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Biochar of Reed (*Phragmites autralis*) on Representative Locations in Mekong Delta of Vietnam

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Abstract

This experiment purpose is finding that using biochar of reed plants (Phragmites autralis); it is a plant species grows a seasonal cycle, it also is a very high biomass in Mekong Delta (MD) of Vietnam. To evaluate fresh, dry biomass and made of reed plants biochar to use them provide bio-organic fertilizer for rice plant (ST 25) in experiment. To achieve this aims some experiments have done by methods in laboratory of The Forestry Institute of Southern Vietnam are contents follow as:(1) investigating biomass of fresh, dry reed plants and made of biochar by use the local method; (2) analyses the chemical indicators in 3 different locations tis area on trunks, leaves, flowers in study area; (3) identify chemical indicators of peat land on 3 different locations of MD; (4) adsorption with pig urine and chemical fertilizer (nitrogen, phosphorus and potash) to see the retention off chemical components dispersed into the environment in the adsorbed biochar; (5) use the formulas of reed plant biochar mixed peat and mineral inorganic fertilizer. The results showed: The reeds in 3 locations of MD can provide big amount of biomass to make of reed biochar fertilizer; reed biochar can adopted as ammonium, nitrate, nitrogen, phosphorus and kalium the pig urine and it also adopted inorganic fertilizer as nitrogen, phosphorus and Kalium. Thus it is possible to use for application treatment environment in the region polluted and planting local rice ST 25 in the experiment area in MD. Biomass and biochar of reed in MD are big amount for the material of environment treatment and agriculture fertilizer; in chemical indicators of trunks, leaves and flowers in locations have some indictors are difference and some are not differences; the chemical indicators of some location are not differences; the mixed biochar, peat and inorganic in formulas in 5 days and 10 days were not differences; biochar can adsorb some chemical components of pig urine and nitrogen, phosphorus and kalium fertilizer; biochar can mixed peat and inorganic mineral fertilizer to planting rice ST 25 in Mekong Delta.

Keywords: *Biomass of Reed, Reed Plant Biochar, Phragmites Australis, Rice ST 25.*

Introduction

Reed (*Phragmites australia* Cav.) it is a species that can grows and is distributed throughout coastal and mountainous areas [4]. Due to its rapid growth and high biological productivity [10], it often appears in populations over an area dozens to hundreds of hectares [12], with outstanding heights 3 – 6 meter, Its density very high reach 50 -100 plants per square meter, so it is a promising renewable enery source.

In study biochar [5] producing rice straw and rice biochar to made better soil fertility, crop product and reduce greenhouse emissions. Studies biochar on use them to replace inorganic fertilizer [7], so it is useful for agriculture. In studies [13] The Vietnam Soil and Agriculture Institute conclude that in organic fertilizers were produced their quality with organic content >30%, humic acid >5%, total NPK>5% are mixed ingredients including: Biochar, nitrogen, phosphorus, potassium fertilizer elements, trace elements (TE), organic supplements. There is relationship between soil chemical composition and biological density [11], studies the chemical indicators of peat on distributed reed base to find the growth and biomass productivity. Research of ammonium and nitrate adsorption [8] *Phragmites autralis* biochar on aqueous solution in Persian give us look at biochar of reeds. Combine inorganic mineral fertilizer to nitrogen, phosphorus, kalium and reed biochar to different formulas after 5 days and 10 days to analyzed the chemical of them to find the adsorption of nitrogen,phosphorus and potash to use them for fertilizer. Use mixture of fertilizer form biochar to peat and inorganic to plant rice ST 25 by trial to compare the control to develop agriculture for future of Vietnam.

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Material and Method

Material

The steps:

In the dry season as reed plants are old plants when dry leaves and flowers, plants are cut and gathered to a place. Making the dry part into trunks, leaves and flowers; then burn them until all the smoke is gone and cut off the oxygen; after that collect biochar to experiment.

Use pig urine to filter by biochar

Mixed inorganic fertilizer (nitrogen, phosphorus and kalium) dissolve in water to filter through biochar.

Make seedling of rice ST25 of Vietnam (*Oryza sativa*), planting and fertilize by formulas to twice at 30 days and 75 days; measure growth indicators at 60 days and 125 days. The indicators include at 60 days measure stem length (Lst), Number of leaves (Lno.), leaf length (Lle.), leaf width (Lwi.), number of flowers (Fno.), number of flower bud (Bno.), leaf color (Lco.); at 125 days measure (Hcm) height of plant; (Br.bu.) branches of bush; (Br.pl.) branches of plant; (Se.br.) seeds of branch; (Se.bu.) seeds of bush; (St.le.) length of stem; (Fl.se.br.) flat seeds of branch; (Se.co.) color of seeds; (L.co.) color of leaves.

Methods

Biomass Investigation

Types of reed vegetation on different 3 locations.

Each location selected 9 sample plots, total plots are 27, the area of plot is 4 square meter, in each plot selected 9 reed plants to measure them. The indicators of to measure including: The height of plants (H), the diameter at ground of it ($D_{0.0}$), number of plants in per one meter (N/m^2).

In 27 sample plots, a plot selected total 9 plants (3 shortest plants, 3 medium plants, 3 highest plants), cut it at a ground, then write number of plant and number plot to take back the laboratory, divided them into the trunks, leaves, flowers and weigh them infidel each other. Next step dry them wait their weight is not change of the dry trunk, leaves and flowers of reed plants. Third step burning the trunk, leaves, flowers in the designed biochar burner.
Measure of fresh plant biomass by weigh total fresh plants (Wft), weigh fresh plant trunks (Wftr), weigh fresh leaves (Wfl), weigh fresh flowers (Wff), unit is gram (g).
Measure of plant biochar by weigh total plant biochar (Wbt), weigh plant trunk biochar (Wbtr), weigh leave biochar (Wbl), weigh plant flower biochar (Wff), unit is gram (g)

Figure 1. Reed plant made of Reed biochar in Mekong Delta

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Peat Investigation

Based on the high distribution map of peat soil, 15 peat investigation plots were established [9]. Use the hand drill to take samples, total of 15 plots set up to survey the growth and biomass of the reed on three locations of MD. There are 5 plots for locations. Each location to take samples is three [6], and each sample is one kilograms and write coded a member of the site at location as UTM1, UTM2, UTM3, UMT4 [3], following the same name of the survey plots, then gets them to the laboratory of Southern Institute of Forestry Science for analysis.

The characteristics of the peat soil are evaluated through the indicators: pH (H_2O); Humus (%), Total nitrogen (%), P_2O_5 (%), K_2O (%), Fe^{2+} (mg/100 g), SO_4^+ (mg/100 g), humic acid (%). The analysis method of pH (H_2O) was determined with a pH meter. Humus content and humic acid evaluated by Walkley Black [3], total nitrogen by the Kjeldhahl method [3]. P_2O_5 was indicated by the colorimetric method. All indications were analyzed at the laboratory of the Southern Forest Sciences Institute and the Laboratory of Kien Giang University.

