Research Note

Feeding and oviposition of *Haemaphysalis flava* females (Acari: Ixodidae) exposed to different photoperiods, with special reference to morphogenetic diapause

Kazuyoshi FUJIMOTO

Department of Allergy and Immunology, Saitama Medical School, 38 Morohongo, Moroyama-machi, Saitama, 350-0495 Japan

(Received: 4 March 2002; Accepted: 27 May, 2002)

Key words: *Haemaphysalis flava*, engorged female, morphogenetic diapause, medium-day photoperiod, short-day photoperiod, autumn

Abstract: In order to clarify whether or not engorged *Haemaphysalis flava* females exhibit morphogenetic diapause, their feeding and oviposition were observed at 24°C under three photoperiodic conditions (10L–14D, 12L–12D, and 16L–8D). The feeding period was hardly affected by the different photoperiods. However, the oviposition was retarded by exposure to the 10L–14D photoperiod and partly by the 12L–12D photoperiod. These results suggest that engorged *H. flava* females enter morphogenetic diapause under medium-day and short-day photoperiods. Thus, most of the *H. flava* females that are active in the short days of autumn appear to enter morphogenetic diapause and eventually hibernate in the engorged state.

INTRODUCTION

The tick, *Haemaphysalis flava* Neumann, which is known to be a vector of tularemia (Asanuma and Sakurai, 1958; Fujita et al., 1985) is widely distributed in Japan. The nymphs and adults of this tick were abundantly found on vegetation or wild hares in autumn (Asanuma and Sakurai, 1958; Saito, 1959; Fujimoto et al., 1987; Kakuda et al., 1990). Fujimoto (1998) reported that morphogenetic diapause (Belozero, 1982) occurred in engorged *H. flava* nymphs under medium-day and short-day photoperiods (12L–12D and 10L–14D). This suggests that *H. flava* nymphs enter morphogenetic diapause under the short days of autumn. However, it is still unknown whether or not *H. flava* adults exhibit morphogenetic diapause (expressed as a delay in oviposition) under the short days of autumn. In this study, I observed

the feeding and oviposition of *H. flava* females at 24°C under three different photoperiods (16L–8D, 12L–12D, and 10L–14D). The objective of this study is to clarify the existence of the morphogenetic diapause of engorged *H. flava* females under the short days of autumn.

MATERIALS AND METHODS

H. flava adults were collected by the flagging method in the Chichibu mountains of Saitama Prefecture in November 2000 and October 2001. The adults fed on the ears of the domestic rabbits maintained in the laboratories at 24°C under three photoperiodic conditions (16L–8D, 12L–12D, and 10L–14D). The engorged females were detached and placed in Petri dishes, and kept in incubators at 24°C under the same photoperiodic conditions. The feeding and preoviposition periods were recorded for each photoperiodic con-

Table 1. Feeding and oviposition of *H. flava* females at 24°C under three different photoperiods.

Photoperiod	No. of engorged females examined	Feeding period (day)±*SD	Preoviposition period (day)±*SD	% oviposition
16L- 8D	13	7.2±0.4	10.9±1.7	100.0
12L-12D	6	8.2±0.7	9.3±3.1 (n=4)	66.7
			40.0< (n=2)	
10L-14D	8	8.3±0.4	40.0<	0.0

*SD: Standard Deviation.

dition. The observation of the oviposition ended 40 days after detachment.

RESULTS AND DISCUSSION

Table 1 shows the feeding and preoviposition periods of engorged *H. flava* females at 24°C under three different photoperiods. The feeding periods of *H. flava* females at 24°C under 16L-8D, 12L-12D, and 10L-14D photoperiods were 7.2, 8.2, and 8.3 days, respectively. The photoperiod had little effect on the feeding of *H. flava* females, although the periods were slightly prolonged at 12L-12D and 10L-14D photoperiods. On the other hand, the preoviposition period was affected by the photoperiod. The preoviposition period of engorged females at 24°C under a 16L-8D photoperiod was 10.9 days. However, the preoviposition period was partly retarded when they had been exposed to a 12L-12D photoperiod. Moreover, at a 10L-14D photoperiod, none of the engorged females oviposited within 40 days after detachment. These results suggest that the engorged females enter morphogenetic diapause under medium-day and short-day photoperiods. The engorged females kept in a 10L-14D photoperiod did not easily oviposit even when they were transferred into a 16L-8D photoperiod (Fujimoto unpublished). This suggests that the morphogenetic diapause at a 10L-14D photoperiod is very intensive. Belozero (1982) described that morphogenetic diapause makes it possible for the appearance of the later stages in the life-cycle to be syn-

chronized with the appropriate season. In this study, the morphogenetic diapause of engorged *H. flava* females may have a role that synchronizes their egg development with the appropriate seasons in spring to summer.

In conclusion, most *H. flava* females that are active in the short days of autumn appear to enter morphogenetic diapause and eventually hibernate in the engorged state without their ovipositing.

REFERENCES

- Asanuma, K. and Sakurai, N. 1958. On the seasonal occurrence of the tick, *Haemaphysalis flava*, on wild hares (*Lepus timidus brachyurus*) in the endemic area of Yato-byo or tularemia in Chiba Prefecture, Japan (a preliminary note). *Misc. Res. Inst. Nat. Resources*, 48: 28-39 (in Japanese with English summary).
- Belozero, V. N. 1982. Diapause and biological rhythms in ticks. In: *Physiology of Ticks* (ed. Obencin, F. D. and Galun, R.), pp. 469-500, Pergamon Press, Oxford.
- Fujimoto, K. 1998. Effects of photoperiod on the host-feeding and development of *Haemaphysalis flava* nymphs (Acari: Ixodidae). *Med. Entomol. Zool.*, 49: 235-238.
- Fujimoto, K., Yamaguti, N. and Takahashi, M. 1987. Ecological studies on ixodid ticks. 2. Comparison of the seasonal occurrence of the three ixodid ticks, *Haemaphysalis flava*, *Ixodes ovatus* and *I. nipponensis* in the south-western part of Saitama Prefecture. *Jpn. J. Sanit. Zool.*, 38: 7-12 (in Japanese with English summary).
- Fujita, H., Ootake, H. and Ohara, S. 1985. Isolation of *Francisella tularensis* from a tick *Haemaphysalis flava* parasitized on a dead hare and serologic

- survey on range cattle in Kawatabi Farm, Miyagi Prefecture, Japan. *Jpn. J. Sanit. Zool.*, 36: 75-77 (in Japanese with English summary).
- Kakuda, H., Shiraishi, S. and Uchida, T. A. 1990. Seasonal fluctuations of populations and effects of temperatures on development and growth in the tick, *Haemaphysalis flava*. *J. Fac. Agric. Kyushu Univ.*, 35: 17-26.
- Saito, Y. 1959. Studies on ixodid ticks. Part 1. On ecology, with reference to distribution and seasonal occurrence of ixodid ticks in Niigata Prefecture, Japan. *Acta Med. Biol.*, 7: 193-209.