncan's Multiple Range Test Difference (DMRT) at $p \leq 0.05\%$. Based on results, vegetative growth response to PBZ was different between the treatments. For parameter measured as height, T4 (1.62 m) plants had significantly reduced growth compared to T1 (1.92 m), T2 (1.89 m) and T3 (1.96 m), respectively. For internode length, T4 (23.32 cm) plants also showed significantly reduced growth compared to T1 (28.44 cm), T2 (26.83 cm) and T3 (26.11 cm), respectively. No significant difference between treatments was found for stem diameter, canopy size, chlorophyll content and number of leaves in this study. Paclobutrazol application induction also significantly reduced number of shoots in treatment T4 (51.67) compared to T1 (81.92), T2 (63.67) and T3 (66.75), respectively. In terms of reproductive stages, application of PBZ in treatment T2 produced the highest percentage of flowering (75.00%) and number of fruits set (8.54) compared to other treatments. However, overdose concentration by combination of soil and foliar application reduced length of panicle, compaction of flowers and number of fruit set. No flowering was observed in treatment T1 (control). Furthermore, for fruit quality assessments, application of PBZ in treatment T2 enabled increased fruit size, total soluble solids (TSS), total titratable acidity (TTA) and ascorbic acid (vitamin C) of Harumanis mango. This study suggested that the combined application of PBZ by soil drenching plus foliar spray was effective to reduce vegetative growth while application of PBZ by just soil drenching was the most effective treatment in producing higher percentage of flowering and increased fruit quality.

P50 Performance of Different Forage Sorghum Varieties as Affected by Mechanised and Semi-mechanised Planting Density, and Harvest Cycle in Mineral Soil

Muhammad Najib O. G.^{1*}, Nurhazwani M.¹, Halimah H.¹, Faizah Salvana A. R.¹, Hanim A.¹, and Thiyagu D.²

¹Industrial Crop Research Centre, Persiaran MARDI-UPM, MARDI Headquarters, 43400, Serdang, Selangor, Malaysia.

²Industrial Crop Research Centre, Kampung Aur, Mukim Jalan Kandis, 16310, Bachok, Kelantan, Malaysia.

*Email: najibo@mardi.gov.my

Sorghum (*Sorghum bicolor* (L.) Moench) is ranked as the fifth most-cultivated cereal worldwide and is widely used in the production of grains, ethanol, and forage. This crop is considered new in Malaysia and it is mainly cultivated as forage to sustain the domestic livestock industry. As forage, sorghum may be cut several times (multicut) because of its regrowth habit (ratoon). A study was conducted in MARDI Serdang, Selangor to

determine the effect of different planting density (for semi-mechanised and mechanised) and harvest cycle on growth and yield of selected sorghum varieties cultivated in mineral soil. A factorial experiment comprising four planting densities (semi-mechanised: 45 cm x 9.3 cm, 45 cm x 11.3 cm; mechanised: 75 cm x 10 cm, 75 cm x 20 cm) and four varieties (BMR, MS, SG and SPV422) were arranged in a split-plot design with varieties as the sub-plot, in three replications. The crop was cut 10-15 cm above the ground at 50 and 100 days after sowing. Growth (plant height, leaf number, leaf width and stem diameter) and yield at each harvest cycle was recorded. For semi-mechanised density, first harvest had significantly more leaf number than second harvest in all varieties and leaf width in BMR is significantly smaller compared to the others, regardless of harvest cycle. MS had higher total yield (43 M.T/ha) as compared to SPV and SG for first harvest. For second harvest, SPV422 recorded lowest yield compared to the others. For mechanised density, first harvest had significantly larger stem diameter than second harvest in all varieties. At first harvest, MS was significantly taller (216.2 cm) compared to others whereas for second, MS and SG were ranked the same while the others were significantly shorter. MS had highest yield (45 M.T/ha) in first harvest compared to others, followed by BMR, SPV and SG. However, at second harvest, the yield was reduced to 26.4 M.T/ha with no significant differences with BMR. Regardless of any harvesting cycle and variety used, planting density of 75 cm x 9.3 cm gave significantly higher yield (32% more) as compared to 75 cm x 11.3 cm. In conclusion, MS is recommended in both planting systems as it gave significantly higher yield. For semi mechanised system, planting distance of 45 cm x 20 cm is recommended as it incurred less cost for seeds without compromising the yield significantly while for mechanised, 75 cm x 9.3 cm is recommended as it gave significantly higher yield as compared to 75 cm x 11.3 cm.

P51 Paclobutrazol Application for Growth Performance and Flower Enhancement of Extrafloral Nectaried Plant *Turnera ulmifolia* (Turneraceae)

Puteri Edaroyati M. W.^{1*}, Nur Azura A.², Lau W. H.², and Mohd Azmi M. L.³

¹Department of Crop Science¹, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

²Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

³Department of Pathology and Microbiology, Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: putri@upm.edu.my

Genus *Turnera* flowers are among the most frequent flowering plant visited by stingless bee species for the pollen and nectar. This shrub flowers not only enhancing the beauty of landscape garden but also provide steady food resources for stingless bees throughout the year. Paclobutrazol (PBZ) is a plant growth retardant that can accelerate flowering at certain doses in several woody, perennial, and annual plants. Therefore, a study was conducted to determine the optimum PBZ concentrations and applications for growth performance and flower enhancement of the *Turnera ulmifolia*. The study involved three different concentrations (0, 50 and 100 ppm) and two applications (continuous and non-continuous) of PBZ on two months old plants which were raised from semi hardwood cuttings. These factorial treatments were arranged in RCBD with five replications. An interaction between PBZ concentrations and application significantly affected almost all the growth parameter, except for the primary and secondary branches number. Non-continuous PBZ application on plants produced significantly more primary and secondary branches number compared to those continuous PBZ application. Plants response to PBZ concentration and application significantly decrease the primary, secondary, and tertiary branches length. The PBZ at 100 ppm, given non-continuously increased the bud number, flower diameter and numbers compared to the continuous PBZ application. However, continuous PBZ application caused the plant to flower 10 days earlier than non-continuous PBZ application at 50 ppm. Application of PBZ inhibits the extension growth of stem and thus, reduced the plant height. However, PBZ also caused early flowering in *T. ulmifolia*.