Reed Biochar Chemical Indicators

Make of biochar from (Figure 1) the indicators of biochar analyzed include: pH, Humic acid %, C%, OM%, N% total, P% total, K% total, Ca%, Mg%, SiO_2%.

Mixed fertilizer in 5 days and 10 days and experiment application for rice ST 25

With 8 experimental formulas labeled

Formula 1: 100g Biochar (Control)

Formula 2: 4g Nitrogen 46% + 3g phosphorus 61 % + 3g Potash 61% (10g NPK+ 90 g Biochar = 100g fertilizer)

Formula 3: 10g (Nitrogen 16% + Phosphorus 16% + 8%) + 90g Biochar = 100g fertilizer

Formula 4: 10g (Nitrogen 20% + Phosphorus 20% + Potash 15%) + 90g Biochar = 100g fertilizer

Formula 5: 50g Biochar + 40g Peatland + 10g (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 6: 60g Biochar + 30g Peatland + 10g (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 7: 70g Biochar + 20g Peatland + 10g (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 8: 80g Biochar + 20g Peatland + 10g (Nitrogen 20% + Phosphorus 20% + Potash 15%)

The dates after mixed during 5 days and 10 days: Analized indicators are humic acid (%), organic matter OM(%), C (%), N(%), P(%), K(%), Ca(%), Mg(%), SiO_2(%).

Indicators measured on rice after 30 days and 125 days

On 30 days: Indicators measured include (No.Br.) number of branch; (No.subBr.) number of sub branch; (L. le.) leaves length; (St. le.) stem length; (St. co.) color of stem; (L. co.) color of leaves.

On 125 days: Indicators measured include (Hcm) height of plant; (Br.bu.) branches of bush; (Br.pl.) branches of plant; (Se.br.) seeds of branch; (Se.bu.) seeds of bush; (St.le.) length of stem; (Fl.se.br.) flat seeds of branch; (Se.co.) color of seeds; (L.co.) color of leaves

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Data Analysis

The analysis use t-tests and one-way analysis of variance (ANOVA) to compare the mean of biochar and peat [1]. Correlation analysis use the Pearson correlation coefficient described the interdependence between peat quality and the development of reed plants. A correlation is considered significant when the *p*-value is less than 0.05, and the correlation coefficient (r) is more significant than 0.5 in absolute value [2]. The analysis focused on the relationship between the peat environment indicators and the growth of reed plant on 3 different. Spearman's correlation coefficient was used for analysis, and the significance level will be set at α=0.05 [2]. If the correlation coefficient of the variable (peat) levels is significant, hypothesis how will be rejected, indicating a correlation between peat characteristics and reed plant growth.

The characteristics of the biochar on reed plants were evaluated through the indicators: pH(H_2O), humic acid (%), organic matter OM %, C %, N %, P %, K %, Ca %, Mg %, SiO_2 %. The analysis methods of pH by measuring the extraction ratio 1: 2.5; K %, Ca %, Mg % measured with an atomic absorption machine; Silic measured according to method of AOAC (Association of analytical communities); Nitrogen measured according to method Kjeldahl; Phosphorus measured by wavelength colorimetric method; Ash calculated by ashing method.

Data processing, including statistical calculations, description, test hypotheses, and graph drawing, was performed use [1].Microsoft Excel 2016, Statgraplies Centurion 19.12, and IBM SPSS Statistic version 20.0.

Results

Fresh, Dry Plant and Biochar

Table 1: The growth and weight of reed plant in 3 locations of Mekong Delta

Locations	H(m)	$D_{0.0}$(cm)	Wtfr	Wftr	Wfl	Wffl	N/m²	Wf/m²
Lo.1 (Minh Thuan)	2.78	1.37	129.79	96.90	23.67	8.22	55	7.10
Lo.2 (An Minh Bac)	2.77	1.34	131.77	100.72	23.01	8.05	68	8.96
Lo.3 (Kien Luong)	2.75	1.40	105.89	71.80	28.57	5.41	56	5.93
Average	2.77	1.38	122.48	89.81	25.08	7.23	60	7.34
α= 0.05	0.97N	0.87N	0.22N	=0.03*	0.67N	<0.00*	0.24N	

Note: H(m) Height of plant; $D_{0.0}$(cm) Diameter of plant bottom; Wtfr weight of frest plant trunk; Wfltr weight of fresh plant trunk; Wfl weight of plant leaves; Wffl weight of plant flowers; N/m² Number of tree per square metter, Wf/m² weight of fresh plant; MT location Minh Thuan, AMB location An Minh Bac, KL location Kien Luong; (*)significant difference, (N)not significant difference

Comments

The growth and weight of reed plant in 3 locations Mekong Delta showed (Table 1).

The growth of reed plant height 2.77 meters (m) from 2.75 – 2.78 m; the ground diameter is 1.38 centimeters (cm) from 1.34 – 1.40 cm; the weight of total fresh reed plant is 122.48 gram (g), from 105.89 – 131.77 g per plant; the weight of fresh reed plant trunk 89.81 g per plant, from 71.80 – 100.72 g per plant; the weight of fresh reed plant leaves is 25.08 g per plant; the weight of fresh reed plant flowers is 7.23 g per plant, form 5.41 – 8.05 g per plant.

The density of reed plant is 60 plants per square meter, from 55 – 68 plant per square meter. The weight of fresh plant 7.34 kilogram (kg) per square meter.

Statistical analysis in locations is the indicators that did not differ significantly were the height, ground diameter, plant weight, leaf weight and the density of reed per square meter and differ significantly are the fresh reed plant trunk and fresh reed plant flower.

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Table 2: The weight indicators of dry reed plant in 3 locations

Location	Wdrt	Wdrtr	Wdrl	Wdrfl	Wdr/m^2	Wwl/m^2
Lo.1	65.49	43.49	18.57	2.52	3.60	3.54
Lo.2	62.99	44.99	18.57	2.52	4.38	4.68
Lo.3	66.58	42.84	21.21	2.77	3.73	2.20
Average	65.02	43.77	19.45	2.60	3.87	3.47
α= 0.05	0.29N	0.27N	0.07N	=0.02*		

Note: Wdrt weight of dry plant; Wdrtr weight of dry trunk; Wdrl weight dry leaves; Wdr/m^2 weight of dry plant per square metter, Wwl/m^2 weight of lost water in plant per square meter; (*)significant difference, (N)not significant difference.

Comments:

The dry plant weight of reed in 3 locations showed (Table 2):

- The weight of dry plant is 65.02 g per plant, from 62.99 – 66.58 g per plant; the weight of the dry reed plant trunk is 43.77 g per plant, from 42.84 – 44.99 g per plant; the weight of the dry plant leaves is 19.45 g per plant, from 18.57 – 21.21 g per plant; the weight of the dry plant flower per plant is 2.60 g per plant, from 2.52 – 2.77 g per plant.

- The weight of the dry plant per square meter is 3.47 kilogram per square meter, from 2.20 – 3.54 g per square meter. The water in plant was lost in processing made the dry plant is 3.47 kilogram per square meter.

