UNIVERSITI PUTRA MALAYSIA

PHYSIOLOGICAL AND MOLECULAR EFFECTS OF GIBBERELLIC ACID AND PACLOBUTRAZOL ON YOUNG CLONAL PALM GROWTH AND DEVELOPMENT

CHAI SOOK KEAT

FBSB 2022 8

PHYSIOLOGICAL AND MOLECULAR EFFECTS OF GIBBERELLIC ACID AND PACLOBUTRAZOL ON YOUNG CLONAL PALM GROWTH AND DEVELOPMENT

By

CHAI SOOK KEAT

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philisophy

May 2021

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

PHYSIOLOGICAL AND MOLECULAR EFFECTS OF GIBBERELLIC ACID AND PACLOBUTRAZOL ON YOUNG CLONAL PALM GROWTH AND DEVELOPMENT

By

CHAI SOOK KEAT

May 2021

Chair : Associate Professor Parameswari a/p Namasivayam, PhD
Faculty : Biotechnology and Biomolecular Sciences

Gibberellin (GA) and paclobutrazol (PBZ) are both plant hormones for stimulating and retardant of plant growth and development, respectively. The role of both hormones in oil palm growth and development is not thoroughly investigated. Therefore, this study focused on the physiological effects of gibberellic acid (GA_3) or PBZ application on young clonal oil palm and its associated molecular responses. It also involved optimization of a tissue preparation procedure for cryosectioning in future transcriptome profiling of inflorescences. Sucrose treatment with snap freezing of fresh oil palm inflorescences provided cryosections with good cellular morphology and higher RNA yields and quality. On phytohormone application, GA_3 and PBZ treatments were separately conducted on young clonal palms for 56 weeks. The GA_3-treated palms were taller with longer fronds than the control but produced lower biomass. These physiological changes were associated with a higher expression of cell cycle-related genes such as *MYB3R-1*, *E2FB*, *CK1d*, *CDK5RAP3* and *SRO1* and cellulose synthase *CSLC5* (five-fold) and *CCR1* (three-fold) for lignin synthesis. In contrast, PBZ application likely blocked GA biosynthesis by suppressing expression of GA biosynthesis genes *GA20ox* and *GA3ox*. PBZ-treated palms were shorter in height and frond length with lower biomass. Higher expression of the growth suppressor *RCC* and two- to eight-fold lower expression of cytoskeletal motor genes *actin 3* and *kinesin 3*, cellulose synthase *CESA2*, pectin activator *WAK3* and *pectin lyase-like* suggested that PBZ may suppressed cell expansion in leaves by enhancing secondary cell wall rigidity in oil palm. Besides that, lower SPAD values together with two- to five-fold lower expression of chlorophyll synthesis genes *UROD*, *ChlD*, *LIL3*, *PORA* and *CAO* suggested that GA_3 suppressed chlorophyll synthesis in GA_3-treated palms. Conversely, three fold higher *GGR* expression in leaflets of PBZ-treated palms associating with higher SPAD values suggested that accumulated geranylgeranyl pyrophosphate (GGPP) due to suppression of GA synthesis might be channeled towards chlorophyll synthesis. On reproductive development, late flowering in PBZ-treated palms correlated with suppression of floral activator *SOC1* while late flowering GA_3-treated palms displayed elevated expression of flowering repressors *LSD1* (three-

fold) and *GATA21* (two- to five-fold) and reduced expression of the flowering accelerator *COL5* (three-fold). However, sex of inflorescences was not affected by these treatments. In conclusion, GA_3 treatment of oil palm promoted height increment and frond elongation by promoting cell division and elongation but suppressed biomass production. On the contrary, growth retardation following PBZ treatment might be attributed to suppression of cell expansion. Both GA_3 and PBZ treatments appeared to delay flowering but did not affect sex determination in young clonal oil palms.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN FISIOLOGI DAN MOLEKUL OLEH ASID GIBERELIK DAN PACLOBUTRAZOL KE ATAS PERTUMBUHAN AND PERKEMBANGAN KLON KELAPA SAWIT MUDA

Oleh

CHAI SOOK KEAT

Mei 2021

Pengerusi : Profesor Madya Parameswari a/p Namasivayam, PhD
Fakulti : Bioteknologi dan Sains Biomolekul

Giberelin (GA) dan paclobutrazol (PBZ) adalah pengatur pertumbuhan tanaman yang masing-masing merangsang dan merencat pertumbuhan dan perkembangan tanaman. akan tetapi, peranan kedua-dua hormon dalam pertumbuhan dan perkembangan kelapa sawit tidak disiasat dengan menyeluruh. Oleh itu, kajian ini menumpu pada kesan fisiologi rawatan asid giberelik (GA_3) dan PBZ pada klon kelapa sawit muda dan tindak balas molekul yang berkaitan. Ini juga melibatkan pengoptimuman prosedur penyediaan tisu untuk hirisan krio bagi profil transkripome perbungaan masa depan. Rawatan sukrosa dengan pembekuan bunga minyak sawit segar memberikan hirisan krio dengan morfologi selular yang baik serta hasil dan kualiti RNA yang lebih tinggi. Sementara itu, rawatan GA_3 dan PBZ dijalankan secara berasingan pada klon kelapa sawit muda selama 56 minggu. Kelapa sawit yang dirawat dengan GA_3 adalah lebih tinggi, mempunyai pelepah yang lebih panjang berbanding dengan kawalan tetapi menghasilkan biomas yang lebih rendah. Perubahan fisiologi ini dikaitkan dengan pengekspresan yang lebih tinggi gen berkaitan dengan kitaran sel, *MYB3R-1*, *E2FB*, *CK1d*, *CDK5RAP3* dan *SRO1* serta selulosa synthase *CSLC5* (lima kali ganda) dan *CCR1* (tiga kali ganda) untuk sintesis lignin. Sebaliknya, aplikasi PBZ berkemungkinan membantutkan biosintesis GA dengan menyekat ekspresi gen biosintesis GA *GA20ox* dan *GA3ox*. Kelapa sawit yang dirawat dengan PBZ adalah lebih rendah dengan pelepah pendek serta biomassa yang lebih rendah. Ekspresi penyekatan pertumbuhan *RCC* dua kali ganda lebih tinggi manakala dua hingga lapan kali lebih rendah ekspresi gen motor sitoskeletal *actin 3* dan *kinesin 3*, selulosa synthase *CESA2*, pengaktif pektin *WAK3* dan *pektin lyase-like* menunjukkan bahawa PBZ mungkin menyekat pengembangan sel dalam helaian daun dengan meningkatkan ketegaran dinding sel sekunder di kelapa sawit. Selain itu, nilai SPAD yang lebih rendah berserta dengan dua hingga lima kali ganda lebih rendah ekspresi gen klorofil sintesis *UROD*, *ChlD*, *LIL3*, *PORA* dan *CAO* mencadangkan bahawa GA_3 menindas sintesis klorofil di kelapa sawit yang dirawat dengan GA_3. Sebaliknya, tiga kali ganda lebih tinggi ekspresi *GGR* dalam helaian daun kelapa sawit yang dirawat dengan PBZ berkaitan dengan nilai SPAD yang lebih tinggi mencadangkan bahawa geranylgeranyl

pirofosfat (GGPP) yang terkumpul, berikutan penindasan sintesis GA, mungkin telah dialihkan untuk sintesis klorofil. Pada perkembangan pembiakan, proses pembungaan lewat di kelapa sawit yang dirawat dengan PBZ dikaitkan dengan penindasan pengaktif bunga *SOC1* sementara pembungaan lewat di kelapa sawit yang dirawat dengan GA_3 memaparkan lebih tinggi ekspresi penindas pembungaan *LSD1* (tiga kali ganda) dan *GATA21* (dua hingga lima kali ganda) serta pengurangan ekspresi pemecut pembungaan *COL5* (tiga kali ganda). Walau bagaimanapun, seks pembungaan tidak terjejas oleh kedua-dua rawatan ini. Kesimpulannya, rawatan GA_3 atas kelapa sawit mendorong kenaikan ketinggian dan pemanjangan pelepah dengan menggalak pembahagian dan pemanjangan sel tetapi menindas pengeluaran biomassa. Sebaliknya, perencatan tumbersaran berikutan rawatan PBZ mungkin disebabkan oleh penindasan pengembangan sel. Kedua-dua rawatan GA_3 dan PBZ kelihatan seperti melambatkan pembungaan tetapi tidak mempengaruhi penentuan seks klon kelapa sawit muda.

ACKNOWLEDGEMENTS

Many people have contributed to this study by providing help, insightful discussions and comments. First and foremost, my heartfelt gratitude and appreciation goes to my supervisory committee, *i.e.* Dr. Ooi Siew Eng, Dr. Meilina Ong binti Abdullah at Malaysian Palm Oil Board (MPOB), Associate Professor Parameswari Namasivayam and Professor Ho Chai Ling of Universiti Putra Malaysia (UPM) for their constant guidance and invaluable advice. Their thorough and helpful reviews and comments on the thesis were extremely useful to me. In addition, the continuous guidance and expertise in oil palm physiology provided by Haji Mohd Roslan bin Md. Noor were crucial to this study despite having retired from MPOB, his assistance will not be forgotten.

To my MPOB colleagues, I would like to thank my fellow labmates from Biomarker Discovery Group, *i.e.* Azizah Mokri, Feshah Ishak, Rosna Angsor, Kok Sau Yee, Tan Hooi Sin, Nuraziyan Azimi, Norashikin Sarpan, Masniyana Jamil, Roslan Ngadio, the late Shamshulbahri Abdul Manap, Rajini Raj Mohamed and Mohd Amin Shaharodin Samat for their help throughout the entire physiological study. Without their help, this work would not progress smoothly. Besides that, my gratitude also goes to members of Bioinformatic unit for server facility and Mr. Chan Kuang Lim for his bioinformatic support in RNA sequencing analysis. On top of that, clonal oil palm plantlets and planting area provided by Clonal Propagation group are highly appreciated too. I also want to express my gratitude to Dr. Zulkifli Hashim from Unit Agronomy and Geospatial Technology (AGT) for his laboratory service offered on mineral content analysis on oil palm leaflets and soil. Additionally, I would like to give special thanks to Dr. Ting Ngoot Chin and Dr. Chan Pek Lan from Genomics Unit for their advice on real time PCR and the reference genes primers supply. I must also thank MPOB for the funding of this study and GSAS offer.

I am also grateful to Ms Norazlin binti Abdul Aziz from Institute Medical Research for her technical support on microtome sectioning for LCM. Likewise, assistance in statistically analysis offered by Dr. Anwar Fitrianto from Universiti Putra Malaysia is also deeply appreciated. Additionally, training on RNA sequencing data analysis provided by Mr. Steven M. Smith, Mr. Michael Hogan and the late Mr. Jiang Nan from Orion Genomics is very valuable to this work.

Last but not least, I would like to convey my sincere gratitude to my family members. This study would not be accomplished without their emotional and financial supports, especially from my parents and husband. Thank you for your patience and untiring support throughout my journey. I am also in debt to my newborn baby, Athelstan, as I can't take care of him well during thesis writing.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Parameswari a/p Namasivayam, PhD
Associate Professor
Faculty of Biotechnology and Biomolecular Sciences
Universiti Putra Malaysia
(Chairman)

Ho Chai Ling, PhD
Professor
Faculty of Biotechnology and Biomolecular Sciences
Universiti Putra Malaysia
(Member)

Ooi Siew Eng, PhD
Group Leader of Biomarker Discovery Group
Advanced Biotechnology and Breeding Centre
Malaysian Palm Oil Board
(Member)

Meilina Ong Abdullah, PhD
Head of Breeding and Tissue Culture Unit
Advanced Biotechnology and Breeding Centre
Malaysian Palm Oil Board
(Member)

_____
ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 10 February 2022

Declaration by the Graduate Student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and the copyright of the thesis are fully-owned by Universiti Putra Malaysia, as stipulated in the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from the supervisor and the office of the Deputy Vice-Chancellor (Research and innovation) before the thesis is published in any written, printed or electronic form (including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials) as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld in accordance with the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2015-2016) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No.: Chai Sook Keat

Declaration by Members of the Supervisory Committee

This is to confirm that:

- the research and the writing of this thesis were done under our supervision;
- supervisory responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2015-2016) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Associate Professor Dr. Parameswari a/p Namasivayam

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Ho Chai Ling

Signature: _____
Name of Member of Supervisory Committee: Dr. Ooi Siew Eng

Signature: _____
Name of Member of Supervisory Committee: Dr. Meilina Ong Abdullah

