

## Evaluation on the Effectiveness of Organic Acids Combination against *Ganoderma boninense*, the Causal Pathogen of Basal Stem Rot in Oil Palm

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*Basal Stem Rot (BSR) disease mainly caused by Ganoderma boninense has become a serious threat to the South East Asia oil palm industry. With no conclusive remedy to date, the oil palm industry is still in search of effective ways to manage this disease. The present work reports the effectiveness of organic acids combination (OAC) in managing Ganoderma infection in oil palm. In this study, the pre-formulated organic acids combination from a product to control BSR caused by Ganoderma was carried out both in the field and nursery. The trial was conducted for a duration of approximately 18 months. The field trial was carried out at Bode Estate of Kretam Plantations Sabah in Sandakan. The possibility of the OAC in preventing the infection from spreading to newly planted seedlings in the area with Ganoderma history was also assessed via nursery trial at Mile 25, estate of Kam Cheong Sdn Bhd. In the field trial, three different sets of protocols i.e.: A (0.4% v/v with 5 rounds of application), B (0.4% v/v with 3 rounds of application), and C (0.5% v/v with 3 rounds of application) of the OAC treatment were applied along with Ganoderma Selective Medium (GSM) analysis, ergosterol content analysis, in vitro antagonistic evaluation and Scanning Electron Microscope (SEM) observation to comprehensively investigate the efficacy of the combination. Protocols A, B and C had significantly reduced the colonisation / amount of ergosterol content (8.832-9.095 µg/g of trunk tissues) in the infected palms in comparison to those Ganoderma infected but left untreated palms (48.956 µg/g of trunk tissues). However, there was no significant difference between the effectiveness among the three protocols in reduction of Ganoderma colonisation till month-12, in which protocol C proved to perform better compared to the other two protocols. There was slight ergosterol content increment in oil palm tissues treated with various protocols of the OAC at month-18, but were much lesser compared to untreated palms. Nonetheless, none of the protocols in application of OAC gave an absolute control of Ganoderma till the end of the trial, as the treated palms remained infected but with much lower ergosterol content compared to untreated palms. Application of the OAC as soil treatment for prevention of Ganoderma infection to seedlings replanted in the area with Ganoderma history in Kam Cheong Estate showed lesser disease incidences compared to those untreated ones. The infected seedlings which were treated by this product also showed lesser amount of ergosterol content which represents lesser colonisation of the pathogenic fungi. However, OAC-treated seedlings still recorded the presence of ergosterol from low to moderate in some of the tested samples. In vitro experiment of OAC and Ganoderma mycelia further elaborates the possible interaction between these organic acids with Ganoderma when in contact with either the tissues or soil. The in vitro results suggest OAC has destructive effect against the mycelia of Ganoderma with SEM evidences of massive damaging effects of the product to the mycelia of the fungi. Based on the GC-MS analysis, the OAC were identified from the products propanoic acid, acetic acid, benzoic acid, sorbic acid and besylic acid.*

**Keywords:** Oil palm, Ganoderma, basal stem rot, organic acids, ergosterol.

