Vol. 4 (2014) No. 6

Articles

Inhibition Effect of Maccha Extract Microemulsion on Vitamin C Photooxidation in Aqueous Systems
Hasbullah Hasbullah, Sri Raharto, Pudji Hadiuh
pages: 389-390 Full text DOI:10.18517/iaseit.4.6.442

Production Cost Assessment of Palm Empty Fruit Bunch Conversion to Bio-Oil via Fast Pyrolysis
Yoga Perycga, Maharani Dewi Soelikah, Alfonsus Agus Raisowewanto
pages: 394-400 Full text DOI:10.18517/iaseit.4.6.443

Growth and Yield of Chili Pepper under Different Time Application of Wedelia (Wedelia trilobata) and Siam Weed (Chromolaena odorata) Organic Fertilizers
Nanik Syelovati, Zainal Mukhtar, Sri Oktas, Dwinti Wijanesant
pages: 401-404 Full text DOI:10.18517/iaseit.4.6.444

Regional Planning Strategic of Irrigated Agricultural Land Conversion by Considering to The Irrigation System (Case Study : Cirea Irrigation System of Cianjur)
Endang Purnama Dewi, M Yaniar J Purwanto, Asep Sapei
pages: 405-410 Full text DOI:10.18517/iaseit.4.6.445

Value-added and Supporting - Inhibiting Factors for the Wet Processing of Coffee
Yuki Hanayati
pages: 411-415 Full text DOI:10.18517/iaseit.4.6.446

Individual Selection in Two Population of Segregation Based on Yield and Yield component
Nurwanda Eka Sarini, Aries Kusumawati, Iratiwati Chaniago, Irfan Suliantinah
pages: 416-418 Full text DOI:10.18517/iaseit.4.6.451

Optimization of Production Xylanase from Marine Bacterium Bacillus safensis P20 on Sugarcane Bagasse by Submerged Fermentation
Nanik Rahmani, Nadia Ulfia Jabbar Robbani, Irma Herawati Suparto, Yopi Yopi
pages: 419-422 Full text DOI:10.18517/iaseit.4.6.458

Quality Improvement of Cassava Flour of Local Variety of Ternate Through Fermentation Method (Application on Traditional Food of North Maluku "Sagu Impeng")
Hamidin Rasul
pages: 423-425 Full text DOI:10.18517/iaseit.4.6.449

Vehicular Ad Hoc Network Mobility Model
Budi Rahmadya
pages: 426-429 Full text DOI:10.18517/iaseit.4.6.457

Selection of Arbuscular Mycorrhizal Fungi (AMF) Indigenous in Ultisols for Promoting The Production of Glinhali and Aggregate Formation Processes
Amnizal Saidi, El Farda Husan, Azwar Rasyidin, Edwiwal Eddiwal, Ismon L
pages: 430-436 Full text DOI:10.18517/iaseit.4.6.452

Water Potential in Petambo River Estuary and Model of Water Resources Management for Sustainable Agriculture in Gianyar Regency Bali Province
Eryani I GST AG PT, Indayati Lanyi, Santosa I GST NGR, I Nyoman Norken
pages: 437-440 Full text DOI:10.18517/iaseit.4.6.459

A Simple Purification Method of Catechin from Gambier
Phenology Studies in Efforts Produced Off Season Citrus (Citrus nobilis var. microcarpa)
Sulistiarwadi N. P. A, Rael N. Santosa IGN, Asiarini I A
pages: 444-449 full text DOI:10.18517/ijaseit.4.6.462

Involvement of Government Institutions in Agroindustrial Development: A Case of Fruit Processing Industries in East Java, Indonesia
I. B. Suryaningrat
pages: 450-454 full text DOI:10.18517/ijaseit.4.6.448

Gambier: Indonesia Leading Commodities in The Past
Hamda Fauza
pages: 455-460 full text DOI:10.18517/ijaseit.4.6.463

Response of Rice and Carbon Emission to Application of Ameliorant Drags in The Peat Soil with Saturation and Unsaturation Condition
Nelvia Nelvia
pages: 461-465 full text DOI:10.18517/ijaseit.4.6.456

The Substitution of Wheat Flour with Mixed-Cassava (Manihot utilisima) and Red Beans-Flour (Phaseolus vulgaris L.) Toward The Characteristics of Instant Noodles
Novelina Novelina, Nesweel Neswati, Anggun Fitrin
pages: 466-469 full text DOI:10.18517/ijaseit.4.6.464

