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FIELD TRIAL FOR NEW MALAYSIAN COCOA BOARD COMPOUND FERTILIZER

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ABSTRACT – *Several studies regarding fertilizer for cacao had been done and developed in Malaysian Cocoa Board (MCB). The aim of this study was to develop a new compound fertilizer that incorporated these findings. The fertilizer developed will have better nutrient retention, mitigation to Vascular Streak Dieback (VSD) infections and biofertilizer properties. The objective of the study is to observe the efficacy of the new compound fertilizer on a field trial experiment. The fertilizer was applied to 10 trees and compared to conventional fertilizer. Each tree was applied with the fertilizer at the rate of 1kg/tree/year. Disease Severity Index (DSI) for VSD symptoms and pod yield was recorded. Data were collected for one year. The data obtained indicate that there were no significant differences in pod yield collected although conventional fertilizer shows a slightly lower yield than treated trees. DSI data, however, show significantly lower on treated trees. The study indicates that the new fertilizer has the potential to provide sufficient nutrient for producing cacao tree and has beneficial properties on reducing VSD severity.*

Keywords: Cocoa, Biochar, Compound fertilizer, Effective microorganisms.

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INTRODUCTION

Administrating and controlling soil nutrient has always been one of the essential factors in agriculture. This is emphasized when dealing with lower fertility area. As cocoa has reduced in popularity among smallholders, cocoa commodity crops must now adapt to be more successful in such areas. Hence Malaysian Cocoa Board (MCB) has been increasing its research and development effort in fertilizer development. There are several concurrent developments of fertilizer being done with various routes but essentially aiming for higher cocoa productivity.

One of the studies done in MCB is the utilization of biochar as a soil amendment. Paddy husk is a major agricultural byproduct obtained from the food crop of paddy. Generally, it was considered a worthless byproduct of the rice mill. When heated in a closed container without or limited presence of air, a solid carbon-rich product produced (Hariz, 2015). Charred paddy husk is considered as one of the common biochar used in agriculture. When biochar is applied to the soil, the interaction of the biochar and soil is influenced not only by the biochar characteristics but also by the soil properties and will determine the nutrient leaching or retention characteristics of the mixture (Mukherjee and Zimmerman, 2013). When it is added to the soil, biochar has generally been shown to be beneficial for growing crops (Lehmann *et al*., 2003). Biochar contains stable carbon that remains sequestered for much longer periods than it would in the original biomass that biochar was made from (Rondon *et al*., 2007).

Cocoa in Malaysia has been declining in productivity and area since 1999. The cultivated area remained are on undesired area such as acidic coastal soil in Bagan Datuk, Perak. Certain crop yield improvements with biochar have been demonstrated repeatedly for acidic and highly weathered tropical field soils (Kimetu *et a*l., 2008). Cation Exchangeable Capacity (CEC) of biochar is the most important factor influencing ammonium adsorption (Yao et al., 2012). MCB also did a study that shows the effect of charred paddy husk decreases overtime and effected by soil pH. Application of charred paddy husk is beneficial for cocoa cultivation with frequent application annually in increasing CEC and pH (Helmi *et a*l., 2019). CEC value of soil caused by biochar might be a factor in the increased ammonium adsorption ability of the soil and thus reduced total ammonium loss (Lehmann *et al*., 2003, Sika and Hardie, 2014). MCB also did a study on identifying plant growth-promoting bacteria from the cocoa rhizosphere.

Leclercia adecarboxylate had shown the abilities to fix nitrogen, solubilize phosphorus and potassium through agar plat test method and also able to produce Indole Acetic Acid which increases in root growth and development. (Nurfadzilah, 2017).

The cocoa industry also suffers from damaging fungal pathogen that causes the vascular-streak dieback (VSD) disease spread by basidiomycete of *Oncobasidium theobromae* (Samuels *et al*., 2012). MCB has been developing endophytic bacteria with antagonistic effect towards VSD. *Bacillus subtilis* LKM-BL showed antagonistic activity by dual culture method and cells-free extract at 24h growth against VSD was tested as a biological control on cocoa seedlings. It also produced bioactive compounds of macrolactin A and macrolactin B which exhibits strong antifungal activity against *O. theobromae* (Zubir *et al*., 2019). *B. subtilis* LKM-BL showed promising potential as an additive in compound fertilizer.

The objective of this study is to develop a compound fertilizer consist of the amalgamation of several studies done in MCB for better cocoa productivity on problematic soil. The prototype fertilizer was then undergone field trial and its performance were assessed.

MATERIAL AND METHODS

The production of the compound fertilizer is by using melt granulations. Melt granulation is used as an alternative to wet granulation and employs binders that facilitate granulation in their molten form (Desai *et al*., 2013). Although the process used here is not entirely using molten urea as urea tends to absorb moisture from the atmosphere and dissolve. Dissolved or molten urea used as the binder for the compound fertilizer in liquid form. The process of the granulation is as shown in Figure 1. The production of the prototype fertilizer was limited to 10kg due to constraining of the equipment and materials. The produced compound fertilizer was then tested for nutrient content.

