THE EFFECT OF AMELIORANT AND FERTILIZER OF N, P, K IN PEAT SOILS ON CARBON EMISSION, GROWTH AND YIELD OF RICE

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Introduction

The productivity of plant on peat soil is very low, this is caused by low fertility and very high concentrations of phenolic acids. Phenolic acid as a result of lignin biodegradation and the sources of C-release, are of aromatic group (Sabiham, 2010). Phenolic acids are more phytotoxic for plants and causes stunted plant growth (Dohong and Sabiham, 2001), influence the biochemical and physiological processes of plants and nutrients uptake by plant (Driessen, 1978). Phenolic acids and C-release could be reduced with the adition of cations such as Al, Fe, Cu, Zn and Mn. Where the stability of complexes between humic acid-metal getting weaker in the order of $Al^{3+} > Fe^{3+} > Cu^{2+} > Mn^{2+} > Zn^{2+} >> Mg^{2+} > Ca^{2+}$ (Tan, 2003). Dreg is agro-industrial waste contains essential nutrients (macro nutrients such as P, K, Ca, Mg and micro nutrients such as Fe, Cu, Zn, Mn). The research aims to study the effect of dreg as ameliorant and N, P, K fertilizers in peat soils on carbon emissions, growth and yield of rice.

Materials and Methods

Peat soils was taken in the Pelalawan, Riau with the level of decomposition hemic and dreg as ameliorant is agroindustrial waste of Pulp and Paper Industry in Riau (chemical characteristic of peat soil and dreg in Table 1 and 2). Experiment in Form factorial using completely randomized design. The first factor was dreg ameliorant (0, 2.5, 5 and 10 tons/ha), the Second factor was N, P, K fertilizers (1.5, 2 and 2.5 x recommended dose = 200 kg N, 100 kg P_2O_5 and 125 kg K_2O/ha), each combination was repeated 3 times. Parameters observed include: carbon emission (CO_2 and CH_4), number and age out of panicle, pithy grain percentage, weight of dry milled grain and 1000 grain

Table 1. Chemical characteristic and ash content of peat soil (Nelvia, 2014)

Chemical characteristics	Value	Chemical characteristics and ash content	Value
pH H_2O (1:5)	3,2	Base Saturation (%)	6
pH KCl (1:5)	3,0	Micronutrient (DTPA)	
Organic-C (%)	43,73	Fe (mg/kg)	475
N (%)	0,65	Mn (mg/kg)	1
C/N ratio	67,28	Cu (mg/kg)	2
Exc.Ca (cmol (+)/kg)	2,27	Zn (mg/kg)	2
Exc.Mg (cmol (+)/kg)	0,68	Micro nutrient (HNO_3 + $HClO_4$)	
Exc.K (cmol (+)/kg)	0,22	Fe (mg/kg)	3606
Exc.Na (cmol (+)/kg)	0,26	Mn (mg/kg)	12,3
P (mg/kg) (Bray I)	135,4	Cu (mg/kg)	3,1
P (mg/kg) (HCl 25%)	320	Zn (mg/kg)	4,8
CEC (cmol (+)/kg)	72,45	Ash content (%)	15,89

Table 2. Chemical characteristic and ash moisture of dreg (Nelvia, 2014)

Chemical characterization	value	Chemical characterization	value
pH H_2O (1:5)	9,3	Extra Citric Acid 2%	
Extra $HClO_4$ + HNO_3 pa		Macro nutrient	
Macro nutrient		P_2O_5 (g/kg)	1,8
P_2O_5 (g/kg)	2,0	K_2O (g/kg)	3,1
K_2O (g/kg)	3,1	CaO (g/kg)	409,7
CaO (g/kg)	410,3	MgO (g/kg)	23,2
MgO (g/kg)	23,9	Na (g/kg)	25,9
Na (g/kg)	26,8	S (g/kg)	6,4
S (g/kg)	7,2	Micro nutrient	
Micro nutrient		Fe (mg/kg)	3244
Fe (mg/kg)	5000	Mn (mg/kg)	914
Mn (mg/kg)	989	Cu (mg/kg)	105
Cu (mg/kg)	127	Zn (mg/kg)	206
Zn (mg/kg)	224	moisture (%)	15,89

Results

Table 3. The CO_2 and CH_4 production (mg pot^{-1} h^{-1}) from peat soils

Dreg	NPK fertilizers		
tons/ha	1.5 x RD	2 x RD	2.5 x RD
	CH_4 production (mg pot^{-1} h^{-1})		
0	69.771 ab	15.552 abc	17.420 abc
2.5	-7.984 bc	5.7983 abc	22.169 abc
5	81.141 a	7.822 abc	12.686 abc
10	27.115 abc	-5.2413 bc	-31.041 c
	CO_2 production (mg pot^{-1} h^{-1})		
0	811.383 ab	-2.076 ab	148.045 ab
2.5	-450.509 ab	404.372 ab	-1078.754 ab
5	810.530 ab	-2248.468 b	927.613 a
10	-1824.256 ab	-342.894 ab	498.112 ab

The numbers in the same columns and rows which followed the same lowercase letter are not significantly different at 5% DNMRT .

Fig. 1. The growth of rice IR-64 at vegetative phase

Table 4. The number of panicle, panicle age out, pithy grain percentage, weight of dry milled grain and weight of 1000 grain

Dreg	NPK fertilizers		
tons/ha	1.5 x RD	2 x RD	2.5 x RD
	number of panicle (number pot^{-1})		
0	15.33 d	13.33 d	11.00 d
2.5	24.67 c	26.00 c	27.33 c
5	29.33 c	36.00 b	36.00 b
10	39.67 ab	41.00 ab	44.67 a
	panicle age out (day)		
0	56.33 c	73.00 a	73.67 a
2.5	60.00 bc	61.67 bc	61.33 bc
5	59.00 bc	59.67 bc	62.67 b
10	59.00 bc	59.33 bc	60.67 bc
	pithy grain percentage (%)		
0	98.00b	95.60ab	96.00ab
2.5	97.5ab	96.40ab	96.30ab
5	97.0ab	97.80b	95.50a
10	96.4ab	97.10ab	96.40ab
	weight of dry milled grain (g/pot)		
0	24.56f	22.06f	25.19f
2.5	57.69e	62.28e	66.09e
5	82.17d	93.21bc	84.42cd
10	97.81b	121.43a	122.31a
	weight of 1000 grain (g)		
0	20.94bc	20.75c	21.14 bc
2.5	22.32abc	22.91a	22.36abc
5	21.89abc	22.86a	22.15abc
10	21.05bc	22.29abc	22.42ab

The numbers in the same columns and rows which followed the same lowercase letter are not significantly different at 5% DNMRT .

Table 3 and 4 and figure 1 shows that the addition of dregs ameliorants 2.5 tons ha^{-1} and (300 kg N, 150 kg P_2O_5 and 187.5 kg K_2O) ha^{-1} tend to increase panicle age out, pithy grain percentage, weight of 1000 grain and decrease production of CH_4 and CO_2 gas and increase number of panicle and weight of dry milled grain significantly compared to without ameliorant.

Conclusion

The addition of dregs ameliorants 2.5 tons ha^{-1} and (300 kg N, 150 kg P_2O_5 and 187.5 kg K_2O) ha^{-1} decreased carbon emission and increased the growth and yield of rice in peat soil significantly compared to without ameliorant.

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