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

°C	Degree Celsius
2ODD	2-oxoglutarate–dependent dioxygenases
ABA	Abscisic acid
ACS	1-aminocyclopropane-1-caroxylate synthase
AGP	Arabinogalactans
AIR12	Auxin-Induced in Roots
AP	Apetala
AP2/EREBP	Apetala 2/Ethylene Responsive Element Binding Proteins
APC/C	Anaphase-Promoting Complex/Cyclosome
APX	Ascorbate Peroxidise
ASK19	S-phase Kinase Associated Protein 19
BAK1	Brassinosteroid Insensitive 1-Associaated Receptor Kinase 1
BES1	BR-Insensitive-EMS-Suppressor-1
BIN2	BR Insensitive 2
BR	Brassinosteroid
BRI1	Brassinosteroid Insensitive 1
BSK	BR-signalling kinases
BSU1	BRI1 Suppressor 1
BT4	BTB and TAZ domain protein 4
BZR-1	Brassinazole-Resistant-1
CAO	Chlorophyllide a oxygenase
CAT	Catalase
CCR1	Cinnamoyl-CoA reductase 1
CDC	Cell Division Cycle

CDK5RAP3	CDK Regulatory Subunit Associated Protein 3
cDNA	Complementary DNA
Chk1	Checkpoint Kinase 1
CHS1	Chalcone Synthase 1
CK1d	Casein Kinase 1 Isoform Delta
CNRQ	Calibrated Normalized Relative Quantity
CO	Constans
COL	Constans-Like
COP	Constitutive Photomorphogenesis Protein
CPP	*ent*-Copalyl-Piphosphate
CPS	*ent*-Copalyl Diphosphate Synthase
CSL	Cellulose Synthase Like
Ct	Cycle threshold
CYP2	Cyclophillin2
DEF	Deficiens
DEGs	Differentially Expressed Genes
DNA	Deoxyribonucleic Acid
DW	Dry weight
E	Amplification efficiency
ERF3	Ethylene-Responsive Transcription Factor 3
ERF6	Relative of Early Flowering 6
ETO1	Ethylene Overproducer 1
EXP	Expansin
F	Female
FDR	False discovery rate
FF	Fresh frozen

FFPE	Formalin-Fixed, Paraffin-Embedded
FLC	Flowering Locus C
FLD	Flowering Locus D
FLS1	Flavanone-3-Hydroxylase
FPKM	Fragments per kilobase of transcript per million fragments mapped
Fr	Frond
FT	Flowering Locus T
FUL	Fruitful
FW	Fresh weight
GA	Gibberellin
GA13ox	GA13 oxidase
GA20ox	GA20 oxidase
GA2ox	GA 2-beta-dioxygenase
GA_3	Gibberellic acids
GA3ox	GA3 beta-dioxygenase
GAI	GA Insensitive
GAMT	GA Methyl Transferase
GAPDH	Glyceraldehyde-3-Phosphate Dehydrogenase
GGDP	Geranylgeranyl Diphosphate
GH17	O-Glycosyl Hydrolase family 17 protein
GH3.5	Indole-3-acetic acid-amido Synthetase
GID1	GA Insensitive Dwarf 1
GO	Gene Ontology
GOI	Gene of interest
GRAS	GAI, RGA, and Scarecrow

GSEA	Gene Set Enrichment Analysis
H	Hermaphrodite
HMG	3-hydroxy-3-methylglutaryl
HMGS	HMG-CoA synthase
IAA20	Indoleacetic acid-induced protein 20
IDD	Indeterminate Domain
INV1	Invertase 1
IPP	Isopentenyl diphosphate
JA	Jasmonate acid
JAZ1	JA ZIM-domain 1
KA	*ent*-Kaurenoic Acid
KO	*ent*-Kaurene Oxidase
KRP2	Kip-Related Protein 2
KS	*ent*-Kaurene Synthase B
LCM	Laser Capture Microdissection
LFY	Leafy
LIL3	Light-Harvesting-Complex Like protein 3
M	Male
MEP	Methylerythritol 4-Phosphate
mRNA	Messenger Ribonucleic acid
MVA	Mevalonic acid
MYB308	MYB-related protein 308
NAD5	NADH Dehydrogenase subunit 5-like
NCBI	National Center for Biotechnology Information
NDX1	Nudix1
NEF1	No Exine Formation 1

NFL	No Flowering in Short Day
NGS	Next-Generation Sequencing
NIP1-1	NOD26-like Intrinsic protein 1-1
NRT	No reverse transcriptase
NTC	No template control
OCT	Optimal cutting temperature
PBZ	Paclobutrazol
PCS	Petiole cross section
PD00380	Predicted 40S Ribosomal Protein S27-2
PD00569	Manganase Superoxide Dismutase
PDCB3	Plasmodesmata Callose-Binding Protein 3
PIF	Phytochrome Interacting Factor
PNP1	Polyribonucleotide Nucleotidyltransferase 1
PORA	Protochlorophyllide Oxidoreductase A
pOP-EA01332	Predicted protein IFH-1 like
POX	Peroxidase
Q	Phred quality scores
qRT-PCR	Quantitative Real-Time Polymerase Chain Reaction
R^2	Correlation coefficient
RAV1	Related to ABA-insensitive 3/Viviparous 1
RCC	Regulator of Chromosome Condensation
REF6	Relative of Early Flowering 6
RGA	Repressor of GA1-3
RGL	RGA-Like
RIN	RNA Integrity Number

RNA	Ribonucleic acid
ROS	Reactive Oxygen Species
SAM	Shoot apical meristem
SBP	Squamosa-Promoter Binding Protein
SCF	SKP1-Culin-F-box
SCL13	Scarecrow-like 13
SERK2	Somatic Embryogenesis Receptor-Like Kinase 2
SIM	Kip-Related Protein 2
SKIP11	SKP1-Interacting Partner 11
SLR	Slender Rice
SOC1	Suppressor of Constans Overexpression 1
SOD	Superoxide Dismutase
SPB	Squamosa Promoter Binding Protein
SPL	SPB-Like
SPL14	SBP family protein-like 14
SRO1	Similar to RCD One 1
SVP	Short Vegetative Phase
TP	Time Point
TBL	Trichome Birefringence-like
TSF	Twin Sister of FT
UROD	Uroporphyrinogen Decarboxylase
WAK3	Wall-Associated kinase 3
XET	Xyloglucan Endotransglycosylase
XTH	Xyloglucan Hydrolase
Z-ISO	15-cis-zeta-carotene

CHAPTER 1

GENERAL INTRODUCTION

As the world population continues to expand, vegetable oil consumption will increase tremendously. The edible vegetable oil demand has been predicted to triple from 2009 to 2050 (Gottwald, 2018) whereby global consumption of palm oil will quadruple to 240 million tonnes from 2015 to 2050 (Samat, 2018). Consequently, palm oil has emerged as the most consumed vegetable oil since 2010 with 75.45 million metric tons (MT) or 26.3% of global vegetable oil consumption in 2020/21, after soybean oil (28.6%) and rapeseed oil (13.3%) (www.statista.com/statistics). To fulfil and sustain the high demand of palm oil, tissue culture is a promising technique that is able to improve oil palm's yield and quality. It involves the mass propagation of elite high yielding oil palms on culture media to produce more homogeneous clonal oil palms. However, formation of the abnormal mantled inflorescences and fruits in clonal oil palms is the main stumbling block to large scale clonal production. In normal inflorescence development, the male organ will degenerate at stage 4 of flowering development. On the contrary, mantled female inflorescences display feminization of the male organs as the rudimentary stamen primordia of mantled female inflorescences is converted into pseudocarpels and give rise to supernumerary carpel fruits, which results in oil yield losses (Adam *et al*., 2005). Felda Global Ventures (FGV), which produced 1 million clonal palms annually for sale at RM28 each (Roowi *et al*., 2018) suffered an estimated loss of RM0.84 million as the result of 3% tissue culture abnormalities in 2015. Unmethylated *Karma* retrotranpson in *EgDEF1*, an *Apetala 3* homolog, leading to truncated *EgDEF1* in mantled inflorescence is the cause of mantling abnormality (Ong-Abdullah *et al*., 2015). However, the mantling mechanism of floral abnormality remains elusive. Comparative transcriptome analysis of staminodes isolated from normal and mantled inflorescences at stage 3 of flowering development using laser microdissection (LCM) will shed light on the mantling mechanism.

Gibberellins (GAs) are plant growth regulators that stimulate cell elongation and cell division to promote stem elongation (Thomas *et al*., 2005). Besides that, GAs also promotes juvenile-adult phase transition, whereby low GA levels in shoot meristems prevent differentiation and maintain meristem activity (Hay *et al*., 2002). A few studies have shown that GAs produce maleness effect on flowering in watermelon (Zhang *et al*., 2017a), cucumber (Zhang *et al*., 2017b), spinach (West and Golenberg, 2018), asparagus (Lazarte and Garrison, 1980) and hemp (Ram and Jaiswal, 1972) but promote female flower in maize (Bommineni and Greyson, 1990). In short, GA has been shown to be involved in flower sex determination but the maleness or femaleness effect varies between plants.

Studies of GA effect in oil palm were mainly focused on inflorescences and fruit development. For example, gibberellin-like activity was detected in phloem sap of emergent male inflorescences (Otusanya and Adebona, 1985) while non-bioactive GAs, GA_{19} and GA_{44} were in abundance in pre-anthesis inflorescences (Huntley *et al*., 2002). Besides that, endogenous gibberellic acid (GA_3) level was found peak in early

phase of fruit ripening (10-14 week after pollination) but reduced as fruit matured and ripened (Yeap *et al*., 2017). Meanwhile exogenous GA_3 treatment on oil palm showed that application conducted 15 days before harvest could increase fruit bunch weight (Kalidas and Rajasekhar, 2010), while no effect was observed in day 1 to 7 in post-harvest treatment (Sudradjat *et al*., 2021). Besides that, GA_3 application on inflorescences in anthesis induced parthenocarpic fruits without assisted pollination (Thomas *et al*., 1973). An earlier study conducted on oil palm seedlings for two years showed that GA_3 treatment favoured the production of male inflorescences in young oil palms (Corley, 1976). The result was inconclusive because no further details were available on how GA_3 exerts the sex determination effect on the seedling palms at the molecular, biochemical and physiological levels. Hence, an investigation into the physiological and molecular effects of exogenous GA_3 and its antagonist, paclobutrazol (PBZ), on oil palm clonal materials may provide clues into the role of this hormone in vegetative and flower development, particularly in sex determination. The hypothesis of this study was that GA_3 and PBZ affect the vegetative and reproductive development of the oil palm. The objectives of this study were:

1. to optimize oil palm inflorescence preparation procedures, i.e. formalin-fixed paraffin embedded and fresh frozen, and staining procedures, i.e. naphtol blue black and toluidine blue, for cryosection and LCM,
2. to determine the physiological effects of GA_3 and PBZ on vegetative growth and reproduction in young clonal oil palms,
3. to profile the gene expression changes using transcriptome sequencing in young clonal oil palms due to the GA_3 and PBZ application.

REFERENCES

aan den Toorn M, Albrecht C, de Vries S. 2015. On the Origin of SERKs: Bioinformatics Analysis of the Somatic Embryogenesis Receptor Kinases. Mol Plant. 8(5): 762-782.

Abdul Jaleel, C., Gopi, R., Manivannan, P., Panneerselvam, R. (2007). Responses of antioxidant defense system of *Catharanthus roseus* (L.) G. Don. to paclobutrazol treatment under salinity. Acta Physiologiae Plantarum, 29(3): 205-209.

Abdul Rahman, M. N. H., Shaharuddin, N. A., Abdul Wahab, N., Megat Wahab, P. E., Ong-Adbuallah, M., Psyquay Abdullah, N. A., Ghulam Kadir, A. P., Roberts, J. A., Ramli, Z. (2016). Impact of Paclobutrazol on the growth and development of nursery growth clonal oil palm. Journal of Oil Palm Research, 28(4): 404-414.

Achard, P., Gusti, A., Cheminant, S., Alioua, M., Dhondt, S., Coppens, F., Beemster, G. T., Genschik, P. (2009). Gibberellin signaling controls cell proliferation rate in Arabidopsis. Current Biology, 19(14): 1188-1193.

Achard, P., Renou, J. P., Berthomé, R., Harberd, N. P., Genschik, P. (2008). Plant DELLAs restrain growth and promote survival of adversity by reducing the levels of reactive oxygen species. Current Biology, 18(9): 656-660.

Adam, H., Collin, M., Richaud, F., Beulé, T., Cros, D., Omoré, A., Nodichao, L., Nouy, B., Tregear, J. (2011). Environmental regulation of sex determination in oil palm: Current knowledge and insights from other species. Annals of Botany, 108(8): 1529-1537.

Adam, H., Jouannic, S., Escoute, J., Duval, Y., Verdeil, J., Tregear, J. W. (2005). Reproductive developmental complexity in the African oil palm (*Elaeis guineensis*, Arecaceae). American Journal of Botany, 92(11): 1836-1852.

Adam, H., Jouannic, S., Orieux, Y., Morcillo, F., Richaud, F., Duval, Y., Tregear, J. W. (2007). Functional characterization of MADS box genes involved in the determination of oil palm flower structure. Journal of Experimental Botany, 58(6): 1245-1259.

