



UNIVERSITI PUTRA MALAYSIA

**USE OF ORGANIC ENRICHMENT AS ADDITIVES IN COCONUT
COIR DUST SOILLESS CULTURE FOR GROWTH AND YIELD OF
TOMATOES (*Lycopersicon esculentum* Mill. cv. Beril)**

SOLMAZ MOKHTARI

FP 2010 23



**USE OF ORGANIC ENRICHMENT AS ADDITIVES IN COCONUT COIR
DUST SOILLESS CULTURE FOR GROWTH AND YIELD OF TOMATOES**
(Lycopersicon esculentum Mill. cv. Beril)

SOLMAZ MOKHTARI

**MASTER OF SCIENCE
UNVIERSITI PUTRA MALAYSIA
September 2010**



**USE OF ORGANIC ENRICHMENT AS ADDITIVES IN COCONUT COIR
DUST SOILLESS CULTURE FOR GROWTH AND YIELD OF TOMATOES**
(Lycopersicon esculentum Mill. cv. Beril)

By

SOLMAZ MOKHTARI

**Thesis Submitted to the School of Graduate Studies, University Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Master of Science**

September 2010



DEDICATION

To my beloved father and mother

To my dearest brother, sister and my sister in law

To dearly missed my grandparents.



Abstract of thesis presented to the Senate of University Putra Malaysia in fulfillment of the requirement for the degree of Master of Agriculture Science

USE OF ORGANIC ENRICHMENT AS ADDITIVES IN COCONUT COIR DUST SOILLESS CULTURE FOR GROWTH AND YIELD OF TOMATOES (*Lycopersicon esculentum* Mill. cv. Beril)

By

SOLMAZ MOKHTARI

September 2010

Chairman : Professor. Mohd Razi Ismail, PhD

Faculty : Agriculture

Soilless culture is an artificial means of providing support for plants as well as a reservoir for nutrients and water, and is becoming an important part of world agriculture. In Malaysia there is a rapid expansion on the use of locally produced coconut coir dust (CD) as a growth media. The main limitation in using this media its low cation exchange capacity (CEC) and poor water retention that can affect plant development. These limitations may be overcome with organic amendments. Hence, the main objective of this study was to determine the effect of different concentrations of empty fruit bunch (EFB) and vermicompost (VC) as additives on the growth and yield of tomato plants grown in coconut coir dust media.

Experiments were conducted on 100% CD (control) with nutrient solution ($EC=2.5 \text{ mScm}^{-1}$), and 30% of EFB with 70% CD, 10% VC with 90% CD, 20% VC with 80% CD, 30% VC with 70% CD and 40% VC with 60% CD (on pot volume basis)



in which the nutrient concentrations was half of those supplied in the control. The results showed that plants grown in CD with 20% and 10% of VC had higher growth and yield compared to plants grown in 100% CD or CD mixed with EFB. Total yield and fruit quality of tomatoes were improved by vermicompost amendment as additive in the coconut coir based media. The investigation on tissue nutrient content showed high accumulation of N, P, K, Ca and Mg in organic enrichment (EFB and VC) media in comparison to the control (100% CD). The N uptake in shoots from enrichment with half of nutrient concentration ($EC=1.25 \text{ mScm}^{-1}$) was more (EFB = 46.52 mg/plot and 20%VC= 30.96 mg/plot) than in shoots from the control with $EC=2.5 \text{ mScm}^{-1}$ (29.48 mg/plot).

Results on tomato fruit analysis showed higher heavy metal concentrations in CD with high electrical conductivity of 2.5 mS cm^{-1} . Fruits obtained in the three amended media had Zn, Cu and Cd concentrations below UK Guidelines (1989). Pb concentration was also within safe limits according to international guidelines (UK Guidelines, 1989). Overall, these results suggest that with the use of organic amendments lower volume of chemical nutrients can be used to achieve good yield in soilless culture.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**PENGGUNAAN ORGANIK YANG KAYA DENGAN NUTRIEN SEBAGAI
BAHAN TAMBAH PADA PERTUMBUHAN, DAN HASIL POKOK
TOMATO (*Lycopersicon esculentum Mill*) DALAM SABUT KELAPA TANPA
TANAH**