- Statistical analysis in 3 locations, the indicators that did not differ significantly were the dry plant, dry plant trunk, dry leaves, the dry flowers of reed plant and differ significantly is the dry flowers of them.

Table 3: The weight indicators of reed biochar in three locations

Location	Wbit	Wbitr	Wbil	Wbifl
Lo.1	12.95	7.27	4.00	1.68
Lo.2	17.55	9.83	5.41	2.28
Lo.3	10.27	5.75	3.27	1.36
Average	13.59	7.62	4.23	1.77
α= 0.05	<0.01*	<0.01*	<0.01*	<0.01*

Note: Wbit weight of plant biochar; Wbitr weight of biochar trunk; Wbil weight of leave biochar; Wbifl weight of flower plant; (*)significant difference, (N)not significant difference.

Comments:

The weight indicators of reed biochar in three locations showed (Table 3)

The weight reed plant biochar is 13.59 g per plant, from 10.27 – 17.55 g per plant; the biochar weight of the reed plant trunk is 7.62 g per plant, from 5.75 – 9.83 g per plant; the biochar weight of the reed plant leaves is 4.23 g per plant, from 3.27 – 5.41 g per plant; the biochar weight of the reed plant flowers is 1.77 g per plant, from 1.36 – 2.28 g per plant, from 1.36 – 2.28 g per plant.

Statistical analysis in 3 locations, the indicators that did differ significantly were the biochar of plant trunk, dry leaves and the flowers of reed plant with α= 0.05 α<0.00*.

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Chemical Indicators of Biochar

Table 4: Chemical indicators of biochar in reed trunk

Locations	pH	C%	Humic acid	OM%	N%	P%	K%	Ca%	Mg%	SiO%
Lo.1	10.64	17.24	1.43	34.48	0.17	0.39	0.70	0.16	0.15	4.67
Lo.2	10.66	17.24	1.32	34.48	0.17	0.40	0.71	0.10	0.14	4.26
Lo.3	10.68		1.38	34.48	0.15	0.44	0.74	0.15	0.17	5.13
Average	10.66		1.38	34.48	0.16	0.41	0.72	0.14	0.15	4.69
α= 0.05	<0.00*		<0.00*	1.00N	0.64N	0.89N	0.79N	0.11N	=0.02*	<0.00*

(*) significant difference, (N) not significant difference

Comments:

The chemical indicators of reed trunk (Table 4)

pH is 10.66, from 10.64 – 10.68; carbon C% is 17.24%, from 17.24 – 17.24 %; humic acid 1.38, from 1.32 – 1.43 %; organic matter OM% is 34.48 %, from 34.48 – 34.48; nitrogen N% is 0.16 %, from 0.15 – 0.17 %; phosphorus P% is 0.41 %, from 0.39 – 0.44 %; kalium K% is 0.72 %, from 0.70 – 0.74 %; calcium Ca% is 0.14 %, from 0.10 – 0.16 %; magnesium Mg% is 0.15 %, from 0.14 – 0.17 %; silicium SiO% is 4.69 %, from 4.26 – 5.13 %.

Statistical analysis in 3 locations, the indicators that did not differ significantly were the C%, OM%, N%, P%, K%, Ca%. The indicators that did differ significantly were Mg% and SiO% with (α= 0.05) is α<0.02* and. α<0.00*.

Table 5: Chemical indicators of biochar in reed leaves

Locations	pH	C%	Humic acid	OM%	N%	P%	K%	Ca%	Mg%	SiO%
Lo.1	10.38	16.03	1.31	32.07	0.21	0.39	0.75	0.12	0.16	4.72
Lo.2	10.29	18.62	1.27	37.24	0.20	0.40	0.69	0.09	0.16	4.84
Lo.3	10.04	18.96	1.29	37.93	0.19	0.42	0.72	0.10	0.16	5.24
Average	10.24	17.87	1.29	35.75	0.20	0.40	0.72	0.10	0.16	4.93
α= 0.05	<0.00*	<0.00*	0.12N	<0.00*	0.81N	0.5N	0.09N	0.59N	1.0N	<0.00*

( ) significant difference, (N) not significant difference*

Comments:

The chemical indicators of reed leave (Table 5)

pH is 10.24, from 10.04 – 10.38; carbon C% is 17.87 %, from 16.03 – 18.96 %; humic acid 1.29, from 1.27 – 1.31 %; organic matter OM% is 35.75 %, from 32.07 – 37.93; nitrogen N% is 0.20 %, from 0.19 – 0.21 %; phosphorus P% is 0.40 %, from 0.39 – 0.42 %; kalium K% is 0.72 %, from 0.69 – 0.75 %; calcium Ca% is 0.10 %, from 0.09 – 0.12 %; magnesium Mg% is 0.16 %, from 0.16 – 0.16 %; silicium SiO% is 4.93 %, from 4.72 – 5.24 %.

Statistical analysis in 3 locations, the indicators that did not differ significantly were the humic acid, P%, K%, Ca% and Mg%. The indicators that did differ significantly were pH, C%, OM%, N% and SiO% with (α= 0.05) is α<0.00*.

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Table 6: Chemical indicators of biochar in reed flowers

Locations	pH	C%	Humic acid	OM%	N%	P%	K%	Ca%	Mg%	SiO%
Lo.1	9.4	18.97	1.14	41.38	0.18	0.37	0.67	0.18	0.15	4.25
Lo.2	9.0	20.69	1.11	37.93	0.16	0.39	0.68	0.11	0.15	4.65
Lo.3	8.88	20.69	1.02	41.38	0.17	0.33	0.67	0.18	0.14	3.97
Average	9.09	20.12	1.09	40.23	0.17	0.36	0.67	0.16	0.15	4.29
α= 0.05	<0.00*	<0.00*	<0.00*	<0.00*	0.61N	0.15N	0.88N	<0.00*	0.73N	<0.00*

(*) significant difference, (N) not significant difference

Comments:

The chemical indicators in reed flowers showed (Table 6)

- pH is 9.09, from 8.88 – 9.40; carbon C% is 20.12 %, from 18.97 – 20.69 %; humic acid 1.09, from 1.02 – 1.14 %; organic matter OM% is 40.23 %, from 37.97 – 41.38; nitrogen N% is 0.17 %, from 0.16 – 0.18 %; phosphorus P% is 0.36 %, from 0.33 – 0.39 %; kalium K% is 0.67 %, from 0.67 – 0.68 %; calcium Ca% is 0.16 %, from 0.11 – 0.18 %; magnesium Mg% is 0.15 %, from 0.14 – 0.15 %; silicium SiO% is 4.29 %, from 3.97 – 4.65 %.

- Statistical analysis in 3 locations, the indicators that did not differ significantly was the N%, P%, K%, Mg%. The indicators that did differ significantly were pH, C%, acid humic, OM%, Ca% and SiO% with (α= 0.05) is α<0.00*.