Andrés, F., Porri, A., Torti, S., Mateos, J., Romera-Branchat, M., García-Martínez, J. L., Fornara, F., Gregis, V., Kater, M. M., Coupland, G. (2014). SHORT VEGETATIVE PHASE reduces gibberellins biosynthesis at the *Arabidopsis* shoot apex to regulate the floral transition. Proceedings of the National Academy of Sciences of the United States of America, 111(26): E2760-2769.

Barcelos, E., de Almeida Rios, S., Cunha, R. N. V., Lopes, R., Motoike, S. Y., Babiychuk, E., Skirycz, A., Kushnir, S. (2015). Oil palm natural diversity and the potential for yield improvement. Frontiers Plant Science, 6(190): 1-16.

Behjati, S. and Tarpey, P. S. (2013). What is next generation sequencing? Archives of Disease in Childhood: Education and Practice Edition, 98(6): 236-238.

Bernard, J. R. (1974). Microwave irradiation as a generator of heat for histological fixation. Stain Technology, 49(4): 215-224.

Bertelsen, M. G., Tustin, D. S., Waagepetersen, R. P. (2002). Effects of GA_3 and GA_{4+7} on early bud development of apple. Journal of Horticultural Science and Biotechnology, 77(1): 83-90.

Bi, C., Paterson, A. H., Wang, X., Xu, Y., Wu, D., Qu, Y., Jiang, A., Ye, Q., Ye, N. (2016). Analysis of the complete mitochondrial genome sequence of the diploid cotton *Gossypium raimondii* by comparative genomics approaches. BioMed Research International, 3: Article 5040598.

Bolduc, N. and Hake, S. (2009). The maize transcription factor KNOTTED1 directly regulates the gibberellin catabolism gene *ga2ox1*. Plant Cell, 21(6): 1647-1658.

Bommineni, V. R. and Greyson, R. I. (1990). Effect of gibberellic acid and indole-3-acetic acid on growth and differentiation of cultured ear inflorescences of maize (*Zea mays* L.). Plant Science, 68(2): 239-247.

Bowling, A. J., Pence, H. E., Church, J. B. (2014). Application of a novel and automated branched DNA *in situ* hybridisation method for the rapid and sensitive localization of mRNA molecules in plant tissues. Applications in Plant Science, 2(4): Article 1400011.

Bremner, J. M. (1960). Determination of nitrogen in soil by Kjeldahl method. Journal of Agricultural Science, 55(1): 11-33.

Breure, K. (2003). The search for yield in oil palm: Basic principles. In Fairhurst, T. H. and Härdter, R. (Eds.), Oil Palm: Management for large and sustainable yields (pp. 59-98). International Potash Institute (IPI).

Cabané, M., Pireaux, J. C., Léger, E., Weber, E., Dizengremel, P., Pollet, B., Lapierre, C. (2004). Condensed lignins are synthesized in poplar leaves exposed to ozone. Plant Physiology, 134(2): 586-594.

Cao, S., Kumimoto, R. W., Gnesutta, N., Calogero, A. M., Mantovani, R., Holt, B. F. 3rd. (2014). A distal CCAAT/NUCLEAR FACTOR Y complex promotes chromatin looping at the FLOWERING LOCUS T promoter and regulates the timing of flowering in *Arabidopsis*. Plant Cell, 26(3): 1009-1017.

Cardoso, J. C., Ono, E. O., Rodrigues, J. D. (2012). Gibberellic acid in vegetative and reproductive development of *Phalaenopsis* orchid hybrid genus. Horticultura Brasileira, 30(1): 71-74.

Cervantes-Pérez, S. A., Espinal-Centeno, A., Oropeza-Aburto, A., Caballero-Pérez, J., Falcon, F., Aragón-Raygoza, A., Sámchez-Segura, L., Herrera-Estrella, L., Cruz-Hernández, A., Cruz-Ramírez, A. (2018). Transcriptional profiling of the CAM plant *Agave salmiana* reveals conservation of a genetic program, for regeneration. Developmental Biology, 442(1): 28-39.

Chai. L., Li, Y., Chen, S., Perl, A., Zhao, F., Ma, H. (2014). RNA sequencing reveals high resolution expression change of major plant hormone pathway genes after young seedless grape berries treated with gibberellins. Plant Science, 229: 215-224

Chan, P. L., Rose, R. J., Abdul Murad, A. M., Zainal, Z., Low, E. T., Ooi, L. C., Ooi, S. E., Yahya, S., Singh, R. (2014). Evaluation of reference genes for quantitative real-time PCR in oil palm elite planting materials propagated by tissue culture. PLoS One, 9(6): Article e99774.

Chen, D., Yan, W., Fu, L., Kaufmann, K. (2018a). Architecture of gene regulatory networks controlling flower development in *Arabidopsis thaliana*. Nature Communications, 9(1): 4534-4545.

Chen, X., Qi, S., Zhang, D., Li, Y., An, N., Zhao, C., Zhao, J., Shah, K., Han, M., Xing, L. (2018b). Comparative RNA-sequencing-based transcriptome profiling of buds from profusely flowering 'Qinguan' and weakly flowering 'Nagafu no. 2' apple varieties reveals novel insights into the regulatory mechanisms underlying floral induction. BMC Plant Biology, 18(1): Article 370.

Chen, Y. and Tan, B. C. (2015). New insight in the gibberellin biosynthesis and signal transduction. Plant Signaling and Behavior, 10(5): Article e1000140.

Cheng, C., Xu, X., Singer, S. D., Li, J., Zhang, H., Gao, M., Wang, L., Song, J., Wang, X. (2013). Effect of GA_3 treatment on seed development and seed-related gene expression in grape. PLoS One, 8(11): Article e80044.

Cheng, C., Jiao, C., Singer, S. D., Gao, M., Xu, X., Zhou, Y., Li, Z., Fei, Z., Wang, Y., Wang, X. (2015). Gibberellin-induced changes in the transcriptome of grapevine (*Vitis labrusca* × *V. vinifera*) cv. Kyoho flowers. BMC Genomics, 16(1): Article 128.

Cheng, H., Qin, L. J., Lee, S. C., Fu, X. D., Richards, D. E., Cao, D. N., Luo, D., Harberd, N. P., Peng, J. R. (2004). Gibberellin regulates *Arabidopsis* floral development via suppression of DELLA protein function. Development, 131(5): 1055-1064.

Claeys, H., Skirycz, A., Maleux, K., Inzé, D. (2012). DELLA signalling mediates stress-induced cell differentiation in Arabidopsis leaves through modulation of anaphase-promoting complex/cyclosome activity. Plant Physiology, 159(2): 739-747.

Colebrook, E. H., Thomas, S. G., Phillips, A. L., Hedden, P. (2014). The role of gibberellin signalling in plant responses to abiotic stress. Journal of Experimental Biology, 217(Pt 1): 67-75.

Conti, L. (2017). Hormonal control of the floral transition: Can one catch them all? Developmental Biology, 430(2): 288-301.

Corley, R. H. V. and Tinker, P. B. (2003). The Oil Palm (4^{th} ed.). Oxford: Blackwell Science.

Corley, R. H. V. (1976). Sex differentiation in oil palm: effects of growth regulators. Journal of Experimental Botany, 27(3): 553-558.

Corley, R. H. V. (1998). What is the upper limit to oil extraction ratio? In Rajanaidu, N., Henson, I. E., Jalani, B. S. (Eds.), Proceedings of International Conference on Oil and Kernel production in oil palm- A global perspective (pp. 256-269). Palm Oil Research Institute of Malaysia, Kuala Lumpur.

Cosgrove, D. J. (2016). Catalysts of plant cell wall loosening. F1000Research. 5. F1000 Faculty Rev-119.

Costa, C., Giménez-Capitán, A., Karachaliou, N., Rosell, R. (2013). Comprehensive molecular screening: from the RT-PCR to the RNA-seq. Translational Lung Cancer Research, 2(2): 87-91.

Cox, M. P., Peterson, D. A., Biggs, P. J. (2010). SolexaQA: At a-glance quality assessment of Illumina second-generation sequencing data. BMC Bioinformatics, 11(1): Article 485.

da Silva Vieira, M. R., Citadini, V., Pereira, G. P. L., de Souza, A. V., Alves, L. D. S. (2010). Use of gibberellin in floriculture. African Journal of Biotechnology, 9(54): 9118-9121.

Datta, S., Malhotra, L., Dickersom, R., Chaffee, S., Sen, C. K., Roy, S. (2015). Laser Caprture Microdissection: Big data from small samples. Histology and Histopathology, 30(11): 1255-1269.

Dayan, J., Voronin, N., Gong, F., Sun, T. P., Hedden, P., Fromm, H., Aloni, R. (2012). Leaf-induced gibberellins signalling is essential for internode elongation, cambial activity, and fiber differentiation in tobacco stems. Plant Cell, 24(1): 66-79.

Del Carmen Rodríguez-Gacio, M., Matilla-Vázquez, M. A., Matilla, A. J. (2009). Seed dormancy and ABA signaling: The breakthrough goes on. Plant Signaling and Behavior, 4(11): 1035-1049.

Desjardins, P. and Conklin, D. (2010). NanoDrop microvolume quantitation of nucleic acids. Journal of Visualized Experiments, 45: Article e2565.

Devani, R. S., Sinha, S., Banerjee, J., Sinha, R. K., Bendahmane, A., Banerjee, A. L. (2017). *De novo* transcriptome assembly from flower buds of dioecious, gynomonoecious and chemically masculinized female *Coccinia grandis* reveals genes associated with sex expression and modification. BMC Plant Biology, 17(1): Article 241.

Dill, A. and Sun, T. (2001). Synergistic derepression of gibberellin signalling by removing RGA and GAI function in *Arabidopsis thaliana*. Genetics. 159(2): 777-785.

Dill, A., Thomas, S. G., Hu, J., Steber, C. M., Sun, T. (2004). The Arabidopsis F-box protein SLEEPY1 targets gibberellin signalling repressors for gibberellin-induced degradation. Plant Cell, 16(6): 1392-1405.

Doane, T. A., Silva, L. C. R., Horwath, W. R. (2019). Exposure to light elicits a spectrum of chemical changes in soil. Journal of Geophysical Research Earth Surface, 124(8): 2288-2310.

Edmeades, D. C. and Clinton, O. E. (1981). A simple rapid method for the measurement of exchangeable cations and effective cation exchange capacity. Communications in Soil Science and Plant Analysis, 12(7): 683-695.

Eeuwens, C. J., Lord, S., Donough, C. R., Rao, V., Vallejo, G., Nelson, S. (2002). Effects of tissue culture conditions during embryoid multiplication on the incidence of "mantled" flowering in clonally propagated oil palm. Plant Cell, Tissue and Organ Culture, 70(3): 311-323

Eldem, V., Çelikkol Akçay, U., Ozhuner, E., Bakır, Y., Uranbey, S., Unver, T. (2012). Genome-wide identification of miRNAs responsive to drought in peach (*Prunus persica*) by high-throughput deep sequencing. PLoS One, 7(12): Article e50298.

Elliott, R. C., Smith, J. L., Lester, D. R., Reid, J. B. (2001). Feedforward regulation of gibberellin deactivation in pea. Journal of Plant Growth Regulation, 20(1): 87-94.

Eriksson, S., Böhlenius, H., Moritz, T., Nilsson, O. (2006). GA4 is the active gibberellin in the regulation of LEAFY transcription and Arabidopsis floral initiation. Plant Cell, 18(9): 2172-2181.

Evers, D. L., He, J., Kim, Y. H., Mason, J. T., O'leary, T. J. (2011). Paraffin embedding contributes to RNA aggregation, reduced RNA yield, and low RNA Quality. Journal of Molecular Diagnostics. 13(6): 687-694.

Fairhurst, T. H. and Härdter, R. (2003). Oil Palm: Management for large and sustainable yields. International Potash Institute (IPI).

Falcioni, R., Moriwaki, T., de Oliveira, D. M., Andreotti, G. C., de Souza, L. A., Dos Santos, W. D., Bonato, C. M., Antunes, W. C. (2018). Increased Gibberellins and light levels promotes cell wall thickness and enhance lignin deposition in xylem fibers. Frontiers of Plant Science, 9: 1391-1403.

Fang, Z. and Cui, X. (2011). Design and validation issues in RNA-seq experiments. Brief Bioinformatics, 12(3): 280-287.

Farragher, S. M., Tanney, A., Kennedy, R. D., Harkin, P. D. (2008). RNA expression analysis from formalin fixed paraffin embedded tissues. Histochemistry and Cell Biology, 130(3): 435-445.

Fray, R. G., Wallace, A., Fraser, P. D., Valero, D., Hedden, P., Bramley, P. M., Grierson, D. (1995). Constitutive expression of a fruit phytoene gene in transgenic tomatoes causes dwarfism by redirecting metabolites from gibberellin pathway. Plant Journal, 8(5): 693-701.

