

## Effect of temperature on the Cacao swollen shoot virus (CSSV, Badnavirus) vection by the mealybug *Planococcus citri* to cocoa seedlings in the laboratory

Régis Babin<sup>1</sup>

Chloé Cailleaud<sup>2</sup>, Bernard Dufour<sup>3</sup>, Frédéric Dedieu<sup>4</sup>, Nicolas Sauvion<sup>5</sup>, Fabienne Ribeyre<sup>6</sup>

<sup>1</sup>CIRAD

<sup>2</sup>Université Toulouse III Paul Sabatier

<sup>3</sup>CIRAD, UMR PHIM

<sup>4</sup>CIRAD, UMR PHIM

<sup>5</sup>INRAE, UMR PHIM

<sup>6</sup>CIRAD, UMR PHIM

### ABSTRACT

Since the early 2000s, the cocoa industry in Côte d'Ivoire is experiencing the resurgence of the Cacao swollen shoot virus disease (CSSVD). Full-sun cocoa monocultures and low shade plantations are considered as a cause of the rapid spread of CSSVD in the country. The warmer and dryer microclimates prevailing here, aggravated by climate change, would be conducive to vector mealybug outbreaks and would exacerbate CSSVD damage. This has led cocoa sector to encourage shading practices. However, current practices are not supported by sufficient knowledge of CSSVD relationships to microclimate. The virus is transmitted by mealybugs (Hemiptera: Pseudococcidae) through a non-circulative semi-persistent transmission, that means that the virus remains located to the vector mouth parts and that a mealybug remains infectious no more than two days. The present study aims at characterizing the impact of temperature on CSSV vection by mealybugs. The study was conducted in the laboratory of the PRISM department of the Plant Health Institute of Montpellier, in France. The study included three steps: 1) an acquisition period conducted in a growth chamber at 6 different constant temperatures (20, 22, 24, 26, 28 and 30°C) for 24 hours, during which first instars of the mealybug *Planococcus citri* were enclosed in clip-cages on young symptomatic leaves of cocoa seedlings previously artificially infected with a recombinant *Agrobacterium tumefaciens* bacteria containing the cloned sequence of Agou 1 isolate of CSSTBV species ; 2) an inoculation period conducted at the same temperatures, where the young infective mealybug instars were transferred to sprouting cocoa beans and allowed to feed for 48 h ; 3) an incubation period at 25°C, where the cocoa beans were cleared of mealybugs and planted in a tray with potting soil, where they grew until CSSVD symptom onset, which was recorded. Molecular analyses by PCR, with specific primers of Agou 1 isolate, were performed 50 days and 180 days after inoculation period to detect the presence of the virus in

cocoa seedlings. Results show that temperature has an effect on CSSV vection by mealybugs. Transmission rate gradually increased from 28 to 36% at 20°C to reach 82 to 95% at 26°C. The trend was not so clear for upper temperatures of 28 and 30°C. Observations on mealybug behavior suggested that the relationships between transmission and temperature could be explained by mealybug activity, which was stronger at higher temperatures. These results are discussed and perspectives are proposed.

**Keywords:** Thermobiology, Microclimate, Pseudococcidae