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The Effect of Soil Quality on the Survival Rate of Mangrove Vegetation

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Abstract: The aim of this research was to investigate the effect of the quality of soil on survival rate of mangrove vegetation. Three independent variables such as organic materials, N-total and Cation Exchange Capacity (CEC) used to determine the effect of those variables on survival rate of mangrove vegetation, through ordinary least square technique. The results revealed that the survival rate of mangrove vegetation significantly influence by organic materials, N-total and CEC at $\alpha = 0.05$. The coefficient determination ($R^2 = 0.730$) indicated that the 73% of variation on survival rate of mangrove vegetation was explained by the independent variables in the model. Moreover, the research findings suggest that reforestation of mangroves should consider the characteristics and texture of the soil in which the location of reforestation will be made.

Key words: Mangrove vegetation, soil quality, survival rate, pasuruan, CEG

INTRODUCTION

Mangrove forest is tropical coastal vegetation community, a community that lives in humid and muddy areas and are influenced by the tide, salinity, topography and the physical characteristics of soil chemistry. Mangrove vegetation growth is influenced by the physical characteristics the chemical state of the soil as a habitat. In addition, mangrove area is divided into three zones which are proximal zone, the zone facing the sea front, overgrown types of Avicennia; medial zone, overgrown of Rhizophora and the rear zone closer to the mainland (distal zone) overgrown of Bruguiera and Ceriops lumnitzera.

Mangrove habitat parameters and physical-chemical characteristics the soil is very large influence on the growth of mangrove vegetation.

Physical and chemical properties of the soil include pH organic matter, nitrogen, phosphate and Cation Exchange Capacity (CEC). Furthermore, important inputs in the productivity of mangrove systems are both substrates and nutrients in the substrate and in the water. One source of nutrients in the mangrove ecosystem derived from sediment trapped by the mangrove (Kamaruzzaman *et al*., 2001).

The objective of this research was to analyse the effect of the quality of soil on survival rate of mangrove vegetation at mangrove reforestation land in the Nguling Kedawang, Pasuruan Regency, East Java.

MATERIALS AND METHODS

The research was carried out in coastal area in Nguling Kedawung, Pasuruan Regency, East Java Indonesia. Site location was chosen purposively due to the interesting characteristics which are low land area with slope level of 5% and near the shore area that crowded inhabitant settlement of small scale of fishery activities.

Moreover, the soil quality (organic materials, N-total and CEC) and survival rate of mangrove seed collected directly from 30 plots on mangrove reforestation land. The dimension of each plot is 100 m^2 and already planted by 100 seed of mangrove.

Three independent variables which are; organic materials, N-total and Cation Exchange Capacity (CEC) used to determine the effect of those variables on survival rate of mangrove vegetation, through ordinary least square technique. The regression model used in this research is described as follows; in this research, each variable defined as follows:

$$Y = \alpha + \beta_1 OM + \beta_2 NT + \beta_3 CEF + \varepsilon$$

Where:

Y = The survival rate of mangrove calculated by counted up the total seed of mangrove left after several months

OM = Soil organic material is all kinds of organic compounds present in the soil including the results of an overhaul litter

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NT = Nitrogen in the soil in organic and inorganic forms but most in organic form
CEC = Cation Exchange Capacity (CEC) reflects the ability of the soil to provide nutrients and chemical properties that are very closely related to soil fertility
β_n = Coefficient of each variable
α = Constant
ε = Error term

RESULTS AND DISCUSSION

Characteristic of soil in site location: Characteristic of soil in site location showed in Table 1. The results revealed that 13 plots (39.4%) in site location contains organic material between 1.00-1.50 while 11 plots contains organic material between >1.50. In the other hand, just 7 plots have organic material <1.00.

Moreover, minimum organic material in site location was 0.85 and maximum was 1.88 with the average was 1.33. According Sutanto, muddy beaches tend to accumulate organic matter which means quite a lot of potential food for the inhabitants of coastal organisms; a particle that settles in estuaries is mostly organic. As a result of this substrate is very rich in organic matter organic matter improves soil organism populations because organic matter is a source of food for soil organisms.

