Development of *Cheyletus eruditus* (Schrank) (Acarina: Cheyletidae) at Low Temperature*

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Abstract

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Development of the predatory mite *C. eruditus* was examined at 12, 14 and 25 °C and 75% r.h. 12 °C is the low temperature threshold for development of this species where development lasts 164 days, compared with 47 days of its prey *Acarus siro* under the same conditions. Since repressive biological control cannot be successful under those circumstances, the predators can only be used preventively in empty stores.

Key words: *Cheyletus eruditus*; biological control; development; low temperature

C. eruditus is a predatory mite which is commonly used in stored grain and seed for control of acaroid mites in so-called biological control. It can be used preventively (ŽĎÁRKOVÁ, HORÁK 1990) in empty stores as well as repressively (PULPÁN, VERNER 1965) in full stores, i.e. brick stores and silos. A weakness of this form of biological control is the development of *Cheyletus* which is a rather thermophilic mite compared to its prey, the acaroid mites which can multiply even at 2–3 °C. The temperature of stored grain and seed is low, especially in spring when it would be around 10 °C. It was, therefore, necessary to find out whether the biological control could be carried out successfully at such a low temperature, in other words, whether *Cheyletus* can multiply under those conditions and how fast.

MATERIAL AND METHODS

One hundred young females of the predator were kept separately with their food (*A. siro*) at 12 °C and 75% r.h. in vials (10 mm diam., 50 mm long). Ninety percent of them died during six months. Those which survived and reproduced have been mass reared since 1990 until December 1998 under the same conditions. The predators are kept in square-bottom paper bags of 1 kg capacity on 100 g of lettuce seed with its prey *A. siro.* (ŽĎÁRKOVÁ 1986). Once in three or four months, the dust containing predators as well as prey is sifted out of the lettuce seed. The dust is released into small bags (50 × 50 mm) made from nylon mesh at least 0,5 mm and put back on top of the lettuce seed into rearing paper bags. Mites leave the dust through the nylon mesh to return to the rearing medium. This is necessary because the predators multiply much better in substrates without dust (personal experience).

In development experiments different developmental stages of the predator were individually selected from the rearing bags and put into rearing cells (a hole of 10 mm diam. drilled into plexi glass 50 × 20 × 3 mm) together with their prey *A. siro.* The different stages of the predator were: 10 eggs per cell (20 cells), females with 5 eggs each (30 cells), young females without eggs (150 cells), tritonymphs (200 cells). The cells were checked twice a week and changes in development of the predators were recorded. The experiments were carried out at 12, 14 and 25 °C and 75 % r.h. and the data obtained were statistically evaluated. The temperature of 25 °C was used as a control, as it is considered optimal for development of *C. eruditus.*

RESULTS AND DISCUSSION

Even though the predators could reproduce at the low temperature of 12 °C, the time necessary to complete the life cycle was still very long at 164 days (Table 1). Mortality was extremely high, almost 90%; from the 400 cells which were established, 47 developmental stages were obtained. When only *Cheyletus* eggs were put into a cell together with mobile stages of *Acarus* as prey, the latter ate the eggs and barely any hatched. From 200 eggs only

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Tab. 1. Duration of developmental stages of *C. eruditus* under different temperatures (Mean ± SD) in days (N in parenthesis)

Temp. [°C]	Eggs	Larva	Protonymphs	Deutonymphs	Preoviposition period	Total
12	27.1 ± 7.5 (7)	33.1 ± 6.1 (17)	43 ± 5.1 (10)	33.4 ± 9.5 (8)	27.4 ± 5.7 (5)	164 ± 6.8
14	14.2 ± 3.4 (12)	15.7 ± 3.6 (10)	16.4 ± 4.8 (7)	15.7 ± 4.5 (13)	13.8 ± 4.9 (7)	75.8 ± 4.2
14*	16.3 ± 0.9 (7)	–	–	–	–	–
18.5*	7.8 ± 0.9 (21)	9.2 ± 2.4 (15)	8.6 ± 2.9 (23)	8.2 ± 1.5 (21)	7.0 ± 1.3 (29)	40.8 ± 1.8
22*	4.6 ± 0.7 (29)	7.5 ± 2.4 (16)	6.1 ± 1.5 (14)	6.0 ± 2.4 (13)	5.3 ± 1.5 (18)	29.5 ± 1.7
25*	3.3 ± 0.5 (52)	3.5 ± 0.8 (24)	4.5 ± 1.5 (18)	4.1 ± 1.2 (21)	3.0 ± 0.6 (24)	18.4 ± 0.9
25	3.3 ± 0.8 (11)	3.4 ± 0.6 (21)	3.7 ± 0.5 (20)	4.0 ± 1.0 (12)	3.2 ± 0.8 (16)	17.6 ± 0.7

*Results of BARKER (1991)

three larvae were obtained. When a female was present, more of the eggs developed into larvae; out of 150 eggs 22 larvae developed. At 25 °C, the eggs developed into larvae even without females. It may be that parental care, which is known for *C. eruditus,* is important under critical conditions such as temperature. When tritonymphs or young females were put separately into rearing cells with their prey *A. siro*, development continued.

