Investigating the effect of white-rot hymenomycetes biodegradation on basal stem rot infected oil palm wood blocks: biochemical and anatomical characterization

ABSTRACT

Basal Stem rot (BSR) disease of oil palm caused by Ganoderma boninense is one of the major obstacle in oil palm production. The root contact with unattended infected debris left in the plantations during replanting is known to be the primary source of infection spread. Abiding with the law, potentially effective technique of managing Ganoderma infected oil palm debris is deemed necessary because of the zero-burning policy in Malaysian oil palm plantations. The wood degradation abilities of four white-rot hymenomycetes were assessed using oil palm blocks obtained from healthy and diseased portions of oil palm trunks infected with G. boninense. In general, out of four white-rot hymenomycetes, Pycnoporus sanguineus FBR secreted a significantly ($P \leq 0.05$) greater quantity of oxidative enzymes than that secreted by the Grammothele fuligo strains. The ability of G. fuligo ST2 and P. sanguineus FBR to secrete amylase enzymes has been well documented and the enzyme profiles were about 4.5-fold (G. fuligo ST2) and 2.8-fold (P. sanguineus FBR) higher in samples collected at day 120 than at day 30 of biodegradation, supported with Fourier transform infrared (FTIR) spectra. The crystallinity ratio was found to increase in the middle of decay process, owing to the preferential degradation of non-crystalline lignins and hemicelluloses by both strains. Syringyl (S)-lignin units were favorably degraded than guaiacyl (G)-lignin units by both strains, resulting in a decreased S/G ratio in the diseased portions, at the end of decay process. Scanning electron microscopy (SEM) revealed that penetration of fungal hyphae within the wood vessels and the parenchymal tissues with boreholes, resulting in the loosening of the parenchymal tissue and wood rays. Based on the lignocellulolytic enzymes production and the level of degradation, P. sanguineus FBR and G. fuligo ST2 regarded as the best bio-degraders of G. boninense colonized wood blocks. This study provides the novel insight on understanding the biochemical and anatomical changes induced by white-rot hymenomycetes during biodegradation of oil palm wood blocks with an ultimate aim of reducing the Ganoderma inoculum under heavy BSR infection pressure in ecofriendly manner.

Keyword: Hymenomycetes; Hydrolytic; Ligninolytic enzymes; S/G Ratio; Crystallinity; Basal stem rot; Biodegradation