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THE INFLUENCE OF TEMPERATURE AND HUMIDITY ON THE BIOLOGY OF THE HOUSE DUST MITE *DERMATOPHAGOIDES PTERONYSSINUS* TROUESSART 1897 (ACARI : PYROGLYPHIDAE)

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ABSTRACT

Duration of each developmental stage of the house dust mite *Dermatophagoides pteronyssinus* together with the mortality percentage were observed at a combination of five different temperatures namely 20C, 22.5C, 25C, 27.5C and 30C and four different humidities namely 55%, 75%, 85% and 95% r. h.

Results showed that temperature had the greatest effect on the life cycle period. The higher the temperature the shorter the life cycle was aid versa verea. On the other hand, humidity seems to be less effectiveness, though at the higher temperature and humidity no development was occured.

Mortality among all temperatures and humidities appeared nearly the same, but at higher temperature and higher humidity and because of mould growth high mortality occured. High mortality occured at either the egg or larval stage, protonymph and tritonymph had low mortality percentage.

All data were discussed statically to show the significant differences if present.

INTRODUCTION

The house dust mite *Dermatophagoides pteronyssinus* is the most important source of allergy (Spieksma, 1967; Bronswijk and Sinba, 1971). Determination of this mite intensity of infestation is measured successfully by microclimate habitat, this led many workers to study the effects of different combinations of temperatures and humidities (Spieksma, 1967, Koekkoek and Bronswijk, 1972; Murton and Madden, 1977). All above authors, however, have dealt with the biology of the mite within limited conditions. The present work deals with the life cycle of this mite at a wider range of temperatures and humidities.

MATERIALS AND METHODS

Mites for this studies were provided by Dr. Dobson of Glasgow University. On assival they were kept in a felting filter paper inside 3 X I inch glass tube with adequate food which was a mixture of a washed human scales and a yeast powder in a ratio of 9 : 1 respectively. The mites were then kept under a conditions of 25C and 75% r.h. this being an ideal conditions for breeding.

For making observation quite convenient under dissecting microscope, inodified Robertson cells (Small and large) used by Solomen and Cunnington (1964) were used. The cell is made of a black rectangular perspex measuring 6 X 4.5 cm with tapering hole in its center. A black filter paper was fixed to the back of the rectangular, the lid of the cell was a glass slipheid in place by clip. As many as four cells could be kept in 2 liters jar with a glass rods supported by a rubber-bung which had been boiled to remove any volatile toxic substance. A saturated solution of organic salts namely Mg NO3, Na C1, K C1 and Ca HPO 4 for 55% 75%, 85% and 95%r.h. respectively, was poured in the jar for providing the requested humidity.

In experiment, males and females were transferred from the stock culture to the larger type of cell, provided with a little food and kept at a required temperature and humidity, eggs laid by females were transferred singly using a camel hair brush No. 00, into a smaller cell containing a small amount of preconditioned food then kept at the required conditions. Twenty eggs were observed at each temerature and humidity. Cbservation was made daily throughout the life cycle, and the old skin was removed whenever noticed.

RESULTS

Data for all stages of the house dust mite at different temperatures and humidities, together with the percentage mortality are summarizd on table 1. Fig. 1 shows the isopleth for the developmental period (egg—adult) and over all mortality.

Egg : The egg is laid singly by the female it is elongated and spindly has a white-milky colour for the first two days and with approximate length of 166um and a width of 65um, the shell is soft for first six hours then becomes tough.

From the table, it is clear that the incubation period was shorter at the higher temperature, for instant, the mean incubation period at 20C and 27.5C and 55% r.h. were 11.00 and 3.58 days respectively. On the other hand, the effect of humidity was very small, at 25C and 55% and 95% r.h. for example, the mean incubation periods were 5.41 and 4.91 days respectively. Two way analysis of varience gives the highly significant differences between temperatures and humidities (P 0.001).

Mortality is greater at the lower temperature and higher humidity. At 25C and 75% r.h. mortality is the lowest.

Larva : The newly emerged larva is very active and senstive to light and temerature, it is contioneously moving around the cell, a cross the floor, and sides, it is yelowish white and has three pairs of legs, as moulting approches the body swells and setae and legs become exitened longitudinally.