Analysis the Oil Palm Land which can be Converted Into Paddy Fields in Irrigated Areas of Batang Tongan
Deli Yanti, Eri Gas Ekaputra, Roland Asmoro
pages: 470-475 full text DOI:10.18517/ijaseit.4.6.465
Editorial Team

Editor in Chief:
Sri Arnaia Putra, (Scopus ID: 26321207460), Muhammadiyah Yogyakarta University, INDONESIA

Associate Editors:
Taurul, (Scopus ID: 23670369800), California Polytechnic State University, USA
Moustafa M Eissa, (Scopus ID: 35501593900), Helwan University, EGYPT
Wan Mohd Wan Yusoff, (Scopus ID: 15010867700), Universiti Kebangsaan Malaysia, MALAYSIA
Hassanin Badrani Zaman, (Scopus ID: 228526991600), Universiti Kebangsaan Malaysia, MALAYSIA
Son Radu, (Scopus ID: 70005251000), Universiti Putra Malaysia, MALAYSIA
Mohd Razli Ismail, (Scopus ID: 23657691400), Universiti Putra Malaysia, MALAYSIA
Takashi Oku, (Scopus ID: 562872094900), Prefectural University of Hiroshima, JAPAN
Kohei Nakano, (Scopus ID: 74020117900), Gifu University, JAPAN
Nurul Huda, (Scopus ID: 65701655514), Universiti Sultan Zainal Abidin, MALAYSIA
Yandra Antkaman, (Scopus ID: 539456550300), Bogor Agriculture University, INDONESIA
Sate Sampattagul, (Scopus ID: 79061409900), Chiangmai University, THAILAND
Preyush Soni, (Scopus ID: 9244907800), Asian Institute of Technology, THAILAND
Yolanda Lechon Perez, (Scopus ID: 562826260000), Ciemat, Madrid, SPAIN
Gabrielle Andreacchino, (Scopus ID: 562566264600), G. Marconi University, ITALY
Alessandra Pieroni, (Scopus ID: 252925245000), Marconi International University, Florida, USA
Nguyen Hay, (Scopus ID: 156364659000), Nong Lam University, VIETNAM
Rita Muhammad Awang, (Scopus ID: 558577824000), Universiti Putra Malaysia, MALAYSIA
Artson S Prabhaveeroj, (Scopus ID: 811340688000), King Abdulaziz Univ, SAUDI ARABIA
P Mangalini C S De Silva, (Scopus ID: 70056411145), University of Ruhuna, SRI LANKA
Bich Hue Nguyen, (Scopus ID: 361910681000), Nong Lam University, VIETNAM
Paul Kristiansen, (Scopus ID: 230975052000), University of New England, AUSTRALIA
Amitha Bave, (Scopus ID: 21833738300), Bahrom Chandri Krishna Vidyasagar, INDIA
Haitham Alali, (Scopus ID: 496830070000), Amman Arab University, JORDAN
Shahri Azman Mohd Noahl, (Scopus ID: 330876332000), Universiti Kebangsaan Malaysia, MALAYSIA
Lucio Di Nuzio, (Scopus ID: 517351950000), University of Rome Tor Vergata, ITALY

Managing Editor:
Rahmat Hidayat, (Scopus ID: 57191265401), Politeknik Negeri Padang, INDONESIA

Editors:
Nurhamidyah, (Scopus ID: 57191635504), Andalas University, INDONESIA
Anu Beta Janasajaroj, (Scopus ID: 57193699400), Kobe University, JAPAN
Ila Puruspaan, (Scopus ID: 551198328000), National University of Malaysia - MALAYSIA
Zain Ismail Rozman, (Scopus ID: 396597619000), Universiti Teknologi MARA (UITM) (Tareqganj) MALAYSIA
Shahreen Kism, (Scopus ID: 361153431000), Universiti Tun Hussein Onn - MALAYSIA
Chi-Hua Chen, (Scopus ID: 517999880000), National Chiao Tung University, TAIWAN
Guo Yid, (Scopus ID: 59236203100), Polytechnics State of Finland, INDONESIA
Afriz Ismardi, (Scopus ID: 266331029000), Teikoku University - INDONESIA

IJASEIT

About
Editorial Board
Guide for Authors
Journal Contact
Online Submission
Publication Ethics
Browse Authors

NEW Update: IJASEIT in Scopus
NEW Update: IJASEIT in Scimago JR

Scimago Journal Rank

International Journal on Advanced Science, Engineering and Information Technology