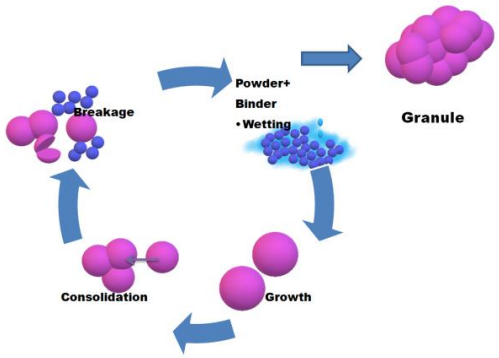

Figure 1: Mechanism involved in granulation

The field trial was conducted in Cocoa Research and Development Center Bagan Datuk. The experiment site is a coastal area and largely cultivated with cocoa and coconuts. Investigations done earlier by other agencies stated that recent alluvium and the inference is that the area is a mud flat underlain by soft marine silty clay (Ali, 2013). The trial consists of two treatments, T1 (new fertilizer) comparing to T2 (conventional compound fertilizer). Each treatment was replicated 10 times. Both treatments were applied using the broadcast method around each tree.

Cocoa pod yield data and Disease Severity Index (DSI) for VSD symptoms were then recorded.

RESULT AND DISCUSSION

Cocoa yield data does fluctuate according to yielding seasons. Pod yield data overtime may show the yielding trends and potential yield. Pod yield data is a good measurement to use that could reduce other environmental factors. Figure 2 indicates that the application of T1 (prototype fertilizer) has a higher yield trend compared to conventional fertilizer. Statistical analysis of the two treatment two-tail t-test (P (T<=t)0.147062) shows that there was no significant difference in pod yield. The yield trends also indicate that T1 would have lower diminishing returned as the yield does not dip lower during the last collected data. Cumulative yield data over a longer period of time is required to fully assess the fertilizer performance on cocoa pod yield.

A special type of scale comprising a number of intervals of known numeric ranges can be used when estimating the severity of plant disease. The interval ranges are most often based on the per cent area with symptoms. Studies in plant pathology and plant breeding often use this type of ordinal scale. The disease severity is estimated by a rater as a value on the scale and has been used to determine a disease severity index (DSI) on a percentage basis, where DSI (%) = [sum (class frequency × score of rating class)]/[(total number of plants) × (maximal disease index)] × 100. The ordinal scale differs from one disease to another. VSD DSI uses a visual scale where symptoms were asses visually. Data collected for VSD DSI for more than a year indicates that the prototype fertilizer has positive effects on reducing VSD severity. Statistical analysis also indicates that there were significant differences in DSI among the two treatments (P (T<=t) 0.024256).

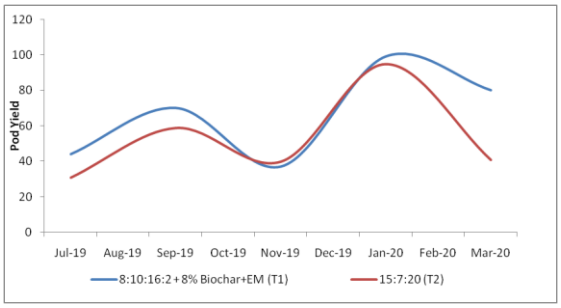

Figure 2: Pod yield data for fertilizer field trial

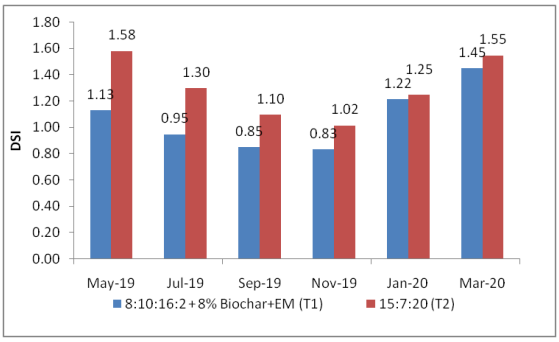

Figure 3. Disease Severity Index of the treated trees for VSD symptoms

CONCLUSION

From the experiment, it shows that the prototype fertilizer is performing as good as conventional fertilizer in producing cocoa yields. The data indicates higher trend of cocoa pod yield and could increase over time. The combination of several technology show positive effect towards cocoa productions. This is made apparent in the effects observed from DSI data that indicates lower severity of VSD infection when applied with the prototype fertilizer. The development of this fertilizer was straight forward and improvements can be made with further studies and testing. This study also enabling the possibility of combination various field of science to produce a superior product in the agency and industry. The prototype fertilizer could now be considered to be developed for the next stage of development in a pilot plant. Further refining of the product formula will be required for mass production.

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