P52 Effect of Plant Growth-Promoting Rhizobacteria (PGPR) on Rice (*Oryza sativa* L.) Grown Under Drought Condition

Emmyrafedziawati A. K. R.*, Abdul Munir A. M., and Farah Diba A. B.

Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.

*Email: p92202@siswa.ukm.edu.my

Plant growth-promoting rhizobacteria (PGPR) could play a significant role in alleviating drought stress in rice. Grown in a glasshouse with two conditions; well-watered and drought, the PGPR were inoculated on rice plants while the control was non-inoculated. The rice seed bio primed with PGPR significantly demonstrated high leaf chlorophyll content, proline content, and the total soluble sugar at the vegetative stage. The plant growth performance in terms of shoot and root length also better than the non-inoculated rice. Thus, the application of PGPRs reduced the adverse effects of drought stress on inoculated rice. The PGPR was useful to improve rice plant performance and development under drought stress by enhancing photosynthetic pigment production.

P53 Effects of UV-C Irradiation on the Postharvest Quality of *Ficus carica* During Storage

Aimi Fatini M. M., and Phebe D.*

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor Malaysia

*Email: phebe@upm.edu.my

Recently, used of UltraViolet-C (UV-C) as residue-free physical sterilization and preservation technology for fruits and vegetables has been given much attention. A study was carried out to examine the effects of UV-C irradiation for postharvest quality of *Ficus carica* or fig fruits. Mature fig fruits which are free from defects and diseases, uniform in size and shape were selected. These fruits were collected from Selangor Fruit Valley, Rawang, Selangor and analysed at the Laboratory of Postharvest, Universiti Putra Malaysia (UPM), Serdang, Selangor. There were five UV-C intensity treatments comprising of 0 (control), 0.01, 0.02, 0.03, and 0.04 kJ m⁻². Each treatment was replicated twice. After UV-C exposure, the fruits were kept at 26 ± 2°C. Each fruit was analysed for its firmness, pH, soluble solid concentrations, titratable acidity and colour at day 0 and 2. Results obtained showed that there is no significant interaction between UV-C intensity x storage day on all variables measured. However, as storage duration prolong, the fruits are softer and tasted sweeter. This study showed that by using UV-C irradiation only the pH of the fruit is affected while prolonged storage may cause the fruits to deteriorate in terms of firmness and the loss of organic acid contents.

P54 Effect of Postharvest Treatments on Storage Stability of Noni (*Morinda citrifolia* L.) Fruit

Nuraisyah Z.¹, Prima L.², and Ezzat M. A.^{1*}

¹Department of Food Technology, Faculty of Food Science and Technology, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

²Indonesian Center for Agricultural Postharvest Research and Development, Ministry of Agriculture, Indonesia.

*Email: ezzat@upm.edu.my

Noni fruit (*Morinda citrifolia* L.) is well known for its therapeutic and nutritional value as this herbal remedy can promote health benefits. However, it is perishable due to postharvest rapid deterioration and can lead to difficulties in long storage duration. Therefore, the aim of this study was to determine the most effective postharvest treatment so as to prolong the shelf life of Noni using Hot Water Dipping (HWD) (60 °C, 1 min) and Modified Atmosphere Packaging (MAP) methods consisting of carbon dioxide (CO₂) and nitrogen (Ni₂) gas respectively. The physicochemical properties such as colour, firmness, weight loss, total soluble solids (TSS), titratable acidity (TA) and scopoletin content of Noni were monitored during 6 days storage at room

temperature. Results obtained show that Noni skin changed from greenish yellow to translucent yellow while HWD storage was stopped at day two due to formation of visible black spots. There was also a slight reduction in weight loss and lower total colour difference (TCD) of Noni flesh during MAP storage. With the scopoletin content of 27.12 mg/g and firmness at 0.8 N, this Ni_2 -based MAP were found to be at the highest concentrations, thus suggesting that it may be the most effective postharvest storage treatment for retaining the quality and stability of the fruit.

P55 Quantification of Primary Metabolites, Phenolics Content, and Antioxidant Properties of *Hydrocotyle bonariensis* and *Centella asiatica*

Nur Haida Z.¹, Maziah M.², and Hakiman M.^{1*}

¹ Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

² Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: mhakiman@upm.edu.my

Hydrocotyle bonariensis or locally known as “Pegaga Embun” is a creeping herb from family Araliaceae. *H. bonariensis* is closely related with *Centella asiatica* (Apiaceae) which commonly known as “Pegaga Kampung” due to their morphological characteristics. In most study on phytochemical properties, *C. asiatica* is more popular than *H. bonariensis*. To date, extensive study has been conducted on *C. asiatica* phytochemical and biological activities, however, very limited study has been conducted on *H. bonariensis*. Hence, this study was carried out to compare the primary metabolites, phenolics content and antioxidant activities of fresh and dry sample of *H. bonariensis* and *C. asiatica*. All the analysis was conducted via *in vitro* assay and measured using UV-vis spectrophotometer. The highest total soluble protein and vitamin C content were produced by fresh sample of *C. asiatica* with 23.28 and 0.35 mg/g. Meanwhile, the highest total soluble sugar and hydrolyzed sugar were recorded from fresh sample of *H. bonariensis* with 1.94 and 3.84 mg/g, respectively. In the phenolics content analysis, the highest total phenolics and flavonoids were exhibited by fresh *H. bonariensis* with 0.96 mg GAE/g and 13.79 mg CE/g DW. Furthermore, the highest DPPH inhibition was recorded from fresh sample of *C. asiatica* with 50.27% and the highest FRAP value was recorded from fresh sample of *H. bonariensis* with 91 mg TE/g. In conclusion, *H. bonariensis* showed a high potential in bioactive compound production and as a source of antioxidant. Hence, an extensive study on *H. bonariensis* should be done in order to maximize the medicinal values of *H. bonariensis*.

