MORTALITY OF ALL LIFE STAGES OF SAW TOOTHED GRAIN BEETLE HELD UNDER VACUUM

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Increased restrictions on potential environmental and health effects of pesticides and pesticide resistance problems led to seek alternative postharvest treatments to solve the insect problem on stored products. Thus, ecologically sound methods such as controlled atmosphere to control insect pests of stored products are needed for an integrated pest management (IPM) approach. Low-oxygen atmospheres derived from the application of vacuum to achieve low pressure have been demonstrated to be effective in the control of postharvest insect pest. Thus, present study aimed at investigating the possibility of using low pressure to control the saw toothed grain beetle, *Oryzaephilus surinamensis* (L) which is an important pest of many stored products.

The effects of low pressures at 48 and 96 mbar absolute pressures (vacuum) were studied on the mortality of all stages of *O. surinamensis* at a temperature of 25^{o}C in 600-mL, thick-walled glass empty Erlenmeyer vacuum flasks with a side arm over a range of exposure periods, ranging from 1 h to 66 h. Studies were conducted with 0-1, 1-2, 2-3 d-old eggs, larvae (15 d-old), 0-1 d-old pupae and adult (7-14 d-old) of *O. surinamensis*. Treatments were conducted by placing vials of test insects into 600-mL, thick-walled Erlenmeyer vacuum flasks with a side arm. Rubber stoppers were fitted with dial-type vacuum gauges and mounted on the flask opening. The side-arm outlet of the flask was connected to a vacuum pump (Riwak Vakum) via a Tygon vacuum hose equipped with a screw-type hose clamp. Digital manometer to monitor the pressure level was also attached to vacuum hose with side arm. The air in the flasks was evacuated with the vacuum pump to a pressure of 48 or 96 mbar. Once the target pressure was attained according to the digital manometer, the vacuum hose was clamped, and the flasks was sealed with a screw-type tube-clamp (Mbata and Phillips, 2001; Finkelman *et al.*, 2006). The vacuum level was marked with pen on the dial-type vacuum gauge mounted on the flask opening. Then, the flasks were transferred into an environmental chamber maintained at 25^{o}C for the given time periods needed for the experiments. Untreated control flasks were set up with test insects in the same way as treated flasks, but vacuum was not applied and transferred into the environmental chamber at 25^{o}C. At the end of each exposure period the vials were removed from the vacuum flasks and placed in a rearing room at a constant temperature of 25^{o}C and at 65% r.h. If the vacuum level on the dial-type vacuum gauge deviated significantly the experiment was discarded. The mortality rates at these conditions were later determined.

The effect of low pressure on the mortality of all life stages of *O. surinamensis* is shown in Figures 1 and 2. Mortality of all developmental stages of *O. surinamensis* exposed to 48 and 96 mbar occurred in a positive dose - response manner, and 100% mortality of all developmental stages was achieved within 57h.

The adult stage was the most susceptible to low pressure requiring 5 h to obtain complete mortality at 48 mbar absolute pressure . However, complete mortality of the same stage at 96-mbar vacuum was achieved within 57 h. Total mortality for larvae and pupae at 48 mbar was achieved in 24 and 26 h exposure periods, respectively. However, complete mortality of the same stages at 96-mbar was achieved in 52 h exposure period. Total mortality for 0-24, 24-48 and 48-72 h old eggs at 48 mbar was achieved in 30, 36 and 36 h exposure periods, respectively. However, total mortality of the same stages at 96-mbar was achieved in 40 h.

Time-mortality data were also subjected to probit analyses. Analysis showed that the adults were the most susceptible life stage to low pressures at 48 mbar; 95% mortality was achieved within 2.7 h. Intermediate stage eggs (1-2 d-old) were the most tolerant life stage to low pressure at 48 mbar, requiring 34.7 h exposure period to achieve 95% mortality. At 96 mbar low pressure, early stage eggs (0-1 d-old) were the most susceptible life stage; 95% mortality was achieved within 35.8 h. Larvae were the most tolerant life stage at 96 mbar, requiring 47.5 h exposure period to achieve 95% mortality. Mortality was higher at 48 mbar compared to 96 mbar vacuum for all life stages of *O. surinamensis*.

Results show that application of low pressure provides a potential non-chemical alternative to fumigants for controlling of stored product pests.

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References

Mbata, G. N., and T.W.Phillips. 2001. Effect of temperature and exposure time on mortality of stored-product insects exposed to low pressure. J. Econ. Entomol. 94: 1302-1307.

