Effect of NPK fertilizer and biochar application to soil chemical properties of irrigation paddy

[1]Sufardi, [2]Khairun Nisa, [1]Zaitun, [3]Chairunas, [4]Anischan Gani, [5]Peter Slavich, and [5]Malem McLeod

[1]Agriculture Faculty, Syiah Kuala University, Banda Aceh 23111, Indonesia; [2]Agency Implementation of Extension and Food Security of West Aceh, Indonesia; [3]Provincial Agricultural Service (BPTP NAD), Banda Aceh, Indonesia; [4]Indonesian Centre for Rice Research, Sukamandi, West Java, Indonesia; [5]*NSW Primary Industries, Australia;*
Coorresponding author: sufardi_usk@yahoo.com; sufardi.usk@gmail.com

Abstract. The objective of experiment was to know effect of NPK and Biochar application to soil chemical properties of paddy rice. The research was conducted in Empetrieng village, Aceh Besar district, Aceh Province, Indonesia. The experimental arranged in a randomized complate block design with two factor and four replication. First factor was NPK 15:15:15 fertilizer application (0 kg ha^{-1}; 60 kg ha^{-1}; and 120 kg ha^{-1}) and second factor was Biochar application (0 ton ha^{-1}; and 10 ton ha^{-1}). The result showed that : (1) application of Biochar affected significanly to soil pH; (2) application of NPK fertilizer affected significanly to K in soil; and 3) interaction of Biochar and NPK fertilizer application affected significantly to pH and P in soil.

Key words: NPK fertilizer, biochar, soil chemical properties, paddy rice

Introduction

Since long time among main food stuff crop, the rice is the main food of Indonesian people. The rice field is dominant sharing in yield of paddy rice because generally rice paddy is planted in wet land. For the rice field paddy, irrigation is very important because influencing yield of paddy rice productivity (Adiratma, 2004). Biochar or charcoal representing one of options to soil management. In reality had exploited in traditional by some of the farmers in village. The various of research result showed, biochar have potency to improve soil fertility.

Biochar contain high Carbon more than 30%. Biochar's decomposition very slow, so it can sustain in soil very long time. Biochar is not an organic fertilizer, because it can not add nutrient into soil, but it has high CEC (cation exchange capacity), so it can bind cations in soil that used for plant growth. Biochar has a lot of pores because it has large surface, so it has high water holding capacity. Although biochar is not fertilizer, but biochar can use as mixed fertilizers (Gani, 2009).

Materials and Methods

The field experiment was established at Empetring Village, Darul Kamal Subdistrict, Aceh Besar District, Aceh Province, Indonesia on December 2009 to May 2010

This research has been experiment field is continued with research in laboratory with the the following step : (a) analyze of soil and biochar samples before research; (b) field trial by planting Ciherang varietas paddy rice, NPK fertilize and biochar treatment treated as according to each plot combination treatment; and (c) soil samples analyze of final research to test to return soil chemical properties after has been conducting of research with NPK fertilize and biochar application.

Soil intake done compositely, each composite is composed 5 dot of sample taken diagonally at deepness 0-20 cm (using to soil drill). Soil sample analyze has done before research to know soil chemical properties. Soil chemical properties have done represented complete or routine analyze consisted of the soil pH, organic carbon, total N, available P, total P, total K, exchangeable cation for like K, Na, Ca, Mg Al, and H, Cation Exchange Capacity and Base Saturation.

The experimental arranged in a randomized complate block design with two factor and four replication. First factor was NPK 15:15:15 fertilizer application. F0 = without fertilizer; F1 = 60 kg ha^{-1} NPK = 150 gram $plot^{-1}$; and F2 = 120 kg ha^{-1} NPK = 300 gram

plot^{-1}. Second factor was Biochar application. B0 = without biochar; and B1 = 10 ton ha^{-1} = 25 kg plot^{-1}. The biochar material was from rice husk.

Results and Discussion

The result of soil chemical analyze at trial location can see at Table 1, 2, 3, and 4. Table 1 showed that the soil analyze before treatment at trial location.

