Research on Biomass and Biochar of Reed (Phragmites australis) in U Minh Thuong National Park, Vietnam

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Abstracts: Aims: Reed (Phragmites autralis) is a plant species with a seasonal reproductive cycle, it has a very high biomass in U Minh Thuong National Park. in Vietnam. To evaluate fresh and dry biomass, then made of biochar on reed plants to use biochar products provide bio-organic fertilizer raw materials for watermelon plant in agriculture. Methods: To achieve that goal several experiments were performed as (1) investtigate the biomass of fresh and dry reeds and made of biochar by using the traditional method; (2) adsorption with pig urine and chemical fertilizer (nitrogen, phosphorus and potash) to see the retention off chemical coponents dispersed into the environment in the adsorbed biochar; (3) mix biochar with inorganic mineral fertilizers and peat to from some inorganic fertilizer – biochar formulas, then consider the chemical composition of that mixture; (4) using some mix biochar fertilizer to grow watermelon with local varieties. Results: The results show that reeds can provide very high biomass to made of biochar fertilizer and reed biochar can adsorption the pig urine as ammonium, nitrate, nitrogen, phosphorus and it also adsorption inorganic as nitrogen, phosphorus and potash. So it is possible to propose the use study for planting watermelon and application treatment environment in the region polluted. Conclusions: Biomass and biochar of reed is very high, biochar can adsorb nitrogen, phosphorus and potash fertilizer; biochar can mixed peat and inorganic mineral fertilizer to planting watermelon in Mekong Delta. .

Keywords: Biomass and Biochar of Reed, Phragmites autralis, watermelon; U Minh Thuong, Vietnam

1. INTRODUCTION

Reed (*Phragmites autralis*) is a fast growing plant in U Minh Thuong Nationnal park Vietnam[10], highest biological productivity among weed species on peatland as U Minh Thuong National Park and growth of reeds in Quang Ninh on mined land has the ability to reduce some polluted metals during the mining process [4], it grows into a very thick vegetation and invades very quickly with the height to 5 meters to the point of covering the ground where it grows, reduces biodiversity of animals and plants. Biomass harvested during winter will have weaker carelations between mineras but constant morphological parameter because nutrient concerntrations above ground [12]. Especially when they mature in dry season, they die with each part of the stem, leaves and flowers, they creat amass of flamable material from 5 – 10 kilograms per one square meters, spread evenly from tree top to the ground. When is a fire, they burn on the plant tops down the leaves and then spread to the ground. Then the fire area lacks oxygen and the wind from surounding areas spreads to creats an increasing windy and fire will burn quicky and strongly. When finished burning they leave behind red charcoal fires and continue to burn underground in the peat layer and fire underground during many days causing serious damage such as U Minh Thuong National Park.

On the other hand, because reed growth has the highest annual biomass, it is also a very potential renewable resource and research on its biomass serves beneficial purposes not only in reducing the risk of forest fires but also harvest a huge amount of biomass every years.

In study boichar [5] producing rice straw and rice straw and rice husk biochar to improve soil fertility, crop producctivity and reduce greenhouse emissions. In this topic, research on reeds on peat soil in U Minh Thuong National Park, a species of plant that produces the largest amount of flammable material, it is a threat to annual forest fires, the topic will focus on research on growth, biomass of stem, leaves, flowers of frestand dry plants. Its research also made of biochar from reed plant by traditional method to produce into reed biochar.

Studies biochar [7] research on the posibility of using biochar to replace manure and inorganic fertilizers in rice production. This study also analyzed the relationship between peat soil properties and the growth and biomass of reeds on different peat soils in U Minh Thuong National Park. In research [13] The Vietnam Soil and Agrochemical) Institute requires product quality with organic content >30%, humic acid >5%, total NPK>5% and there are mixed ingredients including: Biochar, nitrogen, phosphorus, potassium fertilizer, intermediate elements, trace elements (TE), organic supplements. Reseach using biochar [7] to replace manure and ingnorganic fretilizers in rice production. It also study the chemical composition of biochar, on that basis, we will propose directions for use in treating polluted water environments and using it in agriculture by orgarnic and biologycal fertilizers in the future.

There is a relationship between soil chemical composition and biological density [11]. Therefore, this project also studies the chemical parameters of peat soil on distributed reed base to see the growth and biomass productivity are related to chemical indicators.

Study of Amonium and nitrat adsorption [8] *Phragmites autralis* biochar from aqueous solution in Persian give us look at biochar of reeds. Therefore, studying biomass and biochar of reed (*Phragmites autralis*) in U Minh Thuong National Park Vietnam is extremely necessary and has practical significance in this region.

Mixed inorganic mineral fertilizer as nitrogen, phosphorus, potash with biochar by different formulas and biochar, peat and inorganic mineral fertilizer after 5 days and 10 days to analized the chemical of them to check the keeping nitrogen, phosphorus and potash to use them for fertilizer.

Using mixed biochar, peat and inorganic to make fertilizer to planting watermalon by experiment with 7 formulas and control to check that fertilizer for agriculture in the future.

2. MATERIEL AND METHODS

2.1. Material

THE FOLLOWING STEPS:

The reed plants are old plants with dry leaves and flowers during in the dry season. The plants are cut and gathered to a place. Designed traditional manual furnace. Separate the dry part of the trunk, leaves and flowers. Burn until all the smoke is gone, then cut off the oxygen. Collect the biochar to experiment (Figure 1).

Use pig urine from the pig farm to filter through biochar

Use phosphorus and nitrogen from inorganic fertilizer mixed in water to filter through biochar.

