Research Note

The host-feeding activity of *Haemaphysalis longicornis* nymphs (Acari: Ixodidae) in autumn observed under experimental conditions

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Abstract: The feeding activity of *Haemaphysalis longicornis* nymphs that were reared at 24°C under a 16L–8D photoperiod from egg to engorged larva and then placed outdoors was observed under laboratory conditions (24°C, 16L–8D). The rate of engorgement of the nymphs fed on rabbits was high in October (about one month after molting) but decreased from November (about two months after molting). The rate of engorgement of the nymphs that were reared in the laboratory (24 °C, 16L–8D) from egg to unfed nymph was high from October through December. These results suggest that behavioural diapause, which is induced by the short days of autumn, occurs in *H. longicornis* nymphs that have been placed outdoors. However, the rate of engorgement of the nymphs was more than 20% even in December. Thus, the proportion of the nymphs which enter diapause in autumn appears to be low.

INTRODUCTION

The adult *Haemaphysalis longicornis* Neumann entered behavioural diapause in the short days of autumn (Fujimoto, 1999a, b). This behavioural diapause fully explains the disappearance of the adults in autumn. On the other hand, it seems that the behavioural diapause of autumn does not occur in the nymphs, because they are observed on vegetation or hosts from spring to autumn (Namba, 1958; Chikaki, 1976; Shiraishi *et al.*, 1989; Kakuda *et al.*, 1990). However, the host-feeding activity of the nymphs was suppressed by exposure to a short-day photoperiod (10L–14D) during the stages from egg to unfed nymph (Fujimoto, 1995). This may suggest that behavioural diapause occurs in the nymphs as a result of exposure to a short-

day photoperiod. The objective of this study is to clarify whether *H. longicornis* nymphs enter behavioural diapause in the short days of autumn or not.

MATERIALS AND METHODS

Ticks. Adult ticks were collected by the flagging method in the Chichibu Mountains of Saitama Prefecture and were fed on the ears of domestic rabbits that were maintained in a laboratory at 24°C under a 16L–8D (16 hr light/8 hr dark) photoperiod. The engorged females were placed in Petri dishes (4.5 cm in diameter) with wet filter papers on the bottom, and were kept in the same laboratory as above. The eggs deposited by these females were collected daily in Petri dishes and were kept in the laboratory. The larvae that hatched from these eggs were fed on domestic rabbits in

the laboratory. The engorged larvae (detached on August 26) were kept in Petri dishes and divided into two groups. One group was placed outdoors (Saitama Medical School campus) where the ticks were not directly exposed to sunlight or rain. The other group was kept in the laboratory (24°C, 16L–8D photoperiod). The nymphs of each group (molted in mid-September) were used in this study.

Host-feeding activity. The feeding activity of nymphs was observed on the ears of domestic rabbits. The feeding experiments were conducted on October 12 (about one month after they had molted), November 5 or 9 (about two months), and on December 3 or 8 (about three months). Each group of nymphs was allowed to feed in the ear bag (100 ticks per bag) that covered the ears of domestic rabbits under laboratory conditions (24°C, 16L–8D photoperiod) for eight hours after infestation. The number of engorged nymphs was counted for each group in order to calculate the engorgement rate. Each host rabbit was used only once.

RESULTS AND DISCUSSION

Table 1 shows the monthly changes in the rates of engorgement of *H. longicornis* nymphs. The rate of engorgement of *H. longicornis* nymphs that were placed outdoors from the engorged larval stage was 69.5% when they attached to hosts in Oc-

tober, 1999 (about 11 hr in the day length). However, the rate of engorgement decreased to 29.0% in November (about 10 hr) and 23.5% in December (about 9.5 hr). On the other hand, the rate of engorgement of *H. longicornis* nymphs that were placed in the laboratory (24°C, 16L–8D photoperiod) was 61.0% when they attached to hosts in October or November (Table 1). Furthermore, the rate of engorgement was 50.0% even in December. These results suggest that the host-feeding activity of *H. longicornis* nymphs that have been placed outdoors is suppressed from November. In general, low temperatures decrease the activity of ticks. In this study, however, the suppression of host-feeding activity did not appear to be caused by low temperatures, because the nymphs attached to hosts in the laboratory which was maintained at 24°C. Fujimoto (1995) reported that the host-feeding activity of *H. longicornis* nymphs was suppressed by exposure to a short-day photoperiod (10L–14D) during the stages from egg to unfed nymph. This suggests that behavioural diapause occurs in *H. longicornis* nymphs as a result of exposure to a short-day photoperiod. In this study, however, *H. longicornis* nymphs developed in a long-day photoperiod (16L–8D) from egg to engorged larva. Therefore, the suppression of host-feeding activity in the nymphs cannot be fully explained by behavioural diapause. According to Belozarov (1982),

Table 1. Monthly changes in the engorgement rates of *H. longicornis* nymphs that were placed outdoors and in the laboratory.

Months	Outdoors group				Laboratory group (24°C, 16L–8D)			
	No. of rabbits used	Total no. of nymphs used	No. of nymphs engorged	Mean % engorgement	No. of rabbits used	Total no. of nymphs used	No. of nymphs engorged	Mean % engorgement
October	2	200	139	69.5	2	200	122	61.0
November	2	200	58	29.0	2	200	122	61.0
December	2	200	47	23.5	1	100	50	50.0

The nymphs used in this experiment were reared at 24°C under a 16L–8D photoperiod from egg to engorged larva.

The engorged larvae were divided into two groups (outdoors and laboratory groups) after detachment from host rabbits (August 26).

The engorged larvae of each group molted into the nymphs in mid-September.

however, unfed ticks retain their sensitivity to day length throughout the period of their starvation. This suggests that *H. longicornis* nymphs retain such sensitivity until autumn during which days shorten. In this study, thus, the suppression of host-feeding activity appears to be due to the behavioural diapause induced by the short days of autumn. On the other hand, the rate of engorgement of the nymphs was more than 20%, even in December. This suggests that the proportion of the nymphs which enter diapause in autumn is low. According to Belozero (1982), high temperatures reduce the proportion in diapause for long-day reaction ticks such as *H. longicornis*. Thus, the low proportion of diapause in the nymphs may be related to the atmospheric temperature in autumn.

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摘 要

実験条件下で観察されたフタトゲチマダニ
若虫の秋における吸血活動

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卵から飽血幼虫期まで 24℃, 16L-8D の日長条件下で飼育し, その後, 屋外に置いたフタトゲチマダニ若虫の吸血活動を実験室内 (24℃, 16L-8D) で観察した。ウサギに吸血させた若虫の飽血率は 10 月において高かったが, 11 月から低下した。卵期から実験室内で飼育した若虫の飽血率は 10 月から 12 月まで高かった。これらの結果は秋の短日によって誘導された行動休眠が屋外に置いた若虫に起こったことを示唆する。しかし, 若虫の飽血率は 12 月においてでさえ 20% を超えたことから, 秋に行動休眠に入る若虫の割合は低いものと思われた。