

Exposure of *Ephestia cautella* (Wlk.) (Lepidoptera, Phycitidae) to Low Pressures: Effects on Adults

S. NAVARRO and M. CALDERON

Ministry of Agriculture, Department of Plant Protection, Stored Products Research Laboratory,
Jaffa, Israel

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Abstract—Adults of *Ephestia cautella* (Wlk.) were exposed to pressures of 100, 200, 300, 400 and 760 mm Hg at $26 \pm 1^\circ\text{C}$ and $70 \pm 5\%$ r.h., in a specially designed apparatus in which a controlled atmospheric gas composition was maintained. Adult life was shortened at all reduced pressures; at 100 mm Hg all adults died in 14 hr. Oviposition was affected at reduced pressures resulting in a significant reduction in the number of eggs laid. At 100 mm Hg oviposition was negligible. A hypothesis to explain these observations is mentioned.

INTRODUCTION

THE EFFECT of low pressure on the mortality of various stored product insects was investigated by BACK and COTTON (1925) who examined absolute pressures of 25–51 mm Hg and found that pupae and adults of all the species tested, except *Trogoderma ornatum* (Say), were killed within 24 hr. BARE (1948) studied the effects of prolonged exposure to high vacuum on stored tobacco insects. He concluded that ten days exposure to an absolute pressure of 15–65 mm Hg should control all stages of *Lasioderma serricorne* (F.). CALDERON *et al.* (1966) obtained complete mortality of adults of five stored product insect species kept at 10–20 mm Hg for 120 hr.

The present study was carried out to obtain information on the longevity and oviposition of adult *Ephestia cautella* (Wlk.) kept at pressures between 100–400 mm Hg. This serious pest of stored products is frequently found in packaged food, for which the use of low pressures is a feasible alternative to toxic chemicals for insect control.

MATERIALS AND METHODS

Apparatus for maintenance of constant low pressures, in the test chambers

A special apparatus was devised, consisting of an evacuated reservoir connected to the test chamber (100 ml Erlenmeyer flasks) by a valve system that regulates the pressure and air flow in the chambers (NAVARRO and DONAHAYE, 1972). The inlet airflow rate, ranging from 5 to 10 ml/min permits the maintenance of a constant atmospheric gas composition, which is identical to that of the ambient air. This was

checked by taking air samples from the test chambers using a syringe. The samples were then restored to atmospheric pressure through a valve system and their composition was analysed by gas chromatography using a thermal conductivity detector.

The chosen low pressures in the test chambers were regularly read by connecting the system to a dial vacuum gauge manometer which was frequently checked against a closed arm mercury manometer. The whole system was kept under constant conditions of temperature and humidity of $26 \pm 1^\circ\text{C}$ and $70 \pm 5\%$ r.h. respectively.

Test insects

Adult *E. cautella* were obtained from mass cultures reared in ground whole wheat mixed with 12.5% glycerine (NAVARRO and GONEN, 1970). The temperature and the r.h. in the insect culture room were $26 \pm 1^\circ\text{C}$ and $70 \pm 5\%$ r.h. respectively.

Virgin adults aged 0–24 hr were obtained from insects sexed in the last larval stage. This was rendered possible by the clear presence of dark testes in the male larvae. After sexing, the larvae were kept isolated until adult emergence (NAVARRO and GONEN, 1970). Groups of 10 insects (5 males and 5 females) were exposed to low pressures in the test chambers. The floor of the test chamber was covered by an even layer of 1 g of flour previously sieved (80 mesh).

Experimental procedure

Each group of 10 test insects was exposed to either 100, 200, 300 or 400 mm Hg or was kept as a control at 760 mm Hg. From 4 to 18 replicates were exposed for either 2, 4, 6, 8, 10, 12, 14, 16, 24, 48, 72, 96, 120 or 144 hr as appropriate. After each exposure the number of surviving insects and the number of eggs laid were recorded. The longevity and oviposition curves were drawn using average values compiled from the results of the above mentioned exposure times.

RESULTS

Effect on longevity

Longevities at different pressures are expressed in Fig. 1. Adults exposed to 100 mm Hg are dead within a day. The length of adult life increases as the pressures increase but even at 400 mm Hg longevity was less than that of insects kept under atmospheric pressure.