Table 8: Comparison of chemical indicators of reed biochar stems, leaves and flowers (pH, C%, humic acid, OM%)

Location	pH			C%			Humic acid			OM%		
	Trunk	Leaves	Flower	Trunk	Leaves	Flower	Trunk	Leaves	Flower	Trunk	Leaves	Flower
Lo.1	10.66	10.38	9.41	17.24	16.03	18.97	1.43	1.31	1.14	34.48	32.07	37.93
Lo.2	10.27	10.29	9.01	17.24	18.02	20.69	1.32	1.27	1.11	34.48	37.24	41.38
Lo.3	10.07	10.04	8.88	17.21	18.96	20.69	1.38	1.29	1.02	34.48	37.93	41.38
Average	10.33	10.24	9.1	17.23	17.67	20.12	1.38	1.29	1.09	34.48	35.75	40.23
α= 0.05	0.00*	0.00*	0.00*	1.00N	0.00*	0.00*	0.002*	0.12N	0.00*	1.0N	0.00*	0.00*

(*) significant difference, (N) not significant difference

Comments:

Comparison of chemical indicators of reed biochar stems, leaves and flowers (pH, C%, humic acid, OM%) showed (Table 8)

The chemical indicator are pH, C%, humic acid and OM% in stems, leaves and flowers of the reed plant biochar showed (Table 8a): pH of the plant trunk biochar is 10.33, leaves biochar is 10.24, flower biochar is 9.1, pH from 9.1 – 10.33. C% of plant trunk is 17.23 %, plant leaves is 17.67 %; flower biochar is 20.12 %, C% from 17.23 – 20.12 %. Humic acid of the plant trunk is 1.38 %, plant leaves is 1.29 %, plant flower is 1.09 %, from 1.38 – 1.09; OM% of plant trunk is 34.48 %, plant leaves is 35.75 %, plant flower is 40.23 %, from 34.48 – 40.23 %.

Statistical analysis in 3 locations, the indicators that did not differ significantly were the C% of plant trunk, acid humic of leaves, OM% of trunk. The indicators that did difer significantly were pH of trunk, leaves and flowers, C% of leaves and flowers, humic acid of trunk and flower, OM% leaves and flowers with (α= 0.05) is α<0.00*.

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Table 9: Comparison of chemical indicators of reed biochar stems, flowers and leaves (N%, P%, K%)

Location	N%			P%			K%		
	Trunk	Leaves	Flower	Trunk	Leaves	Flower	Trunk	Leaves	Flower
Lo.1	0.17	0.21	0.18	0.44	0.39	0.37	0.72	0.75	0.67
Lo.2	0.17	0.20	0.16	0.40	0.39	0.39	0.71	0.69	0.68
Lo.3	0.15	0.19	0.17	0.39	0.42	0.33	0.72	0.72	0.67
Average	0.16	0.20	0.17	0.41	0.40	0.36	0.72	0.72	0.67
α= 0.05	0.64N	0.81N	0.61N	0.09N	0.50N	0.15N	0.08N	0.09N	0.88N

(*) significant difference, (N)not significant difference

Comments:

Comparison of chemical indicators of reed biochar stems, flowers and leaves (N%, P%, K%) showed (Table 9)

- The chemical indicators are N%, P% and K% in trunk, leaves and flowers of reed plant biochar (Table 8b): N% of trunk is 0.16 %, leaves is 0.20 and flowers is 0.17 %, from 0.16 – 0.20 %.; P% of trunk is 0.41 %, leaves is 0.40 % and flowers is 0.36 %, from 0.36 – 0.41 %; K% of trunk is 0.72 %, leaves 0.72 % and flowers is 0.67 %, from 0.67 – 0.72%.

- Statistical analysis in 3 locations, the all of indicators that did not differ significantly of trunk, leaves and flowers with (α= 0.05) is α>0.05N.

Table 10: Comparison of chemical indicators of reed biochar stems, flowers and leaves (Ca%, Mg%, SiO_2%)

Location	Ca%			Mg%			SiO%		
	Trunk	Leaves	Flower	Trunk	Leaves	Flower	Trunk	Leaves	Flower
Lo.1	0.16	0.12	0.18	0.15	0.16	0.14	4.67	4.72	4.25
Lo.2	0.10	0.09	0.11	0.14	0.16	0.15	4.26	4.84	4.65
Lo.3	0.17	0.10	0.18	0.17	0.16	0.13	5.13	5.24	3.97
Average	0.14	0.10	0.16	0.15	0.16	0.14	4.69	4.93	4.29
α= 0.05	0.11N	0.06N	=0.01*	=0.03*	1.0N	0.73N	<0.00*	<0.00*	<0.00*

(*) significant difference, (N) not significant difference

Comments:

Comparison of chemical indicators of reed biochar stems, flowers and leaves (Ca%, Mg%, SiO_2%) showed (Table 10)

The biochar chemical indicators are Ca%, Mg% and SiO% in stems, leaves and flowers of the reed plant biochar showed (Table 8c): Ca% of the plant trunk biochar is 0.14 %, leaves biochar is 0.10, flower biochar is 0.16, from 0.10 – 0.16. Mg% of plant trunk biochar is 0.15 %, plant leaves is 0.16 %; flower biochar is 0.14 %, Mg% from 17.23 – 20.12 %. SiO% of the plant trunk biochar is 4.69 %, plant leaves is 4.93 %, plant flowers is 4.29 %, SiO% from 4.29 – 4.93 %.

Statistical analysis in 3 locations, the indicators that did not differ significantly were the biochar Ca% in trunk, leaves; biochar Mg% of leaves and flowers. The indicators that did differ significantly were biochar Ca% of flowers; biochar Mg% of trunk, biochar SiO of trunk, leaves and flowers with (α= 0.05) is α<0.05*.

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Table 11: Chemical analysis of biochar in three locations

Location	pH	C%	Humic acid	OM%	N%	P%	K%	Ca%	Mg%	SiO
Lo.1	9.66	18.96	1.23	37.93	0.17	0.40	0.70	0.15	0.15	4.78
Lo.2	9.86	18.85	1.23	37.70	0.18	0.40	0.69	0.12	0.15	4.58
Lo.3	10.15	17.41	1.29	34.83	0.19	0.38	0.71	0.15	0.15	4.55
α= 0.05	0.24N	0.055N	0.53N	0.054N	0.057N	0.072N	0.045N	0.03*	0.05*	0.043N

(*) significant difference, (N) not significant difference

Comments:

Chemical analysis of biochar in three locations showed (Table 11)

The chemical composition of reed biochar in the 3 area selected for investigation shows (table 6): pH (9.66 – 10.15); carbon C% (17.41 – 18.96); humic acid (1.23 – 1.29); organic matter OM% (34.83 – 37.93); nitrogen N% (0.17 – 0.19%); phosphorus P% (0.38 – 0.40%); Kalium (0.69 – 0.71%), calcium Ca% (0.12 – 0.15%); magnesium Ca% (0.2 – 0.15%), silicium SiO% (4.55 – 4.78%).

Because reed biochar has alkaline pH from 9 to 10, so it can used as a fertilizer to improve the acid sulfate soil is the best. The organic matter content in biochar is higher than 30%, so it can be used as organic fertilizer for agriculture.

