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CONTROL OF BROWN-LEGGED MITE ADULTS USING NITROGEN ATMOSPHERE

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ABSTRACT

Aleuroglyphus ovatus has a worldwide distribution and is a common pest of various stored products. Modified atmosphere may be nont-toxic option for control of the mites in value added products; such as seeds, spices and dry/dried fruits. However, there is few published information on the efficacy of modified atmosphere on mites and there is no information on *Aleuroglyphus sp.* Therefore this study brings the first report on efficacy of modified atmospheres (N_2) on Brown-legged mite (*Aleuroglyphus ovatus*). We tested the efficacy of modified 100% gaseous nitrogen atmospheres on mite adults' survival. We found that 100% nitrogen caused 100% imago mortality after 33 hours; LT_{50} =8.88 (8.18-9.53) and LT_{90}= 21.62 (20.04-23.61). The results were obtained due to support of research grant (QI101B088) provided by Ministry of the Czech Republic.

Key words: nitrogen, N_2, atmosphere, stores, mites, *Aleuroglyphus ovatus*

INTRODUCTION

Brown-legged mite, *Aleuroglyphus ovatus* (Troupeau, 1878) is a small acaroid mite (Hughes, 1976; Kucerova and Stejskal, 2009). *A. ovatus* has a worldwide distribution and is a common pest of various stored products such as grain products, seeds, stored wheat and barley (Athanassiou et al., 2005; Stejskal and Hubert, 2008; Hubert et al., 2009). When optimal temperatures are reached (Xin and Shen, 1964; Yan et al., 1992), *A. ovatus* has capacity for rapid reproduction and population increase (Aspaly et al., 2007; Xia et al., 2009). Elevated populations of storage mites negatively influence the quality of stored commodities by disseminating moulds (Hubert et al., 2004), causing allergenic reactions (Fernandez-Caldas et al., 2000; Stejskal and Hubert, 2008) or leads to pulmonary and urinary acariasis (Xia et al., 2009). Effective control of storage mites is not easy. Although structure of *A. ovatus* pheromone is identified (Shibata, et al., 1998), no monitoring product is commercially available. Mite populations are generally difficult to suppress by residual pesticides (Collins, 2006; Nayak, 2006; Hubert et al., 2007) or fumigants such as methyl bromide or phosphine (Bowley and Bell, 1981; Şen et al., 2009). In addition, usage of toxic insecticides is associated with medical risks, occurrence of pesticide residues in food or with interaction with construction materials in the treated building. The non-chemical alternatives to pesticides are modified atmospheres for control of pests (Emekci et al., 2004; Navarro, 2006). Because of the limited information on efficacy of modified atmospheres on mites

(Navarro et al., 1985; LungShu et al, 1998; Navarro, 2006) we have explored the laboratory efficacy of N_2 atmosphere on adults of *A. ovatus.*

MATERIALS AND METHODS

Mites

The specimens of Brown-legged mite, *Aleuroglyphus ovatus* (Troupeau, 1878) were taken from the cultures kept at the Crop Research Institute, Prague; the culture originated from the Central Science Laboratory Sand Hutton (York, UK). The mites were mass-reared in frit-chambers plugged with rubber. The rubber was pierced with a steal tube (5 mm diameter). Both ends of the glass tube were covered with muslin. The rearing diet (100 g) consisted of 44 g oat flakes, 44 g wheat germ, 12 g yeast. The frits were placed into Secador desiccators (P-Lab, Praha, Czech R.) and kept at 85% RH and 25°C in darkness. Before the experiment, adults were collected with a fine brush from the surface of the rubber or the sides of the frit and counted under a Stemi 2000-C dissection-microscope.

Testing apparatus and experimental procedure

We tested *A. ovatus* in a N_2 apparatus that was composed from 10 small plastic boxes (Lock&Lock HPL834, 3900ml) serially connected by plastic hoses (PVC, transparent, diameter 6/9mm, Deutsch & Neumann GmbH). Nitrogen atmosphere (100 % N_2 –5.0, purity (% obj.): ≥ 99,999) was delivered from the pressured metal cylinder (Linde Gas a.s.) using outlet valve C200/2B-3SS (Linde Gas a.s.). We checked oxygen content using oxygen sensor GMH 3691 (Greisinger electronic GmbH). Each plastic box (in 10 repetitions) contained 50 specimens of experimental mites in vials. We maintained 75% r.h. of air by saturated solution of NaCl in each plastic box. We measured the temperature and humidity by data loggers (TinyTag Ultra 2, Gemini Data Loggers Ltd., UK). Nitrogen exposure times were: 1 - 36 h. After exposure we placed the treated mites in chambers maintained at 75% r.h. and 27°C. Mortality check was executed 24 h after MA-exposure termination. Results were analyzed by logistic regression mortality model ($\chi 2$ – test) for LT_{50} and LT_{90} using statistic program XLSTAT.

RESULTS AND DISCUSSION

Fig. 1 shows the obtained statistical model describing dependence of *A. ovatus* mortality on exposure time by 100% nitrogen atmosphere (75% r.h. and 27°C). We estimated lethal time parameters as follows: LT_{50} =8.88 (8.18-9.53) and LT_{90}= 21.62 (20.04-23.6). We found that 100% nitrogen atmosphere caused 100% imago mortality after 33 hours. Since our study is the first report showing an acaricidal effect of N_2 on *A. ovatus*, we cannot directly compare our results with data obtained by other MA- scientists. On the basis of the results presented here, the tested nitrogen atmosphere could be potential candidates in the control of the *A. ovatus* in food and feed commodities.

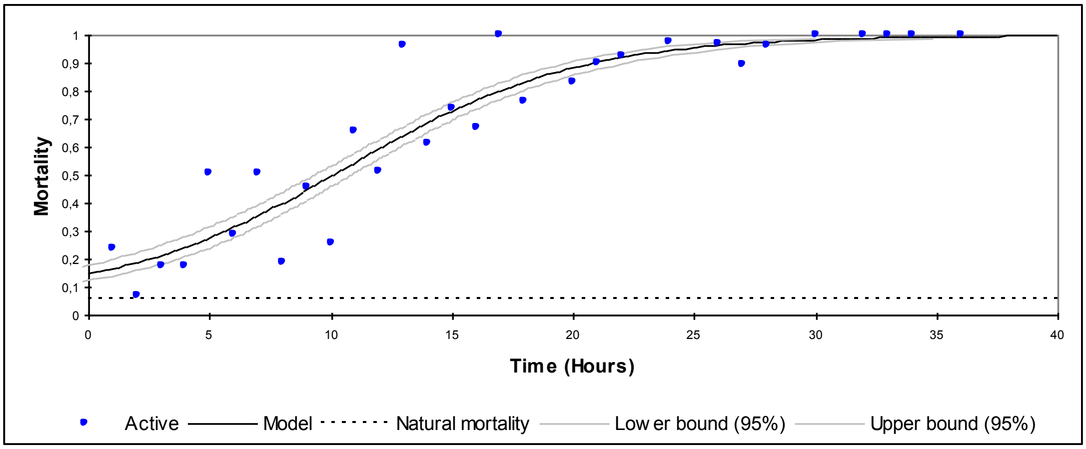

Fig. 1- Mortality of *Aleuroglyphus ovatus* (model parameters, n=10, Intercept±SE-3.33±0.23; Slope±SE 3.43±0.2, Lethal time (h), LT_{50} (95% CL) 8.88 (8.18-9.53); LT_{90} (95% CL) 20.04 (20.04-23.61); $\chi 2 = 619.1$, df 1; P <0.0001)

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