P56 Extending the Storage Life of Jackfruit at Sub-optimal Temperature Using Artificial Ripening

Joanna C. L. Y.^{1*}, Siti Aisyah A.¹, Suhana Y.¹, Wan Mohd Reza Ikwan W. H.¹, Nur Sulastri J.¹, Ngan C. K.², Nur Izzati M.¹, Mohamad Fikkri A. H.¹, Mohamad Abhar A. H.¹, and Nur Hidayah S.¹

¹Horticulture Research Centre, ²Soil Science, Water and Fertilise Research Centre, MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: joanna@mardi.gov.my

Jackfruit (*Artocarpus heterophyllus* Lam.) is a tropical climacteric fruit and is prone to chilling injury (CI) when stored at sub-optimal temperature (<12 °C). The present work on the effect of storage temperature (2, 7 and 12°C) using artificial ripening on the postharvest qualities of jackfruit was investigated. Fruit quality traits, such as colour (lightness (L^*), chroma (C^*) and hue (h°)), firmness, soluble solids concentration (SSC), pH, titratable acidity (TA) and ascorbic acid (AA), were estimated. The control group (without artificial ripening) stored at 2°C and 7°C failed to ripen normally when transferred to ambient temperature after two weeks of storage due to severe chilling injury. Jackfruit treated with artificial ripening resulted in satisfactory levels of consumer acceptance of its pulps in term of taste, aroma, and texture for at least 3 weeks. Moreover, cold

storage of 2 and 7°C using artificially ripened fruits significantly reduced decay incidence compared to fruit stored at 12°C. In conclusion, the ripe and ready-to-eat jackfruit can be stored up to three weeks at 2°C.

P57 Selection of Experimental Domain Factors using Two-level Factorial Design on Polyphenols, Phenolic Acids and Flavonoids Content of Lemon Peel (*Citrus limon*)

Nur Haida Z.¹, Sharin, A. G.², Nakasha J. J.¹, and Hakiman M.^{1*}

¹Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

²High Voltage Engineering Research Laboratory, Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

*Email: mhakiman@upm.edu.my

Citrus limon or commonly known as lemon is belongs to Rutaceae family, one of the most popular *Citrus* species alongside with orange and mandarin. Lemon is popular due to its wide range of phytochemical compounds which contribute to various biological properties in curing and improving human health. The flesh is the main part of lemon while the peel is mostly being discarded as a waste. However, consumers are not aware that lemon peel also contains variety of bioactive compounds that might be useful to human. In this study, a two-factorial design was used to evaluate the significant extraction factors in achieving higher recovery yield of total polyphenols, phenolic acids, and flavonoids content from lemon peel. The independent factors were drying temperature (40-60°C), aqueous methanol percentage (20-60%), extraction temperature (28-60°C), extraction time (30-60 minutes), and storage duration (0-14 days). Among all the examined factors, results showed that drying temperature, storage duration, and extraction temperature were the most significant and contributing factors affecting the total polyphenols, phenolic acids, and flavonoids content from lemon peel with $P < 0.05$, whereas, aqueous methanol percentage and extraction time exhibited the least significant and contribution with $P > 0.05$. In conclusion, the experimental domain factors were successfully obtained from this experiment. Therefore, further investigation on optimization employing the obtained factors will be conducted in the future study using response surface methodology.

P58 Quality Aspect of Lowland Cauliflower During Storage

Nur Syafini G.^{1*}, Joanna C. L. Y.¹, Azhar M.N.¹, Mohd Nazrul Hisham D.², and Mohd Lip J.²

¹Horticulture Research Centre,

²Technology Commercialisation and Business Centre

Malaysian Agricultural Research and Development Institute (MARDI), MARDI Headquarters, Persiaran MARDI-UPM, 43400 Serdang, Selangor, Malaysia.

*Email: syafini@mardi.gov.my

Cauliflower (*Brassica oleracea* var. *botrytis*) has greatly increased in demand and well recognized as a highly market demand. In Malaysia, cauliflower is produced from very limited highland areas in Cameron Highlands and Ranau and been imported from China due to high demand. The technology of lowland cauliflower cultivation has also been emphasized to cater for the high local demand of this temperate vegetable thus, enabling to reduce the extreme usage of limited land areas. Mature lowland cauliflower curds are at least 16-19 cm in diameter with 400-450g in weight. Optimum harvesting maturity recommended at day 75-85 after transplanting. The best quality of lowland cauliflower has a slightly creamy-yellowish colour, compact, firm, and relatively smooth curds. Although the curd is slightly yellow in terms of appearance, it is still good for consumption. Lowland cauliflower contained on average higher ascorbic acid content (55 mg/100 g fresh weight) than white cauliflower (imported from China); 48 mg/100 g fresh weight. Total soluble solids in lowland cauliflower contained 6.63 °Brix compared to white cauliflower (4.27 °Brix). Dark spotted, riciness (loose or protruding floral parts), or fuzziness curds are signs of over mature and start to senescence. Lowland cauliflower stored at 5°C maintained acceptable visual quality during 3-4 weeks storage. However, after 4

weeks storage, the curd appeared less compact and firm. A brownish discoloration developed in some of the florets. Storage at higher temperatures (10°C) rapidly cause deterioration of cauliflower quality and shelf life reduced less than 2 weeks. Yellowing of the curd and development of brownish spots were rather faster in cauliflower stored at 28°C (ambient condition). On day 4-5, the cauliflower firmness reduced. In summary, lowland cauliflower store at 5°C maintains better visual quality for longer periods of time (4 weeks) compared to storage at higher temperatures. Storage at higher temperature reduce the quality of cauliflower due to wilting, curd browning and black spotting development

P59 Evaluation of Growth and Quality of Purple Red *Brassica* Influenced by Different LED Wavelengths in Indoor Vertical Farming

Rosniza K.¹, Winnie Y. S. P.¹, Ajit S.^{1*}, Joshua Y. L.¹, Farahzety A. M.², Zulhazmi S.², and Mohd Abid A.²

¹School of Biosciences, University of Nottingham Malaysia Campus, 43500 Semenyih, Selangor, Malaysia.