The chemical composition of biochar has very lơ indicators such as nitrogen 0.17 – 0.19%, phosphorus 0.38 – 0.40%, kalium 0.69 – 0.71%, these indicators in fertilizer that are essential for plant. So if we want to use reed biochar to make organic fertilizer in agriculture, it is necessary to add inorganic chemical indicators.

Statistical analysis in 3 investigation locations, the chemical indicators that did not have significant differences between locations are pH, carbon C%, humic acid, organic matter OM%, nitrogen N%, phosphorus P%, kalium K%, and siliccium SiO%. The chemical components that have meaningful differences are calcium Ca% and magnesium Mg%

Chemical Indicators of Peat land

Table 12: Peat chemical indicators in 3 locations (pH, Humic acid, N%, P%, K%, NH_4^+, SO_4^{2-}, Fe^{2+})

Location	pH	Humic acid	N%	P%	K%	NH_4^+ mg/L	SO_4^{2-} mg/L	Fe^{2+} mg/L
Lo.1	4.42	17.54	0.42	0.08	0.30	15.92	0.06	2.13
Lo.2	4.47	15.30	0.29	0.10	0.22	16.48	0.07	1.41
Lo.3	4.35	6.24	0.16	0.12	0.11	17.33	0.08	0.82
Average	4.41	13.06	0.10	0.10	0.21	16.70	0.07	1.45
α= 0.05	0.22N	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*

Note: *mg/L (milligram per water litter)*

(*) significant difference, (N) not significant difference

Comments:

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Peat chemical indicators in 3 locations (pH, Humic acid, N%, P%, K%, NH_4+, SO_4^{2-}, Fe^{2+}) showed (Table 12)

- The peat chemical indicators of 3 locations (Table 7) includes: pH is 4.41, from 4.35 – 4.37; humic acid is 13.06 %, from 6.24 – 17.54 %; nitrogen N% is 0.10 %, from 0.08 – 0.12 %; phosphorus is 0.10 %, from 0.08 – 0.12 %; kalium K% is 0.21 %, from 0.11 – 0.30 %; NH4+ is 16.70 %, from 15.92 – 17.33 %; SO42- is 0.07, from 0.06 – 0.08 %; Fe2+ is 1.45 %, from 0.82 – 2.13 %.

Statistical analysis in 3 locations, the indicators that did not differ significantly was the pH. The indicators that did differ significantly were, C%, humic acid, N%, P%, K%, NH_4+, SO_4^{2-} and Fe^{2+} with (α= 0.05) is α<0.00*.

Adsorption of Pig Urine and Inorganic Fertilizer

Table 13: Adsorption of biochar by pig urine is filtered through biochar

Locations	pH	NH_4^+ (mg/L)	NO_2^- (mg/L)	NO_3^- (mg/L)	N (mg/L)	P (mg/L)	K (mg/L)
Pi0 (pig urine)	8.8	150	1.5	nothing	984	48	0.13
Pi1(30gBiochar)	9.07	140	0.6	nothing	860	17	0.14
Pi2(50gBiochar)	9.21	135	0.55	nothing	838	13	0.15
Pi3(70gBiochar)	9.41	134	0.5	nothing	821	10	0.17
Pi4(90gBiochar)	9.53	130	0.45	nothing	726	4	0.20
α= 0.05	<0.00*	<0.00*	<0.00*		<0.00*	0.00*	0.00*

Note:

Pi0: Pig urine without filtering reed biochar

Pi1: Pig urine when filtered 1000 milliliters with 30 grams biochar

Pi2: Pig urine when filtered 1000 milliliters with 50 grams biochar

Pi3: Pig urine when filtered 1000 milliliters with 70 grams biochar

Pi4: Pig urine when filtered 1000 milliliters with 90 grams biochar

(*) significant difference, (N) not significant difference

Comments:

Adsorption of biochar by pig urine is filtered through biochar showed (Table 13)

Pig urine was analyzed with the following chemical composition: pH is 8.8; NH4+, NO2- is 150 milligram per liter (mg/L); NO2- is 1.5 mg/L, NO3- is nothing, nitrogen (N) is 984 mg/L, phosphorus (P) is 48 mg/L; kalium (K) is 0.13 mg/L; among these, nitrogen and NO_2^- are found to have very high concentrations, especially nitrogen at 0.098 gram per liter and NH_4^+ at 0.015 gram per liter that they are the cause of environmental pollution.

Pig urine was sequentially filtered through reed biochar with weights of 30 gram (g), 50g, 70g, 90g. The results obtained pH were 9.07, 9.21, 9.41 and 9.53 (compared to control was 8.8). NH4+ analyzed as 140mg/L, 135 mg/L, 134mg/L,130mg/L. NO2- analyzed as 1.5 mg/L, 0.6 mg/L, 0.55 mg/L, 0.5 mg/L, 0.45 mg/L. NO3+ all of nothing. Nitrogen N is 984 mg/L, 860 mg/L, 838 mg/L, 821 mg/L and 726 mg/L.Phosphorus N is 48 mg/L, 17 mg/L, 13 mg/L, 10 mg/L and 4 mg/L. Kalium K analyzed is 0.13 mg/L, 0.14 mg/L, 0.15 mg/L, 0.17 mg/L and 0.20 mg/L.

Statistical indicators that have significant differences all of indicators with (α= 0.05) is α<0.05*.

Table 14. The reed biochar adsorption inorganic nitrogen (N), phosphorus (P) and kalium (K)

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Biochar	N%	P%	K%
30 gram	0.17	0.35	0.43
50 gram	0.22	0.41	0.45
70 gram	0.24	0.44	0.46
90 gram	0.31	0.46	0.48
α= 0.05	<0.00*	<0.00*	<0.00*

(*) significant difference, (N) not significant difference

Comments:

Dissolve 1000 milliliters and 10 gram nitrogen 46%, then filter through biochar with amounts 30, 50, 70 and 90 gram, result analyzed showed (Table 14):

Adsorption of nitrogen as 30 gram is 0.17% and 90 gram is 0.31%; phosphorus at 30 gram is 0.35% and 90 gram 0.46%; Kalium at 30 gram is 0.43% and 90 gram 0.48%.

This result showed biochar can absorbable nitrogen, phosphorus and kalium in the natural environment.

Statistical indicators that have significant differences all of indicators with (α= 0.05) is α<0.00*.

Table 15. The reed biochar adsorption with pig urine

Biochar	pH	N%	P%	K%	NO_2-	NO_3+	NH_4+
30 gram	8.87	0.47	0.29	0.32	0.28	0.89	11.77
50 gram	8.93	0.52	0.32	0.35	0.30	1.19	13.21
70 gram	8.95	0.54	0.34	0.36	0.33	1.33	13.89
90 gram	8.97	0.56	0.37	0.39	0.36	1.46	14.48
α= 0.05	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*

(*) significant difference, (N) not significant difference

Comments:

The reed biochar adsorption with pig urine showed (Table 15)

- Prepare 1000 milliliter of pig urine filtered to reed biochar with increasing weight from 30, 50, 70, 90 grams, the results showed as pH increased from 8.87 – 8.97; Nitrogen increased from 0.47 – 0.56%; Phosphorus increased from 0.32 – 0.39%, Kalium increase from 0.32 – 0.39%; NO2- increased from 0.28 – 0.36%, NO3- increase from 0.89 – 1.46%, NH4+ increased from 11.77 – 14.48%.

