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BIOFERTILIZER AND BIOENHANCER CONCEPTS FOR SUSTAINABLE OIL PALM SEEDLING PRODUCTION

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Introduction

In oil palm production, nitrogen fertilizer is the most expensive nutrient input required. At an average recommended rate of 0.5 to 1.0 kg N/matured palm/year (148 palms/ha) and with an average price of urea at RM 587/tonne, total nitrogen fertilizer cost to the industry is estimated to be RM 470 million/year. These phenomena had synergistically increased cost on oil palm production and make it less profitable especially during the current low price of the commodity. The concept of Biological Nitrogen Fixation (BNF) and plant growth enhancement by diazotrophic microorganisms (*Acetobacter diazotrophicus*, *Herbaspirillum* spp., *Azoarcus* spp., *Azospirillum* spp. and *Bacillus* spp.) in association with non-leguminous crops is becoming increasingly important in attempts to develop a sustainable agricultural system. The process could prevent ground water pollution, save nitrogen fertilizer and reduce the cost in crop production (Hardarson, 1993). Cocking (2000) has highlighted a new technique which could increase the biological nitrogen fixation capacity with cereals and other non-legumes by establishing N_2-fixing bacteria within roots of the host plants. This new inoculation technology is aimed at significantly reducing the use of synthetic nitrogenous fertilizer in the agricultural sector. Inoculation of the diazotrophic microorganisms could also benefit the host plant by improving root development, biomass, yield and nitrogen content (Okon and Kapulnik, 1986). The inocula (*Azospirillum*) have been shown to save at least 67% of inorganic-N requirement in sweet potato cultivation (Saad *et al.*, 1999). Exploitation of BNF concept through application of selected inoculum on oil palm seedlings can potentially save cost on nitrogen fertilizer and make the palm oil industry more profitable (Dobereiner and Baldani, 1998; Shamsuddin *et al.*, 2000b). Thus, this study was conducted to develop a sustainable oil palm fertilization system (especially N) in Malaysia beginning with oil palm seedlings at the nursery stage.

Materials and Methods

Two glasshouse experiments (**Expt. 1 & 2**) were conducted in UPM glasshouse (undrained pots) with Selangor series soil at 8 kg/pot. The soil was maintained at field capacity (28% moisture) and labeled with ^{15}N by adding 100 ml/pot of $(^{15}NH_4)_2SO_4$. **In Expt. 1**, each pot was planted with a two months old oil palm plantlets and applied with three treatments; 1) Control (+ killed inoculum (Sp7), 2) *Azospirillum brasilense* (Sp7), 3) *A. lipoferum* (CCM 3863) and harvested at 120 days after planting (DAP). **In Expt. 2**, newly germinated oil palm seeds were planted at one seed/pot with seven treatments: 1) Control 1 (+ killed Sp7, non-sterile soil), 2) Control 2 (+ killed Sp7, sterile soil), 3) Control 3 ($+N_i$), 4) *A.brasilense* (Sp7), 5) *A. lipoferum* (CCM 3863), 6) Locally isolated rhizobacteria (UPMB 10) and 7) UPMB 13, with three different harvests (130, 260 and 390 DAP). A duplicate of Expt. 2 was conducted under *in vitro* conditions using sterilized tissue cultured oil palm plantlets in large test-tubes (**Expt. 3**). In Expt. 1, effect of the inocula on photosynthetic rates was also determined. The samples