Made watermelon (*Citrillus lanatus*) seedlings, planting and apply mixed fertilizer twice at 30 days and 40 days; measure growth indicators at 30 days and 70 days. The indicators include at 30 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 70 days as stem length (Lst), leaf color (Lco.), fruit length (Lfr.), fruit width (Wfr.), fruite weigth (Few.), physis in fruit (Pfr.), fruit color (Fco.), sweetness level (Sle.)

2.2. Biomass Investigation

Types of reed vegetation on diferent peat thickness: Peat thickness: (0cm); (>0 – 30 cm), (>30 -60 cm); (>60 – 90 cm).

Each thickness selected 5 sample plots; Total plots are 20, the area of plot is 4 square meters, in each plot selected 9 reed plants to mearsure 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 20 sample plots on 4 peat thickness, in a plot select total 9 plants (3 shortest plants, 3 medium plants, 3 highest plants), cut it from the ground, then write number of plant and number plot to take them to the laboratory, then take divide the trunk, leaves, flowers and weigh them invidual each other. After take divide at still fresh weigh them before, next step dry them until the weight is not change at that weigh the dry trunk, dry leaves and dry flower of reed. The third step is burn the trunk, leaves, flowers in the designed biochar burner

Determination of fresh plant biomass by weigh total fresh plants (Wft), weigh fresh plant trunks (Wftr), weigh fresh leaves (Wfl), weigh fresh flowers (Wff), unit of weigh is gram (g).

Determination of dry plant biomass by weigh total dry plant (Wdt), weigh dry plant trunk (Wdtr), weigh dry plant leaves (Wdfl), weigh dry plant flowers (Wff), unit of weigh is gram (g).

DETERMINATION OF PLANT BIOCHAR BY WEIGH TOTAL PLANT BIOCHAR (WBT), WEIGH PLANT TRUNK BIOCHAR (WBTR), WEIGH LEAVE

biochar (Wbl), weigh plant flower biochar (Wff), unit of weigh is gram (g). (Figure

1)

2.3. Soil investigation

Based on the high distribution map of peat soil, 20 soil investigation plots were established [9]. Using a hand drill to collect samples, a total of 20 plots were set up to survey the growth of the reed at three different peat thickness levels. There were 5 plots for the thickness 4 level, 0 cm 5 plots, from 5- 30 cm 5 plots; 30 – 60cm 5 plots, from 60 - 90 cm 5 plots (20 plots in total). Each site to collect samples is three [6], and each sample is one kilograms and coded a number of the site 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 were 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) were determined with a pH meter. Humus content and humic acid were 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.

2.4. Reed biochar chemical indicators

Biochar analysis include indicators: pH, Humic acid %, C%, OM%, N% total, P% total, K% total, Ca%, Mg%, Ash %. All of indicators analyzed follow the soil analysis as above.

2.5. Mix fertilizer and applicating experiment for watermelon

Mix fertilizer: 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(%)

2.6. Data Analysis

The analysis involves using t-tests and one-way analysis of variance (ANOVA) to compare the mean differences between peat and reed growth on the different thickness levels of peat [1]. Correlation analysis using 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 different peat thicknesses. 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 extration ratio 1: 2.5; K%, Ca%, Mg% mearsured with an atomic absorption machine; Silic mearsured according to method of AOAC (Asociation of analytical communities); Nitogen measured according to method Kjeldahl; Phosphorus measured by wavelength colormetric method; Ash calculated by ashing method.

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

3. RESULTS AND DISCUSSIONS

3.1. Research Results of growth and fresh biomass

Table 1: The height and diameter of trunk at ground

No.	Peat thickness	Height (H)	Diameter ($D_{0.0}$)	Density (N/m^2)	Volume (Ym^3)	Weight (kg)
1	0 cm	3.39	1.8	87	0.04	15.46
2	5 -30 cm	4.17	1.9	62	0.04	14.96
3	30 -60 cm	4.48	2.99	56	0.09	21.90
4	60 – 90 cm	4.74	3.17	49	0.10	20.58
	α=0.05	<0.001	<0.001	<0.001	<0.001	<0.001

Comments: The height of reed (Table 1) at the thickness 0 centimeter (cm) is 3.39 cm; from 5 – 30 cm is 4.19 cm;

from 30 – 60 cm is 4.48 cm; from 60 – 90 cm is 4.47 cm. The diameter at ground of reed on 0 cm peat thickness is 1.8 cm; at the peat thicness 5 – 30 cm is 1.9 cm; 30 – 60 cm is 2.99 cm; 60 – 90 cm is 3.17 cm. The density of reed on one square meters at peat thickness 0 cm is 87 plants, at 5 – 30 cm is 62 plants, at 30 – 60 cm is 56 plants and 60 – 90 cm is 49 plants. The volume of the reed trunk 0cm peat thickness on 1 square meters is 0.04 cubic meters, 5 – 30 cm peat thickness is 0.04 cubic meters, 30 – 60 cm peat thickness is 0.09 cubic meters, 60 -90 cm peat thickness is 0.10 cubic meter. The weight of reed plant at the 0 cm peat thickness is 15.46 kilogarms per 1 square meter, 5 -30 cm peat thickness is 14.96 kilograms, 30 - 60 cm peat thickness is 21.90 kilograms; 60 – 90 cm peat thickness is 20.58 kilograms.

Statistical analysis with ANOVA the investigated indicators were all significantly diferent at the α = 0.05, the p-value of indicators had less than 0.001.

In general: Growth indicators increase with peat thickness such as height, stem diameter volume and biomass of reed plant. The result (Table 1) Showed the Reed height is highest of grass from 3.39 meters to 4.74 meters; the diameter of plant is very big of grass form 1.8 – 3.17 centimeters, the density also very high from 49 – 87 plants per m2, the volume 0.04 – 0.1 m3/m2 equivalent to 400 m3 per hectare (ha) to 1000 m3/ha a volume huge biological productivity and weigh from 15.46 – 20.58 kg/m2 equivalent to 154.600 – 205.810 kg/ha, biological.