French, P., Matsuyuki, H., Ueno, H. (1990). Paclobutrazol: Control of lodging in Japanese paddy rice. In Grayson, B. T., Green, M. B., Copping, L. G. (Eds.),

Proceedings of the Conference held by the Society of Chemical Industry- Pest management in rice (pp. 474-485). Elsevier Applied Science Publishers Ltd.

Fukazawa, J., Ito, T., Kamiya, Y., Yamaguchi, S., Takahashi, Y. (2015). Binding of GID1 to DELLAs promotes dissociation of GAF1 from DELLA in GA dependent manner. Plant Signaling and Behavior, 10(10): Article e1052923.

Gangappa, S. N. and Botto, J. F. (2014). The BBX family of plant transcription factors. Trends in Plant Science, 19(7): 460-470.

Gao, Y., He, C., Zhang, D., Liu, X., Xu, Z., Tian, Y., Liu, X. H., Zang, S., Pauly, M., Zhou, Y., Zhang, B. (2016). Two Trichome Birefringence-Like Proteins mediate xylan acetylation, which is essential for leaf blight resistance in rice. Plant Physiology, 173(1): 470-481.

Gibson, S. W. and Todd, C. D. (2015). Arabidopsis AIR12 influences root development. Physiology and Molecular Biology of Plants, 21(4): 479-489.

Glagoleva, A. Y., Shmakov, N. A., Shoeve, O. Y., Vasiliev, G. V., Shatskaya, N. V., Börner, A., Afonnikov, D. A., Khlestkina, E. K. (2017). Metabolic pathways and genes identified by RNA-seq analysis of barley near-isogenic lines differing by allelic state of the Black lemma and pericarp (Blp) gene. BMC Plant Biology, 17(Suppl 1): Article 182.

Gomi, K., Sasaki, A., Itoh, H., Ueguchi-Tanaka, M., Ashikari, M., Kitano, H., Matsuoka, M. (2004). GID2, an F-box subunit of the SCF E3 complex, specifically interacts with phosphorylated SLR1 protein and regulates the gibberellin-dependent degradation of SLR1 in rice. Plant Journal, 37(4): 626-634.

Gottwald, E. (2018). Certifying exploitation: Why “Sustainable”palm oil production is failing workers. New Labor Forum, 27(2): 74-82.

Gou, J., Strauss, S. H., Tsai, C. J., Fang, K., Chen, Y., Jiang, X., Busov, V. B. (2010). Gibberellins regulate lateral root formation in *Populus* through interactions with auxin and other hormones. Plant Cell, 22(3): 623-639.

Greer, Y. E., Gao, B., Yang, Y., Nussenzweig, A., Rubin, J. S. (2017). Lack of Casein Kinase 1 delta promotes genomic instability - The accumulation of DNA damage and down-regulation of checkpoint kinase 1. PLoS One, 12(1): Article e0170903.

Grizzle, W. E. (2009). Models of fixation and tissue processing. Biotechnic and Histochemistry, 84(5): 185-193.

Gubler, F., Chandler, P. M., White, R. G., Llewellyn, D. J., Jacobsen, J. V. (2002). Gibberelin signalling in barley aleurone cells: Control of SLN1 and GAMYB expression. Plant Physiology, 129(1): 191-200.

Gul, H., Tong, Z., Han, X., Nawaz, I., Wahocho, S. A., Khan, S., Zhang, C., Tian, Y., Cong, P., Zhang, L. (2019). Comparative transcriptome analysis between ornamental apple species provides insights into mechanism of double flowering. Agronomy, 9(3): 112-128.

Guo, X., Yu, C., Luo, L., Wan, H., Zhen, N., Li, Y., Cheng, T., Wang, J., Pan, H., Zhang, Q. (2018). Developmental transcriptome analysis of floral transition in *Rosa odorate* var *gigantean*. Plant Molecular Biology, 97(1-2): 113-1130.

Gupta, R. and Chakrabarty, S. K. (2013). Gibberellic acid in plant: still a mystery unresolved. Plant Signaling and Behavior, 8(9): Article e25505.

Gutierrez, L., Mauriat, M., Guénin, S., Pelloux, J., Lefebvre, J. F., Louvet, R., Rusterucci, C., Moritz, T., Guerineau, F., Bellini, C., van Wuytswinkel, O. (2008). The lack of a systematic validation of reference genes: a serious pitfall undervalued in reverse transcription-polymerase chain reaction (RT-PCR) analysis in Plants. Plant Biotechnology Journal, 6(6): 609-618.

Haga, N., Kobayashi, K., Suzuki, T., Maeo, K., Kubo, M., Ohtani, M., Mitsuda, N., Demura, T., Nakamura, K., Jürgens, G., Ito, M. (2011). Mutations in MYB3R1 and MYB3R4 cause pleiotropic developmental defects and preferential down-regulation of multiple G2/M-specific genes in *Arabidopsis*. Plant Physiology, 157(2): 706-717.

Hajihashemi, S. and Kiarostami, K. (2007). Effects of paclobutrazol and salt stress on growth and ionic contents in two cultivars of wheat. Pakistan Journal of Biology Sciences, 10(1): 41-48.

Hassidim, M., Harir, Y., Yakir, E., Kron, I., Green, R. M. (2009). Over-expression of CONSTANS-LIKE 5 can induce flowering in short-day grown *Arabidopsis*. Planta, 230(3): 481-491.

Hay, A., Kaur, H., Phillips, A., Hedden, P., Hake, S., Tsiantis, M. (2002). The gibberellin pathway mediates KNOTTED1-type homeobox function in plants with different body plans. Current Biology, 12(18): 1557-1565.

He, L., Qian, J., Li, X., Sun, Z., Xu, X., Chen, S. (2017). Complete chloroplast genome of medicinal plant *Lonicera japonica*: Genome rearrangement, intron gain and loss, and implications for phylogenetic studies. Molecules. 22(2): 249-260.

Hedden, P. and Graebe, J. E. (1985). Inhibition of gibberellin biosynthesis by paclobutrazol in cell-free homogenates of *Curcurbita maxima* endosperm and *Malus pumita* embryos. Journal of Plant Growth Regulation, 4(2): 111-122.

Hedden, P. and Phillips, A. L. (2000). Gibberellin metabolism: new insights revealed by the genes. Trends in Plant Science, 5(12): 523-530.

Hedden, P. and Sponsel, V. (2015). A Century of Gibberellin Research. Journal of Plant Growth Regulation, 34(4): 740-760.

Hellemans, J., Mortier, G., de Paepe, A., Speleman, F., Vandesompele, J. (2007). qBase relative quantification framework and software for management and automated analysis of real time quantitative data. Genome Biology, 8(2): Article R19.

Helliwell, C. A., Chandler, P. M., Poole, A., Dennis, E. S., Peacock, W. J. (2001). The CYP88A cytochrome P450, *ent*-kaurenoic acid oxidase, catalyzes three steps of the gibberellin biosynthesis pathway. Proceedings of the National Academy of Sciences of the United States of America, 98(4): 2065-2070.

Hisamatsu, T. and King, R. W. (2008). The nature of floral signals in *Arabidopsis*. II. Roles for Flowering Locus T (FT) and gibberellin. Journal of Experimental Botany, 59(14): 3821-3829.

Hou, K., Chen, J. W., Li, J. Y., Shen, H., Chen, L., Wu, W. (2013). Effect of gibberellic acid and chlormequat chloride on growth, coumarin content and root yield of *Angelica dahurica* var. Formosana. Journal of Agricultural Science Technology, 15(7): 1415-1423.

Hou, X., Zhou, J., Liu, C., Liu, L., Shen, L., Yu, H. (2014). Nuclear factor Y-mediated H3K27me3 demethylation of the *SOC1* locus orchestrates flowering responses of *Arabidopsis*. Nature Communications, 5: Article 4601.

Hou, X., Lee, L. Y., Xia, K., Yan, Y., Yu, H. (2010). DELLAs modulate jasmonate signalling via competitive binding to JAZs. Developmental Cell, 19(6): 884-94.

Hua, Y., Ekkhara, W., Sansenya, S., Srisomsap, C., Roytrakul, S., Saburi, W., Takeda, R., Matsuura, H., Mori, H. (2015). Identification of rice *Os4BGlu13* as a β-glucosidase which hydrolyzes gibberellin A4 1-O-β-D-glucosyl ester, in addition to tuberonic acid glucoside and salicylic acid derivative glucosides. Archives of Biochemistry and Biophysics, 583: 36-46.

Hua, Y., Sansenya, S., Saetang, C., Wakuta, S., Cairns, J. R. K. (2013). Enzymatic and structural characterization of hydrolysis of gibberellins A4 glucosyl ester by a rice β-D-glucosidase. Archives of Biochemistry and Biophysics, 537(1): 39-48.

Huntley, R. P., Jones, L. H., Hanke, D. E. (2002). Cytokinins and gibberellins in sap exudate of the oil palm. Phytochemistry, 60(2): 117-127.

Inada, S. and Shimmen, T. (2000). Regulation of elongation growth by gibberellins in root segments of *Lemna minor*. Plant Cell Physiology, 41(8): 932-939.

Itoh, H., Ueguchi-Tanaka, M., Sato, Y., Ashikari, M., Matsuoka, M. (2002). The gibberellin signalling pathway is regulated by the appearance and disappearance of SLENDER RICE1 in nuclei. Plant Cell, 14(1): 57-70.

Iwamoto, M., Kiyota, S., Hanada, A., Yamaguchi, S., Takano, M. (2011). The multiple contributions of phytochromes to the control of internode elongation in rice. Plant Physiology, 157(3): 1187-1195.

Jaillais, Y. and Vert, G. (2016). Brassinosteroid signalling and BRI1 dynamics went underground. Current Opinion in Plant Biology, 33: 92-100.

Jaligot, E., Hooi, W. Y., Debladies, E., Richaud, F., Beule, T., Collin, M., Agbessi, M. D. T., Sabot. F., Garsmeur, O., D'Hont, A., Syed Alwee, S. S. R., Rival, A. (2014). DNA methylation and expression of the *EgDEF1* gene and neighbouring

retrotransposons in mantled somaclonal variants of oil palm. PLoS One, 9(3): Article e91896.

Jaligot, E., Rival, A., Beule, T., Dussert, S., Verdeil, J. L. (2000). Somaclonal variation in oil palm (*Elaeis guineensis* Jacq.): the DNA methylation hypothesis. Plant Cell Reports, 19(7): 684-690

Jenks, M. A., Andersen, L., Teusink, R. S., Williams, M. H. (2001). Leaf cuticular waxes of potted rose cultivars as affected by plant development, drought and paclobutrazol treatments. Physiologia Plantarum, 112(1): 62-70.

Ji, Y. H., Chen, G. X., Zheng, X. Y., Zhong, Q. W., Zhang, M. Y., Wu, Z. H., Wen, C. L., Liu, M. C. (2019). Comprehensive transcriptome reveals an opposite regulatory effect of plant growth retardants in controlling seedling overgrowth between roots and shoots. International Journal of Molecular Sciences, 20(13): Article E3307.

Jiang, D., Yang, W., He, Y., Amasino, R. M. (2007). *Arabidopsis* relatives of the human lysine-specific Demethylase1 repress the expression of FWA and FLOWERING LOCUS C and thus promote the floral transition. Plant Cell, 19(10): 2975-2987.

Jouannic, S., Lartaud, M., Hervé, J., Collin, M., Orieux, Y., Verdeil, J. L., Tregear, J. W. (2011). The shoot apical meristem of oil palm (*Elaeis guineensis*; Arecaceae): developmental progression and dynamics. Annals of Botany, 108(8): 1477-1487.

Jung, J. H., Ju, Y., Seo, P. J., Lee, J. H., Park, C. M. (2012). The SOC1-SPL module integrates photoperiod and gibberellic acid signals to control flowering time in Arabidopsis. Plant Journal, 69(4): 577-588.

Kaldenhoff, R. and Fischer, M. (2006). Functional aquaporin diversity in plants. Biochimica et Biophysica Acta Biomembranes, 1758(8): 1134-1141.

Kalidas, P. and Rajasekhar, P. (2010). Effect of gibberellic acid on the yield of oil palm. Bioscieces, Biotechnology Research Asia, 7(1): 433-436.

Kazaz, S. and Karagüzel, O. (2010). Influence of growth regulators on the growth and flowering characteristics of goldenrod (*Solidago xHybrida*). European Journal of Scientific Research, 45(3):498-507.

Khan, M., Rozhon, W., Poppenberger, B. (2014). The role of hormones in the aging of plants- A Mini-review. Gerontology, 60(1): 49-55.

