UNIVERSITI PUTRA MALAYSIA

EFFECTS OF COMPOST SOURCES AS A COMPONENT OF SEEDLING GROWING MEDIA AND FERTILIZER ON GROWTH PERFORMANCE OF CAULIFLOWER (Brassica Oleracea L. Var. Botrytis)

FARAHZETY ABDUL MUTALIB

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By

FARAHZETY ABDUL MUTALIB

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

August 2014

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DEDICATION

To my beloved father and mother

Tuan Haji Abdul Mutalib Haji Zakaria and

Puan Hajah Mardziah Mohd Latif

To all the people involved..

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

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August 2014

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The use of agricultural wastes into renewal agricultural products such as fertilizer and growing medium can contribute towards reducing the import bill and safer food as well as avoiding environmental pollution. Two experiments were carried out to assess the effects of five different agriculture waste composts as a nursery media component and source of organic fertilizer for production of cauliflower under protective structure. The five different compost sources used were oil palm empty fruit bunches compost (EFBC), chrysanthemum residue compost (CRC), soybean waste compost (SWC), green waste vermicompost (GWV) and vegetable waste vermicompost (VWV). For cauliflower transplant production, the growth media comprised of a mixture with ratio of 30% compost to 70% sphagnum peat moss (v/v) and 100% of sphagnum peat moss was used as a control. The treatments were laid out in randomized complete block design (RCBD) and replicated four times. Results showed that substitution of peat with compost increased bulk density, available water, porosity and nutrients content of media mixtures. The CRC added media and 100% peat were found to have similar physical characteristics, electrical conductivity (EC) and nutrient content. The highest seedling height, total leaf number, total leaf area, and shoot dry weight were recorded in both CRC mixture and peat media. However, CRC mixture significantly ($P<0.05$) improved root morphology of cauliflower seedlings compared with those grown in other substrate mixtures. Results showed that peat could be 30% partially substituted by CRC, EFBC, GWV or VWV however the use of SWC can negatively affect plant growth. The physical and chemical properties of SWC added media were found to be unsuitable for seedling growth due to the higher pH, EC and bulk density. This study indicated that composts enhanced seedling growth in several occasions and these growth enhancements could be attributed to the improvement of the physical and chemical properties of the growing media.

Similar compost sources were used as organic fertilizer to assess the effects on the soil properties, nutrient status, growth performance and yield of cauliflower under a protective structure. Composts (EFBC, CRC, SWC, GWV and VWV) as source of fertilizer were applied prior to transplanting and an inorganic fertilizer (N: P_2O_5: K_2O: MgO; 12:12:17:2:TE) was used as a control. The treatments were laid out in randomized complete block design (RCBD) replicated three times. The amount of fertilizer applied was calculated based on 180 kg N ha^{-1}. Results indicated that, the use of composts as organic fertilizer significantly affected soil properties, plant growth, photosynthetic capacity, nutrient status and yield of cauliflower. Application of VWV significantly ($P<0.05$) affected shoot development of cauliflower planted under protective structure. The growth performance of cauliflower receiving vegetable waste vermicompost (VWV) was similar with those receiving inorganic fertilizer in plant height and plant biomass and greater in total leaf area. The nutritional status of the plants demonstrated that the nutrients were adequate and met the requirements for plant growth and curd development in all fertilizer treatments. Highest curd weight was found with VWV application however, it did not differ significantly with EFBC and inorganically fertilized plants. Both EFBC and VWV applications enhanced the ascorbic acid content. However, curds of VWV could be harvested earlier compared to the other treatments. From the results, composts could produce similar crop growth and yields as inorganic fertilizer when the same amount of N was applied to the plants. However, the effects of compost on plant growth and yield were not always positive and might vary depending on the source of waste, compost maturity and available N of the compost.