Table 2: Fresh reed plant biomass

No.	Peat thickness	Wft (g)	Wftr (g)	Wfl (g)	Wff (g)
1	0 cm	176	95	74	6.8
2	5 -30 cm	242	138	95	9.31
3	30 -60 cm	391	234	152	14.87
4	60 – 90 cm	423	237	187	21.44
	α=0.05	<0.0001	<0.0001	<0.0001	<0.0001

Wft: Weight of total fresh reed plant
Wftr: Weight of fresh reed plant trunk
Wfl: Weight of fresh reed plant leaves
Wff: Weight of fresh reed plant flowers

Comments: The fresh plant biomass (Table2) showed: The weight of fresh reed plant total (Wft) per plant at the 0 cm peat thickness is 176 grams; 5 – 30 cm peat thickness is 242 grams, 30 – 60 cm peat thickness is 391 grams, 60 – 90 cm peat thickness is 423 grams; the weight of the fresh reed trunk (Wftr) at 0 cm peat thicness is 95 grams per plant, 5 – 30 cm peat thickness is 138 grams; 30 -60 cm peat thickness is 234 grams; 60 – 90 cm peat thickness is 237 grams; the weight of the fresh reed leaves at the 0 cm peat thickness is 74 grams per plant; 5 - 30 cm peat thickness is 95 grams; 30 – 60 cm peat thickness is 152 grams; 60 - 90 cm peat thickness is 187 grams. The weight of fresh reed flowers (Wff) at the 0 cm peat thickness is 6.8 grams per plant; 5 – 30 peat thickness is 9.31 grams; 30 – 60 cm peat thickness is 14.87 grams; 60 – 90 cm peat thickness is 21.44 grams.

Statistical analysis with ANOVA the investigated indicators were all significantly diferent at the α = 0.05, the p-value of indicators had less than 0.001.

- In general: The weight indicators increase with peat thickness such as weight of fresh reed plant total (Wft), fresh trunk of reed plant (Wftr), fresh leaves of reed plant (Wfl), fresh flowers of reed plant; these indicators increase with peat thickness. The result showed weight of a plant 176 – 423 grams, a plant stem 95 – 237 grams, a plant leaves 74 – 187 grams, a plant flowers 6.8 – 21.44 grams. This result showed the trunk have weight is highest.

3.2. Dry biomass

Table 3: Dry reed plant biomass

No.	Peat thickness	Wdt (g)	Wdtr (g)	Wdl (g)	Wdf (g)
1	0 cm	127.34	79.55	33.78	4.4

2	5 -30 cm	181.01	121.84	57.64	7.53
3	30 -60 cm	312.42	196.78	102.73	12.91
4	60 – 90 cm	358.58	217.78	122.16	19.64
	α=0.05	<0.0001	<0.0001	<0.0001	<0.0001

Wdt: Weight of total dry reed plant
Wdtr: Weight of dry reed plant trunk
Wdl: Weight of dry reed plant leaves
Wdf: Weight of dry reed plant flowers

Comments: The dry plant biomass (Table 3) showed: The dry biomass total per plant (Wdt) at 0 cm peat thickness per plant is 127.34 grams, 5 – 30 cm is 181.01 grams, 30 – 60 cm is 312.42 grams, 60 -90 cm is 358.58 grams; The dry biomass of plant trunk (Wdtr) at 0 cm peat thickness per plant is 79.55 grams, 5 – 30 cm is 121.84 grams, 30 – 60 cm is 196.78 grams, 60 -90 cm is 217.78 grams. The dry biomass of plant leaves at the 0 cm peat thickness per plant is 33.78 grams, 5 – 30 cm is 57.64 grams, 30 – 60 cm is 102.73 gram, 60 – 90 cm is 122.16 grams. The dry biomass of plant flowers at 0 cm peat thickness per plant is 4.4 grams, 5 - 30 cm is 7.53 gram, 30 – 60 cm is 12.91 grams, 60 – 90 cm is 19.64 grams.

Statistical analysis with ANOVA the investigated indicators were all significantly diferent at the α = 0.05, the p-value of indicators had less than 0.001.

- In general: The weight indicators increase with peat thickness such as weight of dry reed plant total (Wdt), dry trunk of reed plant (Wftr), dry leaves of reed plant (Wfl), dry flowers of reed plant; these indicators increase with peat thickness. The results showed a dry plant from 127.34 – 358.58 grams, a dry plant stem 79.55 – 217.78 grams, a dry plant leaves 33.78 – 122.16 grams, a dry plant flowers from 4.4 – 19.64 grams. This results showed the trunk is highest.

3.3. Biochar of reed in U Minh Thuong

Table 4: Reed plant biochar

No.	Peat thickness	Wbt (g)	Wbtr (g)	Wbl (g)	Wbf (g)
1	0 cm	26.16	14.41	8.16	2.59
2	5 -30 cm	36.15	20.98	10.75	4.42
3	30 -60 cm	62.37	35.64	19.16	7.58
4	60 – 90 cm	73.57	39.44	22.59	11.54
	α=0.05	<0.0001	<0.0001	<0.0001	<0.0001

Wbt: Weight of total reed plant
Wbtr: Weight of biochar on reed plant trunk
Wbl: Weight of biochar reed plant leaves
Wbf: Weight of biochar reed plant flowers

Comments: The reed plant biochar (Table 4) showed: The reed biochar total per plant (Wbt) at 0 cm peat thickness per plant is 26.16 grams, 5 – 30 cm is 36.15 grams, 30 – 60 cm is 62.37 grams, 60 -90 cm is 73.57 grams; The reed biochar of plant trunk (Wbtr) at 0 cm peat thickness per plant is 14.41 grams, 5 – 30 cm is 20.98 grams, 30 – 60 cm is 35.64 grams, 60 -90 cm is 39.44 grams. The reed biochar of plant leaves at the 0 cm peat thickness per plant is 8.16 grams, 5 – 30 cm is 10.75 grams, 30 – 60 cm is 19.16 grams, 60 – 90 cm is 22.59 grams. The reed biochar of plant flowers at 0 cm peat thickness per plant is 2.59 grams, 5 - 30 cm is 4.42 gram, 30 – 60 cm is 7.58 grams, 60 – 90 cm is 11.54 grams.

