ACTIVITY OF FRASS EXCRETION IN THE SILKWORM LARVAE, *BOMBYX MORI* L. (LEPIDOPTERA : BOMBYCIDAE)

By

Nagao KOYAMA, Tatsuo TAKIZAWA and Tomio ABE*

Biological Laboratory, Shinshu University, Ueda-city, Japan (386)

INTRODUCTION

A considerable number of studies were hitherto carried out on the activity of frass excretion in the silkworm larvae (SUZUKI 1927, FURUYAMA and SEKIGUCHI 1934, FUKUDA and ISOKO 1936, ITAYA 1941, MUROGA 1943, TANAKA 1953, SUZUKI *et al.* 1954, WASHIDA 1965, 1966 etc.).

In these works the frass-excretion feature following with larval growth was clarified only under natural condition. Although, the photic condition seemed to be of an important factor effective on feeding and development of the silkworm as suggested by recent papers (MIYAGAWA 1952, HIRASAKA *et al.* 1968, 1969, KOYAMA 1969, HIRASAKA and KOYAMA 1970, 1972, 1973, KOYAMA *et al.* 1979 etc.). Then, we reared the silkworms under different photoperiodic conditions and investigated the excretion feature of frass. The results are given in the present paper.

Before going further we wish to express our hearty thanks to Mr. S. KOBAYASHI, Nagano Agriculture Experiment Station and the members of Nagano Sericulture Experiment Station for assistance of the experiment.

MATERIAL AND METHOD

The hybrid between *Shunrei* and *Shogetsu* was used for the material insect.

The silkworms were reared under the temperature of 24.0±1°C, the relative humidity of 60~70% and the photic conditions such as 24L, 12L12D, 6L18D and 24D, respectively.

The number of faeces excreted was counted by a frass-collector, which is shown in Fig. 1.

A group of the silkworms was confined in a rearing chamber (a) and given mulberry leaves with shoot. Faeces excreted fell to a funnel (c) through wire-net

* Present address; Miyagi Sericulture Experiment Station, Watari-machi, Watari-gun, Miyagi-pref. (989-23)

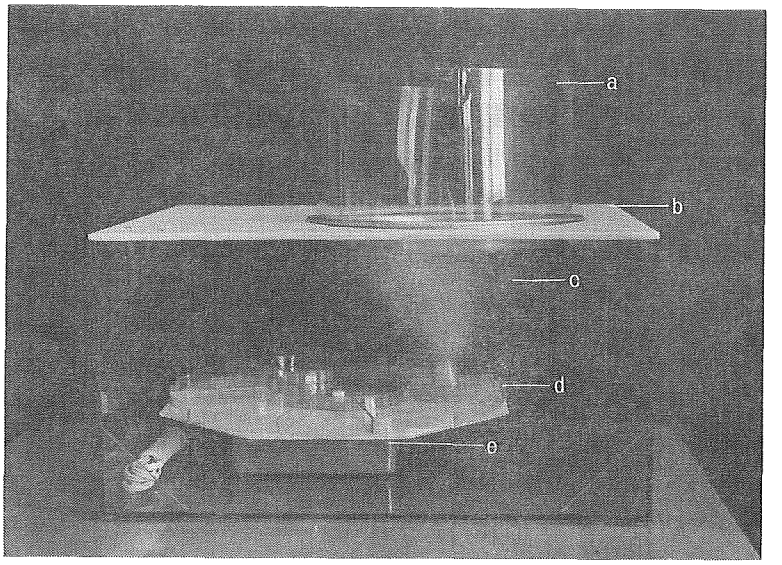

Fig. 1 Frass-collector
Abb.–see the text.

settled at the stage level (b). The collected faeces in the funnel dropped on the rolling stage (d), which was divided into 12 parts and rotated once a day by a timer (e). The frass number was counted every 2 hours. The light intensity in photophase was 400 lux.

The experiment was carried out from the 2nd instar stage to the 5th one, because the faeces of the 1st one were too difficult to collect in this apparatus.