Table 1. Soil analyze before treatment

Variable	Unit	Value
pH (H_2O)		6.78
C organic	%	1.47
Total N	%	0.19
P available	ppm	8.75
Exchangeable cation		
K	me/100g	0.22
Na	me/100g	0.84
Ca	me/100g	7.22
Mg	me/100g	0.42
Al	me/100g	tu
H	me/100g	0.14
Cation Exchange Capacity	me/100g	42.80
Base Saturation	%	20
Electrical conductivity	µmhos/cm	1.20
P_2O_5	%	0.07
K_2O	%	0.06
Sand	%	9
Silt	%	52
Clay	%	39

Biochar application only significantly affect on soil pH and not signicifantly on C organic, total N, P available and K available (Table 2). NPK application only significantly affect on K and the F2 treatmant has the highest K (0,385 me 100 g^{-1}) compare with F0 and F1 treatments (Table 3).

Table 2. Average of soil chemical properties affected by Biochar application

Variable	Treatment	
	Without Biochar (0 kg plot^{-1})	With Biochar (25 kg plot^{-1})
pH (H_2O)	7,277 b	7,203 a
C – Organic (%)	1,523 a	1,490 a
N – Total (%)	0,203 a	0,200 a
P – Available (ppm)	8,560 a	8,640 a
K – Available (me 100 g^{-1})	0,323 a	0,330 a

Table 3. Average of soil chemical properties effect NPK aplication

Variable	Treatment		
	F0 (0 g plot^{-1})	F1 (150 g plot^{-1})	F2 (300 g plot^{-1})
pH (H_2O)	7,285 a	7,220 a	7,215 a
C – Organik (%)	1,550 a	1,545 a	1,425 a
N – Total (%)	0,210 a	0,200 a	0,195 a
P – Available (ppm)	8,475 a	8,520 a	8,805 a
K – Available (me 100 g^{-1})	0,300 a	0,295 a	0,385 b

Soil chemical properties of soil pH and available P only significantly affect biochar and NPK application, while the other didn't significantly affect biochar and NPK application (Table 4). Combination of without biochar and without NPK treatment resulting soil pH value is the highest, that is 7,40 and differing reality with other treatment. Treatment of 10 ton biochar ha^{-1} with 120 kg NPK ha^{-1} resulting value soil pH 7,24 (neutral criterion). Biochar application treatment can neutralizing of soil pH.

Without biochar and without NPK treatment showed that organic C value is the highest (1,60%) compare with other treatment and include low criterion. Total N value of 10 ton biochar ha^{-1} with 120 kg NPK ha^{-1} treatment affect is the lowest, that is 0,18% (low criterion).

Available P value is the highest affect treatment of 10 ton biochar ha^{-1} with 120 kg NPK ha^{-1} treatment, that is 9,03 % (neutral criterion). Available K value is the highest affect treatment of 10 ton biochar ha^{-1} with 120 kg NPK ha^{-1}, that is 0,40 me 100 gram^{-1} (neutral criterion).

Chan et al. (2007) expressing various research which have been conducted shows biochar application have the real benefit agronomis. But, this results isn't universal character because some the other research also there is showing different result or even negative effect. This matter because of gyration wides various biochar properties according to base material, and also nature of various biochar, according to its base substance, and also immeasurable interaction between biochar and soil type.

Gani (2009) explained that biochar application can arrest and make the water and nutrient more available for plant. If used as soil amandement with organic and inorganic fertilize, biochar can improve the productivity, also retention and nutrient availability for plant. Lehmann (2007) explained that biochar exploiting of agriculture area is high affinitas to nutrient and persistence.

Table 4. Average of soil chemical properties effect biochar and NPK treatment.

Treatment Combination	pH	C (%)	N (%)	P (ppm)	K (me 100 gr^{-1})
B0 F0	7,40 b B	1,60 a A	0,21 a A	8,74 a B	0,31 a A
B0 F1	7,24 a A	1,52 a A	0,19 a A	8,36 a A	0,29 a A
B0 F2	7,19 a A	1,45 a A	0,21 a A	8,58 a A	0,37 a A
B1 F0	7,17 a A	1,50 a A	0,21 a A	8,21 a A	0,29 a A
B1 F1	7,20 a A	1,57 a A	0,21 a A	8,68 b A	0,30 a A
B1 F2	7,24 a A	1,40 a A	0,18 a A	9,03 b B	0,40 a A
BNT 0,05	0,105	0,340	0,049	0,437	0,103

Conclusion

The conclusion of the research are : (1) Aplication of Biochar affected significanly to pH; (2) Aplication of NPK affected significanly to K; and (3) Combination of NPK and biochar aplication affected significanly to soil chemical properties (pH and Posphorus).

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