

Effects of thermo-photoperiod on induction and termination of hibernation in *Chilo partellus* (Swinhoe)

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Abstract

Determination of critical threshold for induction and termination of diapause (hibernation) are important for better understanding the bio-ecology and population dynamics of *Chilo partellus* (Swinhoe) under varying climatic conditions. We studied initiation and termination of hibernation under five temperature and photoperiod regimes viz., 27°C + 12L:12D, 22°C + 11.5L:12.5D, 18°C + 11L:13D, 14°C + 10.5L:13.5D and 10°C + 10L:14D under fixed and ramping treatments, and the observations were recorded on various phenological and developmental characteristics at weekly intervals. Present studies revealed that the induction of hibernation in *C. partellus* larvae takes from 46 to 56 days depending upon temperature and photoperiod conditions. Induction of hibernation varied from 7.9 to 18.3% across treatment conditions, indicating that not all *C. partellus* larvae undergo diapause under prevailing environmental conditions. Weight, length and head capsule width of diapausing larvae were found significantly lower than the non-diapausing larvae. The non-diapausing *C. partellus* larvae required a thermal threshold of 1068 degree-days under ambient conditions, while in case of hibernating larvae it varied significantly across treatment conditions. Diapausing larvae underwent up to five supernumerary moults, wherein highest percentage of diapausing larvae (35.7%) exhibited two supernumerary moults. The developmental time of diapausing larvae varied from 94.9 to 160.4 days across treatments. A population loss of 17.2–28.3% was recorded in *C. partellus* due to hibernation, which has implications for population buildup of post-hibernation first brood and management strategies.

Keywords: Abiotic factors, *Chilo partellus*, degree-days, diapause induction, diapause termination, hibernation

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Introduction

Diapause in insects has evolved as an important life history component at a particular stage, which plays a key role in controlling ecology, phenology, and physiology (Andrewartha, 1952; Xiao *et al.*, 2010). Diapause is genetically programmed physiological state of arrested metabolic activity that enables an insect to survive under predictable adverse climatic

conditions and diminishing resources needed for development, reproduction and mutagenesis (Neal *et al.*, 1997; Youcum *et al.*, 2011; Lehmann *et al.*, 2015), and synchronizes activity cycles with favorable conditions thus ensuring effective resource utilization (Tauber *et al.*, 1986; Arbab, 2014). During diapause, the insect passes through several processes such as induction, maintenance, termination and post-diapause development (Xiao *et al.*, 2010; Hodek, 2012), and undergoes several changes such as suppression of developmental and reproductive functions, accumulation of metabolic reserves, and reduced metabolic activity (Beck, 1980; Qiang *et al.*, 2012). Diapause is not always an adaptive advantage as it can also pose a threat to insects, for example, if an insect

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