

**Cold hardiness of the South American tomato pinworm *Tuta absoluta*
(Lepidoptera: Gelechiidae): both larvae and adults are chill-susceptible**

Vimbai L Tarusikirwa , Reyard Mutamiswa, Frank Chidawanyika, Casper Nyamukondiwa

Abstract

Background: For many insects, including invasive species, overwintering survival is achieved behaviourally (e.g. through migration) or physiologically by entering diapause, a state of arrested physiological development that may be accompanied with depressed supercooling points (SCPs). Diapause allows in situ adaptation to adverse environmental conditions, providing sufficient parent propagules for insect pest proliferation when optimal conditions resurface. This phenomenon has however not been observed in the invasive South American tomato pinworm *Tuta absoluta* in its Mediterranean invaded areas. Moreover, no studies have looked at its overwintering survival in sub-Saharan Africa. Here, we thus investigated the cold hardiness of *Tuta absoluta* larvae and adults to better explain its local overwintering adaptation strategy.

Results: Larval lower lethal temperatures ranged from -1 to -17 °C for 0.5 to 4 h durations. Adults showed lower temperature activity limits than larvae albeit freeze strategy experiments showed neither survived internal freezing. Fasting and dehydration pre-treatment generally depressed SCPs, although asymmetrically, conferring more negative SCPs for larvae. Ramping rates, synonymic to diurnal temperature changes also significantly affected SCPs while, inoculative freezing significantly compromised freezing temperatures in both larvae and adults.

Conclusion: Our results suggest that (i) *Tuta absoluta* larvae and adults are chill-susceptible and may successfully overwinter, (ii) larvae appear more cold hardy than adults and (iii) ecological factors e.g. inoculative freezing, cooling rates, feeding- and hydration-status may affect cold hardiness. These results are important in determining species range limits, population phenology, modelling pest risk status and allows temporal life-stage specific targeting of management strategies.