Statistical analysis with ANOVA the investigated indicators were all significantly diferent at the α = 0.05, the p-value of indicators had less than 0.001.

In general: The weight indicators increase with peat thickness such as weight of the reed biochar of plant total (Wbt), weight of the reed biochar the reed trunk (Wbtr), the leaf biochar of reed plant (Wbl), the flower biochar of reed plant (Wbf); these indicators increase with peat thickness. The results showed (Table 4) a plant biochar 6.16 – 73.57 grams, a plant trunk biochar 14.41 – 39.44 grams, a plant leaf biochar 8.16 – 22.59 grams and a plant flower biochar 2.59 – 11.54 grams.

This results show (Table 4) (Figure 2) the effctiveness of biochar is as follows: A dry plant/a plant biochar (a dry plant weight give a plant biochar) from 123.34/26.16 – 358.58/73.57 grams, a dry plant trunk/a trunk biochar from 79.55/14.41 – 217.78/39.44 grams, a dry plant leaves/a plant leaf biochar 33.78/8.16 – 122.16/22.59 grams, a dry plant flowers/a plant flower biochar 4.4/2.59 – 19.64/11.54 grams.

The results of biochar yeild from dry plants are as follows (Figure 2): Biochar made a total dry plant 16.62 – 20.52%, made a dry plant trunk 18 – 18.11%, made a dry plant leaves 18.49 – 24.16%, made a dry plant flowers 58.76 – 58.86%, this results, the stem and the leaves is very imfortance are 18 – 24%.

Figure 2: Reed biochar of trunk, leaves and flowers

3.4. Characteristic of peat soil thickness in U Minh Thuong

Table 5. Characteristic of peat soil thickness in U Minh Thuong

No.	Peat thickness	Humic acid (%)	SO_4^{2-} (mg/100g)	P_2O_5 (%)	NH_4^+ (mg/100g)	pH	Nt (%)	K_2O (%)	Fe^{2+} (mg/100g)
1	0 cm	6.06	0.082	0.119	17.40	4.32	0.17	0.12	0.82
2	5 -30 cm	15.29	0.073	0.104	16.84	4.47	0.30	0.22	1.41
3	30 -60 cm	17.67	0.060	0.080	15.89	4.42	0.42	0.30	2.13
4	60 – 90 cm	18.85	0.036	0.063	13.90	4.10	0.72	0.50	3.85
	α=0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

- Comments: Analysis of biochar chemical indicators in U Minh Thuong (Table 5) showed: The indicators such as humic acid increase with peat thickness 0 cm - 90 cm is 6.06 – 18.85%; SO_4^{2-} is 0.082 mg/100g - 0.036 mg/100g; P_2O_5 is 0.119% - 0.063 %; NH^{4+} is 17.4 mg/100g - 13.9 mg/100g; pH is 4.1 - 4.47; nitrogen total from 0.17 to 0.72%; K_2O from 0.12 – 0.5 %; Fe^{2+} from 0.82 mg/100g to 3.58 mg/100g.

Statistical analysis with ANOVA the investigated indicators were all significantly different at the α = 0.05, the p-value of indicators had less than 0.001.

Chemical indicators that increase as peat thickness are humic acid, total nitrogen, potassium and Fe^{2+}; Chemical indicators that decrease as peat thickness increase are SO_4^{2-}, P_2O_5, NH_4^+

3.5. Compare the chemical indicators of peat and biochar in U Minh Thuong National Park

Table 6. Compare the chemical indicators of peat and biochar in U Minh Thuong National Park

No.	Material type	pH	Humic acid %	Nitrogen total %	P_2O_5%	K_2O%	OM%
1	Peat	4.33	17.27	0.48	0.08	0.34	28.12
2	Biochar	10.10	1.30	0.18	0.40	0.71	34.82
	α=0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

- Comments: Analysis of chemical indicators of peat and biochar in U Minh Thuong national park (Table 6) showed: pH of peat is 4.33 and biochar is 10.10; Humic acid of peat is 17.27% and biochar 1.30%; Nitrogen of peat is 0.48% and biochar 0.18%; Phosphorus of peat is 0.08% and biochar is 0.40%; Potassium of peat is 0.34% and biochar is 0.71%, OM% organic matter of peat is 28.12% and biochar 34.

pH of peat is 4.33 shows high aciddity, biochar 10.10 shows high alkalinity; Humic acid of peat 17.27% and biochar 1.30% bigger than many times; Nitrogen of peat is 0.48% and biochar is 0.40% smaller; K_2O% Potassium of peat is 0.34% smaller biochar 0.71%; OM% organic matter of peat is 28.12% samller biochar 34.82%. These results showed if combining peat and biochar in creating bio-organic fertilizer is effcetive.

Results in indicators of peatland and biochar (Table 6): pH biochar is alkaline, peat is acidic and can be mixed to become neutral; Humic acid of biochar 1.3% and peat 17.27%; Nitrogen's biochar 0.42% and peat 0.08%; Peat phosphorus is 0.42 and peat 0.08%; Biochar potash is 0.71% and peat 0.34%; Organic matter (OM%) of biochar is 34.82% and pesat is 28.12%.

