Use of Arbuscular Mycorrhiza as a Soil Ameliorant against *Ganoderma* in Oil Palm

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Introduction

Basal stem rot caused by *Ganoderma boninense* has emerged as the most widespread and threatening disease of oil palm in Malaysia. To date no specific and effective management strategies have been successful in controlling this disease. The role of Arbuscular Mycorrhiza (AM) in enhancing plant growth as well as a bioprotector has been well documented (Azizah et al 1986) AM fungi has been proven to impair the development of soil borne pathogens and consequently inhibit or reduced disease severity. Several protective mechanism put forward as a result of AM association include competition for infection site and host photosynthate (since both AM and pathogen occupy the same ecological niche), activation of plant defence mechanism as well as the overall change in the physiology of the plant. The present study aimed to evaluate the role of AM in enhancing growth and physiology of oil palm and to study the potential of utilizing AM as a biocontrol agent against *Ganoderma boninense*

Materials and Methods

Isolation and identification of antagonist from rhizosphere and mycorhizosphere soil of *Ganoderma* infected palms was done in the laboratory. The isolates were then tested for their antagonism against *Ganoderma boninense* in vitro. Glasshouse trials were carried out to determine the optimum level of AM inoculum density for maximum growth and nutrient uptake and to evaluate the role of AM fungi in improving plant physiology and inducing changes to the root morphology of oil palm seedlings. Further study to evaluate the potential of AM as a biocontrol agent was also done in the glasshouse. Rubber wood blocks (6x6x12cm) colonized with *Ganoderma boninense* was used as the inoculum source. The 7 month old mycorrhizal and nonmycorrhizal palm seedlings were inoculated with these blocks. The parameters were recorded 3, 6 and 9 months after *Ganoderma* inoculation.

Results and Discussion

A total of over 10 fungal genera (comprising >20 species) were isolated from both rhizosphere and mycorhizosphere soils of oil palm. Some species have greater antagonistic activities against *Ganoderma*. Highest growth inhibition was recorded for *Trichoderma viridae* followed by *Aspergilus flavus, Penicillium notatum and A. niger.* Oil palm seedlings responded positively to AM inoculation. The results obtained showed that 44% root colonization was recorded as early as 3 months after AM inoculation. The inoculum density has been known to influence plant response to AM symbiosis. Results showed that 40 g inoculum/seedling (mixed species of AM comprising spore, extramatrical hyphae and infected root segments with the MPN value of 9.94/10 g inoculum) gave maximum growth and optimum root colonization of oil palm roots. AM association also resulted in better and more vigorous plant, significantly increasing dry matter production, total leaf area, nutrient uptake, photosynthetic rate and relative water content of the seedlings while reducing the stomatal resistance. Increased in lignin deposition and higher total phenolic contents were also found in the 1° and 2° roots of AM plants. The most obvious evidence is the morphological change in the oil palm root system. AM made the root more dense with massive root hairs and significantly longer 2° and 3° roots. The results from the mycorrhiza versus *Ganoderma* study showed that foliar symptom as a result of *Ganoderma* infection was delayed in AM plants. Number of dead palm also decreased with AM treatment. AM association also significantly reduced the number of primary roots infected by the disease and also the area of tisuue decay in the stem bulb. Presence of AM also enhanced both bacterial and fungal population (cfu) at all sampling time. Maximum population was recorded for mycorrhizal seedlings but without *Ganoderma*. The presence of *Ganoderma* clearly inhibited both bacterial and fungal population. Increase in bacteria and fungal population will act as a natural physical barrier, which could impede growth or spread of the *Ganoderma* fungi. Increase in phenolic content in mycorrhizal roots further act as a chemical barrier inhibiting the spread of *Ganoderma* since phenols has been proven to possess some antibiotic properties against soil borne pathogens.

Conclusions

AM symbiosis significantly enhanced oil palm growth and nutrient uptake and also improved palm physiology and root morphology. These growth improvements in combination with the increase in lignin and phenolic contents in the 1° and 2° mycorrhizal oil palm roots have undoubtedly increased the plant's resistance or reduced the plant's susceptibility to attack by soil borne fungal pathogens.

Benefits from the study

Enhancement of plant growth and yield through mycorrhizal symbiosis. Oil palm association with the AM fungi significantly increased efficiency of the roots to absorb water and nutrient from the soil, hence reducing input of chemical fertilizers into the soil.

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Graduate Research

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