Finkelman, S., Navarro, S., Rindner, M., and R. Dias. 2006. Effect of low pressure on the survival of *Trogoderma granarium* Everts, *Lasioderma serricorne* (F.) and *Oryzaephilus surinamensis* (L.) at 30^{o}C. J. Stored Prod. Research 42: 23–30.

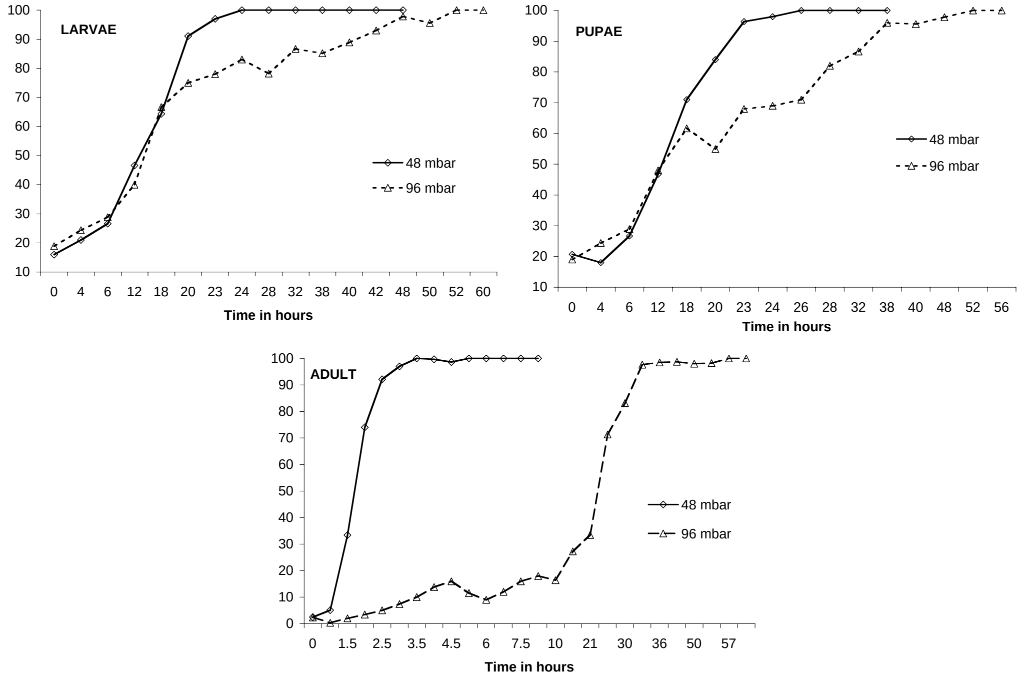

Fig. 1- Mortality of adult, larva and pupal stages of *O. surinamensis* exposed to low pressure (48 and 96 mbar) at various exposure times.

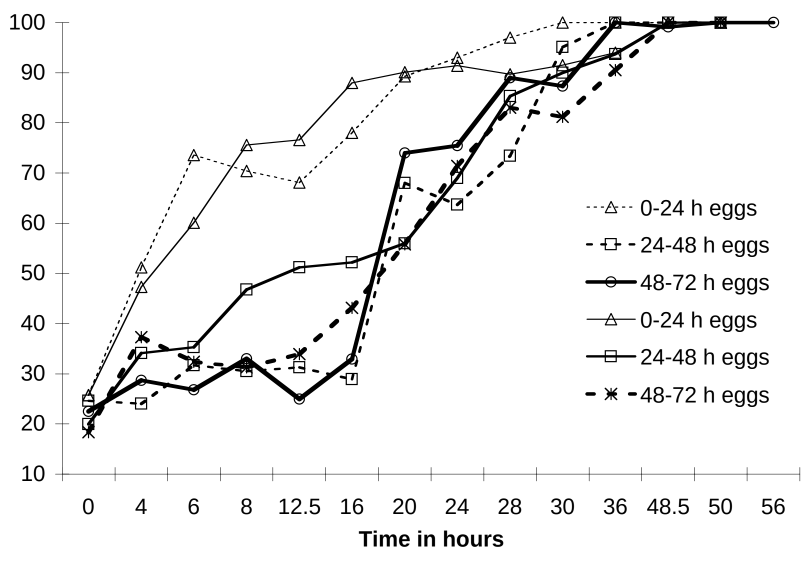

Fig. 2- Mortality of egg stage of *O. surinamensis* exposed to low pressure (48 and 96 mbar) at various exposure times.