Between biochar and peatland have indicators higher and lower, so when mixed them together, they will promote the effectiveness of fertilizer.

Statistical analysis at a significance level of 0.05 means the above indicators are less than 0.001

3.6. Chemical indicators of Pig urine after filtering through reed biochar

Table 7. Chemical indicators of Pig urine after filtering through reed biochar

No.	Material type	pH	NH_4^+ (mg/L)	NO_3^- (mg/L)	Total nitrogen (mg/L)	Phosphorus (mg/L)
1	Pig urine (Pi0)	8.8	150	1.5	984	48
2	Pig urine (Pi1)	9.07	140	0.6	860	17
3	Pig urine (Pi2)	9.21	135	0.55	838	13
4	Pig urine (Pi3)	9.41	134	0.5	821	10
5	Pig urine (Pi4)	9.53	130	0.45	726	4
	α=0.05	<0.001	<0.001	<0.001	<0.001	<0.001

Pi0: Pig urine without filtring reed biochar
Pi1: Pig urine when filtered 1000 mililiters with 30 grams biochar
Pi2: Pig urine when filtered 1000 mililiters with 50 grams biochar
Pi3: Pig urine when filtered 1000 mililiters with 70 grams biochar
Pi4: Pig urine when filtered 1000 mililiters with 90 grams biochar

Comments: When giving 1000 ml of urine taken direstly from pig water to pass through reed biochar with (Pi1 = 30 grams, Pi2 = 50 grams, Pi3 = 70 grams, Pi4 = 90 grams) showed (Table 7):

In 30 gram biochar pH the water higher when biochar higher from 8.8 as 30 grams is 9.07, 50 grams is 9.21, 70 grams is 9.41, 90 grams is 9.53. This increase is due to the high alklinity of biochar (about pH = 10 - 11). Amonium beginning is 150 miligrams per litter, through 30 grams biochar remaining is 140 miligrams, through 50 gram biochar remaining is 135 miligrams, through 70 grams remaining is 134 miligrams, through 90 grams is remining is 130 miligrams. Nitrate (NO_2^- (mg/L) begin 1.5 miligrams/liter, passed 30 grams biochar remaining is 0.5 miligrams,

passed 50 grams biochar remaining 0.55 miligrams, passed 70 grams biochar remaining is 0.45 miligrams. Total nitrogen begin is 984 mg/L, on 30 grams biochar is 860 miligram, on 50 grams is 838 miligrams, on 70 grams biochar is 821 miligrams, on 90 grams is 726 miligrams. Phosphoruss begin is 48 miligrams, on 30 grams biochar is 17 miligrams, on 50 grams is 13 miligrams, on 70 grams is 10 miligrams, on 90 grams is 4 miligrams per liter. In other study [21] reed biochar can removal of ammonium from water, so it can reduce green house. In study [24] low cót and easy rice husk modification to efficiently enhance ammonium and nitrate adsorption that can help to use reed biochar for agriculture.

Statistical analysis at a significance level of 0.05 means the above indicators are less than 0.001

The results show that if the amount of biochar increases, the ability to retain more chemical indicators of livestock wastewater such as amonium, nitric, nitrogen and phosphorus increases.

Table 8. Content of chemical indicators of pig urine lost after filtering through reed biochar

No.	Material type	NH_4^+ (mg/L)	NO_2- (mg/L	Total nitrogen (mg/L)	Phosphorus (mg /L)
1	(Pi0) – (Pi1)	10	0.9	124	31
2	(Pi0) - (Pi2)	15	0.95	146	35
3	(Pi0) – (Pi3)	16	0.1	163	38
4	(Pi0) - (Pi4)	20	0.15	258	44

Pi0 – Pi1: Content of pig urine water indicators lost after flitering through 30 grams biochar
Pi0 – Pi2: Content of pig urine water indicators lost after flitering through 50 grams biochar
Pi0 – Pi3: Content of pig urine water indicators lost after flitering through 70 grams biochar
Pi0 – Pi4: Content of pig urine water indicators lost after flitering through 90 grams biochar

Figure 3. Adsorption filter for pig feed water and inorganic fertilizer

- Comments: In (Table 8) (Figure 3) showed 30 grams of reed biochar can retain 10 miligrams of amonium, in 50 grams is 15 miligrams, in 70 grams is 16 miligrams and in 90 gram is 20 miligrams of amonium. Nitrate in 30 grams is 0.9 miligrams, in 50 grams biochar is 0.95 miligrams, in 70 grams is 1 miligrams and in 90 grams biochar is 1.5

miligrams. Total nitrogen, in 30 grams biochar is 124 miligrams, in 50 grams biochar is 146 miligrams, in 70 grams biochar is 163 miligrams, in 90 grams biochar is 258 miligrams.

Table 9. Remaining chemical indicators of phosphorus and nitrogen dissolved water after filtering through reed biochar

No.	Material type	Phosphorus (mg/L)	No.	Material type	Nitrogen (mg/L)
1	P0	448	1	N0	556
2	P1	443	2	N1	549
3	P2	441	3	N2	543
4	P3	438	4	N3	424
5	P4	432	5	N4	364
	α=0.05	<0.001		α=0.05	<0.001

P0: Mix 1000 mililiters of water with 10 grams of 16 % phosphorus
P1: Water mixed with nitrogen flitered through 30 grams of reed biochar
P2: Water mixed with nitrogen flitered through 50 grams of reed biochar
P3: Water mixed with nitrogen flitered through 70 grams of reed biochar
P4: Water mixed with nitrogen flitered through 90 grams of reed biochar

Comments: Mix 1000 mililiter of water with 10 grams phosphorus 16% (Table 9) begin is 448 miligrams, in 30 grams biochar is 443 miligrams, in 50 grams is 441 miligrams, in 70 grams is 438 miligrams and in 90 grams biochar is 432 miligrams. Thus, when phosphorus water passes through biochar more phosphorus be lost and remaining.