The performance appeared on the egg developmental stage is repeated here too, the higher the temperature the shorter the developmental period, also the humidity non effectiveness is clear here. Mortality at this stage was lower than at the egg stage, particularly at lower temperature, but at higher humidity it was higher.

Nymph : The nymphal stage is very easily distinguished from the larval stage by having four pairs of legs, while larva has three. There are two nymphal stages, the protonymph and deutonymph, the former one having one pair of genital sucker, whereas the deutonyhph has two pairs.

As in the larval stage, nymphal stage is much effected by temperature, as the temperature increased nymphal stage become shorter. The two stages took approdimatelly the some period for development though protonymph was lightly shorter. Mortality was much less than that at the egg and larval stages.

Adult : Nymphal stage ending with adult, male and female are readily distinguishable, the male has a smaller body, its fourth pair of legs is shorter than the third one, and the penis lays between the third and fourth pairs of legs. Female has larger body, the bursa copulatrix open posterior-Venterally. Mating takes place two days after emergence, and the first egg is laid two to three days after mating.

Performance of overall development (egg-adult) is shown in Fig. 1. It is quite clear that the best environmental conditions for development in which the period was the shorter the mortality was the lower; are the temperatures between 25C—30C at all levels of humidity with the exception of 95% r. h.

DISCUSSION

The performance appeared by the effect of temperature on the life cycle of this mite is not surprise, since Entomologist (Howe, 1960; Hassan, 1983 and othes) confirmed this phenomenon on the life cycle of the insects. Wigglesworth (1965) concluded that temperature has a direct effect on the hormon secretion that controls the growth. The effectiveness was greater at the early stages then at the pre-adult stages of this mite, this was probably due to the growth proccess which is at its peak in the early stage, thus any change on that environmental condition may effect the embryo. This may explain also the fact that the egg stage had the highest mortality and the longest developmental period.

On the other hand, effect of humidity was much less than the temperature, development occured at all levels though at 85% and 95% r.h. number of individual obtained was very small when compared with other humidities, the reason was the mould growth at higher humidities.

The little differences which may noticed between the present studies and the previous ones are either due to food or environmental conditions. Spieksma (1968) found that acetone-washed human scale and yeast in a ratio of 3 : 2 respectively was the most satisfactory food for this mites.

The temperature and humidity fluctuation reported by many workers may be due to use of different incubators for obtaining the requested temperatures, and use of different ways of solution preperation for requested humidities, also studied under uncontrolled conditions, all these definitely effect on the development pattern.

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تأثير درجات الحرارة والرطوبة على حياتية حلم غبار المنازل

Dermatephagoides pteronyssinus Trouessart, 1897 (Acari: Pyroglyphidae)

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الخلاصة

درست فترة الحضانة ونسبة الوفيات لكل طور من أطوار حلم غبار المنازل *D. Pteronyssinus* تحت خمس درجات حرارية هي (٢٠م ، ٢٢٫٥ ، ٢٥°م ، ٢٧٫٥م و ٣٠م) وأربع رطوبات نسبية هي (٥٥٪ ، ٧٥٪ ، ٨٥٪ ، ٩٥٪) .

لقد بينت النتائج ان لدرجة الحرارة الاثر الكبير على فترة الحضانة وعلى دورة الحياة ، فكلما ارتفعت الحرارة قصر الزمن اللازم لاكمال الطور والعكس صحيح ومن ناحية اخرى فان الرطوبة النسبية تبدو أقل تأثير من درجة الحرارة ولو أن في درجات الحرارة العالية والرطوبة العالية ايضا لم يحدث أي تطور .

نسبة الوفيات ما بين درجات الحرارة والرطوبة تبدو متشابهة ، ولو ان في درجات الحرارة العالية والرطوبة العالية ونمو الفطريات كانت نسبة الوفيات عالية . ان نسبة الوفيات في الطورين البيضي واليرقي اكبر مما حدث في الطور الحوري .

جميع النتائج حللت احصائيا وظهرت النتائج ان فترات الحضانة ما بين افراد الحلم تختلف اختلافاً معنوياً اذا ما أخذت الحرارة والرطوبة كل على انفراد ، أما ما بين الحرارة والرطوبة مجتمعة فهي غير معنوية .

Fig. 1. An sopleth represented egg-adult development of the house dust mite. The bold lines delimited the region at which the mean development does not excessed the indicated number of days. Environmental conditions are represented by dots. Mortality percentages are showed by the shading area.