Effect on oviposition

The numbers of eggs laid daily by the *E. cautella* adults are shown in Fig. 2. Adults exposed to 400 mm Hg pressure laid fewer eggs than those kept at normal pressure. The number laid fell with pressure until at 100 mm Hg it was negligible.

DISCUSSION

To the best of our knowledge, oviposition of insects exposed to low pressures has not previously been investigated. The values obtained on this work show that oviposition of *E. cautella* kept at 400 mm Hg is sub-normal, and the lower the pressure at which the moths are kept, the smaller the number of eggs laid. The reason for this may be the early death of adults at lower pressures.

BACK and COTTON (1925), BARE (1948) and CALDERON *et al.* (1966), all found that pressures below 100 mm Hg were rapidly lethal to adult stages of various species

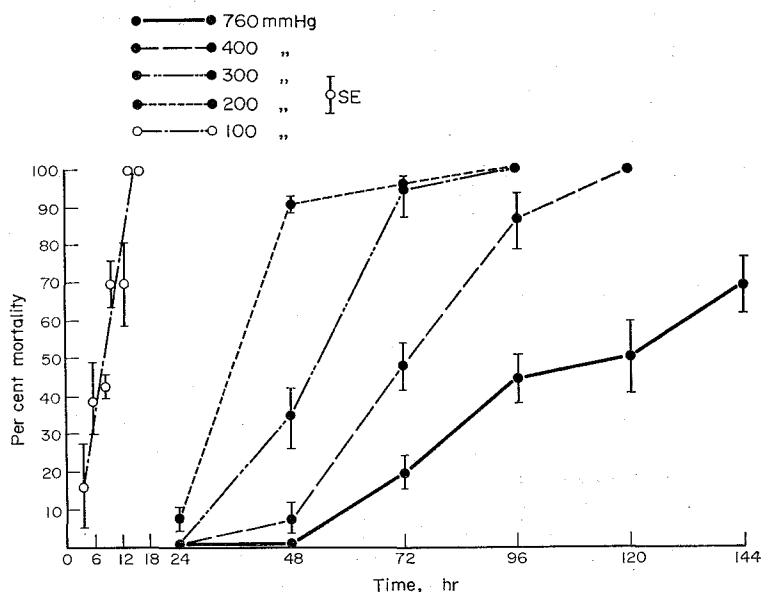


FIG. 1. Longevity of *Ephestia cautella* adults exposed to different low pressures.

tested. In the present work the significant effect of different pressures above 100 mm Hg on the reduction of adult longevity is clearly shown. LIVINGSTONE and READ (1940), attributed the detrimental effect of low pressures on *Ephestia elutella* (Hbn.) and *Lasioderma serricornis* (F.) to loss of water. Since BURGESS and HASKINS (1965) showed that at normal atmospheric pressure low humidity halved the length of adult life of *E. cautella* at 30°C. Water loss may provide a reasonable explanation for the reduction in longevity of *E. cautella* adults at low pressures.

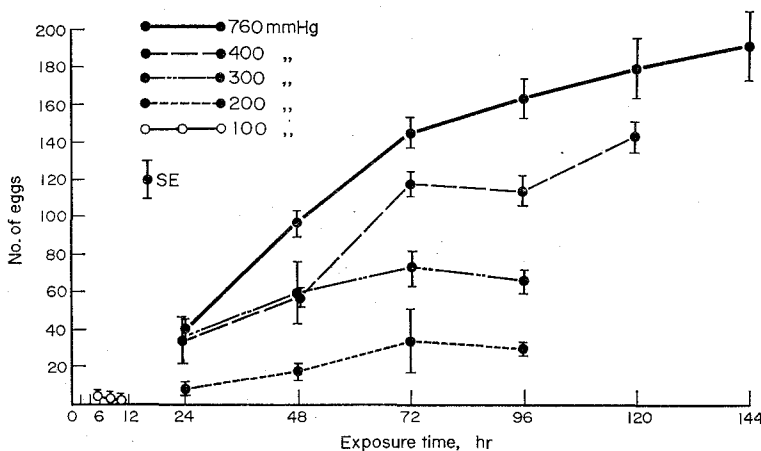


FIG. 2. Oviposition of *Ephestia cautella* exposed to different pressures.

The levels of low pressure used in this work are easily obtainable in the food packaging industry. The results show that it is feasible to use low pressures for insect control in packaged foodstuffs.

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