N0: Mix 1000 mililiters of water with 10 grams of 46% nitrogen
N1: Water mixed with nitrogen flitered through 30 grams of reed biochar
N2: Water mixed with nitrogen flitered through 50 grams of reed biochar
N3: Water mixed with nitrogen flitered through 70 grams of reed biochar
N4: Water mixed with nitrogen flitered through 90 grams of reed biochar

- Comments: As above, mixed 1000 mililiters of water with 10 grams nitrogen 46% (Table 9) begin no biochar is 556 miligrams, in 30 grams biochar is 549 miligrams, in 50 grams is 543 miligrams, in 70 grams is 424 miligrams and in 90 grams biochar is 364 miligrams. Thus, when nitrogen water passes through more nitrogen it be lost and remaining.

Table 10. Content of chemical indicators lost of nitrogen dissolved water after filtering through reed biochar

No.	Material type	Phosphorus (mg/L)	No.	Material type	Nitrogen (mg/L)
1	P0 – P1	5	1	N0 – N1	7
2	P0 – P2	7	2	N0 – N2	13
3	P0 – P3	10	3	N0 – N3	32
4	P0 – P4	26	4	N0 – N4	92

P0 – P1:Content of phosphorus lost after flitering through 30 grams of reed biochar
P0 – P2: Content of phosphorus lost after flitering through 50 grams of reed biochar
P0 – P3: Content of phosphorus lost after flitering through 70 grams of reed biochar
P0 – P4: Content of phosphorus lost after flitering through 90 grams of reed biochar

Comments: Phosphorus water as filtered through reed biochar is retained as follows (Table 10): In 30 grams is 5 miligrams, in 50 grams biochar is 7 miligrams, in 70 grams biochar is 10 miligrams, in 90 grams biochar is 26 miligrams phosphorus remaining. The study effectiveness of reed biochar in mitigating phosphorus dynamics in paddy soil [22] it can use biochar like fertilizer in crops.

N0 – N1: Content of nitrogen lost after flitering through 30 grams of reed biochar
N0 – N2: Content of nitrogen lost after flitering through 50 grams of reed biochar
N0 – N3: Content of nitrogen lost after flitering through 70 grams of reed biochar
N0 – N4: Content of nitrogen lost after flitering through 90 grams of reed biochar

- Comments: Nitrogen water as filtered through reed biochar is retained and remaining as follow (Table 10): in 30 grams is 7 miligrams of nitrogen, in 50 grams of reed biochar is 13 miligrams, in 70 grams of reed biochar is 32 miligrams, in 90 grams of reed biochar is 92 miligrams nitrogen remaining. Adsorption of ammonium on biochar prepared from gaint reed [23] it can use reed biochar in this experiment for fertilizer rice crops

3.9. Mixed fertilizres

Table 11: Mixed Nitrogen, phosphorus and Potash with biochar

No.	Days	OM%	Humic acid	N%	P%	K%	Ca%	Mg%	SiO%
1	5 days	34.48	1.36	0.85	1.94	9.03	0.13	0.15	4.40
2	10 days	35.48	1.23	1.26	2.10	7.05	0.17	0.14	4.39
3	Control	36.52	1.29	0.19	0.39	0.69	0.16	0.14	4.25
	α=0.05	0.21 N	0.24 N	<0.000	<0.000	<0.000	0.1 N	0.91 N	0.58 N

- Comments: Mixed Nitrogen, phosporus and potash with reed biochar (Table 11) showed after 5 days and 10 days. The indicators N%, P% and K% after statistical analysis at a significance level of 0.05 means the above indicators are less than 0.000. The indicators after statistical analysis at a not significance are organic matter (OM%), Ca%, Mg%, SiO%. This result show that biochar of reed that it can stabilize nitrogen in biochar so it can be used to mix fertilizer for agriculture.

Table 12: Mixed Nitrogen 16%, phosphorus 16% and Potash 8% with biochar

No.	Days	OM%	Humic acid	N%	P%	K%	Ca%	Mg%	SiO%
1	5 days	35.46	1.12	0.79	2.21	11.45	0.18	0.15	4.32
2	10 days	35.58	1.34	1.39	2.20	13.32	0.11	0.11	4.69
3	Control	36.13	1.29	0.19	0.39	0.69	0.12	0.12	4.25
	α=0.05	0.71 N	0.07 N	<0.000	<0.000	<0.000	0.003	0.04	<0.000

- Comments: Mixed agricultural mineral fertilizer 16% N 16% P 8% Kwith biochar (Table 12): Mixed 10% (16% N 16% p 8% K) and 90% biochar keeped after 5 days and 10 days compare control. Organic matter and humic acid are not statistical significally different. The indicators as N%, P%, K%, Ca%, Mg%, SiO% are different compare control. With nitrogen, phosphorus and potash are main components of fertilizer can exist effectively in biochar after 5 – 10 days, it can use to add mineral fertilizer to biochar fertilizer.

Table 13: Mixed Nitrogen 20%, phosphorus 20% and Potash 15% with biochar

No.	Days	OM%	Humic acid	N%	P%	K%	Ca%	Mg%	SiO%
1	5 days	34.48	1.32	1.06	2.26	15.47	0.18	0.17	4.64
2	10 days	37.25	1.24	2.35	1.96	7.55	0.11	0.10	4.47
3	Control	36.13	0.19	0.39	0.39	0.69	0.16	0.12	4.25
	α=0.05	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	0.003	0.38 N

- Comments: Another type of fertilizer in agriculture mineral fertilizer 20% N 20% P 15% K mixed with biochar (Table 13): Results show the indicator SiO% is not different in statistical significant. The other indicators as organic matter, humic acid, N%, P%, K%, Ca%, Mg% are higher compare control. It can use for mixed them in agricultural fertilizer.