Q2

SJR 2017
0.24

powered by scimagojr.com

Scopus CiteScore

1.31
2017

CiteScore

Powered by Scopus
Response of Rice and Carbon Emission to Application of Ameliorant Dregs in The Peat Soil with Saturation and Unsaturation Condition

Nevia

Department of Agrotechnology, faculty of Agriculture, Riau University. Indonesia
E-mail: nnelvia@yahoo.co.id

Abstract—Fertility of peat land is very poor and makes it not suitable for crop without any high input. This condition was indicated by the very high soil acidity (low pH), low availability of macro (N, K, Ca and P), and micro (Cu, Zn, Mn and Bo) nutrients and high cation exchange capacity (CEC) but low base saturation (BS), the presence of toxic organic acid. The main organic acids, as a result of lignin biodegradation and the sources of C-release, are of aromatic group consisting mainly of derivate phenolic acids. The peat soil material was taken at depths from 0 to 30 cm, with weathering rate saprik and dregs from Indah Kiat Pulp and Paper at Perawang, Riau. These experiments using split plot design, the main plot is the condition of the water (unsaturated and saturated) and the subplot is ameliorant dregs consisting of 4 levels (0, 10, 15 and 20 ton ha\(^{-1}\)), each combination was repeated 4 times. The activities were focused on the interaction of water condition and ameliorant dregs, and its influences to growth and yield of rice, C-emission (CO\(_2\) and CH\(_4\)). The results showed that the application of dregs improves plant growth and increase the yield of rice (weight of dry milled grain) compared without dreg both at unsaturated condition and saturated conditions. The carbon-release in the forms of CO\(_2\) and CH\(_4\) fluxes in saturated conditions is smaller than unsaturated conditions. The application dreg 10 t ha\(^{-1}\) increase the number of productive tillers and the weight of milled rice about 35 and 75% compared without dreg on saturated condition, whereas the increase is greater unsaturated conditions about 63 and 80%. The application of dregs 10-20 t ha\(^{-1}\) in saturated condition can reduce CO\(_2\) and CH\(_4\) emissions about 18.19% and 93.71% compared without dreg, otherwise the application dreg 10-20 t ha\(^{-1}\) increase the production of CO\(_2\) and CH\(_4\) in unsaturated conditions.

Keywords—PutRice, peat soil, ameliorant dregs, CH\(_4\) and CO\(_2\) emission, saturated, unsaturated condition

I. INTRODUCTION

This document is a template. An electronic copy can be downloaded from the conference website. For questions on paper guidelines, please contact the conference publications committee as indicated on the conference website. Information about final paper submission is available from the conference website.

Indonesia has 188 million ha land, including peatland about 20.9 million ha, (Wahyunto et al., 2005). Peatland fertility is very poor and makes it not suitable for crop without any high input. This condition was indicated by the very high soil acidity (low pH), low availability of macro (N, K, Ca, and P), and micro (Cu, Zn, Mn and Bo) nutrients and high cation exchange capacity (CEC) but low base saturation (BS), and the presence of toxic organic acid (Simbolon, 2009).

The main organic acid, as a result of lignin biodegradation and the sources of C-release, are of aromatic group consisting mainly of derivate phenolic acids. The concentration of such organic acids ranging from the highest to lowest is as follows: ferulic acid ≈ synapic acid > p-coumaric acid > p-hydroxybenzoic acid > vanillic acid > syringic acid (Sabiham, 2010). Phenolic acids are more phytotoxic for plants and causes stunted plant growth (Tsutuski, 1984; Stevens, et al., 1994; Dohong and Sabiham, 2001), influence the biochemical and physiological processes of plants and nutrients uptake by plant (Driessen, 1978).

The drying and wetting processes on the peat materials affected the stability of organic acids, wich was indicated by loss of C- through CO\(_2\) and CH\(_4\) releases. The release of CO\(_2\) and CH\(_4\) from fibric peat was higher than that from hemic and sapric peats (Sabiham, 2010), Yagi and Minami (1990) reported that the highest rate of CH\(_4\) emission during cultivation period (44.8 g CH\(_4\) m\(^{-2}\)) was in rice field consisting peat.

