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Global threats to cassava: Uncovering the pathogen complexes behind witches' broom and frogskin diseases

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Abstract

Cassava production is increasingly threatened by emerging diseases with complex and poorly understood etiologies. Two of the most concerning syndromes—Cassava Witches' Broom Disease (CWBD) in Southeast Asia and Cassava Frogskin Disease (CFSD) in South America—highlight the urgent need for global surveillance and integrated disease management strategies.

CWBD causes shortened internodes, leaf proliferation, and poor root development, leading to severe yield losses and propagation challenges. Recent investigations by the International Center for Tropical Agriculture (CIAT) have revealed a strong association between the fungus Ceratobasidium theobromae and CWBD symptoms. The pathogen, consistently detected in symptomatic cassava since the first outbreaks, was confirmed to be graft-transmissible and localised within the xylem and epidermis using RNAscope® *in situ* hybridisation. Notably, its patchy distribution suggests the potential to rescue pathogen-free cuttings from infected plants—critical for developing disease management protocols and quarantine measures.

In contrast, CFSD presents a delayed onset, with symptoms confined largely to the roots, complicating early detection and response. While various pathogens, including torrado-, ampelo-, and poleroviruses, as well as phytoplasmas, have been associated with CFSD, recent evidence points to Cassava torradovirus-like virus 2 (CsTLV2) as a key causal agent. Through single-virus grafting experiments and a robust multi-pathogen detection pipeline, we demonstrated differential susceptibility between cassava genotypes. Most South American lines exhibited symptoms upon infection, whereas several African varieties showed resistance or tolerance, with no observable foliar symptoms. RNAscope® further enabled precise spatial localisation of viral presence within host tissues.

Together, these studies shed light on the pathogen-host interactions underlying two of cassava's most damaging emerging diseases. They underscore the need for rapid diagnostics, resistance screening, and careful germplasm exchange regulation to prevent global

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spread. The identification of African cassava lines with resistance potential provides a valuable resource for pre-breeding and targeted resistance breeding programmes aimed at safeguarding global cassava cultivation.

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