Research Note

Effect of exposure to short-day photoperiods on the host-feeding activity of *Ixodes persulcatus* Schulze nymphs (Acari: Ixodidae) reared in a long-day photoperiod before and after molting

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Abstract: In order to clarify whether or not *Ixodes persulcatus* Schulze nymphs reared in a long-day photoperiod before and after molting enter behavioural diapause by exposure to short-day photoperiods, their feeding activity was observed using mice at 24°C under four photoperiodic conditions (16L–8D, 12L–12D, 11L–13D, and 10L–14D). The percentage of engorged nymphs reared at 24°C under a 16L–8D photoperiod before and after molting was very high (74%) when they were kept under the same conditions 7–8 months after molting. However, the engorgement percentage of the nymphs became lower as the exposed day-length shortened. These results suggest that the nymphs reared in a long-day photoperiod before and after molting enter behavioural diapause by exposure to short-day photoperiods. Judging from the percentage of engorgement, however, the proportion of occurrence in the behavioural diapause appears to be low. The low occurrence of behavioural diapause may be due to the age of the nymphs.

INTRODUCTION

Ticks enter diapause to synchronize the different stages of their development with seasonal changes in the climate (Belozero, 1982). Fujimoto (1993) reported that *Ixodes persulcatus* Schulze nymphs entered behavioural diapause by exposure to a short-day photoperiod (10L–14D) from the engorged larval stage. This suggests that the nymphs enter behavioural diapause in the short days of autumn. However, the larvae which are the preceding instar of the nymphs are found on vegetation from spring to summer, in addition to autumn (Uchikawa, 1993). Therefore, some of the nymphs develop in the long days of spring to summer, and are subsequently exposed to the short days of autumn. In this study,

I clarify whether or not *I. persulcatus* nymphs reared in a long-day photoperiod before and after molting enter behavioural diapause by exposure to short-day photoperiods. This information would be helpful to better understand the seasonal activity of *I. persulcatus* nymphs.

MATERIALS AND METHODS

Ixodes persulcatus adults were collected in the Chichibu Mountains of Yamanashi Prefecture using the flagging method. The adults were fed on the ears of domestic rabbits maintained in the laboratory at 24°C under a 16L–8D (16 hr light/8 hr dark) photoperiod. The detached females were placed in Petri dishes (4.5 cm in diameter) with wet filter papers on the bottom and kept in the same laboratory as

above. The eggs deposited by the females were placed in Petri dishes and incubated at 24°C under a 16L-8D photoperiod. The larvae that were hatched from these eggs were fed on mice in the same laboratory as above. The detached engorged larvae were placed in Petri dishes and reared at 24°C under a 16L-8D photoperiod. The nymphs that molted from the engorged larvae were kept for 7-8 months at 24°C under a 16L-8D photoperiod, and subsequently transferred into four photoperiodic conditions (16L-8D, 12L-12D, 11L-13D, and 10L-14D groups). The transferred nymphs were kept for 30-40 days at 24°C under each photoperiodic condition and were used in this study. Each of the four photoperiodic groups of nymphs was placed on the heads of mice with an infestation density of 20 per mouse, which were kept in incubators that were maintained at 24°C under each photoperiodic condition. The mice were confined in small cages (food cages for mice) for about 8 hrs after infestation and then they were set free. Five mice were used for each group. The number of engorged nymphs was counted for each group, and the rate of engorgement was calculated as an index of the host-feeding activity. Observations ended 7 days after infestation.

RESULTS AND DISCUSSION

Table 1 shows the percentages of engorgement of *I. persulcatus* nymphs exposed to four photoperiods 7-8 months

after molting. In the 16L-8D and 12L-12 D photoperiod groups, the mean percentages for engorgement of nymphs were very high at 74.0 and 68.0, respectively. However, the percentage of engorgement of the nymphs was reduced to 59.0% when they were transferred to an 11L-13 D photoperiod. Furthermore, the percentage of engorgement was reduced to 52.0% at a 10L-14D photoperiod. There were significant differences in the percentages of engorgement of nymphs between 16L-8D and 11L-13D ($X^2=5.03$, $0.02 < P < 0.05$) or between 16L-8D and 10L-14D ($X^2=10.38$, $0.001 < P < 0.01$). These results suggest that the nymphs reared in a long-day photoperiod (16L-8D) before and after molting enter behavioural diapause by exposure to short-day photoperiods. However, the percentage of engorgement of the nymphs was more than 50%, even at a 10 L-14D photoperiod. Thus, the proportional occurrence of behavioural diapause appears to be low in the nymphs exposed to short-day photoperiods. According to Belozarov (1982), unfed ticks retain their sensitivity to day length for a long period while awaiting a host. However, increasing age leads to a weakening of the photoperiodic induction and maintenance of tick diapause (Belozarov, 1982). In other words, the photoperiodic sensitivity of ticks weakens with the lapse of time after molting. In this study, the nymphs were transferred to short-day photoperiods 7-8 months after molting. Thus, the low occurrence of behavioural diapause may be

Table 1. Percentage of engorgement of *I. persulcatus* nymphs exposed to four photoperiodic conditions 7-8 months after molting.

Photoperiodic conditions (hr)	No. of mice used	Total no. of nymphs used	Mean % engorgement
10L-14D	5	100	52.0
11L-13D	5	100	59.0
12L-12D	5	100	68.0
16-8D	5	100	74.0

The nymphs used in this experiment were reared at 24°C under a 16L-8D photoperiod from egg to molting to the nymphal stage. The rearing nymphs were kept for 7-8 months under the same rearing conditions, and then exposed to four photoperiodic conditions (24°C) for 30-40 days.

due to the age of the nymphs.

Uchikawa (1993) reported that *I. persulcatus* nymphs were collected on floor vegetation in autumn, although the number collected was few. These few nymphs may be aged ticks which have lived for a long period after molting. Hereafter, it will be necessary to clarify the effects of age on the photoperiodic sensitivity of *I. persulcatus* nymphs.

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