Kinetic Parameters of Gross N Mineralization and Nutrient Status of Peat Soils for Sago Palm (Metroxylon sagu Rottb.) Growth

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Peat soils have been paid attention regarding their existence in large area in tropical countries for agricultural development, which is related to satisfying the demand of carbohydrate. Sago palm (Metroxylon sagu Rottb.) can produce 15-24 ton of starch ha-1 year –1, which indicates an extremely high yield of starch compared to other crops. Sago palm has an ability to withstand harsh environment of peat soils. There was a fact that a lower in starch production and slower in growth rate was observed in sago palms growing in peat soils, than those of grown in mineral soils, which was because of lower nutrient availability in peat soils. However, there are few research studying nutrient status of peat soils for improving the growth and increasing the production of sago palm. This study concerns on nutrient status and gross N mineralization of peat soils for sago palm growth.

The result showed that compare to mineral soils in coastal lowland area, peat soils showed lower chemical properties, which indicated low soil pH, low total N and exchangeable NH4+ and low concentration of cations in soil. Compare to the effect volcanic activity or depression position, which enriched the elemental composition of inland peat, concentration of cations in seawater inversely had little impact on the concentration of elements in soils in total and in exchangeable form. This indicated that improvement of nutrients status of peat soils in coastal lowland area, where sago palm grows, is important.

The result of this study demonstrated that the change of cations concentration in leaves of sago palms grown in coastal lowland area was not affected either by soil total cations or soil exchangeable cations. However, there was a significant effect of cations in soil solution on concentration of cation in the leaves. These findings indicated that the concentrations of cations in the leaves of sago palm cultivated on coastal lowland peat soils depended directly on the concentrations of the cations in the soil solution. Contrary to those of cations, there were no significant effects of concentration of inorganic N in soil solution, in exchangeable form as well as in total form on concentration of N in sago palm leaf. This was likely because the amount of N in soil solution and exchangeable form is a resultant of inorganic N production and consumption processes working in soils, inferring that concentration of inorganic N in soils may deplete or increase with

time. This situation suggests that gross N mineralization, rather than net N mineralization, is a better reference for estimation of soil ability to provide inorganic N to the plant.

Gross N mineralization was evaluated the kinetic parameters, namely: mineralization potential (N_o), apparent activation energy (Ea) and mineralization rate constant (k) values. In this study, the value of (N_o) ranged from 571 – 2445 mg kg^{-1}, with the average of 1150 mg kg^{-1}. However, N_o was not significantly affected by soil total N and total C content. Ea value ranged from 281 – 8181 J mol^{-1}, with the average of 2253 J mol^{-1}. Those data indicated highly diverse in the Ea value of peat soils. Three levels of Ea were suspected to exist in peat soils, i.e.: peat soils with low Ea value, which less or same with 1000 J mol^{-1}, peat soils with mid Ea value which ranges of more than 1000 to about 3000 J mol^{-1}, and peat soils with high Ea value, which more than 8000 J mol^{-1}. It was suspected that response of gross N mineralization to the change of temperature depended on the Ea value.

There was notable increase of k value of the soils, which has high Ea value with increasing temperature. There was no considerable increase of k value of the soils with mid level of Ea, whereas the increase of k value of the soils, which had low level of Ea, was small with increasing temperature. Field measurements of air temperature showed that mean annual maximum and minimum was 31.9oC and 23oC. Because of this small different of mean annual maximum and minimum temperature, soils from Riau 1 has high k value any air temperature levels in the tropical area over the year.

Greatly diverse of the kinetic parameters of gross N mineralization was related organic C and N composition of peat soils. Although the result showed that there was no significant influence of soil C/N ratio to k and Ea value of the peat soils, alkyl C/O-alkyl C ratio of peat soils has a negative influence on k value. Hence, this alkyl C/O-alkyl C ratio could be used to estimate k value of gross N mineralization. In contrast, the study showed that no significant correlation was found between Ea value and alkyl C/O-alkyl C ratio. Similarly, the relationship of this Ea value with alkyl C/O-alkyl C ratio was likely to depend on temperature levels.

Effect of organic N composition on the kinetic parameters of gross N mineralization was also investigated. The result indicated that there was no significant effect of hexosamine N/amino N ratio on the k value and Ea value of the soils. This was probably because of soil organic N was not completely digested in acid hydrolysis. However, no significant correlation between aromatic N/peptide N ratio and peptide/primary amine ratio resulted from XPS analysis and the k and Ea

value of the soils. It seems that the *k* value and *Ea* value did not depend on the relative proportion on the N fraction per se in soils.

As stated above that peat soils with high *k* value, which has low ratio of alkyl C/O-alkyl C, indicates a higher content of rapidly decomposed organic matter. In this condition, the supply of N from mineralization will reduce fast, and soils could no longer maintain the level of available N. This implied that to keep high the level of soil available N in soils with high gross N mineralization rate, an additional N should be added to the soils. However, a significant effect of N fertilizers on plant height and leaf formation has not been observed in this research. Leaf samples of sago palms collected on December 1998 and 1999 did not show any significant effect of N fertilizer on the concentration of N in leaves. In contrast, significantly higher concentration of N was present in the samples of young leaves collected in June 2000 from the LP-100 and Urea treated palms than in the control palms. This result shows that concentration of N in sago palm leaves increases with soil-applied N, regardless of controlled release or soluble N. It was suspected that sago palm treated with soluble fertilizer are benefited from increasing soil pH and N mineralization rate following soluble fertilizer application.