The drainage of peat release oxygen (O\(_2\)) into the surface, with promotes decomposition. Emission estimates, for land use systems with a depth of 60 cm drainage is around 55 Mg CO\(_2\) ha\(^{-1}\) year\(^{-1}\) (Hooijier et al. 2010), based on a linear relationship between depth of water table and emissions.
Phenolic acids and C-release could be reduced to the granting of polivalec cations such as Al, Fe, Cu, Zn and Mn, thus reducing the bad effects. Where the stability of complexes between humic acid-metal getting weaker in the order of $\text{Al}^{3+} > \text{Fe}^{3+} > \text{Cu}^{2+} > \text{Mn}^{2+} > \text{Zn}^{2+} > \text{Mg}^{2+} > \text{Ca}^{2+}$ (Tan, 2003). Nelvia (2008) reported that application of ameliorant Fe and rock phosphates containing high Fe cation increased the stability of peat soil and reduced the carbon loss around 1.7 Mg of C ha$^{-1}$ year$^{-1}$ (64%) in 5 cm of saturated condition, 1.3 Mg of C ha$^{-1}$ year$^{-1}$ (58%) in two times of field capacity condition and 1.0 Mg of C ha$^{-1}$ year$^{-1}$ (41%) in field capacity condition.

Dregs is the precipitate formed from liquid clarification process in the pulp mill recovery and no longer useful for the pulping process. Nelvia et al. (2008) reported that dregs contain polivalec cations such as Al, Fe, Cu, Zn, Mn, Mo, and also contains other nutrients such as P, K, Ca, and Mg, the application of 15 tons dregs / ha of peatlands increases stover dry weight, dry weight of corn kernels per ear, 1000 grain weight seeds respectively 127%, 35% and 40% compared without dreg. This research aimed to study the potential of using dregs to reducing C-release (CO$_2$ and CH$_4$) and increasing growth and yield of rice on peat soil in unsaturation and saturation.

II. MATERIAL AND METHODS

This research was conducted from July to December 2010 in a greenhouse of Agriculture Faculty of Riau University. Soil chemical properties of peat soils materials and dregs was analyzed at soil laboratory of Soil Research Bogor. The peat soil material was taken at depths from 0 to 30 cm, with weathering rate saprik and dregs from Indah Kiat Pulp and Paper (IKPP) at Perawang, Riau.

The peat soil material was taken at depths from 0 to 30 cm, with weathering rate saprik at Kerumutan village, Pelalawan Regency, Riau Province, while dregs from from Riau Indah Kiat Pulp and Paper (IKPP) at Perawang, Riau, dregs chemical properties can be seen in Table 1. These experiments using split plot design, the main plot is the variety rice was planted. Basic fertilizers: Urea, TSP, and KCl each with a dose of 350, 150, and 150 kg ha$^{-1}$ experiments using split plot design, the main plot is the variety rice was planted. Basic fertilizers: Urea, TSP, and KCl each with a dose of 350, 150, and 150 kg ha$^{-1}$ respectively.

To measure the flux of CO$_2$ and CH$_4$, a chamber for trapping the gases made from the fiberglass with the size of 0.75 m x 0.20 m x 0.20 m, was used Syringes were used to take the samples of gases from the chamber. The samples were then put on the vacuum bottles. In this research, Gas Chromatography Shimadzu 14-B and Chromatopac Shimadzu C-R6A were used to determine the CO$_2$ and CH$_4$ emissions. The emissions were calculated by using following equation (Boer et al., 1996):

$$\Phi_M = \left(\delta[\text{CO}_2/\text{CH}_4]dt \times h_0 \times 16.123 \times 44.01 \times 273.2 \times \frac{(60/24.410)}{(t_f + 273.2)} \right) \text{mg m}^{-2} \text{h}^{-1}$$

Where: $\delta[\text{CO}_2/\text{CH}_4]dt = \text{change of the concentrations of CO}_2$ and CH$_4$ in chamber after the periode of t minute (s); $h_0$ = the height of chamber; $t_f$ = the average of air temperature in chamber; Value of 16.123 = the weight of CH$_4$ molecule, 44.01 = weight of CO$_2$; Value of 273.2 = temperature in Kelvin; 22.41 = volume of gas molecule; and Value of 60 means 60 minutes (1 hour). Other parameters were observed between: plant height 42 days after planting, the maximum tillers and productive tillers number, straw dry weight and grain dry milled weight.

III. RESULTS AND DISCUSSION

A. Chemical Composition of Peat

Several chemical characteristics of peats (Table 1) interesting to discuss. Although the total N is high, but the C/N ratio is very high, this means that N is a structural constituent of peat organic matter that is available N is low, thereby becoming a limiting factor for plant growth. cation exchange capacity (CEC) value is very high, but base saturation (BS) is very low, thus inhibiting the provision of nutrients, mainly K, Ca and Mg for plants.

