

Title Enhanced effectiveness of vacuum or CO₂ in combination with increased temperatures for control of storage insects.

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Abstract

Laboratory studies were conducted to determine the combinations that enhance the effectiveness of insect control based on vacuum or CO₂ in combination with increased temperatures as quarantine treatment of storage pests. The effects of commodity (cocoa beans) moisture content and the partial pressure of oxygen on the effectiveness of vacuum were studied. For *Tribolium castaneum*, *Ephesia cautella* [*Cadra cautella*] and *Plodia interpunctella*, the egg stage was the most resistant to low pressure: the duration required to obtain LT99 was 22, 45 and 49 h, respectively. For *Tribolium castaneum*, the larval and adult stages were the most susceptible, with an LT99 of 7 h. For *E. cautella* and *P. interpunctella*, the adult stage was the most susceptible, with LT99 of only 6 and 5 h, respectively. The evaluation of the effect of CO₂ at 45 deg C on the reduction of exposure time for diapausing larvae of *T. granarium* indicated that by increasing the CO₂ concentration to 90%, the LT99 value was reduced to approximately 10 h (LT99 value of 29 h at 35 deg C). For *E. cautella*, the larval stage was the most resistant to 90% CO₂ at 40 deg C, with an LT99 value of only 6 h. For *O. surinamensis* under the same conditions, the LT99 value was 9 h for the most resistant egg stage. A transportable flexible storage system was developed for the control of insect pests. Experiments were carried out using a 15 m³ capacity plastic container termed the "Volcani Cube" or "GrainPro Cocoon". Bioassays in field trials [location not given] at 30 deg C demonstrated that complete mortality of test insects representing all the four developmental stages of *E. cautella* and *Tribolium castaneum* was observed upon three-day exposure to vacuum maintained between 23 and 75 mm Hg.