UNIVERSITI PUTRA MALAYSIA

EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON BRIS FERTILITY AND GROWTH PERFORMANCE OF SELECTED KENAF (HIBISCUS CANNABINUS L.) VARIETIES

MOHD HADI AKBAR BIN BASRI

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By

MOHD HADI AKBAR BIN BASRI

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

June 2014
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DEDICATION

Especially to whom their love and support behind my fulfillment of this study:
My father, Basri Bin Hj. Wasli,
My mother, Rosmah Binti Abdullah,
My sisters and brothers,
My fiancee,
Noorsuhaila Binti Abu Bakar,
My friends,
Thank you and I love u all
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

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June 2014

Chairman : Assoc. Prof. Arifin Abdu, PhD
Faculty : Forestry

Kenaf (Hibiscus cannabinus L.) in Malaysia are widely planted on low fertility problematic soil known as Beach Ridges Interspersed with Swales (BRIS). BRIS soils have low nutrient concentration, low fertility, and lack of many important soil properties that affects the yield and productivity of kenaf. Therefore, in the first study, a pot experiment was carried out to determine and compare the effects of biochar, chicken manure, urea and zeolite on soil pH variability and elevation in a sandy loam acidic soil. Fan and Mackenzie’s method was modified and used to determine the soil pH in the pots. Soil pH in the pots was measured using a glass micro-electrode and spatial variability was interpolated and mapped using GIS software. Kriged maps clearly showed the presence of variability and elevation in pH within each treatment. Furthermore, the position of patches with maximum and minimum values for pH changed between all treatments used in the experiment. The highest elevation was found in Zeolite treated soil followed by urea and biochar. However, a significant decrease was measured in soil pH in chicken manure treated soil. These findings could be the first step towards establishing temporal stability in the pattern of spatial distribution of soil pH affected by the soil amendments. A second study was conducted in a glasshouse experiment to determine the effects of mixed organic-inorganic fertilizer application on the properties of BRIS soils and the growth of Hibiscus cannabinus L. Altogether, there were 16 treatments: (T1)-control (100% BRIS soil), (T2)-NPK (chemical fertilizer), (T3)-CM (chicken manure), (T4)-B (biochar), (T5)-Z (zeolite), (T6)-NPK+CM, (T7)-NPK+B, (T8)-NPK+Z, (T9)-CM+B, (T10)-CM+Z, (T11)-B+Z, (T12)-NPK+CM+B, (T13)-NPK+CM+Z, (T14)-CM+B+Z, (T15)-NPK+B+Z and (T16)- NPK+CM+B+Z. Results showed that application of inorganic material or organic fertilizer in combination with chemical fertilizer (T2 and T16) improved soil fertility, which are reflected by the increase in exchangeable K, Ca and Mg, cation exchange capacity (CEC), total N, total C and available P. The highest level of kenaf growth was observed in T15 treatment. Application of biochar, zeolite or chicken manure alone on the soils did not result in better kenaf growth compared to the
control. Zeolite and biochar should be applied with other fertilizers or organic substrates to obtain a positive crop yield and improve the soil properties. In addition, more studies of the application of chicken manure at different ratios should be conducted to obtain the best yield. A combination treatment, T\textsubscript{15} (NPK + biochar + zeolite) can be suggested to farmers, especially for cultivation of kenaf on sandy BRIS soil in order to obtain the best kenaf growth performance and indirectly reduce excessive use of chemical fertilizers. Optimization of the fertilizer rate for BRIS soils and selection of suitable soil amendments is crucial in these soils to obtain higher yields. Hence, in the third study a field experiment was conducted to evaluate optimization of fertilizers and their effects on soil chemical properties, physiology and the growth response of *Hibiscus cannabinus* L. cultivated on BRIS soils. Eight treatments were evaluated; (T\textsubscript{1}) control, (T\textsubscript{2}) biochar, (T\textsubscript{3}) chicken manure, (T\textsubscript{4}) urea, (T\textsubscript{5}) chicken manure + urea, (T\textsubscript{6}) biochar + chicken manure, (T\textsubscript{7}) urea + biochar, and (T\textsubscript{8}) biochar + chicken manure + urea. The biomass and physiological characteristics were recorded every month, while the soil was analyzed following standard laboratory procedure. The results showed that the application of organic and inorganic fertilizer (urea) significantly increased the nutrient content of the soil compared to the T\textsubscript{1} (control), T\textsubscript{3} (chicken manure) showed the highest mean values for pH, CEC, and exchangeable bases (Na, Mg, and Ca). In contrast, effects on growth measurement were found indicating that T\textsubscript{8} showed the highest mean values compared to other treatments. The physiological results showed that application of nitrogen fertilizer significantly increased the rate of photosynthesis and stomata conductivity. In conclusion, mixing of biochar with organic (chicken manure) and inorganic fertilizers (urea) improved the fertility of sandy soil and significantly showed the highest results in plant diameter, plant height and number of leaves. Further research and other related study are recommended in order to validate these findings.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN-KESAN BAJA ORGANIK DAN TAK ORGANIK KE ATAS KESUBURAN BRIS DAN PRESTASI PERTUMBUHAN VARIETI KENAF (HIBISCUS CANNABINUS L.) YANG TERPILIH

Oleh

MOHD HADI AKBAR BIN BASRI

Jun 2014

Pengerusi : Prof. Madya Ariffin Abdu, PhD
Fakulti : Perhutanan

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I certify that an Examination Committee has met on June, 20 2014 to conduct the final examination of Mohd Hadi Akbar Bin Basri on his Master of Science thesis entitled “Effects of Organic and Inorganic Fertilizers on BRIS Fertility and Growth Performance of Selected Kenaf (Hibiscus cannabinus L.) Varieties” 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.

Members of the Examination Committee were as follows:

Azmy Mohamed, PhD
Associate Professor
Faculty of Forestry
Universiti Putra Malaysia
(Chairman)

Mohamad Azani Alias, PhD
Associate Professor
Faculty of Forestry
Universiti Putra Malaysia
(Internal Examiner)

Mohd Zaki Hamzah, PhD
Associate Professor
Faculty of Forestry
Universiti Putra Malaysia
(Internal Examiner)

Mohd Zaki Abdullah, PhD
Research Officer
Forest Research Institute Malaysia
(External Examiner)

NORITAH OMAR, PhD
Assoc. Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

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

**Arifin Abdu, PhD**  
Associate Professor  
Faculty of Forestry  
Universiti Putra Malaysia  
(Chairman)

**Ahmed Osumanu Haruna, PhD**  
Associate Professor  
Faculty of Agriculture and Food Sciences  
Universiti Putra Malaysia Bintulu Campus  
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DECLARATION

Declaration by graduate student

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Name of Chairman of Supervisory Committee: Arifin Abdu, PhD

Signature: ____________________

Name of Member of Supervisory Committee: Ahmed Osumanu Haruna, PhD
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