Kim, D., Pertea, G., Trapnell, C., Pimentel, H., Kelley, R., Salzberg, S. L. (2013). TopHat2: accurate alignment of transcriptomes in the presence of insertions, deletions and gene fusions. Genome Biology, 14(4): Article R36.

King, K. E., Moritz, T., Harberd, N. P. (2001). Gibberellins are not required for normal stem growth in *Arabidopsis thaliana* in the absence of GAI and RGA. Genetics, 159(2): 767-776.

Kohorn, B. D. and Kohorn, S. L. (2012). The cell wall-associated kinases, WAKs, as pectin receptors. Frontiers of Plant Science, 3: Article 88.

Kong, Z., Ioki, M., Braybrook, S., Li, S., Ye, Z. H., Julie Lee, Y. R., Hotta, T., Chang, A., Tian, J., Wang, G., Liu, B. (2015). Kinesin-4 functions in vesicular transport on cortical microtubules and regulates cell wall mechanics during cell elongation in plants. Molecular Plant, 8(7): 1011-1023.

Koornneef, M. and van der Veen, J. H. (1980). Induction and analysis of gibberellins sensitive mutants in *Arabidopsis thaliana* (L) Heynh. Theoretical and Applied Genetics, 58(6): 257-263.

Kou, E., Huang, X., Zhu, Y., Su, W., Liu, H., Sun, G., Chen, R., Hao, Y., Song, S. (2021). Crosstalk between auxin and gibberellin during stalk elongation in flowering Chinese cabbage. Scientific Reports, 11: Article 3976.

Kudapa, H., Garg, V., Chitikineni, A., Varshney, R. K. (2018). The RNA-Seq-based high resolution gene expression atlas of chickpea (*Cicer arietinum* L.) reveals dynamic spatio-temporal changes associated with growth and development. Plant, Cell and Environment, 41(9): 2209-2225.

Kusaba, S., Kano-Murakami, Y., Matsuoka, M., Tamaoki, M., Sakamoto, T., Yamaguchi, I., Fukumoto, M. (1998). Alteration of hormone levels in transgenic tobacco plants overexpressing the rice homeobox gene *OSH1*. Plant Physiology, 116(2): 471-476.

Kwan, Y. Y. and Syed Alwee, S. S. R. (2016). Application of MAS into oil palm crop improvement. Planter. 92(1087): 715-722.

Lamade, E. and Setiyo, I. E. (1996). A rapid method for estimating leaf area index with the Li-Cor LAI 2000 PCA for oil palm. In Ariffin, D., Mohd Basri, W., Rajanaidu, N., Mohd Tayeb, D., Paranjothy, K., Cheah, S. C., Chang, K. C., Ravigadevi, S (Eds.), Proceedings of the 1996 PORIM International Palm Oil Congress (Agriculture)- Competitiveness for the 21st century (pp. 415-420). Palm Oil Research Institute of Malaysia, Kuala Lumpur.

Lazarte, J. E. and Garrison, S. A. (1980). Sex modification in *Asparagus officinalis* L. Journal of the American Society for Horticultural Science, 105(5): 691-694.

Lee, D. J. and Zeevaart, J. A. D. (2005). Molecular cloning of GA 2-oxidase3 from spinach and its ectopic expression in *Nicotiana sylvestris*. Plant Physiology, 138(1): 243-254.

Lee, J. and Lee, I. (2010). Regulation and function of *SOC1*, a flowering pathway integrator. Journal of Experimental Botany, 61(9): 2247-2254.

Lee, S., Cheng, H., King, K. E., Wang, W., He, Y., Hussain, A., Lo, J., Harberd, N. P., Peng, J. (2002). Gibberellin regulates *Arabidopsis* seed germination via RGL2, a GAI/RGA-like gene whose expression is up-regulated following imbibition. Genes Development, 16(5): 646-658.

Legros, S., Mialet-Sierra, I., Caliman, J. P., Siregar, F. A., Clement-Vidal, A., Febre, D., Dingkuhn, M. (2009). Phenology, growth and physiological adjustments of oil palm (*Elaeis guineensis*) to sink limitation induced by fruit pruning. Annals of Botany, 104(6): 1183-1194.

Li, F., Wu, X., Lam, P., Bird, D., Zheng, H., Samuels, L., Jetter, R., Kunst, L. (2008). Identification of the wax ester synthase/acyl-coenzyme A: diacylglycerol acyltransferase WSD1 required for stem wax ester biosynthesis in *Arabidopsis*. Plant Physiology, 148(1): 97-107.

Li, J., Jiang, J., Qian, Q., Xu, Y., Zhang, C., Xiao, J., Du, C., Luo, W., Zou, G., Chen, M., Huang, Y., Feng, Y., Cheng, Z., Yuan, M., Chong, K. (2011). Mutation of rice *BC12/GDD1*, which encodes a kinesin-like protein that binds to a GA biosynthesis gene promoter, leads to dwarfism with impaired cell elongation. Plant Cell, 23(2): 628-640.

Li J, Smyth P, Flavin R, Cahil S, Denning K, Aherne S, Guenther SM, O'Leary JJ, Sheils O. (2007). Comparison of miRNA expression patterns using total RNA extracted from matched samples of formalin-fixed paraffin-embedded (FFPE) cells and snap frozen cells. BMC Biotechnology, 7: Article 36.

Li M, An F, Li W, Ma M, Feng Y, Zhang X, Guo H. (2016). DELLA proteins interact with FLC to repress flowering transition. Journal of Integrative Plant Biology, 58(7): 642-655.

Li, S., Zhang, L., Wang, Y., Xu, F., Liu, M., Lin, P., Ren, S., Ma, R., Guo, Y. D. (2017). Knockdown of a cellulose synthase gene BoiCesA affects the leaf anatomy, cellulose content and salt tolerance in broccoli. Scientific Reports, 7: Article 41397.

Li, W., Katin-Grazzini, L., Gu, X., Wang, X., El-Tanbouly, R., Yer, H., Thammina, C., Inguagiato, J., Guillard. K., McAvoy, R. J., Wegrzyn, J., Gu, T., Li, Y. (2017). Transcriptome analysis reveals differential gene expression and a possible role of gibberellins in a shade-tolerant mutant of perennial ryegrass. Frontiers of Plant Science, 8: Article 868.

Liao, Z., Chen, M., Guo, L., Gong, Y., Tang, F., Sun, X., Tang, K. (2004). Rapid isolation of high quality total RNA from Taxus and Ginkgo. Preparative Biochemistry and Biotechnology, 34(3): 209-214.

Lineberger, R. D. and Steponkus, P. L. (1980). Cryoprotection by glucose, sucrose and raffinose to chloroplast thylakoids. Plant Physiology, 65(2): 298-304.

Little, C. H. and MacDonald, J. E. (2003). Effects of exogenous gibberellin and auxin on shoot elongation and vegetative bud development in seedlings of *Pinus sylvestris* and *Picea glauca*. Tree Physiology, 23(2): 73-83.

Liu, X., Li, Y., Yang, H., Zhou, B. (2018). Chloroplast genome of the folk medicine and vegetable plant *Talinum paniculatum* (Jacq.) Gaertn.: Gene organization, comparative and phylogenetic analysis. Molecules. 23(4): 857-864.

Magome, H., Nomura, T., Hanada, A., Takeda-Kamiya, N., Ohnishi, T., Shinma, Y., Katsumata, T., Kawaide, H., Kamiya, Y., Yamaguchi, S. (2013). CYP714B1 and CYP714B2 encode gibberellin 13-oxidases that reduce gibberellin activity in rice. Proceedings of the National Academy of Sciences of the United States of America, 110(5): 1947-1952.

Magyar, Z., de Veylder, L., Atanassova, A., Bakó, L., Inzé, D., Bögre, L. (2005). The role of the *Arabidopsis E2FB* transcription factor in regulating auxin-dependent cell division. Plant Cell, 17(9): 2527-2541.

Mahajan, M., Ahuja, P. S., Yadav, S. K. (2011). Post-transcriptional silencing of flavonol synthase mRNA in tobacco leads to fruits with arrested seed set. PLoS One, 6(12): Article e28315.

Manivannan, P., Jaleel, C. A., Kishorekumar, A., Sankar, B., Somasundaram, R., Panneerselvam, R. (2008). Protection of *Vigna* unguiculata (L.) Walp. plants from salt stress by paclobutrazol. Colloids and Surfaces B: Biointerfaces, 61(2): 315-318.

Marowa, P., Ding, A., Kong, Y. (2016). Expansins: roles in plant growth and potential applications in crop improvement. Plant Cell Reports, 35(5): 949-965.

Martínez-García, P. J., Parfitt, D. E., Bostock, R. M., Fresnedo-Ramírez, J., Vazquez-Lobo, A., Ogundiwin, E. A., Gradziel, T. M., Crisosto, C. H. (2013). Application of genomic and quantitative genetic tools to identify candidate resistance genes for brown rot resistance in peach. PLoS One, 8(11): Article e78634.

McClure, C. D. and Southall, T. D. (2015). Getting down to specifics: Profiling gene expression and protein-DNA interactions in a cell type-specific manner. Advances in Genetics, 91: 103-151.

McGinnis, K. M., Thomas, S. G., Soule, J. D., Strader, L. C., Zale, J. M., Sun, T. P., Steber, C. M. (2003). The *Arabidopsis* SLEEPY1 gene encodes a putative F-box subunit of an SCF E3 ubiquitin ligase. Plant Cell, 15(5): 1120-1130.

Micke, P., Ohshima, M., Tahmasebpoor, S., Ren, Z., Östman, A., Pontén, F., Botling, J. (2006). Biobanking of fresh frozen tissue: RNA is stable in nonfixed surgical specimens. Laboratory Investigation, 86(2): 202-211.

Mizutani, M. and Ohta, D. (2010). Diversification of P450 genes during land plant evolution. Annual Review of Plant Biology, 61: 291-315.

Mohammadi, M. H. S., Etemadi, N., Arab, M. M., Aalifar, M., Arab, M., Pessarakli, M. (2017). Molecular and physiological responses of Iranian Perennial ryegrass as affected by Trinexapac ethyl, Paclobutrazol and Abscisic acid under drought stress. Plant Physiology and Biochemistry, 111: 129-143.

Mueller, A. (2013). The effect of drying and drying temperature on soil analytical test values (Master's thesis, Oklahama State University, USA). Retrieved from https://core.ac.uk/download/pdf/215265689.pdf.

Müller, C. J., Valdés, A. E., Wang, G., Ramachandran, P., Beste, L., Uddenberg, D., Carlsbecker, A. (2016). PHABULOSA mediates an auxin signalling loop to regulate vascular patterning in *Arabidopsis*. Plant Physiology, 170(2): 956-970.

Murase, K., Hirano, Y., Sun, T. P., Hakoshima, T. (2008). Gibberellin-induced DELLA recognition by the gibberellin receptor GID1. Nature, 456(7221): 459-463.

Murphy, D. J. (2014). The future of oil palm as a major global crop: opportunities and challenges. Journal of Oil Palm Research, 26(1): 1-24.

Murphy, J. and Riley, J. P. 1962. A modified single solution method for the determination of phosphate in natural waters. Analytica Chimica Acta, 27: 31-36.

Mutert, E. and Fairhurst. T. H. (1999). Oil Palm clones: Productivity enhancement for the future. Better Crops International, 13(1): 45-47.

Nagel, O. W., Konings, H., Lambers, H. (2001). Growth rate and biomass partitioning of wild type and low-gibberellin tomato (*Solanum lycopersicum*) plants growing at a high and low nitrogen supply. Physiologia Plantarum, 111(1): 33-39.

Neamah, S. I. and Hamad, A. H. (2020). The effects of paclobutrazol on enhancing tolerance of *Plantago major* L. to cadmium stress *in vitro*. Australian Journal of Crop Science, 14(12): 2028-2035.

Nemhauser, J. L., Mockler, T. C., Chory, J. (2004). Interdependency of brassinosteroid and auxin signalling in *Arabidopsis.* PLoS Biology, 2(9)*: Article e258.*

Ng, L., Melcher, K., The, B., Xu, E. H. (2014). Abscisic acid perception and signalling: structural mechanisms and applications. Acta Pharmacologica Sinica, 35: 567-584.

Ng, S. K., von Uexküll, H., Härdter, R. (2003). Botanical aspects of the oil palm relevant to crop management. In Fairhurst, T. H. and Härdter, R. (Eds.), Oil Palm: Management for large and sustainable yields. (pp. 13-26). International Potash Institute (IPI).

Nir, I., Moshelion, M**.**, Weiss, D. (2014). The *Arabidopsis* gibberellin methyl transferase 1 suppresses gibberellin activity, reduces whole-plant transpiration and promotes drought tolerance in transgenic tomato. Plant, Cell and Environment, 37(1): 113-123.

Nizam, K. and Te-chato, S. (2009). Optimizing of root induction in oil palm plantlets for acclimatization by some potent plant growth regulators (PGRs). International Journal of Agricultural Technology, 5(2): 371-383.

