Survival of adults and larvae of grain beetles at lethal low temperature

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Abstract

Survival of adults and larvae of *Tribolium confusum* Jacquelin du Val., *Oryzaephilus surinamensis* (L.) and *Trogoderma granarium* (Everts) exposed to low temperature (-16ºC) was studied in the laboratory. The main effects and interactions of exposure time (0.2, 0.5, 1, 2, 4, 8, 24 and 48 h), developmental stage (larva, adult), larval age (~3, ~18 d), and adult age (~7, ~25 d), were investigated for each species (2-way ANOVA). Probit analysis was used to determine the lethal time required for 50 and 99% kill (LT_{50} and LT_{99}) of the population of each species. All experimental beetles were unacclimated and were kept at 25ºC before cold treatment. Survival differed significantly among tested species with *T. granarium* being the most cold-tolerant followed in decreasing order by *O. surinamensis* and *T. confusum*. After 4-h exposure time 100% mortality was achieved in all cases with the exception of grown larvae of *T. granarium* and *O. surinamensis,* and adults of *T. granarium* which needed 48, 8, and 24 h, respectively. Larvae were generally more cold-tolerant than adults in all species but differences were not always significant. Main effects of exposure time, developmental stage and individual's age on mortality proved to be significant for all species. Interactions between above-mentioned factors varied significantly among tested species. Our results are discussed in terms of other studies on cold tolerance in grain beetles, and analyzed on the basis of improving the efficacy of cold treatments against stored-products pests.

Keywords: *Tribolium confusum, Oryzaephilus surinamensis, Trogoderma granarium*, Survival, Low temperature