

New symptoms and management of vascular streak dieback of cocoa under climate change

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MCC 01 and MCC 02 cacao clones, the combination decreased VSD incidence by 72.8% after the first application in the first year and by 77.0% after the second application in the second year. These data showed the effectiveness of the combination of composted plant residues and *T. asperellum* applied through soil in controlling VSD in the field. The treatment could potentially be used on a large scale for suppressing this disease.

Symptom diversity of vascular streak dieback disease of cocoa in Sulawesi: a co-infection phenomenon

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Vascular streak dieback (VSD) symptoms caused by *Ceratobasidium theobromae* have changed from green-spotted chlorosis to a new symptom, necrosis. Either symptom or both symptoms can be present on a tree at the same time. Symptom diversity has been associated with *Lasiodiplodia theobromae*, an endophytic fungus, and therefore a hypothesis of co-infection has been proposed. This paper examines 1,500 infected tissues with VSD disease symptoms in different altitudes across Sulawesi, and tests for the presence of both *C. theobromae* and other fungi (endophytic community) using PCR analysis, confirmed using specific primers of Than_ITS1&2 and universal primers of ITS 1&4.

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Vascular streak dieback (VSD), which is caused by a fungus, causes serious problems in cocoa throughout the Asia-Pacific region, including Indonesia. This study analysed changes in symptoms to improve management of the disease. The results showed that symptoms change after the first signs of chlorosis appear on the leaf lamina. These changes usually involve darkening of the lamina and necrosis of the vascular tissue. The symptoms can cause 80% damage.

Microscopy of hyphae in twigs, leaves and leaf laminae, and sporocarps of infected stems showed that the fungus associated with these new symptoms is *Oncobasidium theobromae* Talbot & Keane, now renamed *Ceratobasidium theobromae* (Talbot & Keane) Samuels & Keane. Isolation of fungi from infected xylem confirmed that growth is slow, and the fungus cannot easily be subcultured.

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