Nizam, K. and Te-chato, S. (2012). *In vitro* flowering and fruit setting of oil palm *Elaeis guineensis* Jacq. Journal of Agricultural Technology, 8(3): 1079-1088.

Nunez-Elisea, R. and Davenport, T. L. (1998). Gibberellin and temperature effects on dormancy release and shoot morphogenesis of mango (*Mangifera indica* L.). Scientia Horticulturae, 77(1): 11-21.

Ohtsubo, M., Kai, R., Furuno, N., Sekiguchi, T., Sekiguchi, M., Hayashida, H., Kuma, K., Miyata, T., Fukushige, S., Murotsu, T., Matsubara, K., Nishimoto, T. (1987). Isolation and characterization of the active cDNA of the human cell cycle gene (*RCC1*) involved in the regulation of onset of chromosome condensation. Genes Development, 1(6): 585-593.

Okamoto, K., Ueda, H., Shimada, T., Tamura, K., Kato, T., Tasaka, M., Morita, M. T., Hara-Nishimura, I. (2015). Regulation of organ straightening and plant posture by an actin–myosin XI cytoskeleton. Nature Plants, 1: Article 15031.

Ong-Abdullah, M., Ordway, J. W., Jiang, N., Ooi, S. E., Kok, S. Y., Sarpan, N., Azimi, N., Hashim, A. T., Ishak, Z., Rosli, S. K., Malike, F. A., Bakar, N. A., Marjuni, M., Abdullah, N., Yaakub, Z., Amiruddin, M. D., Nookiah, R., Singh, R., Low, E. T., Chan, K. L., Azizi, N., Smith, S. W., Bacher, B., Budiman, M. A., van Brunt, A., Wischmeyer, C., Beil, M., Hogan, M., Lakey, N., Lim, C. C,, Arulandoo, X., Wong, C. K., Choo, C. N., Wong, W. C., Kwan, Y. Y., Syed Alwee, S. S. R., Sambanthamurthi, R., Martienssen, R. A. (2015). Loss of Karma transposon methylation underlies the mantled somaclonal variant of oil palm. Nature, 525(7570): 533-537.

Ooi, S. E., Lee, F. C., Ong-Abdullah, M. (2012). A rapid and sensitive *in situ* RNA hybridisation method for oil palm tissues. Journal of Oil Palm Research, 24(2): 1235-1239.

Ooi, S. E., Sarpan, N., Abdul Aziz, N., Nuraziyan, A., Ong-abdullah, M. (2019). Differential expression of heat shock and floral regulatory genes in pseudocarpel initials of mantled female inflorescences from *Elaeis guineensis* Jacq. Plant Reproduction, 32(2): 167-179.

Otusanya, O. O. and Adebona, A. C. (1986). Gibberellin-like activity in phloem sap of the oil palm tree (*Elaeis guineensis*). Canadian Journal of Botany, 64: 214-216.

Padrón, I. E. S., Meza, P. M. P., Díaz, C. M. L. (2020). Evaluation of sucrose and GA_3 in an *in vitro* shoot culture of *Alpinia purpurata* (Zingiberaceae). Ciencia y Tecnología Agropecuaria. 21(2): Article e1193.

Pantaleo, V., Szittya, G., Moxon, S., Miozzi, L., Moulton, V., Dalmay, T., Burgyan, J. (2010). Identification of grapevine microRNAs and their targets using high-throughput sequencing and degradome analysis. Plant Journal, 62(6): 960-976.

Papasavvas, A., Triantafllidis, V., Zervoudakis, G., Kapotis, G., Samaras, Y., Salahas, G. (2008). Correlation of SPAD-502 meter readings with physiological parameters and leaf nitrate content in *Beta vulgaris*. Journal of Environmental Protection and Ecology, 9(2): 351-356.

Park, S. T. and Kim, J. (2016). Trends in next-generation sequencing and a new era for whole genome sequencing. International Neurourology Journal, 20(Suppl 2): S76-83.

Pawełkwoicz, M. E., Skarzyńska, A., Pląder, W., Przybecki, Z. (2019). Genetic and molecular bases of cucumber (*Cucumis sativus* L.) sex determination. Molecular Breeding, 39: Article 50.

Phadung, T., Krisanapook, K., Phavaphutanon, L. (2011). Paclobutrazol, water stress and nitrogen induced flowering in 'Khao Nam Phueng' pummelo. Kasetsart Journal (Natural Science), 45: 189-200.

Phares, C. A., Atiah, K., Frimpong, K. A., Danquah, A., Asare, E. T., Aggor-Woananu, S. (2020). Application of biochar and inorganic phosphorus from fertilizer influenced rhizophere soil characteristics, nodule formation and phytoconstituents of cowpea grown on tropical soil. Heliyon, 6(10): Article e05255.

Picker, J., Mosnier, A., Kraxner, F., Havlík, P., Obersteiner, M. (2016). What are the limits to oil palm expansion? Global Environmental Change, 40: 73-81.

Pilkington, S. M., Crowhurst, R., Hilario, E. *et al.* (2018). A manually annotated *Actinidia chinensis* var. *chinensis* (kiwifruit) genome highlights the challenges associated with draft genomes and gene prediction in Plants. BMC Genomics, 19: Article 257

Pinto, A. C. R., de Jesus Deléo Rodrigues, T., Leite, I. C., Barbosa, J. C. (2005). Growth retardants on development and ornamental quality of potted 'Lilliput' *Zinnia elegans* Jacq. Scientia Agricola, 62(4): 337-345.

Plaza-Wüthrich, S., Blösch, R., Rindisbacher, A., Cannarozzi, G., Tadele, Z. (2016). Gibberellin deficiency confers both lodging and drought tolerance in small cereals. Frontiers of Plant Science, 7: Article 643.

Porri, A., Torti, S., Romera-Branchat, M., Coupland, G. (2012). Spatially distinct regulatory roles for gibberellins in the promotion of flowering of *Arabidopsis* under long photoperiods. Development, 139(12): 2198-2209.

Rafigue, T., Yamamoto, S., Fukui, K., Mahmood, Z., Niino, T. (2015). Cryopreservation of sugarcane using the V cryo-plate technique. Cryo-Letters, 36(1): 51-59.

Rajanaidu, N., Rohani, O., Jalani, B. S. (1997). Oil Palm clones: Current status and prospects for commercial production. Planter, 73(853): 163-184.

Ram, H. Y. M. and Jaiswal, V. S. (1972). Induction of male flowers on female plants of *Cannabis sativa* by gibberellins and its inhibition by abscisic acid. Planta, 105: 263-266.

Ramachandran, V., Ong-Abdullah, M., Ho, C. L., Syed Alwee, S. S. R., Namasivayam, P. (2014). Modified RNA *in situ* hybridization protocol for oil palm (*Elaeis guineensis* Jacq.) fruit and inflorescence. Journal of Oil Palm Research, 26(4): 300-307.

Ramakers, C., Ruijter, J. M., Lekanne Deprez, R. H., Moorman, A. F. M. (2003). Assumption-free analysis of quantitative real-time polymerase chain reaction (PCR) data. Neuroscience Letters, 339(1): 62-66.

Randoux, M., Jeauffre, J., Thouroude, T., Vasseur, F., Hamama, L., Juchaux, M., Sakr, S., Foucher, F. (2012). Gibbrellins regulate the transcription of the continuous flowering regulator, RoKSN, a rose TFL1 homologue. Journal of Experimental Botany, 63(18): 6543-6554.

Rastogi, A., Siddiqui, A., Mishra, B. K., Srivastava, M., Pandey, R., Misra, P., Singh, M., Shukla, S. (2013). Effect of auxin and gibberellic acid on growth and yield components of linseed (*Linum usitatissimum* L.). Crop Breeding and Applied Biotechnology, 13(2):136-143.

Reinecke, D. M., Wickramatathna, A. D., Ozga, J. A., Kurepin, L. V., Jin, A. L., Good, A. G., Pharis, R. P. (2013). Gibberellin-3-oxidase gene expression patterns influence gibberellins biosynthesis, growth and development in pea. Plant Physiology, 163(2): 929-945.

Richter. R., Bastakis, E., Schwechheimer, C. (2013). Cross-repressive interactions between *SOC1* and the GATAs GNC and GNL/CGA1 in the control of greening, cold tolerance, and flowering time in *Arabidopsis*. Plant Physiology, 162(4): 1992-2004.

Rinne, P. L., Paul, L. K., Vahala, J., Kangasjärvi, J., van der Schoot, C. (2016). Axillary buds are dwarfed shoots that tightly regulate GA pathway and GA-inducible 1,3-β-glucanase genes during branching in hybrid aspen. Journal of Experimental Botany,67(21): 5975-5991.

Rocha, A. J., de Souza Miranda, R., Sousa, A. J. S., da Silva, A. L. C. (2016). Guidelines for successful quantitative gene expression in real-time qPCR Assays. In Samadikuchaksaraei, A. (Ed.), Polymerase Chain Reaction for Biomedical Applications (pp. 1-14). IntechOpen, DOI: 10.5772/65850.

Rohani, O., Syed Alwee, S. S. R., Rafii, M. Y., Ong-Abdullah, M., Tarmizi, A. H., Zamzuri, I. (2000). Tissue culture of oil palm. In Basiron Y, Jalani BS, Chan KW (Eds.), Advances in Oil Palm Research (pp. 238-283). Malaysian Palm Oil Board.

Roowi, S. H., Mohammed Kassim, R., Raja Hirdan, R. H. N., Daud, A. F., Burhan, M. N., Mandangan, N., Abdul Rahim, M. F., Kamarudin, M. L. B., Roslan, M. M., Samin, N. B., Ishak, N. A., Hj Mohamad, M. N., Tan, J. S., Syed Alwee, S. S. R. (2018). Is there a future in tissue culture for the oil palm industry? In Wong, C. K. (Ed.), Proceeding of the International Seminar on Status of Oil Palm Tissue Culture Technology (pp. 59-71). Malaysia Palm Oil Board.

Russell, D. W. and Davidson, H. (1982). Regulation of cytosolic HMG-CoA reductase activity in pea seedlings: contrasting responses to different hormones, and hormone-product interaction, suggest hormonal modulation of activity. Biochemical and Biophysical Research Communications, 104(4): 1537-1543.

Ryan, J. M. and Nebenführ, A. (2018). Update on myosin motors: Molecular mechanisms and physiological functions. Plant Physiology, 176(1): 119-127.

Samach, A. and Gover, A. (2001). Photoperiodism: The consistent use of CONSTANS. Current Biology, 11(16): R651-R654.

Samat, A. (2018). Introduction: Risk and opportunities for Singapore companies. Retrieved from https://d2ouvy59p0dg6k.cloudfront.net/downloads/saspo_business_guide.pdf.

Sarpan, N., Kok, S. Y., Chai, S. K., Fitrianto, A., Nuraziyan, A., Zamzuri, I., Ong-Abdullah, M., Ooi, S. E. (2015). A model to predict floral development stage of inflorescences from *Elaeis guineensis* Jacq. Journal of Oil Palm Research, 27(4): 315-325.

Schlemmer, M. R., Francis, D. D., Shanahan, J. F., Schepers, J. S. (2005). Remotely measuring chlorophyll content in corn leaves with differing nitrogen levels and relative water content. Agronomy Journal, 97(1): 106-112.

Schmieder, R. and Edwards, R. (2011). Quality control and preprocessing of metagenomics datasets. Bioinformatics, 27(6): 863-864.

Schmieder, R., Lim. Y. W., Rohwer, F., Edwards, R. (2010). TagCleaner: Identification and removal of tag sequences from genomic and metagenomic datasets. BMC Bioinformatics, 11: Article 341.

Schneider, G. and Schliemann, W. (1994). Gibberellin conjugates: an overview. Plant Growth Regulation, 15(3): 247-260.

Schneider, G., Jensen, E., Spray, C. R., Phinney, B. O. (1992). Hydrolysis and reconjugation of gibberellins A_{20} glucosyl ester by seedlings of *Zea mays* L. Proceedings of the National Academy of Sciences of the United States of America, 89(17): 8045-8048.

Schomburg, F. M., Bizzell, C. M., Lee, D. J., Zeevaart, J. A., Amasino, R. M. (2003). Overexpression of a novel class of gibberellin 2-oxidases decreases gibberellin levels and creates dwarf plants. Plant Cell, 15(1): 151-163.

Schroeder, A., Mueller, O., Stocker, S., Salowsky, R., Leiber, M., Gassmann, M., Lightfoot, S., Menzel, W., Granzow, M., Ragg, T. (2006). The RIN: an RNA integrity number for assigning integrity values to RNA measurements. BMC Molecular Biology, 7: Article 3.