²Horticulture Research Centre, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: Ajit.Singh@nottingham.edu.my

Understanding the effects of various light wavelengths on plant reactions in terms of growth and accumulation of essential nutrients such as antioxidants is crucial in order to obtain optimal light conditions for the production of high quality vegetables in indoor vertical farming. *Brassica rapa chinensis* (Purple Red Pak Choy) is one of the brassiceous vegetables that has rapid growth and is identified to have health-promoting qualities, among which is anthocyanin, a useful antioxidant for dietary consumption. This crop was used to evaluate the effects of red (RL), blue (BL) and green (GL) wavelengths on plant morphology, relative chlorophyll content and accumulation of functional phytochemical which is specifically anthocyanin content. Light treatments consisted of three different wavelengths combinations: full spectrum, white light (WL) as a control (the proportions of RL, BL and GL wavelengths were 42%, 15% and 43%, respectively), the combination RL₈₁BL₁₉ (the proportions of RL and BL wavelengths were 81% and 19%, respectively) and RL₇₀BL₂₁GL₉ (the proportions of RL, BL and GL wavelengths were 70%, 21% and 9%, respectively). The study was conducted in LED Light Research Lab MARDI, a walk-in growth room with 12-hour photoperiod. Environmental conditions in the LED light lab were controlled to maintain the temperature, CO₂ and relative humidity. Results indicate that the largest plant width and height were of the plants exposed under RL₈₁BL₁₉ followed by RL₇₀BL₂₁GL, while plants grown under WL were relatively small. Plants under RL and BL supplemented with GL had lower plant height and width compared to those exposed to RL₈₁BL₁₉. Similarly shoot fresh and dry weights of RL₈₁BL₁₉ exposed plants had the greatest measurements, followed by RL₇₀BL₂₁GL and WL. The chlorophyll content and anthocyanin accumulation were significantly higher in RL₈₁BL₁₉ plants compared to those of other treatments. GL seemed not to have a direct positive impact on the overall growth and accumulation of chlorophyll and antioxidant content in purple red Brassica. Based on this finding it is recommended that RL₈₁BL₁₉ be the optimal wavelength proportion for purple red brassica production in indoor vertical farm.

P60 Effects of LED Lights Exposure in Combination with Different Concentrations of Seaweed Extract in Reducing Chilling Injury Incidence on Pineapple (*Ananas comosus* L. cv. Morris)

Norazira M. N., and Wan Zaliha W. S.*

Faculty of Fisheries and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

*Email: wzaliha@umt.edu.my

Pineapple cv. Morris is susceptible to chilling injury (CI) when stored at low storage temperature below 13°C and shows symptoms such as blackheart and internal browning. These CI symptoms usually develop after the pineapples were returned to physiological temperatures of between 18 to 30°C. Many researches have been conducted to reduce CI incidence in pineapples although some of these postharvest treatments may be toxic for consumptions or too expensive. As such, a study was conducted using exposure of Light Emitting Diodes

(LED) and in combination of different concentrations of water based seaweed (SW) extract to reduce CI as this treatment is considered cheap and safer to use. For this, a complete randomized block design was used and comprising of two factors: i) LEDs (red and blue); and ii) different concentrations of SW (0%, 50% and 100%) with three replications. All postharvest qualities parameters such as weight loss, flesh colour, CI score, firmness, soluble solid concentration, titratable acidity, and sensory evaluations were measured every 5+2 days (5 days in at 5°C and following 2 days at ambient) intervals after 20 days storage. Results obtained showed that most of the treated fruits were similar to control treatment. This is because the dilution in SW water based extract concentrations is not sufficient to reduce the chilling effect (CI) although LEDs and SW may had the potential to maintain organoleptic attributes. In conclusion, both factors, LEDs and SW water based extract were not effective in reducing CI on pineapple fruits stored at 5+2 days. However, prolong exposure to blue LED on whole pineapple fruit and dipped in SW extract had a tendency to reduce CI incidence and this may increase the shelf life for at least 17 days (15 day in chiller and 2 days at ambient temperature) as this will enhance sweetness and sourness of the fruit.

P61 The Effect of Different Concentrations of Gibberellin in Developing Parthenocarpic Chili (*Capsicum annuum* L.)

Siti Farah H., and Wan Zaliha W. S.*

Faculty of Fisheries and Food Science, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

*Email: wzaliha@umt.edu.my

Parthenocarpy has receive a lot of attention on the research field nowadays because of the capability of certain crop fruit to produce seedless fruits. Parthenocarpy plants are produced with the removal of stamen before the flower anthesis to prevent pollination and fertilization. Parthenocarpy chili had a potential to be developed with the exogenous application of gibberellins (GA₃) on the stigma of flower to promote fruit development. This study was aimed to determine the effect of different concentrations of GA₃ in developing parthenocarpic chili fruit without affecting other quality attributes. Different concentrations of GA₃ (200 ppm, 400 ppm and 600 ppm) were applied three times towards the chili flower on day 78, 87 and 96 after transplanting. Parameters such as fresh weight, number of chili fruits, length of chili, number of seeds, colour, fruit firmness and lycopene content were evaluated. Among all GA₃ treatments, plants treated with 600 ppm GA₃ had the potential to develop parthenocarpic chili fruit as it showed the lowest number of seeds and the highest fresh weight. Nevertheless, no adverse effects of GA₃ were recorded on all postharvest quality parameter. As a conclusion, the application of GA₃ at 600 ppm could be the effective concentration to be applied as it tended to exhibit parthenocarpic chili fruit and maintained other postharvest quality of the fruit.

P62 Comparison of Seed Germination under Different Aerobic Rice Cultivation System

Aiman Hanafi M. F.*, Siti Maslizah A. R., and Nur Suraya A.

