Research Note

Effect of age on the host-feeding activity of *Ixodes nipponensis* nymphs (Acarina: Ixodidae) exposed to short-day photoperiods

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Key words: *Ixodes nipponensis*, unfed nymphs, host-feeding activity, age, diapause, photoperiod.

Abstract: The host-feeding activities of unfed *Ixodes nipponensis* nymphs exposed to short-day photoperiods (10L-14D and 12L-12D) under constant temperature (25°C) were observed at three different ages (within a month, 3, and 5 or more months after molting). The rates of engorgement (quantitative value of the host-feeding activity) of nymphs exposed to 10L-14D and 12L-12D were only 2.0 and 10.1%, respectively, when the nymphs attached to hosts at the age within a month after molting. However, the rates of the nymphal engorgement became higher with the lapse of time after molting. At the age of 5 or more months after molting, the rates of engorgement of nymphs exposed to 10L-14D and 12L-12D were 43.6 and 59.2%, respectively. These results suggest that the diapause of unfed *I. nipponensis* nymphs induced by exposure to short-day photoperiod weakens with the time elapsed after molting.

Introduction

Diapause in ticks can be classified into two basic types; *i.e.*, behavioral diapause and morphogenetic diapause (Belozero, 1982). Behavioral diapause is observed in unfed ticks and morphogenetic diapause in engorged ticks. In general, the diapauses in ticks are controlled by photoperiod, but age also has an effect on the regulation of the diapause (Belozero, 1982). In the previous paper, Fujimoto (1994) reported that the host-feeding activity of *I. nipponensis* nymphs was suppressed by exposure to short-day photoperiods (10L-14D or 12L-12D). This suggests that *I. nipponensis* nymphs entered diapause by exposure to short-day photoperiod. In this paper, however, the nymphs used were limited in age (3- to 6-week-old nymphs). In the present study, therefore, I observed the effects of age on the maintenance of the diapause of unfed *I. nipponensis* nymphs induced by exposure to short-day photoperiods.

Materials and methods

Engorged nymphs that detached from lizards of the species *Takydromus tachydromoides* (Schlegel), collected in Saitama Prefecture, were placed in tick containers (Petri dishes with wet filter papers at the bottom), and kept in an incubator at 25°C under a 16L-8D photoperiod (16 hr light/8 hr dark). Adults derived from these engorged nymphs were fed on the ears of domestic rabbits in the laboratory (25±3°C, 16L-8D photoperiod). The engorged females detached were placed in tick containers, and kept in an incubator as above. The eggs deposited by these females were collected daily from the containers and incubated at 25°C under two photoperiodic conditions (10L-14D and 12L-12D). The larvae hatched from these eggs were fed on mice under each photoperiodic condition. The engorged larvae detached were reared at 25°C under each photoperiodic condition, and the nymphs obtained were used in this study. The nymphs used were divided into three age groups (within a month, 3, and 5 or more months) by the time elapsed after

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Table 1 Percentage of engorgement of *I. nipponensis* nymphs of several ages exposed to two short-day photoperiodic conditions.

Photoperiodic conditions from egg to unfed nymph (hr)	Months after molting								
	1 $\geq$			3			5 $\leq$		
	No. of mice used	Total No. of nymphs used	Mean % engorgement	No. of mice used	Total No. of nymphs used	Mean % engorgement	No. of mice used	Total No. of nymphs used	Mean % engorgement
10L-14D	5	100	2.0	9	200	17.7	8	188	43.6
12L-12D	9	179	10.1	4	80	52.5	5	125	59.2

molting. Each of the three age groups of nymphs reared at each photoperiodic condition was placed on the head of a fixed mouse in an infestation density from 18 to 25 per mouse, and kept in an incubator (25°C, 10L-14D photoperiod). The number of engorged nymphs detached was counted for each photoperiodic condition and each age group, and the rate of engorgement was calculated as the value of host-feeding activity.

Results and discussion

As shown in Table 1, the rate of engorgement of nymphs exposed to 10L-14D from eggs to the experiment was very low (2.0%) when the nymphs attached to hosts within a month after molting. However, the rate of the nymphal engorgement became higher with the time elapsed after molting; *i.e.*, the rate increased to 17.7% at the age of 3 months and 43.6% at 5 or more months. There were significant differences in the rate of engorgement of nymphs between the age within a month after molting and that of 3 months ($\chi^2=13.31$, $p<0.001$), and between the ages of 3 and 5 or more months ($\chi^2=34.55$, $p<0.001$). A similar result was observed in nymphs exposed to 12L-12D, in which the rate of engorgement was 10.1% at the age within a month, but increased to 52.5% at 3 months and 59.2% at 5 or more months. A significant difference was found between the rates of engorgement of nymphs at the age within a month after molting and of those at 3 months ($\chi^2=58.02$, $p<0.001$). Fujimoto (1994) reported that the rate of

engorgement (5.0-11.2%) of unfed *I. nipponensis* nymphs exposed to short-day photoperiods (10L-14D or 12L-12D) was significantly lower than that (58.7%) exposed to a long-day photoperiod (16L-8D), and suggested that short-day photoperiod induced a behavioral diapause in the nymphs. In the present study, furthermore, the rate of engorgement of nymphs exposed to short-day photoperiods became higher with the lapse of time after molting. This suggests that the diapause of unfed *I. nipponensis* nymphs induced by exposure to short-day photoperiod weakens with the time elapsed after molting. In general, it is well known that the diapause termination in many species of insects needs a reactivation process which occurs during a long period of chilling. However, unfed *I. nipponensis* nymphs became free of diapause without a period of cold. This is very interesting in the relation to the functions of the diapause in the nymphs.

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摘 要

短日条件下で飼育したタネガタマダニ若虫の
飽血率に及ぼす脱皮後の経過日数の影響

25°C, 短日条件 (10L-14D, 12L-12D) で飼育した
タネガタマダニ若虫の宿主への寄生活動 (飽血率で示

す) を三つの異なる年齢集団 (脱皮後 1 カ月以内, 3
カ月, 5 カ月以上) で観察した. 脱皮後 1 カ月以内に
宿主へ寄生させた若虫の飽血率は 10L-14D で 2.0%,
12L-12D で 10.1% と低かった. しかし, 脱皮後の
日数が経過するにつれて飽血率は上昇し, 脱皮後, 5
カ月以上経ると飽血率は 10L-14D で 43.6%, 12L-
12D で 59.2% となった. 以上の結果は, 短日条件で
誘発された若虫の休眠は脱皮後の日数がたつにつれ
て弱まることを示唆する.