The situation got worst because exchangeable Na, K, Ca and Mg is very low and therefore inhibit the growth and yield. Availability and total micro nutrient content are very low except for Fe is quite high, causing micro nutrient deficient for plants. According to Simbolon (2009) peat soil pH is very low, the availability of macro (N, P, K, Ca and Mg) nutrient are low and deficient micro (Cu, Zn, Mn, Fe, B and Mo) nutrient, CEC is very high but BS is low. Where the availability of Cu is the lowest compared to other micro nutrient because the Cu bounds to organic compounds functional groups such as carboxyl (COOH) and phenolic (-OH) to form organo—cation complex of Cu (chelate) that are not available for plants.

Several chemical characteristics (macro and micro nutrient) contained in dregs quickly available in peat, because hasil extraction with 2% citric acid is almost equal to the extraction with mineral acids (HClO$_4$ and HNO$_3$ pa) (Table 2). Dissociation of H ions from organic compounds cause the concentration of H$^+$ ions on peat soil is very high, H$^+$ ions can hydrolyze dregs so that it dissolves quickly. Results of analysis of heavy metal content in the dregs (Pb, Cd, As, Hg, Co, Ni, Cr, Ag, Sn and Mo) total are very low (Table 3), are not including those identified B3 waste so it can be dumped in landfill light weight category.

### TABLE 1

<table>
<thead>
<tr>
<th>Chemical characteristics</th>
<th>Value</th>
<th>Chemical characteristics and ash content</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH H$_2$O (1:5)</td>
<td>3.2</td>
<td>Base Saturation (%)</td>
<td>6</td>
</tr>
<tr>
<td>pH KClI (1:5)</td>
<td>3.0</td>
<td>Micro nutrient (Extract. DTPA)</td>
<td>475</td>
</tr>
<tr>
<td>Organic-C (g kg$^{-1}$)</td>
<td>437.3</td>
<td>Fe (µg/g)</td>
<td>1</td>
</tr>
<tr>
<td>Total-N (g kg$^{-1}$)</td>
<td>6.5</td>
<td>Mn (µg/g)</td>
<td>2</td>
</tr>
<tr>
<td>C/N ratio</td>
<td>67.28</td>
<td>Cu (µg/g)</td>
<td>2</td>
</tr>
<tr>
<td>Exc.Ca (cmol (+)/kg)</td>
<td>2.27</td>
<td>Zn (µg/g)</td>
<td>2</td>
</tr>
<tr>
<td>Exc.Mg (cmol (+)/kg)</td>
<td>0.68</td>
<td>Micro nutrient (Extract. HNO$_3$)</td>
<td>32</td>
</tr>
<tr>
<td>Exc.C (cmol (+)/kg)</td>
<td>0.22</td>
<td>+ HClO$_3$, pa)</td>
<td>3.1</td>
</tr>
<tr>
<td>Exc.Na (cmol (+)/kg)</td>
<td>0.26</td>
<td>Fe (µg/g)</td>
<td>3606</td>
</tr>
<tr>
<td>P.O.$_5$ (µg/g) (Bray I)</td>
<td>135.4</td>
<td>Mn (µg/g)</td>
<td>12.3</td>
</tr>
<tr>
<td>P.O.$_5$ (mg/100g) (HCl 25%)</td>
<td>32</td>
<td>Cu (µg/g)</td>
<td>4.8</td>
</tr>
<tr>
<td>CEC (cmol (+)/kg)</td>
<td>72.45</td>
<td>Zn (µg/g)</td>
<td>15.89</td>
</tr>
</tbody>
</table>

