

Consequences of diapause on post-diapause development, reproductive physiology and population growth of *Chilo partellus* (Swinhoe)

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Abstract. We investigate the effects of diapause on post-diapause development, reproductive physiology and population growth of *Chilo partellus* (Swinhoe) (Crambidae: Lepidoptera). Aestivating and hibernating larvae of *C. partellus* are exposed to diapause terminating conditions (consisting of an LD 12 : 12 h photocycle at $27 \pm 1^\circ\text{C}$ and $65 \pm 5\%$ relative humidity with a fresh diet) to terminate the diapause and observations are made on percentage pupation, pupal duration and weight, adult reproductive performance and population growth parameters. We find that the diapause in *C. partellus* significantly reduces the percentage pupation and weights of pupae, ultimately lowering the weight and reproductive performance of adults. Reduced weights of adult females are found to be directly associated with a lower number of egg cells in ovaries. Nevertheless, the reproductive performance of *C. partellus* males is also found to be greatly affected in the diapause (hibernation and aestivation) experiencing population in terms of the deposition of a lower number of spermatophores and eupyrene sperm in the reproductive tracts of females compared with the nondiapausing population. The results of the present study clearly indicate that a reduction in longevity, fecundity and egg viability, as well as a reduced rate of deposition of spermatophores and eupyrene sperm, in a diapause experiencing population of *C. partellus* ultimately leads to a reduction in population growth parameters, thus having implications for bio-ecology and population dynamics under a changing climatic scenario.

Key words. *Chilo partellus*, diapause development, egg viability, eupyrene sperm, fecundity, longevity.

Introduction

Diapause is a genetically programmed physiological state of arrested metabolic activity that is expressed at a particular stage of insects as a result of predictable unfavourable environmental factors (Tauber *et al.*, 1986; Dhillon *et al.*, 2017). Among these environmental factors, temperature plays an important and critical role in developmental biology, with a particular temperature range deciding the type of diapause, such as hibernation (Dhillon *et al.*, 2017) or aestivation (M. K. Dhillon, F. Hasan, A. K. Tanwar, A. P. S. Bhadauriya, unpublished data), as well as survival and its duration in insect species (Dhillon & Hasan, 2017a). In insects, diapause has evolved as an important life-history component that controls their ecology, phenology and physiology

(Andrewartha, 1952; Xiao *et al.*, 2010; Hodek, 2012). Nevertheless, it is an important approach used by many insect species to survive adverse environmental conditions (Tauber *et al.*, 1986; Hodek, 2012; Dhillon *et al.*, 2017). However, in recent decades, it has attracted attention because diapause often leads to a deteriorating effect on post-diapause development and subsequent life-history traits, such as the survival rate of adults, fecundity, progeny viability and other population growth factors in insects undergoing diapause (Ellers & van Alphen, 2002; Sadakiyo & Ishihara, 2012; Win & Ishikawa, 2015). Such effects have ecological and physiological significance in terms of a direct effect on population growth and/or an indirect effect on the diapause strategy of individuals, as a result of changes in the pattern of allocation of metabolic reserves (Sadakiyo & Ishihara, 2012). During diapause, the available metabolic reserves are very limited and diapausing individuals need to allocate an increasing amount of these metabolic reserves in the form of energy, which in turn has deleterious effects in developing

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