Further Direction of Sago Palm Studies from Soil Science Point of View

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Abstract

Sago palm can grow on various types of soil from peat to mineral soil, both in a flooded and upland environment. Sago palms grown on peat soils are reported to have slower growth and lower yields than those grown on mineral soils. This indicates that sago palm is a plant that responds to the nutrient content of the soil and the environment in which it grows. However, fertilization experiments carried out have not given satisfactory results in terms of the response to the growth and yield of sago palm. The sago palm plant did not respond well to the fertilization treatments given, even at several times as the recommended dose. This is thought to be related to the limited fertility of peat soils which have the low cation binding capacity of peat soils and are vulnerable to the leaching of nutrients into groundwater. Therefore, research needs to be focused on increasing nutrient use efficiency by plants, including to find more genetically efficient plants in nutrient use and good land management, and to the use of slow release fertilizers, biochar, and nanofertilizers. Environmental issues are also concerns and sago palm plants attract attention in reducing greenhouse gas emissions and increasing carbon storage in peat soils. The sago plant must be able to play a role in preventing further peat degradation because it is a plant that can grow in a flooded environment.

Key words: Carbon, Fertilizer efficiency, Nitrogen, Soil fertility, Tropical peat soils

Nitrogen-fixing bacterial community in sago palm roots in different soil environments of East Malaysia and South Thailand

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Abstract
The diversity and taxonomic composition of endophytic bacteria and nitrogen-fixing bacteria (NFB) in sago palm roots were examined from two sites in East Malaysia (clay loam of mineral soil, and shallow peat soil) and five sites in South Thailand (clay loam, sandy clay loam, sandy clay, and clay soils) by the amplicon sequencing of 16S rRNA and *nifH* gene. As a result, Shannon diversity and Simpson's evenness of bacteria and NFB were not different among sampling sites (although the root sample in shallow peat soil had a low value). The soil bulk density, clay content, volumetric water content, pH, EC, exchangeable cation contents, and total N affected both communities of endophytic bacteria and NFB. As a result of phylogenetic analysis of NifH (translated from *nifH* gene amplicon), NifH adjacent to *Bradyrhizobium*, *Burkholderia*, *Cupriavidus*, *Frankia*, *Geobacter*, *Anaeromyxobacter*, *Desulfovibrio*, *Clostridium*, and *Spirochaeta* were highly detected. Surprisingly, NifH close to *Burkholderia xenovorans* was dominant (> 30% relative abundance) in the strong acidity (pH 4.1) of shallow peat soil in Malaysia. The relative abundance of aerobic or facultative anaerobic NFB (*Bradyrhizobium*, *Burkholderia*, *Frankia*, and *Cupriavidus* genera) was negatively correlated with the relative abundance of anaerobic NFB (*Clostridium*, *Geobacter*, *Anaeromyxobacter*, *Desulfovibrio*, and *Spirochaeta*). It is suggested that the key players of root endophytic NFB in sago palm roots shifted by the oxygen level in the root interior affected by waterlogging in the soil.

Key words: Biological nitrogen-fixation, *Bradyrhizobium*, *Burkholderia*, *nifH* gene, Soil physicochemical properties, Waterlogging

Characteristics of Sago Palm Suckers as Planting Material and Their Subsequent Growth in Deep Peat Soil

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Abstract

Sago palm (*Metroxylon sagu* Rottb.) grows in Southeast Asia and Melanesia. In Indonesia, sago palm cultivation is distributed also in problem soils such as peat land. As conventional practice of new sago palm planting, sucker (offshoot) has been often used for its propagation. However, at the sites of sago palm production, some constrains such as survival percentage are pointed out. In this study, we prepared sago palm suckers that had different initial sizes and various durations of culture in the nursery and compared their growth after transplanting in the field. Sago palm suckers were grouped into 2 categories based on their weight: 2–4 kg (smaller size: S) and 4–8 kg (larger size: L). The sago palm suckers were cultured on the raft for 2, 4, 8, or 12 weeks in a canal. Accordingly, the plots were named depending on the initial size of sucker and culture duration as S2, S4, S8, S12, L2, L4, L8 and L12. The survival percentage of the sago palms after transplanting in the field tended to be high in small initial size plants and shorter duration in the nursery. The change in leaf number in the field was influenced by mostly duration and the longer cultured plants in the nursery tended to be larger in the field. The change in leaflet number, length and width showed similar tendency with the change in the leaf number. The newly growing shoot length seemed to be large in L12 plot, but there was no significant difference regardless of different initial sucker sizes and different durations in the nursery. The shoot length showed positive correlations with leaf number or leaflet size in length (and the other leaflet parameters as well) 3, 5, 7 week after transplanting (WAT), however their relationships were not significant 9 WAT.

As described above, the discrepancy between the influences of initial sucker size and culture duration on the survival percentage and the growth after transplanting was found. Accordingly, appropriate contemplation relating to trade-off between the existence of transplanted materials and their subsequent growth in the field, that is to say survival of the fittest, is needed to be considered for finding stable growth of the transplanted materials in the field.

Key words: Growth parameter, Sago palm, Sucker, Survival percentage, Transplanting

Climatic Factors Affecting Palm Yield and Yield Prediction: A Case Study of Aromatic Coconut

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Abstract
Aromatic coconut's export value is the fourth highest among all Thai fruit crops. However, there are some periods during the year when the coconut supply does not meet the high demand. This research project aimed to determine climatic factors causing the coconut yield fluctuation and to predict the yields in advance for precision aromatic coconut farming. The study from five aromatic coconut orchards in Ratchaburi and Nakhon Pathom provinces collected from 2019-2022 showed that fruit drop in rainy season caused the lesser production in the summer. However, rainfall, air temperature and humidity had no effect on stigma receptivity, amount of nectar, nectar sugar concentration, anther dehiscence and pollen viability of coconut flowers. Numbers of anthophiles and pollinators had positive correlation with relative humidity, but negative correlation with light intensity. Stingless bee tended to reduce coconut fruit drop in rainy season. Stepwise multiple linear regression revealed that air and soil temperature of the past year provided the most accurate prediction of coconut yield with rC = 0.77. Multivariate time series analysis, harmonic regression and dynamic Bayesian networks generated equations that could predict yield seven months in advance (with 95% confidence interval) based on temperature, relative humidity, and amount of rainfall from the previous three months together with number of inflorescences and number of female flowers. This work's results will be useful for farmers, coconut collectors, exporters or processing industry in their production and marketing planning accordingly with predicted yield. Although the growing environment of sago palm is different from that of coconut palm, the results of the current study may be beneficial to sago palm research progress in the very near future.

Key words: Anthophiles, Dynamic Bayesian networks, Pollen viability, Stigma receptivity, Stepwise Multiple Linear Regression