**Base Saturation (%)**

Fe (µg/g): 475

Mn (µg/g): 1

Cu (µg/g): 2

Zn (µg/g): 2

Micro nutrient (Extract. HNO$_3$): 32

+ HClO$_3$, pa): 3.1

Fe (µg/g): 3606

Mn (µg/g): 12.3

Cu (µg/g): 4.8

Zn (µg/g): 15.89

Ash content (%): 15.89
TABLE III
CHEMICAL CHARACTERIZATION AND MOISTURE OF DREGS

<table>
<thead>
<tr>
<th>Chemical characteristics</th>
<th>Value</th>
<th>Chemical characteristics and ash content</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH H$_2$O (1:5)</td>
<td>9.3</td>
<td>Macro nutrient (Extract. Citric Acid 2%)</td>
<td>1.8</td>
</tr>
<tr>
<td>HClO$_4$ &amp; HNO$_3$ (pa)</td>
<td></td>
<td>P$_2$O$_5$ (g kg$^{-1}$)</td>
<td>1.8</td>
</tr>
<tr>
<td>P$_2$O$_5$ (g kg$^{-1}$)</td>
<td>2.0</td>
<td>K$_2$O (g kg$^{-1}$)</td>
<td>3.1</td>
</tr>
<tr>
<td>K$_2$O (g kg$^{-1}$)</td>
<td>3.1</td>
<td>CaO (g kg$^{-1}$)</td>
<td>409.7</td>
</tr>
<tr>
<td>CaO (g kg$^{-1}$)</td>
<td>410.3</td>
<td>MgO (g kg$^{-1}$)</td>
<td>23.2</td>
</tr>
<tr>
<td>MgO (g kg$^{-1}$)</td>
<td>23.9</td>
<td>Na (g kg$^{-1}$)</td>
<td>25.9</td>
</tr>
<tr>
<td>Na (g kg$^{-1}$)</td>
<td>26.8</td>
<td>S (g kg$^{-1}$)</td>
<td>6.4</td>
</tr>
<tr>
<td>S (g kg$^{-1}$)</td>
<td>7.2</td>
<td>Micro nutrient (Extract. Citric Acid 2%)</td>
<td>3244</td>
</tr>
<tr>
<td>Micro nutrient (Extract.</td>
<td></td>
<td>Fe (µg g$^{-1}$)</td>
<td>5000</td>
</tr>
<tr>
<td>HClO$_4$ &amp; HNO$_3$ (pa)</td>
<td></td>
<td>Mn (µg g$^{-1}$)</td>
<td>914</td>
</tr>
<tr>
<td>Fe (µg g$^{-1}$)</td>
<td>5000</td>
<td>Cu (µg g$^{-1}$)</td>
<td>105</td>
</tr>
<tr>
<td>Mn (µg g$^{-1}$)</td>
<td>989</td>
<td>Zn (µg g$^{-1}$)</td>
<td>206</td>
</tr>
<tr>
<td>Cu (µg g$^{-1}$)</td>
<td>127</td>
<td>Zn (µg g$^{-1}$)</td>
<td>15</td>
</tr>
<tr>
<td>Zn (µg g$^{-1}$)</td>
<td>224</td>
<td>Mn (µg g$^{-1}$)</td>
<td>914</td>
</tr>
<tr>
<td>Ag (µg g$^{-1}$)</td>
<td>8.9</td>
<td>Pb (µg g$^{-1}$)</td>
<td>0.1</td>
</tr>
<tr>
<td>Cd (µg g$^{-1}$)</td>
<td>0.2</td>
<td>Cd (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>As (µg g$^{-1}$)</td>
<td>3.8</td>
<td>As (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Hg (µg g$^{-1}$)</td>
<td>0.23</td>
<td>Co (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Co (µg g$^{-1}$)</td>
<td>1.7</td>
<td>Cr (µg g$^{-1}$)</td>
<td>8.5</td>
</tr>
<tr>
<td>Cr (µg g$^{-1}$)</td>
<td>167</td>
<td>Se (µg g$^{-1}$)</td>
<td>120</td>
</tr>
<tr>
<td>Se (µg g$^{-1}$)</td>
<td>355</td>
<td>Ag (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Ag (µg g$^{-1}$)</td>
<td>nm</td>
<td>Sb (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Sb (µg g$^{-1}$)</td>
<td>nm</td>
<td>Sn (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Sn (µg g$^{-1}$)</td>
<td>nm</td>
<td>Mo (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Mo (µg g$^{-1}$)</td>
<td>nm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE III
HEAVY METAL CONTENT OF DREGS