- Statistical indicators that have significant differences all of indicators with (α= 0.05) is α<0.00*

Use Biochar Formulas

Table 16: Mixed fertilizer of biochar, peat and inorganic

Formulas	pH	C%	Humic acid	OM%	N%	P%	K%	Ca%	Mg%	SiO
Fo.1a (5 days)	10.35	18.26	1.27	41.20	0.18	0.39	0.72	0.14	0.15	4.57
Fo.1b (10 days)	10.26	17.24	1.32	34.48	0.17	0.40	0.71	0.10	0.14	4.26
Fo.2a (5 days)	10.04	17.54	1.22	39.03	4.22	3.55	11.81	0.15	0.13	4.63
Fo.2b (10 days)	10.46	17.31	1.35	36.98	4.87	4.11	13.59	0.14	0.14	4.38
Fo.3a (5 days)	10.08	17.23	1.23	37.89	2.35	2.69	9.18	0.13	0.15	4.25
Fo.3b (10 days)	10.05	17.31	1.22	36.36	2.96	3.80	12.33	0.14	0.15	4.41
Fo.4a (5 days)	9.59	18.00	1.31	39.92	2.46	3.86	13.56	0.15	0.14	4.52
Fo.4b (10 days)	10.21	17.66	1.28	36.70	3.35	3.53	15.47	0.14	0.14	4.36
Fo.5a (5 days)	10.15	17.65	1.23	38.17	3.33	3.63	13.41	0.14	0.14	4.44
Fo.5b (10 days)	9.31	17.31	1.34	41.86	3.36	4.52	14.31	0.14	0.13	4.46

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Fo.6a (5 days)	10.41	18.57	1.31	35.62	4.28	4.23	14.85	0.14	0.15	4.37
Fo.6b (10 days)	10.10	18.54	1.40	36.98	4.81	4.86	15.62	0.15	0.15	4.53
Fo.7a (5 days)	9.94	18.39	1.33	40.22	4.72	4.81	15.70	0.14	0.15	4.32
Fo.7b(10 days)	9.57	18.14	1.23	37.93	5.66	5.77	10.64	0.14	0.14	4.44
Fo.8a (5 days)	10.09	18.76	1.25	36.87	5.30	5.25	16.36	0.15	0.14	4.76
Fo.8b (10 days)	10.23	20.01	1.41	40.75	6.23	6.36	18.36	0.14	0.16	4.64
α= 0.05	0.78N	0.83N	0.06N	0.00*	0.00*	0.00*	0.00*	0.64N	0.85N	0.00*

Note:

Fo.1a: Formular 1 (Control 5 days). Fo.1b: Formula (Control 10 days).

Fo.2a: Formular 2 (5 days). Fo.2b: Formula 2 (10 days)

Fo.3a: Formular 3 (5 days). Fo.3b: Formula 3 (10 days).

Fo.4a: Formular 4 (5 days). Fo.4b: Formula 4 (10 days)

Fo.5a: Formular 5 (5 days). Fo.5b: Formula 5 (10 days).

Fo.6a: Formular 6 (5 days). Fo.6b: Formula 6 (10 days)

Fo.7a: Formular 7 (5 days). Fo.7b: Formula 7 (10 days).

Fo.8a: Formular 8 (5 days). Fo.8b: Formula 8 (10 days)

Mix fertilizer: With 8 experimental formulas labeled

Formula 1: 100g Biochar (Control)

Formula 2: 3,3g Nitrogen 46% + 3,3g phosphorus 61 % + 3,3g Potash 61% (10g NPK+ 90 g Biochar = 100g fertilizer)

Formula 3: 10% (Nitrogen 16% + Phosphorus 16% + 8%) + 90% Biochar = 100% fertilizer

Formula 4: 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%) + 90% Biochar = 100% fertilizer

Formula 5: 50% Biochar + 40% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 6: 60% Biochar + 30% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 7: 70% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)

Formula 8: 80% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)

The dates after Mixed during 5 days and 10 days: Analized indicators are humic acid (%), organic matter OM(%), C (%), N(%), P(%), K(%), Ca(%), Mg(%), SiO2(%)

(*) significant difference, (N) not significant difference

Comments:

Formulas for mixing biochar with inorganic fertilizers from formula 2 to 4 showed (Table 16):

Formulas 2 – 4 (10 gram Nitrogen 46%, 10 gram Phosphorus 61%, 10 gram Kalium 61% mixed 90 gram reed biochar keeping 5 days and 10 days) after analyzer chemical indicators as pH (10.04 – 10.46); Carbon C% (17.31 – 17.54%); Humic acid (1.22 – 1.35%); Humic acid (1.22 – 1.35%); Organic matter OM% (36.36 – 39.92%); Nitrogen N% (2.46 – 4.87%); Phosphorus P% (2.69 – 4.11%); Kalium K% (9.18 – 15.47%); Calcium Ca% (0.13 – 0.15%); Magnesium (0.13 - 0.15%); Silicium SiO% (4.25 – 4.52%); These formulas compare the control only Organic matter, Nitrogen, Phosphorus and Kalium are difference that showed in analysis of biochar chemical data.

- The chemical indicators: In formula 2 Nitrogen is 4.22 % in 5 days and 4.87% in 10 days; phosphorus is 3.55% in 5 days and 4.11% in 10 days; Kalium is 11.81% in 5 days and 13.59% in 10 days; Organic matter

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OM% is 39.03 in 5 days and 36.98% in 10 days. In formula 3 Nitrogen is 2.35% in 5 days and 2.96% 10 days; Phosphorus 2.69% in 5 days and 3.80 in 10 days; Kalium is 9.18% in 5 days and 12.33 in 10 days; Organic is 37.89% in 5 days and 36.36% in 10 days. Formula 4 Nitrogen is 2.46% in 5 days and 3.55% in 10 days; Phosphorus is 2.69% in 5 days and 3.86% in 10 days; Organic matter is 37.89% in 5 days and 36.36% in 10 days. In the criteria of the Ministry of Agriculture and Rural Development with the mandatory criteria for organic fertilizer are the organic is 30%, the nitrogen ratio is 2%, the phosphorus ratio is 2% and the kalium ratio is 3%. Comparing these criteria, the above experiment is satisfactory and feasible for the research potential of reed biochar fertilizer.

- Regarding the effectiveness of mixing inorganic fertilizers are formula 2 (10%N, 10% P, 10% K) and formula 4 (20% N, 20% P, 15% K) are effective in adsorption nitrogen, phosphorus and kalium in biochar are the highest.

Statistical indicators that do not have significant differences are pH, humic acid, calcium, magnesium and silicium. The indicators with statistically significant differences are nitrogen, phosphorus, kalium, and organic matter.