Oleh

SOLMAZ MOKHTARI

September 2010

Pengerusi : Professor. Mohd Razi Ismail, PhD

Fakulti : Pertanian

Kultur tanpa tanah adalah kaedah bukan semulajadi yang membantu dalam penyimpanan dan pembekalan nutrient dan air pada tumbuhan, dan kaedah ini menjadi semakin penting dalam dunia pertanian. Di Malaysia penggunaan sabut kelapa (CD) yang dihasilkan sebagai media pertumbuhan tempatan dari bahan buangan kelapa sedang berkembang pesat. Namun begitu, masalah utama yang dihadapi dalam penggunaan sabut kelapa- adalah pertukaran kapasiti kation (CEC) yang rendah, dan status pemegang air yang boleh memberi kesan pada-pertumbuhan pokok. Akan tetapi kelemahan sedemikian boleh di atasi dengan penambahan bahan organic tambahan dalam media. Oleh yang demikian, objektif utama experiment ini adalah untuk mengkaji kesan penambahan tandan sawit kosong (EFB) dan pelbagai kuantiti (10%, 20%, 30% and 40%) vemicompos (VC) pada pertumbuhan dan hasil pokok tomato di dalam media sabut kelapa. Di dalam ujikaji

ini, pokok tomato ditanam dalam pelbagai campuran CD: 100% CD (sebagai kawalan) dengan larutan nutrien ($EC=2.5 \text{ mScm}^{-1}$), 70% EFB + 30% CD, 10% VC + 90% CD, 20% VC + 80% CD, 30% VC+ 70% CD dan 40% VC + 60% CD dengan larutan separuh nutrient ($EC=1.25 \text{ mScm}^{-1}$). Dalam semua rawatan media yang merupakan campuran dengan bahan organik tambahan, nutrien yang diberi kepada media adalah pada separuh kekuatan sahaja.

Keputusan kajian menunjukkan bahawa pertumbuhan dan hasil pokok dalam media CD yang bercampur dengan 10% dan 20% vermikompos adalah lebih tinggi berbanding dengan media 100% CD atau CD bercampur dengan EFB.

Penambahan vermikompos sebagai bahan tambahan di dalam sabut kelapa telah meningkatkan kualiti pemarkaran dan keseluruhan hasil buah tomato. Tambahan pula bekalan bahan kimia pada daun dan di dalam media N, P, K, Ca and Mg bertambah baik apabila media dicampurkan dengan vermikompos dan tandan kelapa sawit kosong berbanding dengan sabut kelapa sahaja.

Keputusan analisis buah tomato menunjukkan peningkatan kepekatan logam dengan media sabut kelapa yang menerima nutrient pada konduktiviti elektrik yang tinggi (2.5 mScm^{-1}). Kepekatan logam berat seperti Zn, Cu dan Cd di dalam tiga jenis media yang bercampur dengan bahan tambahan organik adalah lebih rendah berbanding garis panduan antarabangsa (UK Guidelines, 1989). Mengikut piawaian antarabangsa kepekatan Pb juga adalah didalam tahap selamat (UK Guidelines, 1989). Secara keseluruhan, keputusan kajian ini mencadangkan bahawa dengan

penambahan bahan organik ke dalam media pertumbuhan (tanpa tanah) seperti CD, pertumbuhan dan hasil yang baik boleh diperolehi dengan menggunakan isipadu baja kimia yang lebih rendah.

ACKNOWLEDGEMENTS

In the name of Allah the Beneficial and the Compassionate

I would like to express my sincere thank and profound appreciation to the chairman of my supervisory committee, Professor Dr. Mohd Razi Ismail, Department of Crop Science, Faculty of Agriculture for his supervision, kind support beyond supervisory duties and for being so patient and understanding. I am also indebted to Professor Dr. Mohamed Hanafi Bin Musa my co-supervisor for his time and advice, as well as for his encouragement and friendship. Special thanks to Dr. Puteri Edaroyati Megat Wahab as a member of my supervisory committee for her critical comments and suggestion during the course of this master project.

Completion of this research work is also much owed to my beloved father and mother, who guided and supported me to achieve the highest level of education. My beloved brother Rouzbeh and my sister, Saloomeh for their kind consideration and all the valuable supports. My deepest thanks to my dear friend Reza for his encouragement and friendship, also other family members for I am indebted to them for their support.

I would like to extend my sincere thanks to the staff and management of Institute Tropical Agriculture (ITA), Faculty of Agriculture, and Department of Horticultural Science Lab for kind their assistance and equipments provided for the laboratory and glass house studies. My appreciations and honest thanks are due to all Lecturers and staff members of (ITA) in particular Professor, Dr. Sariah Meon director of ITA, Zulkarami Berahim (Research Officer) and all my friends who helped me a lot during the past few years as well as for their encouragement and friendship.



Finally, most profound thanks go to the Malaysian government and people represented by University Putra Malaysia, for giving me this opportunity to study in their prestigious and reputable institute.



I certify that a Thesis Examination Committee has met on the September 2010 to conduct the final examination of Solmaz Mokhtari on her Master of Agriculture Science thesis entitled “Use of Organic Enrichment as Additives in Coconut Coir Dust Soilless Culture for Growth and Yield of Tomato (*Lycopersicon esculentum* L.)” in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the relevant degree.