<table>
<thead>
<tr>
<th>Chemical characteristics</th>
<th>Value</th>
<th>Chemical characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction (HClO$_4$ +</td>
<td></td>
<td>Extraction (citric acid</td>
<td></td>
</tr>
<tr>
<td>HNO$_3$ (pa)</td>
<td></td>
<td>Citric Acid 2%)</td>
<td></td>
</tr>
<tr>
<td>Pb (µg g$^{-1}$)</td>
<td>8.9</td>
<td>Pb (µg g$^{-1}$)</td>
<td>0.1</td>
</tr>
<tr>
<td>Cd (µg g$^{-1}$)</td>
<td>0.2</td>
<td>Cd (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>As (µg g$^{-1}$)</td>
<td>3.8</td>
<td>As (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Hg (µg g$^{-1}$)</td>
<td>0.23</td>
<td>Co (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Co (µg g$^{-1}$)</td>
<td>1.7</td>
<td>Cr (µg g$^{-1}$)</td>
<td>8.5</td>
</tr>
<tr>
<td>Cr (µg g$^{-1}$)</td>
<td>167</td>
<td>Se (µg g$^{-1}$)</td>
<td>120</td>
</tr>
<tr>
<td>Se (µg g$^{-1}$)</td>
<td>355</td>
<td>Ag (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Ag (µg g$^{-1}$)</td>
<td>nm</td>
<td>Sb (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Sb (µg g$^{-1}$)</td>
<td>nm</td>
<td>Sn (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Sn (µg g$^{-1}$)</td>
<td>nm</td>
<td>Mo (µg g$^{-1}$)</td>
<td>nm</td>
</tr>
<tr>
<td>Mo (µg g$^{-1}$)</td>
<td>nm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. The effect of application of ameliorant dregs in the peat at saturation and unsaturation condition on growth and yield of rice

The application of dregs improves plant growth (plant height, number of maximum tillers, number of productive tillers and weight of dry straw) and increase the yield of rice (weight of dry milled grain) compared without dreg both at unsaturated and saturated conditions (Table 4 and Fig. 1). Rice can not grow well in peat, which is not applied ameliorant dreg, the cause is the low nutrient availability and high content of phenolic acids that are toxic to plants. Tim Sintesis Kebijakan (2008) reports that rice plants grown in peat soil with a thickness of over 2 m deficient Cu failed to form a grain. The peat composition is dominated by lignin of 65% to 80% and 78% to 93% for the peats of Jambi and Central Kalimantan respectively (Sahibah, 2010), and 71.46% for the peats of Riau (Nelvia, 2009). Orlov (1995) showed the processes of lignin disintegration that result in several derive phenolic acids. Phenolic acids are more phytotoxic for plants and causes stunted plant growth (Tsutuki, 1984; Stevens, et al., 1994; Dohong and Sahibah, 2001), influence the biochemical and physiological processes of plants and nutrients uptake by plant influence the biochemical and physiological processes of plants and nutrients uptake by plent (Driessen, 1978). Tsutuki et al. (1994) stated that the concentration of phenolic acids at the range of 0.6 to 3.0 mM could hamper the root growth of rice up to 50%. Todano et al. (1992) reported that derivate phenolic acids, such as ferulic, synapic, p-cumaric, and p-hydroxybenzoic acids are phytotoxic for rice, particularly during the first stage of plant growth. He also mentioned that ferulic acid in peat is more toxic compared to the other derive phenolic acids.

Note: The numbers in the same columns which followed the same lowercase letter are not significantly different at α 5% DNMRT test.

Fig. 1. The growth of rice at vegetative and generative phase in unsaturated (a) and saturated condition (b)

The application dreg 10 t ha$^{-1}$ increase the maximum number of tillers, number of productive tillers, straw dry weight and the weight of milled rice by 65, 35.29, 110 and 75%, respectively compared without dreg on saturated condition, whereas the increase is greater unsaturated conditions about 80, 63, 59 and 80%, respectively (Table 4). This is due to the improvement of the condition of the peat soil chemistry by ameliorant dreg in the form increase nutrient availability and decreasing the solubility of phenolic acids. Its caused by the dregs contain macro (P, K, Ca, Mg, S) and micro (Fe, Cu, Zn, Mn, Mo) nutrients or polivalen cations and quickly available in peat (Table 2). Reduced
solubility of phenolic acids occurs due to the formation of complex compounds of phenolic acids with cations Fe, Cu, Zn, Mn, Ca and Mg are dissolved from the dreg. Sabiham (2010) reported that the concentration of derivate phenolic acids namely: ferulic, syanapic, p-cumaric, vanillic, syringic and p-hydroxybenzoic acids in peats decreased with the addition of mineral soil or basic slag, or the combination of both materials.

