Assessment of the humification degree of peat soil under sago (*Metroxylon sagu*) cultivation based on Fourier Transform Infrared (FTIR) and Ultraviolet-Visible (UV-Vis) spectroscopic characteristics

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SUMMARY

Sago palm (*Metroxylon sagu*) is a tropical crop that can survive the acidic conditions of peat soil, which is cultivated at large scale in Sarawak (Malaysia). The performance of sago palm on deep peat is variable, and not all specimens are able to grow to maturity and produce a trunk. It is hypothesised that sago growth may be influenced by peat humification because a positive relationship between the fertility of peat soil and its degree of humification has been well reported. This article investigates the humification degree of peat soil used for cultivation of sago palms, as indicated by spectroscopic characteristics. The peat soil adjacent to trunking and non-trunking palms was sampled and compared with exposed uncultivated peat. The results showed that, where largely undecomposed woody material predominated in the underlying peat, degree of humification decreased with increasing depth. Uncultivated peat was more highly humified than cultivated peat because the latter was continuously replenished with new plant matter. On the basis of FTIR spectroscopy, no significant difference was found between cultivated peat sampled adjacent to trunking and non-trunking palms. On the other hand, the UV-Vis and FTIR data suggested lower humification degree in the underlying peat which may have led to inconsistent growth.

KEY WORDS: decomposition, Histosol, Malaysia, non-trunking, Sarawak, trunking

INTRODUCTION

Sago palm is a tropical crop that can survive in the low-pH and waterlogged environment of peat. In Sarawak there is a total of 1.7 million hectares of peatland, of which a considerable area has been designated for large-scale sago plantations. Dalat and Mukah Plantations are two established estates that cover areas of 1,600 ha and 20,000 ha, respectively. With this scale of plantation, sago export is ranked the fourth largest agricultural revenue earner in Sarawak (Chew *et al*. 1999).

Sago palms are cultivated for the starch stored in their trunks. Hence, palms that produce trunk are often referred to as 'trunking' specimens. Although sago is well known as one of the crops that adapt to the extreme conditions of peat, the cultivation of sago has not been straightforward. Sago palms grow slowly on peat soil, with lower production than on mineral soils (Purwanto *et al*. 2002). Jong *et al*. (2006) compared the growth performance of sago palms cultivated on deep peat and shallow peat. Their results showed that only 20 % of the palms produced trunks on deep peat; whilst on shallow peat they grew better, with more than 80 % trunking in 5–6 years and attaining maturity in ten years. Sim *et al*. (2005) associated the poor growth of sago on deep peat with limiting nutrients. In fact, the challenge of sago cultivation on deep peat is similarly encountered in oil palm plantations, where lower yield is reported as a result of less humified haemic peat in the deeper horizons of the soil (Veloo *et al*. 2015).

Peat soil is composed primarily of humic substances, which are complicated heterogeneous compounds resulting from the process of decomposition. This process is also referred to as humification. The fertility of peat is closely associated with degree of humification. It is found that peat soil with higher humification displays a lower C:N ratio, indicating a larger mobile nitrogen reserve (Sári & Forró 2008). Venegas-González *et al*. (2013) further report that blackberry (*Rubus* spp.) experiences enhanced nutrient uptake when grown in substrate with increased humification, whilst Requena *et al*. (1997) provide evidence of improved growth performance in relation to humification degree.

For this reason, peat immaturity is expected to associate with retarded sago growth on deep peat. However, there is limited information on the humification profiles of peat soils in Sarawak, particularly those in sago palm plantations. Hence, the objective of our study was to determine the

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