Members of the Examination Committee were as follows:

Madya Radziah Othman, Ph.D.

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Mady Anuar Abdul Rahim, Ph.D.

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Madya Halimi Mohd Saud, Ph.D.

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Mohanned Selamat Madom, Ph.D.

Planting Material, Seed and livestock Breed
Production Unit
Seed and Planting material Complex
Mardi Headquarters
(External Examiner)

BUJANG KIM HUAT, Ph.D.

Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:





This thesis was submitted to the Senate of University Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Agriculture Science.

The members of the Supervisory Committee were as follows:

Mohd Razi Ismail, PhD

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Mohamed Hanafi Bin Musa, PhD

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Puteri Edaroyati Megat Wahab, PhD

Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

HASANAH MOHD GHAZALI, PhD

Professor and Dean
School of Graduate Studies
University Putra Malaysia

Date:



DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institution.

SOLMAZ MOKHTARI

Date: 6 September 2010



TABLE OF CONTENTS

	Page
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	viii
APPROVAL	x
DECLARATION	xii
LIST OF FIGURES	xvi
LIST OF TABLES	xviii
LIST OF ABBREVIATIONS	xx
 CHAPTER	
1 INTRODUCTION	1
2 LITERATURE REVIEW	
2.1 Soilless culture	4
2.2 Growing media	5
2.2.1 Coconut coir dust	5
2.2.2 Chemical and physical characteristics	6
2.2.3 Peat	7
2.3 Compost	8
2.3.1 Empty fruit bunch compost	9
2.3.2 Vermicompost	11
2.4 Electrical conductive and plant growth	14
2.5 Tomato plant growth and fruit quality	16
3 GENERAL MATERIALS AND METHODS	
3.1 Preparation of plant material	18
3.2 Physiological parameter determination	20
3.2.1 Plant height, number of leaves and flowers	20
3.2.2 Fresh and dry matter of shoots and roots	20
3.2.3 Root scanning	20
3.3 Fruit sampling	21
3.3.1 Fruit size and number	21
3.3.2 Fruit total soluble solids	21
3.3.3 Fruit heavy metal content	21
3.4 Nutrient analyses	22

3.4.1	Determination of N,P and K in media	22
3.4.2	Macronutrient and micronutrients analysis in leaves tissue	22
3.4.3	Plant tissue nutrient uptake	23
3.5	Chemical parameter	23
3.5.1	Electrical conductivity	23
3.5.2	Hydrogen ion concentration	23
3.6	Statistical Analysis	23
4	Evaluation of organic enrichment as additives in coconut coir dust soilless culture on growth and yield of tomato (<i>Lycopersicon esculentum</i> Mill)	
4.1	Introduction	24
4.2	Material and Methods	25
4.2.1	Plant Materials and Treatments	25
4.2.2	Plant growth measurements	27
4.2.3	Media analysis sampling	27
4.2.4	Fruit yield and quality determination	28
4.3	Results	28
4.3.1	Dry matter content for preliminary experiment	28
4.3.2	Effect of organic enrichment on growth of tomato	31
4.3.3	Effect of organic enrichment on tomato fruit yield	34
4.3.4	Fruit size and number	36
4.3.5	Effect of organic enrichment amendments on Total soluble solid	40
4.3.6	Blossom end rot of tomato fruit	42
4.3.7	EC and pH	43
4.3.8	Flowering in 100% CD and organic enrichment treatments	44
4.3.9	Effects of organic additives on nutrient uptake in tomato plants	46
4.4	Discussion	52
4.5	Conclusion	56
5	Organic enrichment treatments to improved growth and yield of tomato plants	
5.1	Introduction	57
5.2	Materials and Methods	58
5.2.1	Plant materials and treatments	58
5.2.2	Growth responses	59
5.3	Results	60
5.3.1	Growth parameters	60
5.3.2	Plant height	62

5.3.3	Effect of media on leaves number in three different media	64
5.3.4	Effect of treatment on root development in tomato plants	64
5.3.5	Nutrient concentration in vermicompost	66
5.3.6	Nutrient analysis	67
5.3.7	Chemical parameter	70
5.3.8	Fruit analysis	71
5.4	Tomato plant growth with different days of irrigation	72
5.4.1	Effect of different irrigation days on nutrient content of media	76
5.4.2	Effect of nutrient treatments and media on photosynthesis in tomato plants	78
5.4.3	Effect of fertilizer days on tomato fruit size, number and yield	80
5.5	Discussion	83
5.6	Conclusion	87
6	GENERAL DISCUSSION AND CONCLUSION	88
	REFERENCES	92
	APPENDICES	104
	BIODATA OF STUDENT	119