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

KESAN SUMBER KOMPOS BERBEZA SEBAGAI KOMPONEN MEDIA PERTUMBUHAN ANAK BENIH DAN BAJA TERHADAP PRESTASI PERTUMBUHAN KOBIS BUNGA (*Brassica Oleracea* L. Var. Botrytis*)*

Oleh

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Penggunaan sisa pertanian sebagai produk pertanian seperti baja dan media tanaman boleh menyumbang ke arah mengurangkan bil import, makanan yang lebih selamat dan mengelakkan pencemaran alam sekitar. Kajian telah dijalankan untuk menilai kesan lima kompos sisa pertanian yang berbeza sebagai komponen media semaian dan sebagai sumber baja organik untuk pengeluaran kobis bunga di bawah struktur perlindungan tanaman. Lima kompos dari sumber berbeza yang digunakan adalah kompos tandan buah sawit kosong (EFBC), kompos sisa kekwa (CRC), kompos sisa kacang soya (SWC), vermikompos sisa hijau (GWV) dan vermikompos sisa sayur-sayuran (VWV). Campuran substrat ini menggunakan nisbah 30% kompos kepada 70% gambut (v/v) dan media 100% gambut digunakan sebagai rawatan kawalan untuk pertumbuhan anak benih. Eksperimen menggunakan rekabentuk rawak lengkap dengan empat replikasi. Hasil kajian menunjukkan bahawa penggantian gambut dengan kompos meningkatkan kepadatan pukal, kesediaan air, keliangan dan kandungan nutrien dalam media campuran. Media yang mengandungi CRC dan media gambut (100%) didapati mempunyai ciri-ciri fizikal, kekonduksian elektrik (EC) dan kandungan nutrien yang serupa. Ketinggian anak benih, jumlah bilangan daun, jumlah luas daun dan berat kering tertinggi direkod dalam media campuran CRC dan media gambut. Walaubagaimanapun, morfologi akar anak benih kobis bunga dalam media campuran CRC dipengaruhi dengan bererti ($P < 0.05$) berbanding dengan campuran substrat lain. Keputusan mendapati bahawa penggunaan gambut boleh separa digantikan dengan CRC, EFBC, GWV atau VWV manakala penggunaan SWC memberi kesan negatif dan menjejaskan pertumbuhan tanaman. Sifat-sifat fizikal dan kimia media campuran SWC seperti nilai pH, kekonduksian elektrik dan ketumpatan pukal yang tinggi didapati tidak sesuai untuk pertumbuhan anak benih kobis bunga. Kajian ini menunjukkan bahawa kompos menunjukkan peningkatan pertumbuhan anak benih kobis bunga dan peningkatan

pertumbuhan ini disumbangkan oleh peningkatan sifat-sifat fizikal dan kimia media tanaman.

Kompos yang sama digunakan sebagai baja organik untuk menilai kesan ke atas sifat tanah, kandungan nutrien, prestasi pertumbuhan dan hasil kobis bunga di bawah struktur perlindungan tanaman. Kompos (EFBC, CRC, SWC, GWV dan VWV) sebagai sumber baja organik diberikan sebelum pemindahan anak benih kobis bunga dan baja bukan organik (N: P_2O_5: K_2O: MgO; 12:12:17:2:TE) digunakan sebagai kawalan, jumlah baja yang digunapakai adalah dikira berdasarkan pada 180 kg ha^{-1} kandungan N. Eksperimen menggunakan rekabentuk rawak lengkap dengan tiga replikasi. Keputusan menunjukkan penggunaan kompos sebagai baja organik memberi kesan ketara ke atas sifat tanah, pertumbuhan, kapasiti fotosintetik, kandungan nutrien dan hasil kobis bunga. Penggunaan VWV memberi kesan bererti ($P < 0.05$) terhadap pertumbuhan daun kobis bunga yang ditanam di bawah struktur pelindung tanaman. Prestasi pertumbuhan kobis bunga yang menggunakan vermikompos sisa sayur-sayuran (VWV) adalah sama dengan kobis bunga yang menggunakan baja bukan organik dari segi ketinggian pokok dan berat kering daun dan lebih baik dari segi jumlah luas daun. Kandungan nutrien menunjukkan bahawa nutrien adalah mencukupi dan memenuhi keperluan pertumbuhan dan hasil dalam semua rawatan baja yang diberikan. Hasil kobis bunga tertinggi didapati dengan penggunaan VWV, walaubagaimanapun ia tidak berbeza secara statistik dengan pembajaan EFBC dan bukan organik. Kandungan asid askorbik adalah tertinggi dalam kedua-dua rawatan EFBC dan VWV namun, kobis bunga VWV didapati boleh dituai lebih awal berbanding dengan rawatan lain. Keputusan kajian mendapati penggunaan kompos boleh menghasilkan pertumbuhan dan hasil yang sama seperti baja bukan organik apabila jumlah N yang sama dibekalkan kepada pokok. Walaubagaimanapun, kesan kompos keatas pertumbuhan tanaman dan hasil tidak sentiasa positif dan mungkin berbeza bergantung kepada sumber kompos, tahap kematangan kompos dan tahap ketersediaan N setiap kompos.