Table 14 Mixed Biochar, Peatland with NPK (10g 20% Nitrogen. 20% Phosphorus. 15% Potash)

Days	Biochar ratio	OM%	Humic acid	N%	P%	K%	Ca%	Mg%	SiO%
5 days	Formula 1	33.67	1.32	5.48	8.34	15.47	0.18	0.17	4.64
5 days	Formula 2	33.69	1.27	4.52	7.57	9.17	0.14	0.12	4.07
5 days	Formula 3	37.24	1.13	2.17	4.11	8.64	0.10	0.18	4.65
5 days	Formula 4	37.38	1.24	0.61	3.15	6.28	0.18	0.17	4.26
10 days	Formula 5	34.48	1.25	4.32	6.16	15.70	0.10	0.10	4.47

10 days	Formula 6	33.69	1.27	3.62	5.02	10.13	0.15	0.12	4.25
10 days	Formula 7	37.24	1.23	1.81	2.89	7.55	0.12	0.13	3.34
10days	Formula 8	37.38	1.36	0.91	2.19	6.10	0.12	0.11	4.56
Control	Formula C	36.13	1.29	0.19	0.39	0.69	0.15	0.12	4.25
	α=0.05	<0.000	0.17 N	<0.000	<0.000	<0.000	<0.000	0.006	0.62 N

- Comments: Mixed biochar, peatland with NPK (Table 15): Results show the indicators as humic acid and SiO% are not different statistical significant; The other indicators are OM%, N%, P%, K%, Ca%, Mg% they are different compare with control. The indicators N%, P%, K% that have nutrient requirement, they retained in biochar after 5 – 10 days.

Planting watermelon by mixed biochar, peat and inorganic mineral fertilizer

Table 15: Watermelon growth using mixed biochar fertilizer after 30 days

Formula	Stem length (Lst.) (cm)	Number of leaves (Lno.)	Leaf length (Lle.) (cm)	Leaf width (Wfr.)	Number of flowers (Few.)	Number of flower bud (Bno.)	Leaf color (Lco.)
Formula 1	98.78	22.44	11.81	10.30	3.33	1.18	3
Formula 2	235.96	34.33	14.92	12.63	6.07	1.89	5
Formula 3	232.11	34.81	15.30	13.26	6.07	2.07	5
Formula 4	242.15	36.67	15.56	13.37	6.59	2.22	5
Formula 5	248.04	32.99	15.41	13.04	6.59	2.04	5
Formula 6	236.04	34.93	14.70	12.34	6.37	2.00	5
Formula 7	222.26	32.85	15.26	12.96	5.07	1.85	5
Formula 8	232.93	35.19	15.70	13.41	5.85	2.29	5
α=0.05	<0.000	<0.000	0.017	0.022	0.012	0.53 N	<0.000

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%)

- Comments: Watermelon growth using mixed biochar fertilizer with 10g / plant for each formula after 30 days (Table 15): Result in 7 formulas from formula 2 to formula 8 is formula 5 (50g Biochar + 40g Peatland + 10g [Nitrogen 20% + Phosphorus 20% + Potash 15%]) reached stem length 248 centimeter, it is the best of them. The growth in dicators in table 16 also highest. The other formulas are better compare control in formula 1. Most of indicators statistical analysis at a significance level of 0.05 means the above indicators are less than 0.000* and 0.05*. Only indicators number of flower bud is 0.53 N not different significant.

Figure 4: Watermelon fertilized mixed biochar fertilizers after 30 days

Table 16: Watermelon growth using mixed biochar fertilizer after 70 days

Formula	Stem length (Lst.) (cm)	Leaf color (Lco.) (1-5)	Fruit length (Fle.) (cm)	Fruit width (Fwi.) (cm)	Fruit Weight (Fwe.) (gr.)	Physis in fruit (Pfr.) (1-5)	Fruit color (Fco.) (1-5)	Sweetness level (Sle.) (1-5)
Formula 1	275	4	19.7	9.58	1910	3.33	3	3
Formula 2	321	4.89	25.59	12.70	2808	4.67	5	5
Formula 3	336	4.67	26.55	13.33	2898	4.67	4.33	4.33
Formula 4	360	4.78	27.78	13.74	2987	4.67	4.67	4.67
Formula 5	372	5	27.41	13.63	2952	5	5	5

Formula 6	360	5	24.44	12.89	2858	5	5	5
Formula 7	341	4.67	26.48	13.30	2908	4.33	4.33	4.33
Formula 8	341	4.67	26.22	13.11	2866	5	5	5
α=0.05	0.003	0.11 N	0.02	<0.000	0.001	0.02	<0.000	<0.000

Formula 1: 100g Biochar (Cotrol)
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%)

- Comments: Watermelon growth using mixed biochar fertilizer after 45 days show (Table 17): Fertilized as formulas from 1 to 8. For growth status compare formula 1 (control) with all of formulas are higher for stem length, fruit length, fruit width, fruit weight, physis in fruit, fruit color, sweetness level.

Statistical analysis for leaf color in all of formulas is not different significant. In formulas have 4 and 5 is good indicators, but formulas 5 is the best, nearly 3 kilgram / fruit copare Thai Binh province [25] 3.59 -4.18 kilogram. We cant select formula 5 to develop fertilzer in agriculture for watermelon in Mekong Delta.

