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EFFECTS OF ZEOLITE CONCENTRATIONS AND SLOW RELEASE FERTILIZER INCORPORATED IN KENAF CORE FIBER MEDIA ON SELECTED ANNUAL FLOWERS

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By

BILAL ADIL MOHAMMED

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

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DEDICATIONS

To my dear father, mother, and to all those individuals whom without them none of this would be possible

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

EFFECTS OF ZEOLITE CONCENTRATIONS AND SLOW RELEASE FERTILIZER INCORPORATED IN KENAF CORE FIBER MEDIA ON SELECTED ANNUAL FLOWERS

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Kenaf core fiber (KCF) could become a good growing substrate as the material is renewable, easy to handle, lightweight and low cost. However, KCF has poor chemical and physical properties due to its low cation exchange capacity (CEC) and water retention capacity.

The study was conducted to determine the effects of different concentrations of zeolite incorporated to KCF on growth and development of some selected annual flowers; to examine and improve the physical and chemical properties of the substrate consisting of KCF by applying different rates of slow- release fertilizer; determine the effects of different rates of slow-release fertilizer on growth and flowering of marigold plants grown on KCF containing different concentrations of zeolite; and finally to determine the effects of KCF containing zeolite on growth and flowering of marigold, celosia, and cosmos plants.

This study consists of four experiments. The first experiment was conducted using different concentrations of zeolite (0, 10, 20, 30, 40, and 60 g/L media) incorporated into KCF. The second experiment was conducted using concentrations of zeolite (0, 10, 20, 30 and 40 g/L media) incorporated into KCF using marigold as an experimental plant. The third experiment was conducted in order to improve KCF base substrate media by adding different concentrations of zeolite (0, 30 and 60 g/L media), and slow release fertilizer (Osmocote® applied as pre-plant fertilizer 0, 3, 6, 9 and 12 g/L media) and applied as post-plant fertilizer (0 and 5 g/L media) into KCF media. The last experiment involved different levels of zeolite (30, 60 and 90 g/L media) incorporated to KCF using three species of annual flowers celosia, cosmos and marigold as the plant materials. The experimental units were arranged in Randomized Complete Block Design (RCBD).

The results of the first experiment showed that different concentrations of zeolite incorporated to KCF had no significant effect on pH, electrical conductivity (EC), and

nitrogen drawdown index (NDI), wettability, container capacity and air filled porosity of the KCF substrate. However, using different concentrations of zeolite significantly affected the CEC of the KCF substrate media for the concentration of 0 g/L compared to other treatments.

In the second experiment, different concentrations of zeolite incorporated into KCF significantly affected the plant performance of marigold plants where the highest plant growth and flowering of marigold plant were recorded in media containing 40 g/L media zeolite as reflected by plant height, stem width, flower number and flowers size.

In the third experiment, different concentrations of zeolite incorporated into KCF did not have any significant effect on growth and flowering of the marigold plant. However, different concentrations of pre-plant and post-plant fertilizer in KCF affected the growth of marigold significantly. Plants grown on media with 5 g/L slow release fertilizer as a post-plant fertilizer were better than those grown on 0 g/L as indicated by plant height, stem width, and flower sizes. Addition of 12 g/L fertilizer as a pre-plant fertilizer had significantly promoted plant growth in term of plant height, stem width, flower number, and flower sizes.

The result of the last experiment showed that, There was no significant effect of using different concentrations of zeolite on the performance and plant growth. However, different species of annual flowers grew differently as shown in their plant height, stem width, flower number and flower sizes. Celosia showed the best growth performance in KCF incorporated with zeolite followed by marigold and cosmos. On the other hand, marigold had the highest dry weight value compared to celosia and cosmos when grown in KCF incorporated with zeolite.

Results of the study showed that KCF produced from Hibiscus cannabinus incorporated with different concentrations of zeolite could be used in successful production of annual flowers, especially when the media were treated with slow release fertilizer, both on pre-plant and post-plant applications.