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Melaka, Jasin Campus 77300 Merlimau, Melaka, Malaysia.

*Email: aimanhanafiofficial@gmail.com

Drought and heat stress are the common abiotic stresses occurring generally in Asia. This condition could negatively impact rice production in Malaysia. Several studies have been conducted in rice cultivation through a combination of both drought and heat stress. However, the element of seed quality and performance during the germination stage is often overlooked. Thus, a study was conducted with the aim to determine the percentage germination of AEROB1 and MR220CL towards different germinating conditions. The germination test on these two rice varieties was conducted in UiTM Melaka, Jasin Campus under growth chamber and aerobic field plot conditions with temperature 40°C/35°C and 38°C/ 23.3°C, respectively. The results of the

study indicated that under the growth chamber, the AEROB1 and MR220CL showed percentage germination of 98.67% and 92%, respectively. However, in-field plot, percentage germination of AEROB1 and MR220CL showed lower germination rates with values of 97.6% and 90%, respectively. The speed of germination for both varieties was between 71-75%. The results may be due to the condition of growth chamber which causes the seeds to receive uniform light requirement and optimum temperature to pursue their growth as compared to those under field plot where the condition and temperature were varied and difficult to control. The results gained from this study are very important for further exposure to drought, heat and both stresses during the reproductive stage to determine rice productivity and quality. The finding of this study could provide beneficial information to farmers to enhance their rice production particularly during El Nino and dry season.

P63 Seed Quality of Chilli (*Capsicum annuum*) var. Kulai as Affected by Biopolymer Coating

Amyita W. U.^{1*}, Sinniah U. R.², Norhayu A.³, and Azizah M.²

¹Pest and Disease Management Programme, Industrial Crop Research Centre, MARDI Headquarters, 43000 Serdang, Selangor, Malaysia.

²Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

³Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Email: amyita@mardi.gov.my

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae is one of the important vegetables cum spice crops in the world. Despite the economic importance, many constraints decrease chilli production, significantly reducing yield and seed production. The lack of high-quality chilli seeds and the prevalence of seed-borne diseases are among the main constraints in maintaining chilli crop production sustainability. A high-quality seed with better germination, vigour and health is the prerequisite for a good crop. Seed performance is enhanced by applying agrochemicals on seeds by dressing or slurry techniques. The advantages of this method are the non-uniform coating of the seed and dust-off material during transport and handling. Coating seeds with liquid-based polymeric adhesives improve the adherence of agrochemicals on seeds. However, most synthetic polymers are not friendly to the environment due to a substantial amount of polymer remains in the soil, which takes a long time to degrade. Thus, natural polymers originated from plants or biological sources used to develop coatings for crop seeds to substitute synthetic materials. However, critical to the advancement of new seed coating polymers is an assurance that there is compatibility between the polymer and seed germination, plant growth, and timely delivery of the pesticides. Therefore, a study on the effects of biopolymer coating on germination, seedling vigour, and health of chilli var. Kulai was carried out. Seeds were coated with biopolymer solutions at different concentrations and dried back near its initial weight before seed quality assessment was carried out. The experiment was laid out in a Completely Randomized Design with four replications. It shows that the biopolymer coating does not affect the germination percentage of chilli seeds but higher (>90%) than control (81%). However, mean germination time was increased to 3.8 to 4.7 days compared to control (2.9 days) and the germination rate was decreased when seeds were coated with increased biopolymer concentrations. Seedling root and length were shorter when seeds were coated with a higher concentration (>10%) of biopolymer. Biopolymer coating helps control fungi infection when seeds were coated with higher concentrations (>10%) of biopolymer. Even though the biopolymer coating does not improve the seed quality of chilli var. Kulai, it increased the seed germination percentage and health.

P64 Evaluation of Sorghum Seed Viability using Tetrazolium Test

Faizah S. A. R.^{1*}, Muhammad Najib O. G.¹, Halimah H.¹, Nurhazwani M.¹, Hanim A.¹, Zaitalia M.², Amyita W.U.¹, and Ahmad F. M.¹

¹Industrial Crops Research Centre, MARDI, 43400 Serdang, Selangor, Malaysia.

²Seed, Planting Materials and Livestock Production Programme, Technology Commercialization and Business Centre, MARDI, 43400 Serdang, Selangor, Malaysia.

*Email: fsalvana@mardi.gov.my

The tetrazolium (TZ) test is a rapid and effective method for evaluating viability in seeds by using minimal equipment. This test is reliable and accurate thus making it an essential part of seed quality control in laboratories. Results can be obtained within one to two days making it advantageous to test seed species that have trouble in germination due to dormancy. Although being a quick method, the TZ test requires a set of different protocols to test different types of seed. Protocols such as TZ solution concentrations and soaking period need to be predetermined before the test can be used to measure the viability of a certain seed. The purpose of this study was to determine the most suitable method for TZ test and its efficiency in verifying viability in sorghum seeds. Hybrid sorghum seeds were subjected to treatment with different TZ solution concentrations (0.1%, 0.5% and 1.0%) and were kept in the dark for 3 time periods (3, 4 and 5 hours) under temperatures of 30°C with four replications of 30 seeds per treatment. At the end of the staining period, the seed were washed in running water, split lengthways on the cotyledon and classified as viable and non-viable. The best method to evaluate sorghum seed viability through TZ test was identified as that of 0.1% concentration and 3 hours immersion. The chosen method provides a good staining pattern which can easily be used to identify sorghum seed viability while using a very low solution concentration and less amount of time compared to other treatments. The results also indicate that reducing the preconditioning period is feasible and represent an important advancement permitting faster decisions in seed quality control program.