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I certify that a Thesis Examination Committee has met on 28 August to conduct the final examination of Farahzety Abdul Mutalib on her thesis entitled " Effects Of Compost Sources as a Component of Seedling Growing Media and Fertilizer on Growth Performance of Cauliflower (*Brassica Oleracea* L. Var. Botrytis)" in accordance with the 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 Master of Science.

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TABLE OF CONTENTS

		Page
ABSTRACT		i
ABSTRAK		iii
ACKNOWLEDGEMENTS		v
APPROVAL		vi
DECLARATION		viii
LIST OF TABLES		xiii
LIST OF FIGURES		xv
LIST OF PLATES		xvi
LIST OF ABBREVIATIONS		xvii
CHAPTER		
1 INTRODUCTION		1
2 LITERATURE REVIEW		3
2.1 Agriculture Waste		3
2.2 Utilization of Agriculture Waste		3
2.3 Conventional Compost		5
2.3.1 Effects of Compost on Soil and Media Properties		6
2.3.2 Effects on Compost on Plant Nutrient		6
2.3.3 Effects on Compost on Plant Growth, Yield and Quality		7
2.4 Vermicompost		8
2.4.1 Effects on Vermicompost on Soil and Media Properties		9
2.4.2 Effects on Vermicompost on Plant Nutrient		9
2.4.3 Effects on Vermicompost on Plant Growth, Yield and Quality		10
2.5 Seedling Transplant Production		11
2.6 Vegetable Cultivation		11
2.7 Protective Structure		12
2.8 Cauliflower		13
3 EFFECTS OF FIVE TYPES OF COMPOST AS A COMPONENT OF GROWING MEDIA ON SEEDLING GROWTH OF CAULIFLOWER		15
3.1 Introduction		15
3.2 Materials and Methods		16
3.2.1 Study Location and Planting Material		16
3.2.2 Treatments and Experimental Design		17
3.2.3 Seeding and Seedling Management		18
3.2.4 Determination of Physical Properties		18
3.2.5 Determination of Chemical Properties		19
3.2.6 Growth Performance		20
3.2.6.1 Seedling Emergence and First True Leaf Emergence (days)		20
3.2.6.2 Seedling Development		20
3.2.6.3 Seedling Biomass		20
3.2.6.4 Total Root Length, Surface Area and Volume		21

3.2.6.5 Relative Chlorophyll Content 21
3.2.6.6 Nutrient Analysis 21
3.2.7 Statistical Analysis 21
3.3 Results 22
3.3.1 Physical and Chemical Properties of Media Mixture 22
3.3.2 Seedling Growth 23
3.3.2.1 Seedling Emergence and First True Leaf Emergence (days) 23
3.3.2.2 Seedling Height 25
3.3.2.3 Total Leaf Number 25
3.3.2.4 Total Leaf Area 26
3.3.2.5 Seedling Biomass 27
3.3.2.6 Root to Shoot Ratio 27
3.3.2.7 Total Root Length, Root Surface Area and Root Volume 28
3.3.3 Relative Chlorophyll Content 29
3.3.4 Nutrients Concentration 30
3.3.5 Correlation Analysis 31
3.4 Discussion 33
3.4.1 Effects of Compost Substrates as a Component of Growing Media on Physical and Chemical Properties 33
3.4.2 Effects of Compost Substrates as a Component of Growing Media on Seedling Growth and Plant Minerals Accumulation 34
3.5 Conclusion 36