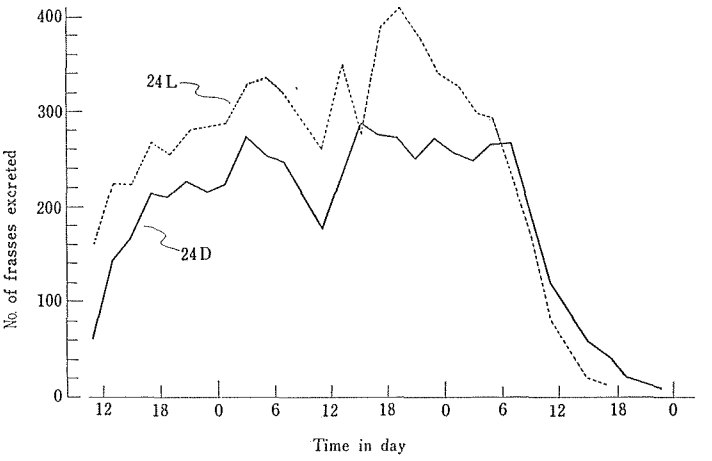

Fig. 2 Number of frasses excreted by 60 individuals in the 2nd instar stage (24L, 24D).

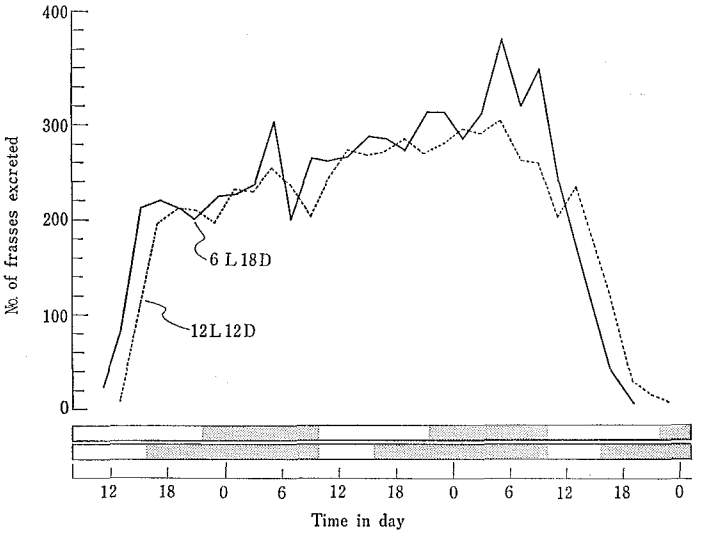

Fig. 3 Ditto (12L12D, 6L18D).

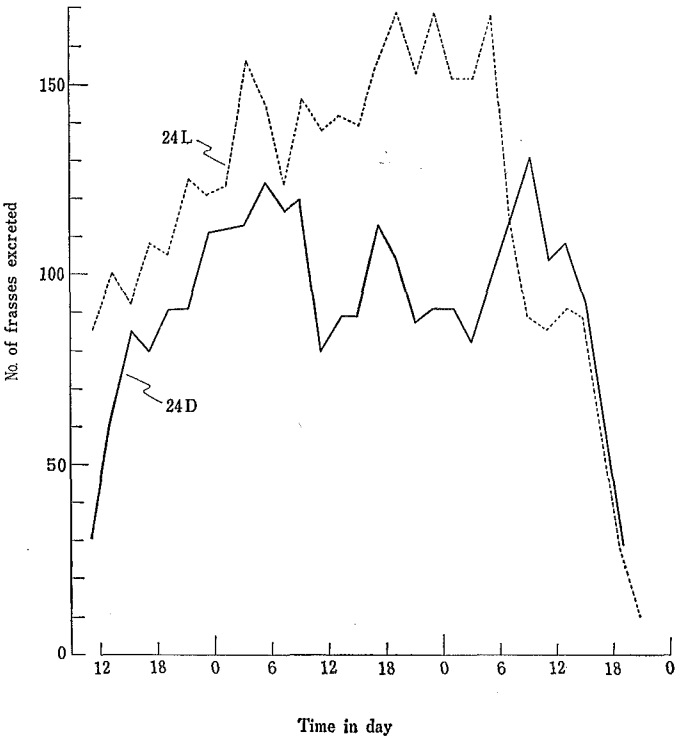

Fig. 4 Number of frasses excreted by 30 individuals in the 3rd instar stage (24L, 24D).

