IN VITRO EVALUATION OF SOLUBLE SILICON (Si) FOR CONTROLLING VASCULAR STREAK DIEBACK DISEASE OF COCOA (*Theobroma cacao*)

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ABSTRACT - Vascular streak dieback (VSD), caused by the fungus *Ceratobasidium theobromae* has killed large amount of cocoa trees in Papua New Guinea in 1960s to 1970s. The disease has since become a serious problem in Malaysia, Indonesia and the Philippines. Average yield loss due to VSD disease in Malaysia is ranges between 10 to 15%. To date, this disease is managed by several methods such as cultural practices, fungicides and resistant clones. However, none of the above approaches provide sufficient protection to cocoa trees. In this study, soluble silicon (Si) was investigated as potential agent for the control of VSD disease under *in vitro* conditions. By employing poison plate technique, a plug of *C. theobromae* growth was cultured on amended coconut water agar (CWA) with Si in five different concentrations (0.5, 1.0, 1.5, 2.0 and 2.5 % v/v). Unamended medium were served as control and each treatment was performed in 7 replicates. After seven days of incubation, results showed that Si had significantly ($p \leq 0.05$) suppressing the radial growth of the pathogen. The effectiveness of Si increased with concentration, and the growth of pathogen was almost completely retarded at 2.5 % silicon nutrient (v/v) with percentage inhibition of diameter growth (PIDG) 95.00%. The lowest concentration of silicon nutrient (0.5%) performed the lowest PIDG (54.29%). The results of *in vitro* study suggest that Si shows a promising agent for inhibiting the pathogen. However, further study is needed to evaluate the potential use of Si in controlling VSD on cocoa seedlings and mature trees.

Keywords: Vascular streak dieback, silicon, *Theobroma cacao*

INTRODUCTION

Vascular streak dieback (VSD) is a main systemic disease of cocoa (*Theobroma cacao* L.) which caused by the basidiomycete fungus *Ceratobasidium theobromae* (syn. *Thanatephorus theobromae*, *Oncobasidium theobromae*). In Malaysia, Keane and Turner were discovered this problem in 1971, where they found particular form of VSD symptoms similar with recorded in Papua New Guinea (Zainal Abidin, 1982). Since then, it was reported to be potentially destructive disease on cocoa in Malaysia by several researchers. The symptoms of VSD includes three blackened vascular traces on leaf abscission scars, chlorosis and necrosis of leaves, enlarged lenticels causing roughening of the bark and dark streaks within the vascular tissue (Guest and Keane, 2007). The disease kills branches of mature cocoa trees, but serious damaging may occurs if the pathogen infests on cocoa seedlings less than ten months old (Guest and Keane, 2018).

Several practices have been applied for managing this disease such as by using fungicides, biological control, resistant planting materials, quarantine method and cultural practices. Presently, the used of silicon (Si) on managing crop diseases have shown a promising alternative. The plants supplied with Si can produce chitinases, peroxidases, phenolics, phytoalexins and polyphenoloxydases that can enhance the defense mechanism in response to fungal infection (Che´rif *et al*., 1994; Remus-Borel *et al*., 2005). It also can promote physical barrier of plants by formation of thick wax layer beneath the cuticle (Sangster *et al*., 2001). The

application of Si on managing cocoa diseases is not widely documented. So, this study was done in order to evaluate the potential of Si on controlling the pathogen of VSD under *in vitro* conditions.

MATERIALS & METHODS

The evaluation of effectiveness of soluble Si on inhibiting the mycelial growth of *C. theobromae* were done by employing poison food technique. Requisite quantity of Si was added to coconut water agar (CWA) plates to obtained final concentration of 0.5, 1.0, 1.5, 2.0 and 2.5 % (v/v). A disc of seven days old culture of *C. theobromae* was then centrally inoculated onto those amended medium. Unamended medium was served as control and each treatment were replicated seven times. The diameter growth of pathogen was recorded throughout one to seven days after inoculation.

RESULTS AND DISCUSSION

The colony diameter of pathogen on day seven after inoculation on amended media is shown on Figure 1. The effectiveness of Si increased with the concentration. It is almost completely suppressed the growth of *C. theobromae* with 95% inhibition at concentration of 2.5%. The diameter of pathogen was inhibited up to 84.29% and 61.43% by the plates impregnated with 0.20% and 0.15% of Si, respectively. The lowest concentration of silicon nutrient (0.5%) performed the lowest PIDG (54.29%).Several authors have reported promising result of Si application on disease control such as rice blast (*Pyricularia grisea),* brown spot of rice *(Bipolaris oryzae*) (Prabhu *et al.,* 2012), anthracnose of sorghum (*Colletotrichum sublineolum*) (Resende *et al.,* 2013) and sugarcane rust (*Puccinia melanocephala*) (Naidoo *et al.,* 2009)

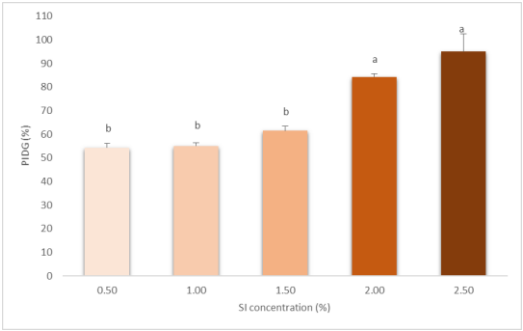

Figure 1: Percentage inhibition of diameter growth (PIDG) of *C. theobromae* on different concentration of Si. Means of colony diameter in the same treatment followed by same letter are not significantly different according to Duncan ($P \leq 0.05$)

CONCLUSIONS

The inhibition on colony diameter of pathogen was clearly indicated that Si has a fungicidal activity that suppress the growth of *C. theobromae*. The best Si concentration to suppress the growth of *C. theobromae* under *in vitro* conditions are 2.00% and 2.50%. Further study on evaluation of Si on cocoa seedling and mature tree certainly need to be done to come up with new approach for controlling VSD.

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