P65 High Quality Cultivars for the Establishment of Herbal Integrated Farming

Farah Fazwa M. A.^{1*}, Syafiqah Nabilah S. B.¹, Norhayati S.¹, Fadhilah Z.², Mazdiana M. Z.², and Rohana A. R.³

¹Forestry Biotechnology Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

²Commercialization and Innovation Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

³Research Planning Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

*Email: farah@frim.gov.my

Herbal industry is identified as one of the potential industries to help the country's economic growth. Natural herbs are gaining popular among people who are sensitive to health care and the use of natural products with therapeutic value. Various efforts have been carried out by the government and NGOs to make Malaysia as one of the herbals producing countries. Cultivation of herbs through integration system is a good initiative in increasing the land productivity of crops. By diversifying several types of crops in one area, farmers can gain benefit in a short, medium, and long terms. Besides that, the use of quality cultivars is also important in ensuring optimal and quality yield. This paper discusses on the approach of using high quality cultivars for the species of *Labisia pumila* and *Citrus microcarpa* as evidenced by the results from previous R&D in integrated farming system. These cultivars are also recommended to be intercropped with lemongrass. In addition, cultivation methods, harvesting cycle, cost involved and expected yield are also discussed in this paper. This approach can be applied by farmers and villagers to generate additional income through the sales of the quality raw materials. This can directly assist the country in ensuring the achievement of sufficient supply of herbal raw materials for local and external demands.

P66 Responses of Seed Germination and Seedling Growth to Seed Priming in *Moringa oleifera*

Farahzety A. M.^{*}, Yap W. S. P., and Singh A.

School of Biosciences, University of Nottingham Malaysia Campus, 43500 Semenyih, Selangor, Malaysia.

^{*}Email: hbxfa1@nottingham.edu.my

Seed priming is a treatment to improve seed quality and plant growth upon germination, and it is applied widely to crop species to improve uniformity and yield. Seed priming is a regulated hydration technique that enables metabolic pre-germination without actual germination. It is one of the most efficient, practical, and short-term approaches to improve seed vigour and germination synchronisation. Therefore, a series of seed priming experiments were conducted to determine the optimal methods of priming treatments that maximise *Moringa oleifera* total germination, germination rate, and seedling vigour. Moringa seeds were treated with hydropriming, osmopriming (KNO₃), and nutripriming (SeedActivator) with a duration of 4, 8, and 12 hours. Results indicated that the highest germination percentage was recorded on seed subjected to hydropriming (63.25%), followed by nutripriming (61.75%) and osmopriming (60%) with the same duration of 4 hours soaking time. These treatments allowed 60 - 63% of the germination between the 6 and 7 days on the petri dish. All pre-germination treatments have significantly early mean germination days (MGT) as compared to the unprimed seeds. In seed pouch study, seeds treated with hydropriming of 4 h had shown best results to improve roots growth in total root length (cm), root projected area (cm²), root-volume (cm³), number of forks, and number of crossings with 240.52 cm vs 170.88 cm, 15.19 cm² vs 8.08 cm², 0.47 cm³ vs 0.29 cm³, 517.80 vs 271.47 and 59.20 vs 28.53, respectively, compared to unprimed seeds. Root average diameter was not significantly different among all treatments. The effect of priming can also be seen in the seedling growth of Moringa grown in a pot with two different media growing. In general, unprimed seeds showed the least plant height, plant circumference, and leaflets among the treatments. The chlorophyll content measurement, however, showed a significantly higher chlorophyll content value for control seedlings. Therefore, seed priming is an effective technique to improve the emergence rate and seedling vigour of Moringa. However, compared with the priming treatments, presoaking with water for 4 hours (hydropriming) is recommended as the most cost-effective priming method.

P67 Seed Quality of Papaya Lines Selected for Tolerance to Papaya Ring Spot Virus Disease

Mohd Nizam Z.^{1*}, and Mohd Azhar H.²

¹Horticulture Research Center, MARDI Pontian, Johor, Malaysia.

²Horticulture Research Center, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

^{*}Email: znizam@mardi.gov.my

Three selected lines of papaya hybrid which are P13, P90 and P248 were the most tolerant papaya lines resistance to papaya ringspot virus (PRSV) from breeding programme initiated in 1991 using Tainung No. 5 and Cariflora as tolerant parents. This study aimed to evaluate seed quality for those selected lines compared to Eksotika papaya seeds. Papaya fruits were harvested at maturity stage of 1 and seeds were harvested, cleaned, and treated with fungicide namely benomyl. The seeds were air dried until reaching 8-13% moisture content. Germination test was conducted with 400 seeds per treatment in a completely randomized design with four replications where radicle protrusion (>1.0 cm) was the criterion for successful seed germination. Seed germination was recorded for 15 days. Percentage of germination, time for 50% emergence (T₅₀), mean germination time (MGT), germination index (GI) and seedling fresh and dry weight were determined. Results showed that Eksotika had the highest germination percentage with 69.5% followed by P13, P90 and P248. The longest MGT and T₅₀ were recorded on P248 with 12.5 and 11.9 days, respectively while the shortest MGT and T₅₀ were recorded on P13. The GI was the highest for Eksotika with value of 29.3 followed by P13, P90 and P248. The heaviest fresh weight was recorded on P90 followed by P13, Eksotika and P248 while the heaviest

dry weight was recorded on P90 followed by Eksotika, P248 and P13. Generally, this study concluded that Eksotika produced highest quality of papaya seed followed by P13, P90 and P248.

P68 Growth Assessment of Mesta (*Garcinia mangostana* L.) Seedlings on Different Growing Media

Mohd Ridzuan M. D.^{1*}, Ab Kahar S.², Puteri Aminatulhawa M. A.², and Salehudin M. R.¹

¹Horticulture Research Centre, Malaysian Agriculture Research and Development Institute (MARDI), 06050 Bukit Kayu Hitam, Kedah, Malaysia.

²Horticulture Research Centre, Malaysian Agriculture Research and Development Institute (MARDI), 43400 Serdang, Selangor, Malaysia.