Characteristic of soil in Table 1 showed that the majority (48.5%) of plots in site location contains nitrogen between 0.7 until 0.9. According to Syekhfani, a protein composed of nitrogen containing compounds and is an extremely important component in plant organs include seeds as well as chlorophyll is the green substance containing N, so that when it leaves the plant N deficiency symptoms chlorosis green pallor.

The average Cation Exchange Capacity (CEC) in site location was 35.50 with range 21.46-52.90. Furthermore, 17 plots contain Cation Exchange Capacity (CEC) between 30.00 until 40.00. The higher of clay minerals and organic material have higher CEC value. Therefore, many soils containing organic material or high clay content have a higher CEC values than soil with low organic matter content and sandy.

The level of survival rate of seed of mangrove has higher variety in site location, depend on plot location. The range of survival rate of mangrove's seed was 5 until 100 trees per plot.

Impact of soil quality on survival rate of mangrove vegetation: The multiple regression analysis carried out to examine the determinants of factor affecting the levels of survival rate on mangrove vegetation. The results of regression analysis are show in Table 2.

Table 1: Characteristics of soil

Items	Frequency	%
Organic material		
<1.00	9.00	27.3
1.00-1.50	13.00	39.4
>1.50	11.00	33.3
$\bar{x}$	1.33	
Nitrogen total		
<0.7	7.00	21.2
0.7-0.9	16.00	48.5
>0.9	10.00	33.3
$\bar{x}$	0.80	
Cation Exchange Capacity (CEC)		
<30.00	7.00	21.2
30.00-40.00	17.00	51.5
>40.00	9.00	27.3
$\bar{x}$	35.50	
Survival rate		
<30	14.00	42.4
30-60	9.00	27.3
>60	10.00	30.3
$\bar{x}$	33.00	

Table 2: Result of regression analisis

Variables	Unstandardized coeffisien	SE	t-values
Constant	-74.527	17.542	-4.249
Organic material	32.953	11.483	2.870*
Nitrogen total	45.512	0.437	4.420*
CEC	1.932	0.020	3.860**

R^2: 0.730; *Significant at $\alpha = 0.05$; **Significant at $\alpha = 0.000$

The finding of the research showed that the coefficient determination ($R^2 = 0.730$) indicated that 73% of variation in survival rate of mangrove vegetation is explained by the independent variables while the rest (27%) of the variation was due to other variable that did not include in the model. The overall regression result was significant as $F_{statistic}$ value of 23.472 and significant at $\alpha = 0.000$. The result provides evidence that the combination of organic material, nitrogen total and CEC had an impact simultaneously on survival rate of mangrove vegetation in site location.

The estimated coefficients are positive; the coefficient of organic material, nitrogen total and CEC are 32.953, 45.512 and 1.932, respectively. Furthermore, organic material and nitrogen total was significant at $\alpha = 0.05$, while CEC at $\alpha = 0.000$. Thus, it can be inferred that for 1% increase of organic material, survival rate of mangrove vegetation will increase by 32.9%. It argues the research findings by Gleason *et al*. (2003) and Ohimain (2004).

Moreover, increasing 1% of nitrogen total and CEC, the survival rate of mangrove vegetation will increase by 45.5 and 1.9%, respectively. The result of this research is support research findings that already done by Ohimain (2004) and McKee and Vervaeke (2009).

In general, three variables that observe in this research such as organic materials, nitrogen total, dan Cation Exchange Capacity (CEC) have significant

influence the levels of survival rate of mangrove vegetation in site location. The levels of survival rate is various in each plots, depend on location of plots and several variables that can be improve the growth rate of mangrove's seed such as organic materials, nitrogen total, Cation Exchange Capacity (CEC) and others (pH soil, phosphate, etc).

CONCLUSION

The relationship among the characteristic of soil quality (organic materials, nitrogen total, CEC) in the area of reforestation with the levels of survival rate of mangrove vegetation was expressed by the result of regression analysis. The results showed that those variables significant influence the survival rate of mangrove vegetation at site location.

Moreover, the survival rate of mangrove vegetation (highest survival percentage) found in sandy clay loam soil texture as planting media.

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