The developmental experiments were carried on for 5 years in the hope that the mites would get acclimatised to low temperature and thus shorten their development eventually. This did not happen. However, BOCZEK (1959) stated that *C. eruditus* reared at 9.4 °C, 85% r.h., and at 10.6 °C, 70% r.h., has a total developmental time from oviposition to emergence of adults of 84 and 82 days, respectively. We are sceptical about these data, considering also the fact that even at 14 °C BARKER (1991) did not observe any development. The present experiments succeeded because a strain of *C. eruditus* reared at 12 °C, 75% r.h., for 8 years was used. The time for development in the 14 °C experiment was the same as in BOCZEK (1959), i.e. 62 days. There is a difference in length of development of more than 10 days between the temperatures of 22 and 25 °C. It is clear that repressive biological control at the temperature of 12 °C can not be successful because the development of the prey *A. siro* takes 47 days (our unpublished results) compared to 164 days of *Cheyletus.* The developmental curves of both species (Fig. 1) meet at a relatively high temperature of 25 °C, at which the development of both species lasts the same number of days. Furthermore, a female of *C. eruditus* lays 70–90 eggs (BOCZEK 1959) during her life span, whereas a female of *A. siro* lays 230 eggs on average (BOCZEK 1957). From these data alone it would seem that biological control can hardly be successful at any temperature. However, from laboratory and field experiments we know that

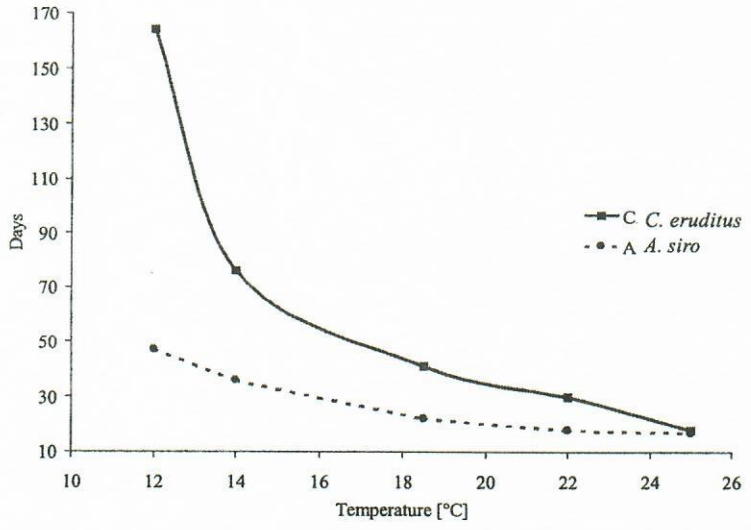

Fig. 1. Development (total days) of *C. eruditus* and *A. siro* at different temperatures

repressive biological control is successful not only on grain but also on oilseeds. There must be other factors, such as the predator's activity, feeding behaviour, natural mortality of the prey etc. which influence the results. But at low temperatures, below 15 °C, we can recommend this organism only for preventive biological control i.e. in empty stores.

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ŽDARKOVÁ E., HORÁK P. (1999): **Vývoj** *Cheyletus eruditus* (Schrank) (Acarina: Cheyletidae) **při nízkých teplotách.** Pl. Protect. Sci., **35**: 14–16.

Vývoj dravého roztoče *Cheyletus eruditus* byl studován při teplotách 12, 14 a 25 °C a 75% relativní vlhkosti vzduchu. Teplota 12 °C je spodní hranicí pro vývoj tohoto druhu, který trvá 164 dní, zatímco vývoj jeho kořisti *Acarus siro* trvá při stejných podmínkách 47 dní. *C. eruditus* se používá jako predátor pro biologický boj proti škodlivým roztočům ve skladech obilí a osiv. Při teplotách pod 15 °C je možné provádět biologický boj pouze preventivně v prázdných skladech.

Klíčová slova: *Cheyletus eruditus*; biologická kontrola; vývoj; nízké teploty

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