Table 17: Rice growth indicators in experimental after 30 days of age

Formula	H(cm)	No.br	No. sub-br	L.le	Tr.le	Tr.co.	L.co
Fo.1	22.55	3	1	13.48	7.11	3	3
Fo.2	36.34	3.96	1.56	27.70	12.26	5	5
Fo.3	36.44	4.03	2	28.85	12.96	5	5
Fo.4	35.96	3.56	1.33	27.04	12.52	5	5
Fo.5	36.63	3.04	1.04	26.78	11.96	4.85	4.85
Fo.6	35.89	3.48	1.37	25.89	12.59	5	5
Fo.7	36.56	3.37	1.37	26.78	12.55	5	5
Fo.8	36.56	3.56	1.44	26.11	12.67	5	5
	34.62	3.50	1.39	25.33	11.83	4.73	4.73
α= 0.05	<0.00*	0.17N	<0.01*	<0.00*	<<0.00*	<0.00*	<0.00*

Note:

Fo.1 (Formula 1): 100% Biochar (Cotrol)

Fo.2 (Formula 2): 3.3% Nitrogen 46% + 3.3g phosphorus 61 % + 3.3g Potash 61% (10g NPK+ 90 % Biochar = 100% fertilizer)

Fo.3 (Formula3): 10% (Nitrogen 16% + Phosphorus 16% + 8%) + 90% Biochar = 100% fertilizer

Fo.4 (Formula 4): 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%) + 90% Biochar = 100% fertilizer

Fo.5 (Formula 5): 50% Biochar + 40% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.6 (Formula 6): 60% Biochar + 30% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.7 (Formula 7): 70% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.8 (Formula 8): 80% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

(No.br) Number of branch;(No.sub-br.) Number of sub branch; (L.le) leaves length; (Tr.le)Stem length; (Tr.co) color of stem; (L.co) color of leaves.

(*) significant difference, (N) not significant difference

Comments:

Growing rice according to experimental formulas, fertilize after 7 days and measured results after 30 days of age showed (Table 17):

- The plant height of the control is 22.55 centimeters (cm), all of formulas from 2 to 8 are analyzed as follows: Fo.2 is 36.44 cm; Fo.3 is 36.44 cm; Fo.4 is 35.96 cm; Fo.5 is 36.63 cm; Fo.6 is 35.98cm; Fo.7 is 36.56 cm; Fo.8

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is 36.56 cm. Number branch of plant (No. Br.) Fo.1 control is 3 and all of formulas from 3.04 - 4.03 cm. Number of sub branch Fo.1 control is 1 and all of formulas from 1.04 – 2 cm. Leaf length Fo.1 control is 13.48 cm and all of formulas from 26.11 – 28.85 cm. Th plant stem length Fo.1 control is 7.11 cm and all of formulas from 11.96 – 12.96 cm. The plant stem color (with 5 the best) Fo.1 is 3 and all of formulas from 4.73 – 5. The plant leaf color Fo.1 control is 3 and all of formulas from 4.73 – 5. All of formulas compare the control is better.

- Statistical indicators that have significant differences all of indicators with (α= 0.05) is α<0.05*. The number of plant branch did not have significant differences with α=0.17N.

Table 18: Rice growth indicators in eperimental formulas after 125 days of age

Formula	H(cm)	Br.bu	Br.pl	Se.br	Se.bu	St.le	Fl.se.br	Se.co	L.co
Fo.1	92.41	29.75	10.52	107.59	3425	72.22	8.07	4.78	4.71
Fo.2	**102.63**	**31.19**	**11.45**	**126.93**	**4375**	**71.96**	**8.15**	**4.93**	**4.93**
Fo.3	95.48	35.74	11.33	134.59	4579	72.30	8.33	4.89	4.89
Fo.4	**93.89**	**33.33**	**10.92**	**158.66**	**5180**	**73.66**	**8.59**	**4.85**	**4.85**
Fo.5	**96.96**	**32.67**	**11.15**	**152.22**	**5090**	**72.48**	**8.48**	**4.89**	**4.89**
Fo.6	**92.26**	**34.11**	**11.89**	**185.37**	**6641**	**82.00**	**8.71**	**4.89**	**4.89**
Fo.7	**95.33**	**34.48**	**10.41**	**163.70**	**5106**	**78.93**	**8.33**	**4,71**	**4.71**
Fo.8	92.48	31.81	9.78	144.48	4238	72.59	8.87	4.63	4.63
	95.18	35.38	10.93	146.69	4829	74.52	8.49	4.84	4.81
α= 0.05	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.00*	<0.05*	<0.02*

Note:

Fo.1 (Formula 1): 100% Biochar (Control)

Fo.2 (Formula 2): 3.3% Nitrogen 46% + 3.3% phosphorus 61 % + 3.3% Potash 61% (10% NPK+ 90% Biochar = 100% fertilizer)

Fo.3 (Formula3): 10% (Nitrogen 16% + Phosphorus 16% + 8%) + 90% Biochar = 100% fertilizer

Fo.4 (Formula 4): 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%) + 90% Biochar = 100% fertilizer

Fo.5 (Formula 5): 50% Biochar + 40% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.6 (Formula 6): 60% Biochar + 30% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.7 (Formula 7): 70% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

Fo.8 (Formula 8): 80% Biochar + 20% Peatland + 10% (Nitrogen 20% + Phosphorus 20% + Potash 15%)= 100% fertilizer

H(cm) height of plant; Br.bu branches of bush; Br.pl branches of plant; Se.br seeds of branch; Se.bu seeds of bush; Tr.le. length of stem; Fl.se.br Flat seeds of branch; Se.co Corlor of seeds; L.co color of leaves

(*) significant difference, (N) not significant difference

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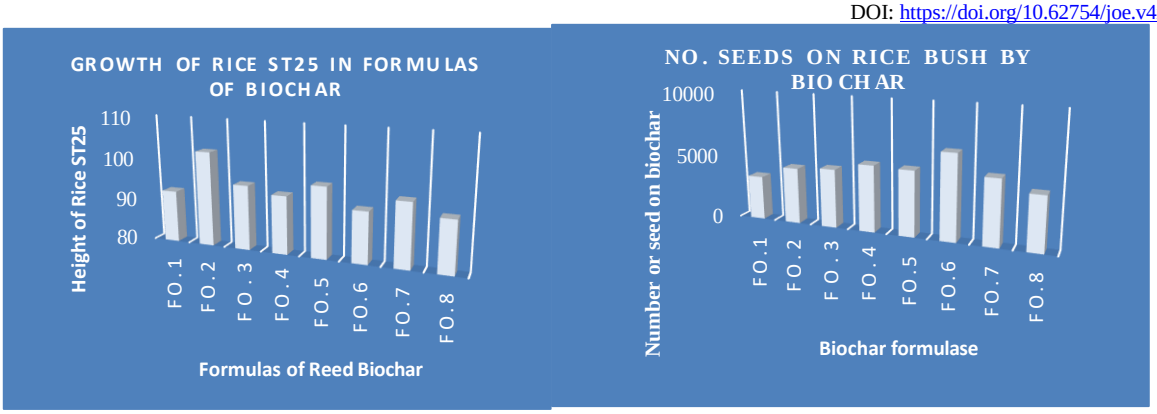