Schurch, N. J., Schofield, P., Gierliński, M., Cole, C., Sherstnev, A., Singh, V., Wrobel, N., Gharbi, K., Simpson, G. G., Owen-Hughes, T., Blaxter, M., Barton, G. J. (2015). Evaluation of tools for differential gene expression analysis by RNA-seq on a 48 biological replicate experiment. ArXiv: 1505: Article 02017.

Scicchitano, M. S., Dalmas, D. A., Bertiauz, M. A., Anderson, S. M., Turner, L. R., Thomas, R. A., Mirable, R., Boyce, R. W. (2006). Preliminary comparison of quantity, quality and microarray performance of RNA extracted from formalin-

fixed, paraffin-embedded, and unfixed frozen tissue samples. Journal of Histochemistry and Cytochemistry, 54(11): 1229-1237.

Seyednasrollah, F., Laiho, A., Elo, L. L. (2015). Comparison of software packages for detecting differential expression in RNA-seq studies. Briefings in Bioinformatics, 16(1): 59-70.

Shan, F., Zhang, R., Zhang, J., Wang, C., Lyu, X., Xin, T., Yan, C., Dong, S., Ma, C., Gong, Z. (2021). Study on the regulatory effects of GA_3 on soybean internode elongation. Plants, 10(8): Article 1737.

Sharma, N., Xin, R., Kim, D. H., Sung, S., Lange, T., Huq, E. (2016). NO FLOWERING IN SHORT DAY (NFL) is a bHLH transcription factor that promotes flowering specifically under short-day conditions in *Arabidopsis*. Development, 143(4): 682-690.

Shearman, J. R., Jantasuriyarat, C., Sangsrakru, D., Yoocha, T., Vanavichit, A., Tragoonrung, S., Tangphatsornruang, S. (2013). Transcriptome analysis of normal and mantled developing oil palm flower and fruit. Genomics, 101(5): 306-312.

Sheil, D., Casson, A., Meijaard, E., van Nordwijk, M., Gaskell, J., Sunderland-Groves, J., Wertz, K., Kanninen, M. (2009). The impacts and opportunities of oil palm in Southeast Asia: What do we know and what do we need to know? Center for International Forestry Research.

Shi, S. R., Liu, C., Pootrakul, L., Tang, L., Young, A., Chen, R., Cote, R. J., Taylor, C. R. (2008). Evaluation of the value of frozen tissue sectin used as 'gold standard' for immunohistochemistry. American Journal of Clinical Pathology, 129(3): 358-366.

Shimada, A., Ueguchi-Tanaka, M., Nakatsu, T., Nakajima, M., Naoe, Y., Ohmiya, H., Kato, H., Matsuoka, M. (2008). Structural basis for gibberellin recognition by its receptor GID1. Nature, 456(7221): 520-523.

Singh, R., Ong-Abdullah, M., Low, E. T., Manaf, M. A., Rosli, R., Nookiah, R., Ooi, L. C., Ooi, S. E., Chan, K. L., Halim, M. A., Azizi, N., Nagappan, J., Bacher, B., Lakey, N., Smith, S. W., He, D., Hogan, M., Budiman, M. A., Lee, E. K., DeSalle, R., Kudrna, D., Goicoechea, J. L., Wing, R. A., Wilson, R. K., Fulton, R. S., Ordway, J. M., Martienssen, R. A., Sambanthamurthi, R. (2013). Oil palm genome sequence reveals divergence of interfertile species in Old and New worlds. Nature, 500(7462): 335-339.

Soh, A. C., Mayes, S., Roberts, J., Ong-Abdullah, M., Ooi, S. E., Hashim, A. T., Ishak, Z., Rosli, S. K., Wong, W. C., Choo, C. N., Kok, S. Y., Azimi, N., Sarpan, N. (2017). Clonal propagation. In Soh, A. C., Mayes, S., Roberts, J. (Eds.), Oil Palm Breeding: Genetics and Genomics (pp. 191-224). CRC Press.

Soh, A. C. (2012). The future of oil palm clones in Malaysia. Journal of Oil Palm, Environment and Health, 3: 93-97.

Somyong, S., Poopear, S., Sunner, S. K., Wanlayaporn, K., Jomchai, N., Yoocha, T., Ukoskit, K., Tangphatsornruang, S., Tragoonrung, S. (2016). ACC oxidase and

miRNA 159a, and their involvement in fresh fruit bunch yield (FFB) via sex ratio determination in oil palm. Molecular Genetics and Genomics, 291(3): 1243-1257.

Sponsel, V. M. and Hedden, P. (2004). Gibberellin biosynthesis and inactivation. In Davies, P. J. (Ed.), Plant Hormones: Biosynthesis, Signal Transduction, Action (pp. 63-94). Kluwer Academic Publishers.

Stahlberg A, Hakansson J, Xian X, Semb H, Kubista M. (2004). Properties of the reverse transcription reaction in mRNA qualification. Clinical Chemistry, 50(3): 509-515.

Subramanian, A., Tamayo, P., Mootha, V. K., Mukherjee, S., Ebert, B. L., Gillette, M. A., Paulovich, A., Pomeroy, S. L., Golub, T. R., Lander, E. S., Mesirov, J. P. (2005). Gene Set Enrichment Analysis: a knowledge-based approach for interpreting genome-wide expression profiles. Proceedings of the National Academy of Sciences of the United States of America, 102(43): 15545-15550.

Sudradjat, Sugianta, Siregar, H. A., Purwanto, O. D. (2021). Effects of gibberellin (GA_3) on the physical quality of oil palm fresh fruit bunches. IOP Conference Series: Earth and Environmental Science, 694(1): Article 012037.

Tait, M. A. and Hik, D. S. (2003). Is dimethylsulfoxide a reliable solvent for extracting chlorophyll under field conditions? Photosynthesis Research, 78(1): 87-91.

Takahashi, N. and Umeda, M. (2014). Cytokinins promote onset of endoreplication by controlling cell cycle machinery. Plant Signaling and Behavior, 9(8): Article e29396.

Takatsuka, H. and Umeda, M. (2014). Hormonal control of cell division and elongation along differentiation trajectories in roots. Journal of Experimental Botany, 65(10): 2633-2643.

Tanaka, N. (2012). Gibberellin is not a regulator of miR156 in rice juvenile-adult phase change. Rice (New York, N. Y.), 5: 25.

Tanaka, R., Oster, U., Kruse, E., Rudiger. W., Grimm, B. (1999). Reduced activity of geranylgeranyl reductase leads to loss of chlorophyll and tocopherol and to partially geranylgeranylated chlorophyll in transgenic tobacco plants expressing antisense RNA for geranylgeranyl reductase. Plant Physiology, 120(3): 695-704.

Taylor, N. G., Gardiner, J. C., Whiteman, R., Turner, S. R. (2004). Cellulose synthesis in the *Arabidopsis* secondary cell wall. Cellulose, 11(3-4): 329-338.

Teotia, S. and Lamb, R. S. (2011). *RCD1* and *SRO1* are necessary to maintain meristematic fate in *Arabidopsis thaliana*. Journal of Experimental Botany, 62(3): 1271-1284.

Thomas, S. G., Phillips, A. L., Hedden, P. (1999). Molecular cloning and functional expression of gibberellin 2-oxidases, multifunctional enzymes involved in gibberellin deactivation. Proceedings of the National Academy of Sciences of the United States of America, 96(8): 4698-4703.

Thomas, S. G., Rieu, I., Steber, C. M. (2005). Gibberellins metabolism and signalling. Vitamins and Hormones, 72: 289-338.

Thomas, R. L., Seth, A. K., Chan, K. W., Ooi, S. C. (1973). Induced parthenocarpy in the oil-palm. Annals of Botany, 37(151): 447-452.

Thudi, M., Li, Y., Jackson, S. A., May, G. D., Varshney, R. K. (2012). Current state-of-art of sequencing technologies for plant genomics research. Briefings in Functional Genomics, 11(1): 3-11.

Trapnell, C. (2009). TopHat: discovering splice junctions with RNA-Seq. Bioinformatics, 25(9): 1105-1111

Tsegaw, T., Hammes, S., Robbertse, J. (2005). Paclobutrazol-induced leaf, stem and root anatomical modifications in potato. HortScience, 40(5): 1343-1346.

Tsiakaras, G., Petropoulos, S. A., Khah, E. M. (2014). Effect of GA_3 and nitrogen on yield and marketability of lettuce (*Lactuca sativa* L.). Australian Journal of Crop Science, 8(1): 127-132.

Tyler, L., Thomas, S. G., Hu, J., Dill, A., Alonso, J. M., Ecker, J. R., Sun, T. (2004). Della proteins and gibberellin-regulated seed germination and floral development in *Arabidopsis*. Plant Physiology, 135(2): 1008-1019.

Ueguchi-Tanaka, M., Ashikari, M., Nakajima, M., Itoh, H., Katoh, E., Kobayashi, M., Chow, T. Y., Hsing, Y. I., Kitano, H., Yamaguchi, I., Matsuoka, M. (2005). GIBBERELLIN INSENSITIVE DWARF1 encodes a soluble receptor for gibberellin. Nature, 437(7059): 693-698.

Upreti, K. K., Reddy, Y. T. N., Shivu, Prasad, S. R., Bindu, G. V., Jayaram, H, L., Rajan, S. (2013). Hormonal changes in response to paclobutrazol induced early flowering in mango cv. Totapuri. Scientia Horticulturae, 150: 414-418.

van de Poel, B., van der Straeten, D. (2014). 1-aminocyclopropane-1-carboxylic acid (ACC) in plants: more than just the precursor of ethylene! Frontiers of Plant Science, 5: Article 640.

Vandesompele, J., de Preter, K., Pattyn, F., Poppe, B., van Roy, N., de Oaeoe, A., Speleman, F. (2002). Accurate normalization of real-time quantitative RT-PCR data by geometric averaging of multiple internal control genes. Genome Biology, 3: Article RESEARCH0034.1.

Varbanova, M., Yamaguchi, S., Yang, Y., McKelvey, K., Hanada, A., Borochov, R., Yu, F., Jikumaru, Y., Ross, J., Cortes, D., Ma, C. J., Noel, J. P., Mander, L., Shulaev, V., Kamiya, Y., Rodermel, S., Weiss, D., Pichersky, E. (2007). Methylation of gibberellins by Arabidopsis GAMT1 and GAMT2. Plant Cell, 19(1): 32-45.

Vargas, A. and Lopez, J. A. (2011). Effect of dose rate, application method and commercial formulations of GA_3 on Banana (*Musa* AAA) Fruit. Fresh Produce, 5(1): 51-55.

Vassilakopoulou, M., Parisi, F., Siddiqui, S., England, A., Zarella, E. R., Anagnostou, V., Kluger, Y., Hicks, D. G., Rimm, D. L., Neumeister, V. M. (2015). Preanalytical variables and phosphoepitope expression in FFPE tissue: quantitative epitope assessment after variable cold ischemic time. Laboratory Investigation, 95(3): 334-341.

Verheye, W. (2010). Growth and production of Oil Palm. In: Verheye, W. (Ed.), Land use, land cover and soil sciences. UNESCO-EOLSS Publishers.

von Ahlfen, S., Missel, A., Bendrat, K., Schlumpberger, M. (2007). Determinants of RNA quality from FFPE samples. PLoS One, 2(12): Article e1261.

Vranová, E., Coman, D., Gruissem, W. (2013). Network analysis of the MVA and MEP pathways for isoprenoid synthesis. Annual Review of Plant Biology, 64: 665-700.

Walker, C. G., Meier, S., Mitchell, M. D., Roche, J. R., Littlejohn, M. (2009). Evaluation of real-time PCR endogenous control genes for analysis of gene expression in bovine endometrium. BMC Molecular Biology, 10: Article 100.

Wang, B., Tseng, E., Regulski, M., Clark, T. A., Hon, T., Jiao, Y., Lu, Z., Olson, A., Stein, J. C., Ware, D. (2016b). Unveiling the complexity of the maize transcriptome by single-molecule long-read sequencing. Nature Communications, 7: Article 11708.

Wang, G. L., Que, F., Xu, Z. S., Wang, F., Xiong, A. S. (2015). Exogenous gibberellins altered morphology, anatomic and transcriptional regulatory networks of hormones in carrot root and shoot. BMC Plant Biology, 15(1): Article 290.

Wang, H., Pan, J., Li, Y., Lou, D., Hu, Y., Yu, D. (2016a). The DELLA-CONSTANS transcription factor cascade integrates gibberellic acid and photoperiod signalling to regulate flowering. Plant Physiology, 172(1): 479-488.

Wang, H., You, C., Chang, F., Wang, Y., Wang, L., Qi, J., Ma, H. (2014). Alternative splicing during *Arabidopsis* flower development results in constitutive and stage-regulated isoforms. Frontiers in Genetics, 5: Article 25.

Wang, Q., Wang, L., Zhu, G., Cao, K., Fang, W., Chen, C., Wang, X. (2016c). DNA marker-assisted evaluation of fruit acidity in diverse peach (*Prunus persica*) germplasm. Euphytica, 210(3): 413-426.