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

KESAN KEPEKATAN ZEOLIT DAN GABUNGAN BAJA LEPASAN PERLAHAN SERAT EMPULUR KENAF TERHADAP TUMBUHAN BUNGA SEMUSIM PILIHAN

Oleh

BILAL ADIL MOHAMMED

Mei 2016

Pengerusi : Profesor Madya. Yahya Awang, PhD

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Serat empulur kenaf (KCF) mampu menjadi substrat pertumbuhan yang baik berdasarkan sifatnya yang boleh diperbaharui, mudah diguna, ringan dan kos yang rendah. Walau bagaimanapun, KCF mempunyai kekurangan pada ciri-ciri kimia dan fizikal berikutan kapasiti pertukaran kation (CEC) yang rendah dan kapasiti pembendungan air.

Kajian ini telah dijalankan bagi mengetahui kesan penggabungan kepekatan zeolit yang berbeza pada KCF terhadap pertumbuhan dan perkembangan bunga bermusim terpilih; bagi menguji serta menambah baik ciri-ciri kimia dan fizikal pada substrat yang mengandungi KCF dengan mengaplikasikan baja lepasan perlahan pada kadar yang berbeza; menentukan kesan baja lepasan perlahan dengan kadar yang berbeza terhadap pertumbuhan dan pembungaan pada tumbuhan marigold yang tumbuh pada KCF yang mengandungi kepekatan zeolit yang berbeza; dan akhir sekali bagi menentukan kesan KCF yang mengandungi zeolit terhadap pertumbuhan dan pembungaan pada marigold, celosia dan tumbuhan cosmos.

Kajian ini mengandungi empat eksperimen. Eksperimen pertama telah dijalankan dengan menggunakan zeolit pada kepekatan yang berbeza (0, 10, 20, 30, 40 dan 60 g/L media) yang digabungkan ke dalam KCF. Eksperimen kedua dijalankan dengan menggunakan zeolit pada kepekatan (0, 10, 20, 30, dan 40 g/L media) yang digabungkan ke dalam KCF dengan menggunakan marigold sebagai tumbuhan uji kaji. Eksperiment ketiga dijalankan bagi tujuan menambah baik asas media substrat KCF sedia ada dengan menambah zeolit dalam kepekatan yang berbeza (0, 30 dan 60 g/L media), dan baja lepasan perlahan (Osmocote® yang diaplikasikan sebagai baja pra-tumbuhan 0, 3, 6, 9 dan 12 g/L media) dan diaplikasikan sebagai baja pasca-tumbuhan (0 dan 5 g/L media) ke dalam media KCF. Eksperimen terakhir melibatkan zeolit pada paras berbeza (30, 60 dan 90 g/L media) yang digabungkan ke dalam KCF menggunakan tiga spesies bunga semusim terpilih iaitu celosia, cosmos dan marigold

sebagai bahan tumbuhan. Segala unit dalam eksperimen ini disusun mengikut Randomized Complete Block Design (RCBD).

Hasil daripada eksperimen pertama telah menunjukkan kepekatan zeolit yang berbeza yang digabungkan bersama KCF tidak mendatangkan kesan yang besar ke atas pH, konduktiviti elektrik (EC), dan indeks pengeluaran nitrogen (NDI), kebolehbasahan, kapasiti bekas dan keliangan terisi udara pada substrat KCF. Walau bagaimanapun, penggunaan zeolit yang berbeza kepekatan ini memberi impak yang ketara terhadap CEC pada media substrat KCF kepada kepekatan 0 g/L berbanding yang lain.

Dalam eksperimen yang kedua, kepekatan zeolit yang berbeza yang digabungkan bersama KCF ini telah memberi kesan yang ketara terhadap prestasi pertumbuhan tumbuhan marigold di mana pertumbuhan dan pembungaan tertinggi dicatatkan bagi tumbuhan marigold pada media yang mengandungi 40 g/L zeolit media berdasarkan kepada ketinggian tumbuhan, saiz batang, bilangan dan saiz bunga.

Dalam eksperimen yang ketiga, zeolit pada kepekatan berbeza yang digabungkan ke dalam KCF tidak mendatangkan kesan yang jelas kepada pertumbuhan dan pembungaan tumbuhan marigold. Akan tetapi, perbezaan pada kepekatan baja bagi pra-tumbuhan dan pasca-tumbuhan dalam KCF dilihat memberi kesan yang ketara kepada tumbuhan marigold. Tumbuhan yang tumbuh pada media yang mengandungi 5 g/L baja lepasan perlahan sebagai baja pasca-tumbuhan didapati adalah lebih baik daripada tumbuhan yang tumbuh pada media 0 g/L berdasarkan kepada tinggi tumbuhan, saiz batang, dan saiz bunga. Tambahan sebanyak 12 g/L baja sebagai baja pra-tumbuhan jelas sekali telah menggalakkan kadar pertumbuhan tumbuhan dari segi ketinggian tumbuhan, saiz batang, bilangan bunga dan saiz bunga.