4 EFFECTS OF FIVE TYPES OF COMPOST AS A FERTILIZER ON GROWTH, NUTRIENT STATUS AND YIELD OF CAULIFLOWER GROWN UNDER PROTECTIVE STRUCTURE 37
4.1 Introduction 37
4.2 Materials and Methods 38
4.2.1 Site Description 38
4.2.2 Planting Materials, Treatments and Experimental Design 38
4.2.3 Crop Establishment and Plot Preparation 39
4.2.4 Chemical Properties of Soil and Composts 40
4.2.5 Plant Growth Performance 40
4.2.5.1 Plant Height and Canopy Width 40
4.2.5.2 Total Leaf Area 41
4.2.5.3 Shoot Dry Weight 41
4.2.6 Chlorophyll Content 41
4.2.7 Photosynthesis and Stomata Conductance 41
4.2.8 Plant Tissue Analysis 41
4.2.9 Yield Component 42
4.2.9.1 Determination of Ascorbic Acid Content (Vitamin C) 42
4.2.10 Statistical Analysis 43
4.3 Results 43
4.3.1 Chemical Properties of Composts 43
4.3.2 Vegetative Growth 43
4.3.2.1 Plant Height 44

4.3.2.2 Canopy Width 44
4.3.2.3 Total Leaf Area 45
4.3.2.4 Shoot Dry Weight 46
4.3.3 Chlorophylls Content 48
4.3.4 Photosynthesis Rate and Stomatal Conductance 48
4.3.5 Leaf Nutrients Status 50
4.3.6 Yield Component 52
4.3.6.1 Curd Maturity 52
4.3.6.2 Curd Diameter 52
4.3.6.3 Curd Weight 52
4.3.6.4 Ascorbic Acid Content (Vitamin C) 52
4.3.6.5 Curd Nutrient Status 53
4.3.7 Soil Chemical Properties 55
4.3.8 Correlation Analysis 57
4.4 Discussion 59
4.4.1 Effects of Compost as Fertilizer on Growth of Cauliflower under Protective Structure 59
4.4.2 Effects of Compost as Fertilizer on Photosynthetic Capacity of Cauliflower under Protective Structure 60
4.4.3 Effects of Compost as Fertilizer on Leaf Nutrient Content of Cauliflower under Protective Structure 61
4.4.4 Effects of Compost as Fertilizer on Yield and Quality of Cauliflower under Protective Structure 62
4.4.5 Effects of Compost as Fertilizer on Soil Chemical Properties of Cauliflower under Protective Structure 63
4.5 Conclusion 64

5 SUMMARY, CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH 66

REFERENCES 69
APPENDICES 88
BIODATA OF STUDENT 100
LIST OF PUBLICATIONS 101

LIST OF TABLES

Table		Page
3.1	Description of five types of compost used	17
3.2	Characteristics of media mixtures with various compost substrates in partial substitution of peat	22
3.3	Mineral elements of media mixture with various compost substrates in partial substitution of peat	23
3.4	Total leaf number and total leaf area of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	27
3.5	Dry mass production and partitioning of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	28
3.6	Total root length, root surface area and root volume of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	29
3.7	Analysis of nutrient elements concentrations in the leaf tissue of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	31
3.8	Pearson's correlation analysis for media mixture properties and growth of cauliflower seedling	32
3.9	Correlation coefficients between mean shoot dry weight and average nutrient concentrations of plant tissue in different media mixture	32
4.1	Main chemical properties of the composts used	43
4.2	Total chlorophyll content, net photosynthesis rate (P_N) and stomatal conductance (*gs*) of cauliflower as affected by various compost as fertilizer	49
4.3	Nutrient content in cauliflower leaf tissues at different growth stages as affected by various compost as fertilizer	51
4.4	Curd maturity, diameter, weight and ascorbic acid content of cauliflower as affected by various compost as fertilizer	53
4.5	Nutrient content in cauliflower curd tissues as affected by various compost as fertilizer	54

4.6 Main soil chemical properties at different stages as affected by various compost as fertilizer 56

4.7 Pearson's correlation analysis for plant growth and leaf nutrient status of cauliflower at harvesting 58

LIST OF FIGURES

Figure		Page
3.1	Percentage of seedling emergence of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	24
3.2	Days for first true leaf to emerge of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	25
3.3	Seedling height of cauliflower as affected by various compost substrates in partial substitution of peat as a component in growing media	26
3.4	Relative chlorophyll content of cauliflower seedling as affected by various compost substrates in partial substitution of peat as a component in growing media	30
4.1	Plant height of cauliflower as affected by various compost as fertilizer	44
4.2	Canopy width of cauliflower as affected by various compost as fertilizer	45
4.3	Total leaf area of cauliflower as affected by various compost as fertilizer	46
4.4	Shoot dry weight of cauliflower as affected by various compost as fertilizer	47