*Email: ridzone@mardi.gov.my

Mesta is a mangosteen variety and has been registered as GA2. Recently, there are requests for exporting Mesta planting material to East Malaysia (Sarawak and Sabah), since the planting material is not readily available in those areas. Exporting planting material to those states requires proper documentation and treatment as specified, for example the planting material should be bare rooted. Thus, the objective of this study is to evaluate the performance of Mesta seedling on different types of non-soil media. The treatments studied were T1: Sand + soil + organic matter (3:2:1), T2: Peatmoss + perlite, T3: Cocopeat + perlite, and T4: Peatmoss + cocopeat + perlite. The result generally showed that the vegetative growth of Mesta in soil mixture (T1) was faster than other non-soil media (T2, T3, and T4) in terms of height and stem diameter. For the dry weight of seedling, there was a great difference between the soil and non-soil media. However, the differences in the root were not significant. As conclusion, it is important to use appropriate growing media for the establishment of plant at the nursery stage. The use of non-soil media seems to be not very promising. With the handling procedure for exporting mangosteen planting materials, cleaning of soil from the root cannot be avoided. Even if cleaning work is a bit tedious, the survival of planting material at the destination will be high when it is handled carefully.

P69 Cryopreservation of *In vitro*-Grown Taro (*Colocasia esculenta*) Apical Meristem Using a Droplet-Vitrification PVS3 Technique

Noor Camellia N. A.^{1*}, Abdul Muhaimin A. K.¹, Umikalsum M. B.¹, and Rozlaili Z.¹

¹Pusat Penyelidikan Tanaman Industri, Ibu Pejabat MARDI, 43400 Serdang, Selangor, Malaysia.

*Email: camellia@mardi.gov.my

This is the first report on the cryopreservation via droplet vitrification PVS3 technique of taro using in-vitro apical meristem as the starting material. This study aimed to examine the effects of PVS3 duration, loading, and unloading type on the survival of taro apical meristem after cryopreservation. The highest growth recovery of 77% was obtained when 1 mm size apical meristem precultured on MS media supplemented with 0.3 M sucrose for 16 h at 25 °C, followed by loading treatment supplemented with 1.5 M glycerol with 5% DMSO for 20 min, dehydrated with PVS3 solution for 10 min, placed on cooled aluminium strips in a droplet of PVS3 before been plunged in liquid nitrogen and then treated with unloading solution supplemented with 1.2 M sucrose for 15 min. Successful vitrified and warmed shoot tips resumed growth within four to eight weeks and developed shoots directly without intermediate callus formation. The morphological characteristics of regenerated plantlets developed from cryopreserved meristems were observed after been transferred to pots containing 100% peat media and no abnormalities were noted compared with the control plantlets (untreated non-cryopreserved shoot tips).

P70 Pre-evaluation on Growth, Yield and Chemical Constituents of Four Selected Herbal Species from Breeding Plot Located at Felcra Nasarudin, Sri Iskandar, Perak

Norhayati S.^{1*}, Farah Fazwa M. A.¹, Syafiqah Nabilah S. B.¹, Masitah M. T.¹, Sari Indra Saputra M. B.², Zunoliza A.³, and Fauziah A.³

¹Plant Improvement Programme, Forestry Biotechnology Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

²FELCRA Berhad, Wisma FELCRA, Lot 4780, Jalan Rejang, Setapak Jaya, Peti Surat 12254, Kuala Lumpur, Malaysia.

³Natural Products Division, Forest Research Institute Malaysia, 52109 Kepong, Selangor, Malaysia.

*E-mail: norhayatisaffie@frim.gov.my

In Peninsular Malaysia, more than 1,300 medicinal plant species have been recorded, and most of these plants have been used by local communities to cure their ailments and to enhance their health. The interest and use of medicinal plants have increased due to the increasing concern on health issues. The demand towards medicinal plants grows to 160,154 kg per month compared to the supply that only covers 112,770 kg per month. Thus, plant breeders of Forest Research Institute Malaysia (FRIM) have taken the initiative to establish a breeding plot of four selected herbal species such as *Andrographis paniculata* (hempedu bumi), *Strobilanthes crispus* (pecah beling), *Clinacanthus nutans* (belalai gajah) and *Orthosiphon stamineus* (misai kucing) at the R&D Centre, FELCRA Nasarudin Belia, Sri Iskandar, Perak, to tackle this issue. The ultimate objective of this experiment is to select high yielding mother plants from the four species with good growth performance, high yield and active chemical constituents. A total of 120 mother plants (30 mother plants per species) were used in this experiment with the planting density of 1.0 m x 1.0 m. Pre-evaluation of the breeding plot was carried out after 6 months planted at the field. Some parameters, such as morphological characteristics, fresh and dried biomass, and environmental data were collected. The chemical constituents analysis through High Performance Liquid Chromatography (HPLC) also were conducted for selection of high yielding mother plants for the species. Results showed *Clinacanthus nutans* achieved high fresh weight (387 kg) followed by *Strobilanthes crispus* (200 kg), *Orthosiphon stamineus* (89 kg) and *Andrographis paniculata* (50 kg). The high value of targeted compounds such as schaftoside, rosmarinic acid, sinensetin, and andrographolide also revealed in each species. The output from the study is not only beneficial to the plant breeder in the aspect of producing new variety, but also to herbal industries, as high-quality herbal products can be produced.

P71 Environmental Stress on Selected Aerobic Seed Quality During Seed Development

Nurulnathasa A.^{*}, and Siti Maslizah A. R.

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Jasin, 77300 Merlimau, Melaka, Malaysia,

*Email: ameerthasa@gmail.com

High-quality seeds are needed to produce high-yield rice (*Oryza sativa* L.) crops as a main source food in Malaysia. Extreme weather in Malaysia continues for a long time resulting in declining of rice production due to the degradation of seed quality of rice. The effects of climate change such as high temperature and water limitation on seed quality of rice has received less attention than on yield of rice. This study help identify the effect of environmental stress (drought/high temperature) on seed quality of aerobic rice during seed development and determine the most critical stages of seed development on seed quality of aerobic rice that affected by every single environmental stress. Aerobic seeds (cv. MRJA 1) were obtain from MARDI and showed 98% germination capacity that was conducted in lab room temperature (20°C-25°C) indicated seed source suitable for next growing season. The seed will be planted in pots at greenhouse (min=25°C, max=38°C). After seedling stages, the plant will be exposed to water limitation and/or elevated temperature (40°C) during seed development, started at 50% anthesis to physiological maturity. Five series of harvesting will be done in order to determine the pattern of seed desiccation, potential longevity and nutrients status once treated with the environmental stresses. This research, it might help breeder to develop a new variety of aerobic seed by

improving the existing variety with more tolerant to environmental stresses. High quality of seed later will improve national rice production to secured food security purposes.