**C. The effect of application of ameliorant dregs in the peat soil at unsaturation and saturation condition on carbon emission**

The Carbon-release in the forms of CO\(_2\) and CH\(_4\) fluxes in saturated conditions is smaller than unsaturated conditions, the application of dregs 10 t ha\(^{-1}\) in saturated condition can reduce CO\(_2\) emissions about 18.19% and CH\(_4\) emissions about 93.71% compared without dreg, otherwise the application dreg 10, 15 and 20 t ha\(^{-1}\) in unsaturated conditions increase the production of CO\(_2\) and CH\(_4\) (Table 5). Unsaturated conditions (aerobic) conditions where the peat is available high due to the high diffusion, so the more active microorganisms both the type and amount of the anaerobic conditions, the result would accelerate the process of decomposition of organic matter. While in saturated conditions (anaerobic) only anaerobic bacteria can live, thus CO\(_2\) as a result of respiration and decomposition of organic matter will be higher in unsaturated than saturated conditions. Boer et al. (1996) reported that the amount of CH\(_4\) emission rate depends on soil water conditions, flooded peatlands emit CH\(_4\) greater than the land is not flooded. Research by Sabiham and Sulistyono (2000) in the laboratory showed that the highest CO\(_2\) production obtained in aerobic incubation and significantly different with anaerobic incubation, while the highest CH\(_4\) production was obtained on anaerobic incubation and significantly different with aerobic incubation.

### TABLE V

<table>
<thead>
<tr>
<th>Water condition</th>
<th>Dregs (ton ha(^{-1}))</th>
<th>CO(_2) production (mg pot(^{-1}) h(^{-1}))</th>
<th>CH(_4) production (mg pot(^{-1}) h(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>saturation</td>
<td>0</td>
<td>8.12 a</td>
<td>29.70 a</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>6.64 b</td>
<td>1.87 c</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>8.38 a</td>
<td>3.07 bc</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>7.31 b</td>
<td>2.68 bc</td>
</tr>
<tr>
<td>unsaturation</td>
<td>0</td>
<td>18.72 b</td>
<td>6.69 b</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>29.71 b</td>
<td>7.61 b</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>52.57 a</td>
<td>19.39 a</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>15.64 b</td>
<td>5.78 b</td>
</tr>
</tbody>
</table>

Note: The numbers in the same columns which followed the same lowercase letter are not significantly different at α 5% DNMT test

The decrease in emissions of CO\(_2\) and CH\(_4\) in the saturated condition by administering dreg 10 t ha\(^{-1}\) is because dreg containing polyvalent cations and release such as Fe and Cu to the soil (Table 2). Fe and Cu cations form complex compounds between organic compounds with Fe or Cu cations, that is stable so it can not be decomposed by microbes. Giving dreg with the higher dose (15-20) has stimulate more rapid decomposition of organic matter, especially in unsaturated conditions, while the formation of complex organic compounds-metal running over time, The result is an increase in emissions of CO\(_2\) and CH\(_4\). Research Sabiham and Sulistyono (2000) in the laboratory showed that administration of Fe\(^{3+}\) cations as much as 5% maximum erapan can reduce 22.94% 23.01% CO\(_2\) and CH\(_4\) in the peat soil of the area Dendang Jambi and 27.67% and 32.97% CO\(_2\) CH\(_4\) in the peat soil of the Sampit, Central Kalimantan. The addition of 15 and 30 g of Fe(OH)\(_3\) per kg of soil to lower the total CH\(_4\) emissions by 43% and 84% during the growth of rice (Jackel and Schnell 2000). Where the stability of complexes between humic acid-metal getting weaker in the order of Al\(^{3+}\) > Fe\(^{3+}\) > Cu\(^{2+}\) > Mn\(^{2+}\) > Zn\(^{2+}\) >> Mg\(^{2+}\) > Ca\(^{2+}\) (Tan, 2003).

**IV. CONCLUSIONS**

The application of dregs improves plant growth and increase the yield of rice compared without dreg both at unsaturated condition and saturated conditions. The application dreg 10 t ha\(^{-1}\) increase the maximum number of tillers, number of productive tillers, straw dry weight and the weight of milled rice by 65, 35, 110 and 75%, respectively compared without dreg on saturated condition, whereas the increase is greater unsaturated conditions about 80, 63, 59 and 80%, respectively.

The Cabon-release in the forms of CO\(_2\) and CH\(_4\) fluxes in saturated conditions is smaller than unsaturated conditions, the application of dregs 10 t ha\(^{-1}\) in saturated condition can reduce CO\(_2\) and CH\(_4\) emissions about 18.19% and 93.71% compared without dreg, otherwise the application dreg 10-20 t ha\(^{-1}\) increase the production of CO\(_2\) and CH\(_4\) in unsaturated conditions.

**REFERENCES**