LIST OF PLATES

Plate		Page
3.1	Experimental layout in RCBD with four replications	17
4.1	Experimental layout in RCBD with three replications	38

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
Ca	Calcium
EC	Electrical Conductivity
CRC	Chrysanthemum Residues Compost
EFBC	Empty Fruit Bunches Compost
gs	Stomatal Conductance
GWV	Green Wastes Vermicompost
K	Potassium
MARDI	Malaysian Agriculture Research and Development Institute
Mg	Magnesium
N	Nitrogen
NPK	Nitrogen – Phosphorus - Potassium
P	Phosphorus
Pn	Photosynthesis
RCBD	Randomized Completed Block Design
R:S	Root to Shoot ratio
SAS	Statistical Analysis System (Software)
SWC	Soybean Waste Compost
VWV	Vegetable Waste Vermicompost

CHAPTER 1

INTRODUCTION

Vegetable industry in Malaysia is highly dependent on imported chemical fertilizers in order to sustain optimum yield production. In 2010, Malaysia imported chemical fertilizers worth RM 4.55 million for agricultural activities including plantation and horticultural crops (Ministry of Agriculture and Agro-based Industry Malaysia, 2011). In 2010, the total vegetable crops occupied 53,057 hectares (Ministry of Agriculture and Agro-based Industry Malaysia, 2011). There is also an increase trend to produce more vegetable crops in order to fulfill the increase population in the country. Malaysia continues to import fresh vegetables mainly from Thailand, Indonesia, Myanmar and Vietnam to meet local consumption as farm labour and production costs are escalating. Since 2008, Malaysia has taken preventive measures and The National Food Security Policy was set out to ensure that food supply is adequate, of quality and safe for consumption. This is due to the increase in food prices and the shortage of food supply at international level that led to food crisis in several countries.

Thus, the use of agricultural wastes as renewable agricultural products such as fertilizer and growing medium can contribute towards reducing the import bill, provide us with safer food and avoid environmental pollution. With continued use, the soil fertility could also improve. The use of organic fertilizers for crops production is more sustainable and is a better management of natural resources than conventional production system. The current interest in reducing the application of chemical fertilizers and increased demand for natural and healthier methods of food production may have a great impact in organic vegetable production. Hence, organic cultivation has become one of the top priorities in our current national agriculture policy. For vegetable cultivation, particularly under protective structure, organic fertilizer is an important alternative to minimize the impact of salt accumulation from intensive and continuous use of chemical fertilization. There have been reports that salt accumulation in soils under plastic houses is a common occurrence (Chang and Liao, 1989; Yoon, 1985). Continuous cropping and repeated use of inorganic fertilizers contributed to the increase in soil acidity, nutrient leaching and reduction of soil physical and organic matter status (Nottidge *et al*., 2005; Ojeniyi, 2000 and Obi and Ebo, 1995). Thus, an alternative source of maintaining soil fertility has to be sourced and organic fertilizer has been proven as a formidable alternative. Utilization of organic matter has been well documented to improve the physical, chemical and biological properties of soils (Tejada and Gonzalez, 2003; Whalen *et al*., 2000). Cook *et al*. (1994) stated that the addition of compost to soil generally improves tilth, structure, infiltration, drainage, and water-holding capacity of soils.

Furthermore, the use of organic wastes as growing media in the production of vegetable seedlings is also important as an alternative to imported commercial growing media and could improve transplant seedling production efficiency. Nursery production of vegetable seedlings is normally practiced to produce seedlings with optimal growth and development. Herrera *et al.* (2008) stated that uniform seedling emergence and rapid growth are essential for efficient crop production. Thus, nutritional quality, structure and stability of the media are important. Besides crop performance, suitable growing media should also have traits such as availability, cost, weight and reusability. Growing media are materials other than soils, in which plants are grown. Other than peat, there are various organic materials such as perlite, vermiculite, rockwool, bark, wood residues, coir, rice hulls, composted materials and others that have been used widely as growing media.

The emphasis was on byproduct organic materials that are locally produced, available and enough supply to be used in large commercial operations. In view of the potential benefits of composted organic wastes as growing media and organic fertilizer, a study was conducted with the objectives:

1. To evaluate the use of five types of compost in mixture with peat as growth medium for seedlings of cauliflower.

2. To evaluate the growth of cauliflower using compost materials as source of fertilizer in comparison with inorganic fertilizer under protective structure

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