Wang, S. Y., Sun, T., Ji, Z. L., Faust, M. (1987). Effect of paclobutrazol on water stress-induced abscisic Acid in apple seedling leaves. Plant Physiology, 84(4): 1051-1054.

Wang, W., Gu, L., Ye, S., Zhang, H., Cai, C., Xiang, M., Gao, Y., Wang, Q., Lin, C., Zhu, Q. (2017a). Genome-wide analysis and transcriptomic profiling of the auxin

biosynthesis, transport and signaling family genes in moso bamboo (*Phyllostachys heterocycla*). BMC Genomics, 18(1): Article 870.

Wang, Y. H. and Irving, H. R. (2011). Developing a model of plant hormone interactions. Plant Signaling and Behavior, 6(4): 494-500.

Wang, Z., Gerstein, M., Snyder, M. (2009). RNA-seq: a revolutionary tool for transcriptomics. Nature Reviews Genetics, 10(1): 57-63.

Weckx, S., Inzé, D., Maene, L. (2019). Tissue culture of oil palm: Finding the balance between mass propagation and somaclonal variation. Frontiers of Plant Science, 10: Article 722.

West, N. W. and Golenberg, E. M. (2018). Gender-specific expression of GIBBERELLIC ACID INSENSITIVE is critical for unisexual organ initiation in dioecious *Spinacia oleracea*. New Phytologist, 217(3): 1322-1334.

Wilkie, J. D., Sedgley, M., Olesen, T. (2008). Regulation of floral initiation in horticultural trees. Journal of Experimental Botany, 59(12): 3215-3228.

Williams, J., Phillips, A. L., Gaskin, P., Hedden, P. (1998). Function and substrate specificity of the gibberellin 3*β*-hydroxylase encoded by the *Arabidopsis GA4* gene. Plant Physiology, 117(2): 559-563.

Woittiez, L. S., van Wijk, M. T., Slingerland, M., van Noordwijk, M., Giller, K. E. (2017). Yield gaps in oil palm: A quantitative review of contributing factors. European Journal of Agronomy, 83: 57-77.

Wolf, S., Hematy, K., Hoefte, H. (2012). Growth control and cell wall signalling in Plants, Annual Review of Plant Biology, 63: 381-407.

Wong, Y. C., Kwong, Q. B., Lee, H. L., Ong, C. K., Mayes, S., Chew, F. T., Appleton, D. R, .Kulaveerasingam. H. (2014). Expression comparison of oil biosynthesis genes in oil palm mesocarp tissue using custom array. Microarrays (Basel), 3(4): 263-281.

Wooi, K. C. (1995). Oil Palm tissue culture- current practice and constraints. In Rao, V., Henson, I. E., Rajanaidu, N. (Eds.), Proceedings of the 1993 ISOPB International Symposium- On recent developments in oil palm tissue culture and Biotechnology (pp. 21-32). Palm Oil Research Institute of Malaysia.

Wuest, S. E. and Grossniklaus, U. (2014). Laser-Assisted Microdissection applied to floral tissues. Methods in Molecular Biology, 1110: 329-344.

Xia, R., Zhu, H., An, Y. Q., Beers, E. P., Liu, Z. (2012). Apple miRNAs and tasiRNAs with novel regulatory networks. Genome Biology, 13(6): Article R47.

Xiao, Y. J., Jiong, G., Yu, J. (2012). Probenazole treatment inhibits anthocyanins biosynthesis via salicylic acid and AtNPR1 signal pathway in *Arabidopsis*. African Journal of Biotechnology, 11(2): 253-261.

Xu, F., Li, T., Xu, P., Li, L., Du, S., Lian, H., Yang, H. (2016). DELLA proteins physically interact with CONSTANS to regulate flowering under long days in *Arabidopsis*. FEBS Letters, 590(4): 541-549.

Yamaguchi, I., Kobayashi, M., Takahashi, N. (1980). Isolation and characterization of glucosyl esters of gibberellin A5 and A44 from immature seeds of *Pharbitis purpurea*. Agricultural and Biological Chemistry, 44: 1975-1977.

Yamaguchi, S. (2008). Gibberellin metabolism and its regulation. Annual Review of Plant Biology, 59: 225-251.

Yamasaki, S., Fujii, N,, Takahashi, H. (2005). Hormonal regulation of sex expression in Plants, Vitamins and Hormones, 72: 79-110.

Yano, R., Nonaka, S., Ezura, H. (2018). Melonet-DB, a Grand RNA-seq gene expression atlas in melon (*Cucumis melo* L.). Plant Cell Physiology, 59(1): Article e4.

Yeap, W. C., Lee, F. C., Shabari Shan, D. K., Musa, H., Appleton, D. R., Kulaveerasingam, H. (2017). WRI1-1, ABI5, NF-YA3 and NF-YC2 increase oil biosynthesis in coordination with hormonal signalling during fruit development in oil palm. Plant Journal, 91(1): 97-113.

Yeap, W. C., Loo, J. M., Wong, Y. C., Kulaveerasingam, H. (2014). Evaluation of suitable reference genes for qRT-PCR gene expression normalization in reproductive, vegetative tissues and during fruit development in oil palm. Plant Cell, Tissue and Organ Culture, 116(1): 55-66.

Yoshida, H. and Ueguchi-Tanaka, M. (2014). DELLA and SCL3 balance gibberellin feedback regulation by utilizing INDETERMINATE DOMAIN proteins as transcriptional scaffolds. Plant Signaling and Behavior. 9(9): Article e29726.

Yoshida, H., Hirano, K., Sato, T., Mitsuda, N., Nomoto, M., Maeo, K., Koketsu, E., Mitani, R., Kawamura, M., Ishiguro, S., Tada, Y., Ohme-Takagi, M., Matsuoka, M., Ueguchi-Tanaka, M. (2014). DELLA protein functions as a transcriptional activator through the DNA binding of the indeterminate domain family proteins. Proceedings of the National Academy of Sciences of the United States of America, 111(21): 7861-7866.

Yu, H., Ito, T., Zhao, Y., Peng, J., Kumar, P., Meyerowitz, E. M. (2004). Floral homeotic genes are targets of gibberellin signalling in flower development. Proceedings of the National Academy of Sciences of the United States of America, 101(20): 7827-7832.

Yu, S., Galvão, V. C., Zhang, Y., Horrer, D., Zhang, T., Hao, Y., Feng, Y., Wang, S., Schmid, M., Wang, J. (2012). Gibberellin regulates the *Arabidopsis* floral transition through miR156-targeted SQUAMOSA promoter binding-like transcription factors. Plant Cell, 24(8): 3320-3332.

Yuan, Y., Teng, Q., Zhong, R., Ye, Z. H. (2016). Roles of *Arabidopsis TBL34* and *TBL35* in xylan acetylation and plant growth. Plant Science, 243: 120-130.

Zawaski, C. and Busov, V. B. (2014). Roles of gibberellin catabolism and signalling in growth and physiological response to drought and short-day photoperiods in Populus trees. PLoS One, 9(1): Article e86217.

Zenoni, S., Reale, L., Tornielli, G. B., Lanfaloni, L., Porceddu, A., Ferrarini, A., Moretti, C., Zamboni, A., Speghini, A., Ferranti, F., Pezzotti, M. (2004). Downregulation of the Petunia hybrida alpha-expansin gene PhEXP1 reduces the amount of crystalline cellulose in cell walls and leads to phenotypic changes in petal limbs. Plant Cell, 16(2): 295-308.

Zhang, J., Shi, J., Ji, G., Zhang, H., Gong, G., Guo, S., Guo, S., Ren, Y., Fan. J., Tian, S., Xu, Y. (2017a). Modulation of sex expression in four forms of watermelon by gibberellin, ethephone and silver nitrate. Horticultural Plant Journal, 3(3): 91-100.

Zhang, M., Zhang, B., Qian, Q., Yu, Y., Li, R., Zhang, J., Liu, X., Zeng, D., Li, J., Zhou, Y. (2010). Brittle Culm 12, a dual-targeting kinesin-4 protein, controls cell-cycle progression and wall properties in rice. Plant Journal, 63(2): 312-328.

Zhang, S., Zhang, D., Fan, S., Du, L., Shen, Y., Xing, L., Li, Y., Ma, J., Han, M. (2016). Effect of exogenous GA_3 and its inhibitor paclobutrazol on floral formation, endogenous hormones, and flowering-associated genes in 'Fuji' apple (*Malus domestica* Borkh.). Plant Physiology and Biochemistry, 107: 178-186.

Zhang, Y., Liu, B., Yang, S., An, J., Chen, C., Zhang, X., Ren. H. (2014a). A cucumber DELLA homolog CsGAIP may inhibit staminate development through transcriptional repression of B class floral homeotic genes. PLoS One, 9(3): Article e91804.

Zhang, Y., Yuan, Y., Liu, Z., Zhang, T., Li, F., Liu, C., Gai, S. (2021). GA_3 is superior to GA_4 in promoting bud endodormancy release in tree peony (*Paeonia suffruticosa*) and their potential working mechanism. BMC Plant Biology, 21: Article 323

Zhang, Y., Zhang, X., Liu, B., Wang, W., Liu, X., Chen, C., Liu, X., Yang, S., Ren, H. (2014b). A *GAMYB* homologue *CsGAMYB1* regulates sex expression of cucumber via an ethylene-independent pathway. Journal of Experimental Botany, 65(12):3201-3213.

Zhang, Y., Zhao, G., Li, Y., Mo, N., Zhang, J., Liang, Y. (2017b). Transcriptomic analysis implies that GA regulates sex expression via ethylene-dependent and ethylene-independent pathways in cucumber (*Cucumis sativus* L.). Frontiers of Plant Science, 8: Article 10.

Zhao, D., Gong, S., Hao, Z., Meng, J., Tao, J. (2015a). Quantitative proteomics analysis of herbaceous peony in response to paclobutrazol inhibition of lateral branching. International Journal of Molecular Sciences, 16(10): 24332-24352.

Zhao, X. Y., Zhu, D. F., Zhou, B., Peng, W. S., Lin, J. Z., Huang, X. Q., He, R. Q., Zhuo, Y. H., Peng, D., Tang, D. Y., Li, M. F., Liu, X. M. (2010). Overexpression of the *AtGA2ox8* gene decreases the biomass accumulation and lignifications in rapeseed (*Brassica napus* L.). Journal of Zhejiang University-Science B, 11(7): 471-481.

Zheng, R. R., Wu, Y., Xia, Y. P. (2012). Chlorocholine chloride and paclobutrazol treatments promote carbohydrate accumulation in bulbs of *Lilium Oriental* hybrids 'Sorbonne'. Journal of Zhejiang University-Science B, 13(2): 136-144.

Zhong, R., Cui, D., Ye, Z. (2017). Regiospecific Acetylation of Xylan is mediated by a group of DUF231-containing O-acetyltransferases. Plant Cell Physiology, 58(12): 2126-2138.

Zhong, R., Cui, D., Dasher, R. L, Ye, Z. H. (2018). Biochemical characterization of rice xylan O-acetyltransferases. Planta, 247(6): 1489-1498.

Zhou, A., Sun, H., Dai, S., Feng, S., Zhang, J., Gong, S., Wang, J. (2019). Identification of transcription factors involved in regulation of flowering in *Adonis Amurensis* through combined RNA-seq transcriptomics and iTRAQ proteomics. Genes, 10(4): 305-317.

Zhou, R., Yu, M., Pharis, R. P. (2004). 16,17-dihydro gibberellin A_5 competitively inhibits a recombinant *Arabidopsis* GA 3*β*-Hydroxylase encoded by the *GA4* gene. Plant Physiology, 135(2): 1000-1007.

Zhu, X., Chai, M., Li, Y., Sun, M., Zhang, J., Sun, G., Jiang, C., Shi, L. (2016). Global transcriptome profiling analysis of inhibition effects of paclobutrazol on leaf growth in Lily (*Lilium Longiflorum*-Asiatic Hybrid). Frontiers of Plant Science, 7: 491-504.

Zhu, Y., Nomura, T., Xu, Y., Zhang, Y., Peng, Y., Mao, B., Hanada, A., Zhou, H., Wang, R., Li, P., Zhu, X., Mander, L. N., Kamiya, Y., Yamaguchi, S., He, Z. (2006). ELONGATED UPPERMOST INTERNODE encodes a cytochrome P450 monooxygenase that epoxidizes gibberellins in a novel deactivation reaction in rice. Plant Cell, 18(2): 442-456.

Zi, J., Mafu, S., Peters, R. J. (2014). To gibberellins and beyond! Surveying the evolution of (di)terpenoid metabolism. Annual Review of Plant Biology, 65: 259-286.

Zyss, D., Ebrahimi, H., Gergely, F. (2011). Casein kinase I delta controls centrosome positioning during T cell activation. Journal of Cell Biology, 195(5): 781-798.