Hasil daripada kajian terakhir menunjukan, tiada kesan ketara dari penggunaan kepekatan zeolit yang berbeza ini terhadap prestasi dan kadar pertumbuhan tumbuhan. Walau bagaimanapun, spesies bunga semusim yang berbeza ini tumbuh secara berbeza dari segi ketinggian tumbuhan, saiz batang, bilangan bunga dan saiz bunga. Celosia mencatatkan kadar pertumbuhan yang terbaik pada gabungan KCF dan zeolit diikuti dengan marigold dan cosmos. Sebaliknya, marigold direkodkan mempunyai nilai berat kering tertinggi berbanding dengan celosia dan cosmos apabila dibiakkan dalam gabungan KCF dan zeolit.

Keputusan yang diperolehi jelas menunjukkan KCF yang terhasil dari Hibiscus cannabinus yang digabungkan dengan zeolit dalam kepekatan berbeza dijangkakan mampu digunakan bagi menjayakan kadar pengeluaran tumbuhan bunga semusim, terutama apabila media di baja dengan menggunakan baja lepasan perlahan, sama ada bagi kegunaan pra-tumbuhan mahupun pasca-tumbuhan.

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Thank you very much.

Bilal

I certify that a Thesis Examination Committee has met on 11 May 2016 to conduct the final examination of Bilal Adil. Mohammed on his thesis entitled "Effects of Zeolite Concentrations and Slow Release Fertilizer Incorporated in Kenaf Core Fiber Media on Selected Annual Flowers" 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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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The member of the Supervisory Committee were as follows:

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This is to confirm that:

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Signature: _____	Signature: _____
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LIST OF ABBREVIATIONS

AFP: Air-filled porosity

CEC: Cation exchange capacity

CGC: Cotton gin compost

CP: Coco-peat

DAT: Day after transporting

EC: Electrical conductivity

KCF: Kenaf core fiber

NDI: Nitrogen drawdown index

PB: Pine bark

PC: Pine chip

PTS: Pine trees

SRFs: Slow release fertilizers

CHAPTER 1

INTRODUCTION

1.1 Background

Suitable soil utilized by nurserymen is important for producing of superior horticultural crops. Top soil as non-exchangeable resource provides adequate nutrients and water that lead to good growth. By increasing the demand of making some area of land more profitable or productive for development, supplying topsoil has been declined. Therefore, utilization of soilless growing media has been promoted in the production of horticultural crops and makes it more popular with nurserymen (Yahya *et al*., 2009).

In this study the growing substrate used is kenaf core fiber (KCF), since it has some advantages of being readily available, easy to handle, and lightweight. As KCF contain high C:N ratio plants grown in this media suffer from high N immobilization as media shrinking furthermore. KCF has been reported to have low CEC. Therefore incorporation of zeolite into KCF would improve the physical and chemical properties of the media.

However when KCF is used as soilless media, the plant growth suffer from two drawbacks, first, using KCF as substrate lead to media shrinking, the second is, high N immobilization induces nitrogen deficiency in plants that leads plants growth unsatisfactory.

1.2 Objectives

The objectives of this research to investigate the effect of different concentrations of zeolite and slow-release fertilizer incorporated in KCF substrate media on growth and development of selected annual flowers and then to determine the chemical and physical properties of the KCF as a growing substrate by using potted African marigold Taishan orange color in addition to other selected annual flowers as a test species. More specifically, the objectives of the study are:

1. To determine the chemical and the physical properties of substrates media consisted of kenaf core fiber incorporated to different rates of zeolite.
2. To determine the effect of zeolite concentrations mixed with the KCF substrate media on the growth and flowering of selected annual followers
3. To determine the effect of different rates of slow-release fertilizer as a pre and post- plant fertilizers on growth and flowering of selected annual flowers grown on KCF with different concentrations of zeolite.

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