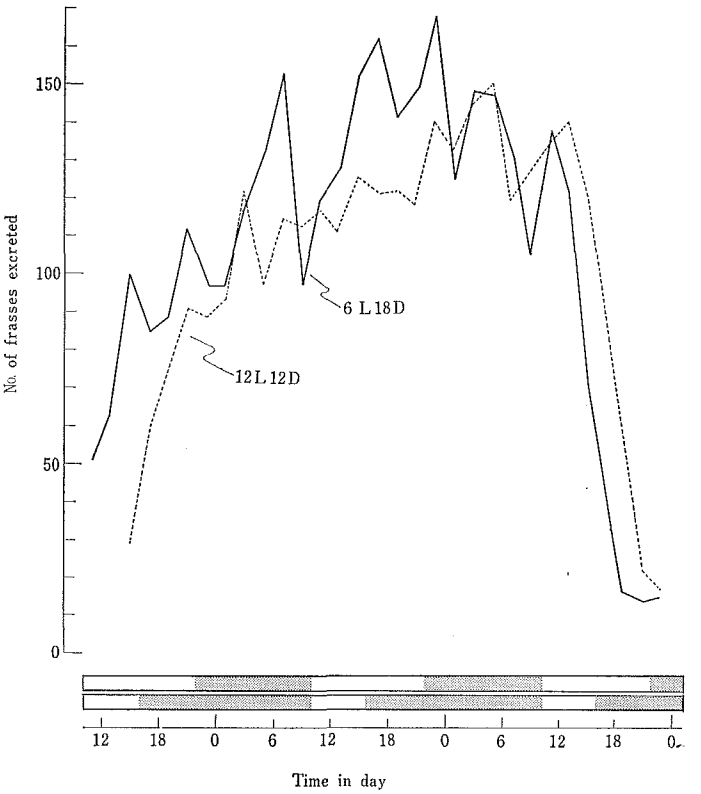

Fig. 5 Ditto (12L12D, 6L18D)

The subjected silkworms to each regime was 60 in the 2nd instar stage, 30 in the 3rd one, 10 in the 4th one and 5 in the 5th one, respectively.

RESULTS

The Second Instar Stage

As seen in Fig. 2 and Fig. 3, the frass-excretion activity tended to increase as the larval growth. In the free-running conditions (24L, 24D), a faint circadian rhythm of the activity with a trough at about 10 o'clock was detectable.

The activity, however, became maximum at late scotophase in 12L12D and 6L18D.

The Third Instar Stage

The number of the faeces excreted every 2 hours is indicated in Fig. 4 and Fig. 5.

The frass-excretion activity increased as the larval growth except in 24D,

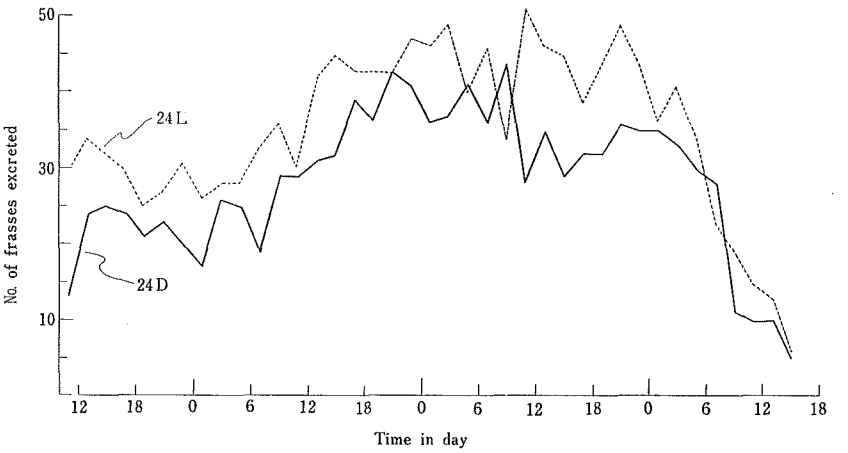

Fig. 6 Number of frasses excreted by 10 individuals in the 4th instar stage (24L, 24D)

