Ontogenetic responses of physiological fitness in Spodoptera frugiperda (Lepidoptera: Noctuidae) in response to repeated cold exposure

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Abstract

In this era of global climate change, intrinsic rapid and evolutionary responses of invasive agricultural pests to thermal variability are of concern given the potential implications on their biogeography and dire consequences on human food security. For insects, chill coma recovery time (CCRT) and critical thermal minima (CTmin), the point at which neuromuscular coordination is lost following cold exposure, remain good indices for cold tolerance. Using laboratory-reared Spodoptera frugiperda (Lepidoptera: Noctuidae), we explored cold tolerance repeated exposure across life stages of this invasive insect pest. Specifically, we measured their CTmin and CCRT across four consecutive assays, each 24 h apart. In addition, we assessed body water content (BWC) and body lipid content (BLC) of the life stages. Our results showed that CTmin improved with repeated exposure in 5th instar larvae, virgin males and females while CCRT improved in 4th, 5th and 6th instar larvae following repeated cold exposure. In addition, the results revealed evidence of cold hardening in this invasive insect pest. However, there was no correlation between cold tolerance and BWC as well as BLC. Our results show capacity for cold hardening and population persistence of S. frugiperda in cooler environments. This suggests potential of fall armyworm (FAW) to withstand considerable harsh winter environments typical of its recently invaded geographic range in sub-Saharan Africa.

Keywords

Climate change, Fall armyworm, Plasticity-tradeoff, Thermal tolerance