Figure 2. Height Growth and seed number of Rice ST 25 on Reed Biochra Formulas

Figure 3. Rice ST 25 use Reed biochar and model of using biochar fertilizers after 125 days old

Comments:

Rice growth indicators in experimental formulas fertilize after 75 days and measure after 125 days of age. The growth of rice plants in 8 formulas showed (Table 18) and (Figure 2 and Figure 3):

- The plant height Fo.1 control is 92.41 cm and all of formulas 92.96 – 102.63 cm [26] (the plant height form 103 -105 centimeter). The branch of bush Fo1 control is 29.75 branch (Br) and all of formulas from 31.19 – 34.48 Br. . The branch of plant Fo.1 is 10.52 Br. and all of formulas from 9.78 – 11.89 Br. The seeds of branch Fo.1 control is 107.59 seed (Se.) and all of formulas from 126.93 – 163.70 seeds [26] (the seed from 68 – 104 per branch and 27 the flat seeds per branch) . The seeds of bush Fo.1 control is 3425 seeds and all of formulas from 4238 – 6.641 seeds The plant stem length Fo.1 is 72.22 cm and all of formulas from 72.30 – 82.00 cm. The flat of branch Fo.1 is 8.07 seed and all of formulas from 8.33 – 8.87 seeds. The seed color Fo.1 is 4.78 (5 is best) and all of formulas from 4.63 -4.93. The leaf color Fo.1 is 4.71 (5 is best) and all of formulas from 4.71 – 4.89

- The biochar group combine with inorganic fertilizer formulas 1 – 4; Formulas 4 have the seed highest is 5180 seeds per bush, the Fo.2 have the height growth is the best 102.63 centimeter but the seed per bush only 4375 seeds per bush.

- The biochar group combines with peat and ingrain formulas from Fo.5 – Fo.7 with the height from 92.26 – 95.33 cm and the seed of bush from 5090 – 6641 seeds per bush, especially formulas 6 is the best with 6641 seeds per bush.

- Statistical indicators that have significant differences all of indicators with (α= 0.05) is α<0.05*.

Discussions

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Growth and density of reed plant investigated in 3 regions of the Mekong Delta compared to herbaceous plant species, reed has the highest growth, biomass and density, so it creates coverage that other weed cannot compete; this advantage will be meaningful when they can be exploited as an endlessly renewable source of raw materials.

Indicators of reed weight include fresh weight, dry weight and weight of reed biochar produced. Investigation results show that the fresh weight of reed plant is 122 gram per plant, dry plant is 65 gram per plant and when creating biochar is 13.6 gram per plant, the density is 60 plants per square meter. In the study result showed biochar of plant trunks, leaves and lowers is plant trunk biochar has the highest weight.

The chemical indicators at 3 locations showed results: On plant trunks such as pH, humic acid, Mg%, SiO% are different between 3 locations, other chemical indicators such as C%, OM%, N%, P%, K% are not different between 3 locations. On plant leaves of reed plant with different chemical indicators include pH, C%, OM%, SiO; the chemical indicators are not different at 3 locations include humic acid, N%, P%, K%, Ca%, Mg%. On plant flowers at 3 locations the chemical indicators are different such as pH, C%, acid humic, OM%, Ca%, SiO%; the chemical indicators are not different as N%, P%, K%, Mg%.

Chemical indicators of peat in 3 locations: pH is not different chemical indicators and humic acid, N%, P%, K%, NH_4^+, SO_4^{2-}, Fe^{2+} are different indicators in 3 locations.

Compare chemical indicators on trunks, leaves and flowers at 3 locations: The chemical indicators are different as pH of trunks, leaves and flowers, C% of leaves and flowers, humic acid of trunks and flowers, OM% of leaves and flowers, Ca% of flowers, Mg% of trunks and SiO of trunk, leaves and flowers; the indicators are not different as C% of trunks, humic acid of leaves, OM% of trunk.

Compare the chemical indicators of reed in 3 locations showed: The indicators are Ca% and Mg%; the indicators are not different in 3 locations are not different as pH, C%, humic, OM%, N%, P%, K% and SiO%.

Biochar mixed peat and inorganic mineral fertilizers to different formulas, chemical analysis after 5 days and 10 days showed the chemical indicators are difference as OM%, N%, P%, K% and SiO% and the chemical indicators are not difference as pH, C%, humic acid, Ca%, Mg%.

The adsorption of biochar when filtering pig urine before and after gradually decreases with the urine and increases with the biochar amount; the chemical indicators are different before and after filter through as pH, NH_4+, NO^{2-}, P, K; the undetected chemical indicators as NO^{3-}.

Adsorption of biochar with inorganic mineral fertilizers: Separate inorganic mineral fertilizers dissolved in water and filtered through biochar in increasing amounts; it was found there was difference in the adsorption rates of N, P, K as the biochar increased.

The adsorption of reed biochar when pig urine is filtered through biochar with increasing volume, the adsorption capacity also increases, the chemical components increase as pH, N%, P%, K%, NO_2-, NO_3-, NH_4+.

Experiment on biochar fertilizer on ST25 rice applied 7 days after sowing and measure growth indicators after 30 days. Growth indicators are clearly different when mixing biochar with peat and inorganic mineral fertilizers by many formulas, measure after 30 days compare with control few formulas result are quite promising for fertilizer biochar in the future.

When mixing biochar, peat and inorganic mineral fertilizer to differences techniques with Vietnam's standards and experimenting on ST 25 rice plants, fertilizing in stage 2 of rice at 75 days old, results are very positive of quality and volume. Biochar formulas with inorganic fertilizers, from formulas 2 – 4, compared to control formulas 1 as growth in height, number of branches on bush, number of branch on plant, number of seeds on branch, number of seeds on bush, the length of the stem, number of flat seeds on branch, the color trunks, the color leaves; most of them better than the control formulas 1. The combination of biochar formulas with peat

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and inorganic fertilizer according to Vietnamese standards has formulas from 5 – 8. Measurement results after 125 days of age showed that the growth indicators exceed compare the control. For yield indicator the formulas 5 – 7 has over 5000 seeds per bush, formulas 6 has 6600 seeds per bush, meanwhile formulas 4 has 5180 seeds per bush also formula the high yield inorganic mineral fertilizer.

Conclusions

Reeds in mekong Delta grow with high height, frest biomass, dry biomass and biochar with quite high productivity to provide biochar for environmental treatment and as raw material for fertilizers in agriculture.

The chemical indicators of reed biochar on trunks, leaves, flowers have been determined to serve as a basis for proposing the supply of reed biochar in the Mekong Delta for environmental treatment industry and agricultural fertilizer.

The chemical indicators of peat where reeds grow in the Mekong Delta have been determined so that can be combined with biochar to be used as raw materials for agricultural organic fertilizers.

Reed biochar, peat, and inorganic fertilizers were mixed and trial on rice ST 25 plants in Vietnam using formulas that showed quite high yield potential for development in Mekong Delta.

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