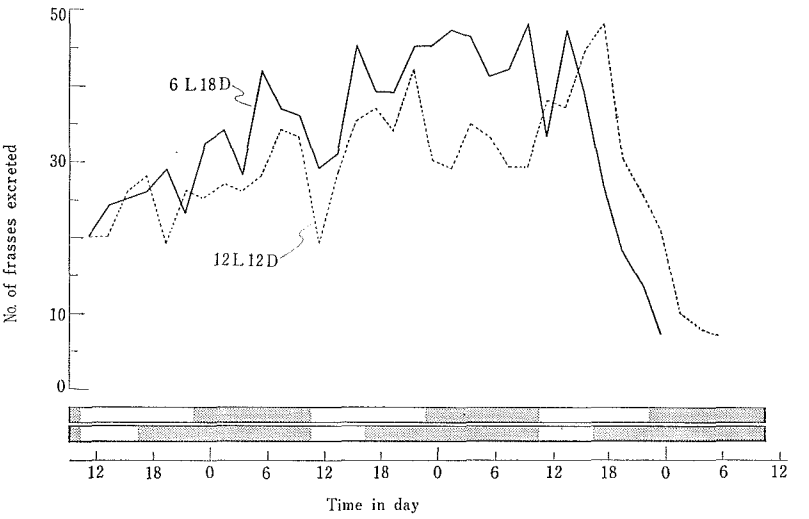

Fig. 7 Ditto. (12L12D, 6L18D)

in which the tendency was not so clear. In 24L and 24D a faint circadian rhythm of the activity was seen as in the previous stage. In 12L12D and 6L18D the peak of the activity was recognized at scotophase, respectively.

The Fourth Instar Stage

The results are shown in Fig. 6 and Fig. 7. As seen in the previous stages,

the excretion activity of frass became large as the larval growth. The free-running rhythm of the activity (24L, 24D) was not so evident, though a rhythm-like trough existed at 6~10 o'clock in the 2nd and the 3rd days. In the photoperiodic regimes the frass number seemed to be larger in scotophase, but such a tendency was not so clear as in the other stages.

The Fifth Instar Stage

In Fig. 8 the frass number in 24L and 24D is shown with the larval growth. The rhythmicity of the frass-excretion activity was not recognizable in early days of this stage, but from the 4th day a daily rhythm with 24 hours-interval was visible having a trough at about 10 o'clock.

In the photoperiodic conditions (12L12D, 6L18D) the sudden fall of the frass-excretion activity was detectable at early photophase in later days of this stage, although in earlier days the excretion activity was not rhythmical.

From the above data the frass number/hr of an individual is calculated as shown in Table 1.

Observed through all stages, the number of faeces was smallest in the 4th instar stage (1.5~1.9). Further it was larger in 24L than in the other regimes. In the photoperiodic regimes the frass-excretion activity was lower in photophase than in scotophase, in which the frass number was larger than in the constant darkness (24D).

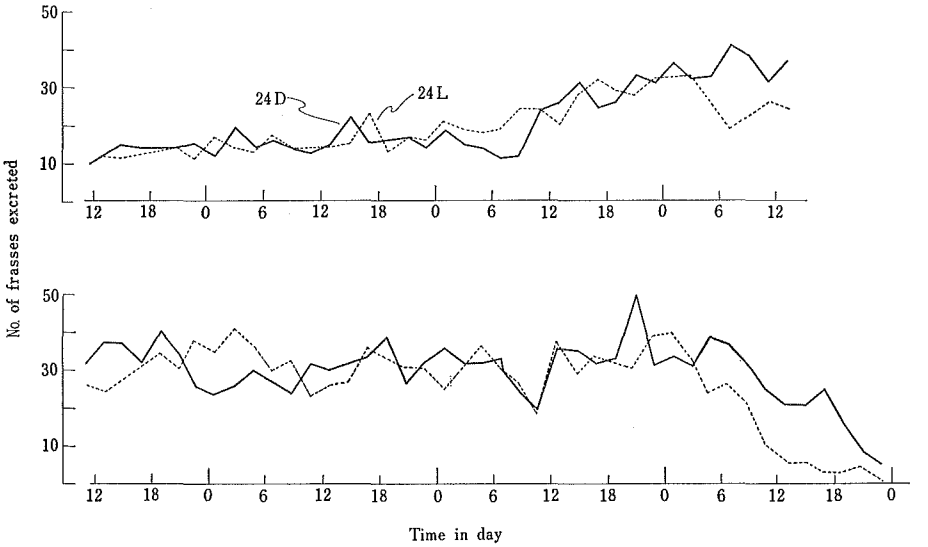

Fig. 8 Number of frasses excreted by 5 individuals in the 5th instar stage (24L, 24D).