Figure 5: Watermelon fertilized mixed biochar fertilizers after 70 days

3.11. Discussions

- The reed growth and biomass : The reed grows every year at he beginning of the rainy season and when the reed flowers are ripe at the end of the dry season. The amount of growth and biomass is very high [19], so it is an abundant source of renewable raw materials. In the U Minh Thuong National Park investigated fresh growth indicators are height from 3.39 to 4.47 meters; the reed base diameter mearsured from 1.8 to 3.17 centimeters; the density of plants counted from 49 to 87 plants per square meter; the average volume is from 0.04 to 0.10 cubic meter per square meter; the average weight is from 15.46 to 20.54 kilograms per square meter. With such amount of fresh biomass, it will have promising potential for useful biomass usage.

- Harvestting mature reeds (flowers are completely ripe) in March 2024, separate into stems, leaves and flowers; then weight them into separate of sampling results to different peat thickness. The results showed that the peat thickness from 0 – 90 cm as follows: Total weight from 127.34 to 358.58 grams per plant; the reed trunk weight from 79.55 to 217.78 grams per plant; the leaf weight from 33.78 to 122.16 grams; the flower weight from 4.4 to 19.64 grams per plant. The dry biomass composition of reeds by weight as a source of raw materials for future biochar production.

- Investigate biochar on each plant by controlled burning of part at the biochar formation stage and then cutting oxygen to get reed biochar gave the following results: Biochar weight per plant from 26.16 to 73.57 grams, The trunk biochar of the plant from 14.41 to 39.44 grams, the weigh of leaf biochar per plant from 8.16 to 22.59 grams,

The weigh of flower biochar from 2.59 to 11.54 grams. Knowing the biochar on each reed plants helps us to evaluate exploitation on the potential for reed biochar, in investigate the density on different peat thickness help us evaluated the amount of biochar available that can be exploited per unit area and also make a basis planning of biochar exploitation for agriculture and environment.

- Researching the chemical properties to peat thickness helps us understand the chemical composition of peat from 0 cm to 90 cm the folowing chemical properties: The indicators decreased are P2O5 from 0.119 decreased 0.063, the sulfuric acid from 0.082 decreased 0.036 mg/100g; Amonium (NH4+) from 17.40 decreased 13.80mg/100g. Indicators increase with peat thickness such as: Humic acid from 6.06% to 18.85%, total nitrogen from 0.17% to 0.72%, potassium (K2O) from 0.12% to 0.050%, Iron (Fe2+) from 0.82% to 3.85%. The chemical properties of peat soil are related to the growth and biomass of the reeds distributed on it. This research helps to understand the peat soil factors in the reed vegetation in which they grow.

- Reed biochar has the ability to retain chemical elements of wastewater discharged from pig farm. In study reed plant (Phragmites autralis) and its biochar were tested treatment wastwater, biochar improved wastwater quality to the medium quality grade [18]. The elements it retains in the form of adsorption are ammonium and nitric, total nitrogen, and phosphorus. Two elements capable of reducing environmental emission are ammonium and nitric. Biochar of reed as soil improvement is when using biochar in agriculture [20]. Meanwhile, two elements that can potentially contribute to agriculture through organic biofertilizers are nitrogen and phosphorus.

- Biochar also has the ability to adsorb inorganic minerals such as phosphorus and nitrogen, which are two main components of inorganic fertilizers and pig urine filter with biochar showed many results; in study biochar from giant reed (Arundo donax L.) at 300 – 6000C it can release of N, P and K and adsorption of N and P [17], so when using reed biochar in agriculture, it helps promote fertilizer efficiency and avoid losses due to evaporation and leaching waste fertilizer on plants, because biochar has the ability to retain it for plants to absorption.

- Mixed inorganic mineral fertilizer as nitrogen, phosphorus and potash with biochar and mixed biochar, peat and inorganic mineral fertilizer after 5 days and 10 days after that analysis chemical. Its results can keeping nitrogen, phosphorus, potash very high in mixed fertilizer, this iss basin to use them for planting in agriculture

Using mixed inogranic mineral fertilizer with biochar and mixed biochar, peat with inorganic mineral fertilizer with many formulas compare biochar to planting watermelon. Result formulas with biochar, peat are growing high and biochar with inorganic are also high. This result help us can use biochar of reed to make fertilizer for agriculture

CONCLUSIONS

- The growth and biomass on reed plants in U Minh Thuong National Park is very high, it is an annual renewable material source, the average reserve is from 0.04 – 0.1 cubic metters per square meter. The dry weight of a reed plant from 127.34 grams to 358.58 grams with density very high.

- Biochar made from dry reed plants gives the following results: The weight of a plant biochar from 26.16 to 73.57 grams, the weight of a plant trunk biochar bighest compare leaves and flowers of biochar.

- Chemical composition analysis according to peat thickness where reed species are distributed shows that as peat thickness increases, chemical indicators also increase and decrease in two directions; the decrease indicators are P2O5, SO42-, NH4+ and the increase indicators with peat thicknes are humic acid, pH, Nitrogen total, K2O, Fe2+.

- Compare the chemical components of peat and biochar in U Minh Thuong National Park shows that biochar has lower indicators such as humic acid %, nitrogen total%, but there are also higher such as phosphorus P2O5%, potassium K2O% and orgarnic matter OM%.

- Reed biochar has the ability to retain chemical indicators of wastewater from pig farm in pig urine, the

substances it is able are ammonium, nitrate, nitrogen, phosphorus; it help to prevent environmental emission and provide nutrients for plants. At the same, it has the ability adsorb two inorganic minerals, nitrogen and phosphorus to help use inorganic biofertilizers effectively.

- Using mixed inogranic mineral fertilizer with biochar and mixed biochar, peat with inorganic mineral fertilizer with many formulas compare biochar to planting watermelon. Its results can help us to use biochar to make fertilizer and planting watermelon with growing well.

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