P72 Fruit Ripeness Effect on the Characteristics, Germination, and Desiccation Tolerance of *Syzygium myrtifolium* Seeds

Nur Farhanis A., and Tsan F. Y.*

Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin, 77300 Merlimau, Melaka, Malaysia.

*Email: tsanfuiying@uitm.edu.my

Syzygium myrtifolium is valued for landscaping and medicinal properties. Seed germination as one of its primary propagation means was studied. The small spherical fruit and seed had increased longitudinal and transversal diameter and weight, but the seed lost moisture from 54% to 46% (wet weight basis) as the fruit progressed from half ripe stage to fully ripen stage. The seeds from the half and fully ripe fruits germinated rapidly within a few days with high germination rate of 95-100%. In the desiccation trial, the seed was found sensitive to drying. Total loss of viability was recorded for seed with its moisture content below 20%.

P73 Effect of Seed Priming Treatments on Seed Quality of Tomato (*Solanum lycopersicum*)

Zaitialia M.^{1*}, Nurul Atilia Shafienaz H.², Amyita W. U.², and Muhamad Arizal B.¹

¹Commercialization Technology & Business Centre, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

²Industrial Crop Research Centre, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: mzai80@mardi.gov.my

Tomato is one of the most important crops grown commercially because it has a high economic value and it is often consumed daily in most parts of the world. However, tomato seed varies in its quality and vigour. Thus, the aim of this study was to determine the effect of priming on germination and seedling emergence growth of tomato seed cv. MAHA 18. An experiment was conducted in the Seed Quality Control Laboratory, Commercialization Technology and Business Centre at MARDI, using a completely randomized design with 3 replications. Nine treatments were used; no priming (control, T1), hydropriming (priming with distilled water for 4 days, T2 and 24 hours, T3), halopriming (priming with 0.2% (T4), 0.7% (T5), and 1.2% (T6) KNO₃ solution for 4 days) and hormonal priming (priming with 50 mg/L (T7), 100 mg/L (T8) and 150 mg/L (T9) for 24 hours). The seeds were sown on peat moss for emergence test. Significant variation for germination percentage, mean germination time, germination index, seed vigour index, seedling fresh weight, seedling dry weight, and seedling length were observed among the treatments. It is recommended to primed tomato seeds with water for 24 hours, as well as KNO₃ with concentration as low as 0.7% for four days.

P74 Yield Performance of Ulam Tenggek Burung in Pilot Scale

Umikalsum M. B.^{1*}, Farahzety A. M.², and Roslee P.³

¹Industrial Crop Research Center, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

²Horticulture Research Center, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

³Agrobiodiversity and Environment Research Center, MARDI Headquarters, 43400 Serdang, Selangor, Malaysia.

*Email: umi@mardi.gov.my

Demand for traditional vegetables and “ulaman” are increasing due to the high nutritional value such as antioxidant and other nutrient content that are important in the daily diet. However, most of these “ulaman” are grown on a small scale and normally grown in the backyard garden. Therefore, the yield and quality considered unfavourable to cater the market. Lack of study on the commercial production of traditional “ulaman” have been reported. The varieties of “ulaman” native to Malaysia can be exploited and commercial further. One of the “ulaman” that has commercial potential is *Melicope ptelefolia* commonly known as tenggek burung. Large-scale propagation techniques, cultivation systems and fertilisation requirements for efficient production of tenggek burung have been successfully developed in previous studies. In this study, we focused on evaluating the production of tenggek burung in pilot scale. The results of this study showed that tenggek burung produced considerably higher yield (vegetative edible shoots) in the first three weeks after pruning. Production of new edible shoots are decreased in the following week. In order to obtain continuous production, crop maintenance such as fertilisation, weeding and pruning should be done on a regular basis.

ACKNOWLEDGEMENTS

The Organising Committee wishes to express appreciation to the following parties for their support, contribution, and participation:

YBhg. Prof. Dato' Dr. Mohd Fauzi Hj. Ramlan (Patron, MSPP)

Keynote Speaker

Plenary Speakers

Session Chairs

Paper Presenters (Oral and Poster)

Participants

Elite Scientific Instruments Sdn. Bhd.

A word of thanks is also due to all those who have assisted in one way or another in organising the conference, and those whose names have been inadvertently omitted from the above list.



ELITE SCIENTIFIC INSTRUMENTS SDN BHD

Co.No.589388-H



- Turnkey For Tropical / Transgenic Greenhouse
- Irrigation & Fertigation Technology
- Greenhouse Monitoring System
- Agricultural Research Instruments
- Laboratory & Scientific Instruments
- Environmental Research Instruments
- Remote Monitoring & Control System



ELITE SCIENTIFIC INSTRUMENTS SDN BHD (Co.No.589388-H)

A-LG-03, BLOCK A, SERDANG PERDANA SELATAN, SECTION 1, 43300 SERI KEMBANGAN, SELANGOR DARUL EHSAN, MALAYSIA

Tel: (603) 8945 6100 Fax (603) 8945 7100 Email: hassim@esi.com.my sales@esi.com.my

URL: www.esi.com.my



PREPARED BY SCIENTIFIC AND TECHNICAL
COMMITTEE

30TH MALAYSIAN SOCIETY OF PLANT
PHYSIOLOGY CONFERENCE - WEBINAR

17 – 18 NOVEMBER 2020

#KITAJAGAKITA

#PATUHI_SOP

#PANDEMIC_COVID_19