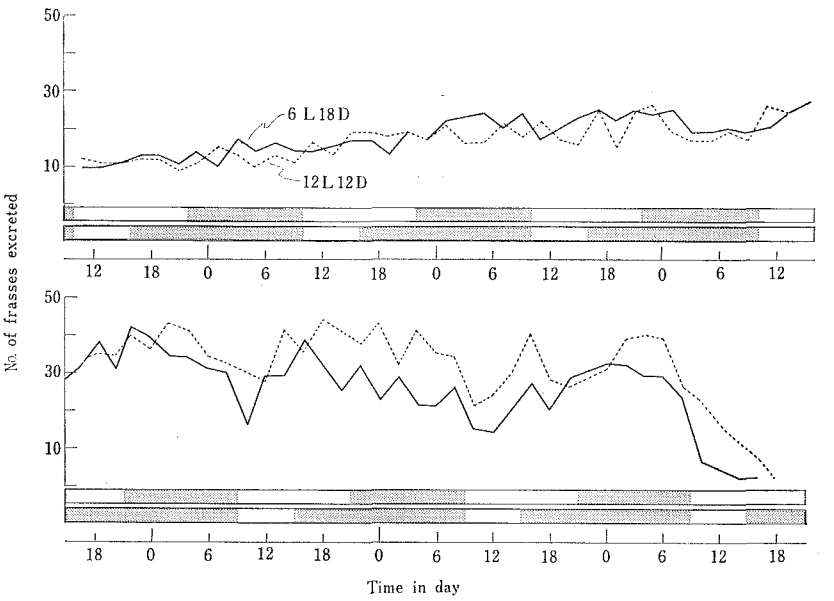

Fig. 9 Ditto (12L12D, 8L18D)

Table 1. Frass no./hr of an individual

Regime \ Instar stage		2	3	4	5
24L		2.44	2.13	1.83	2.44
12L12D	L	1.83	1.76	1.51	2.29
	D	2.13	2.00	1.46	2.64
6L18D	L	1.87	1.76	1.63	1.78
	D	2.30	2.08	1.87	2.42
24D		1.93	1.57	1.55	2.54

CONSIDERATION

As above-mentioned, the number of faeces excreted increases gradually as the larval growth in the same instar stage. It is, however, about 2.0/hr in an individual as already reported by SUZUKI *et al.* (1954). When compared the frass number per hour among each instar stage, it is least in the 4th instar stage in all regimes, though it was smallest in the 2nd instar stage according to FURUYAMA and SEKIGUCHI (1934) or in the 3rd one according to SUZUKI *et al.* (1954). Among all conditions the frass-excretion activity per hour seems highest in 24L except in the 5th instar stage. The alternated light phase is thought to give different effect on the activity from continuous light phase. In 12L12D

and 18L6D, the activity is significantly higher in scotophase than in photophase. Photoperiodic entrainment, therefore, is recognizable to occur in it.

The ontogenetic rhythmicity seen endogenously in free-running condition was remarkable in the silkworm as pointed out by many investigations (KIMURA 1952, 1953, TANAKA F. 1955, 1966a·b, TANAKA S. 1961, HIRASAKA *et al.* 1969, KOBAYASHI and KOYAMA 1974, KOYAMA *et al.* 1975, 1976, NAGASE *et al.* 1976).

The rhythmic feature, however, is quite faint in the activity of frass excretion. According to SUZUKI (1927), the duration from feeding to frass excretion was 1~2 hours in the younger stage and 2~3 hours in the older stage, respectively. The excretion activity corresponds reasonably to the feeding activity experienced 1~3 hours before. The fact tells us the feeding activity of the silkworm is more enhanced in scotophase than in photophase.

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