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MOVEMENT BEHAVIOUR OF THE ERI SILKWORM LARVAL *PHILOSAMIA RICINI* Hutt.

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ABSTRACT

The observations were made throughout the larval duration of eri silkworm, which initially were placed separately. Movement of individuals was observed and the number of solitary ones was recorded every 10 min. for an hour. It is obvious that the characteristic aggregative behaviour variations were associated with the changes of successive larval life stages. Younger individuals introduced higher aggregative rates than older ones. During the fifth instar this rates were minimized and vanished in the late few days. The behavioural conduct was found independent of seasonal variations. From the experiments of the sense organs related to this aggregative behaviour, it is likely that the visual sense has almost no concern with the mechanisms of this behaviour, and the larvae recognize each other by means of olfactory sense and come in contact. It is possibly the contact sense that plays a major role in the aggregative state.

Key Words : Eri silkworm, *Philosamia ricini*, Movement, Aggregative behaviour.

INTRODUCTION

The eri silkworm *Philosamia ricini* Hutt. may be said to rank next to *Bombyx mori* L. for the production of natural silk, which has commercial importance. Being polyvoltine, it can be reared all the year round.

Biological and ecological studies on the eri silkworm were **Eid (1967).**

Although the majority of insects lead a solitary existence a considerable number of species aggregate during certain periods of their lives, while others lead a social life. The larvae of some Lepidoptera aggregate during most or all of their larval period. **Loher (1961),** considered this to be an example of sub-social life as they have co-operative form of feeding. **Okui (1963, 1963a) and Vineet *et al* (1955).** carried out studies on aggregative behaviour of the silkworm *Bomxyx mori* L. including the studies of sense organs related.

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The significance of external factors were studied by **Loher 1960, 1961; Okui 1963a; Slifer *et al* 1964 and Johnson 1965, Karaivanov (1988), Petkov (1998), Tribhuwan and Singh (1998), Mishra *et al* (1998), Kause *et al* (1999) and Kariman (2000).**

MATERIAL AND METHODS

1. The behaviour pattern in different instars

The observations were made daily on 300 eri silkworm larvae in three replicates. The larvae were placed separately on a castor leaf or leaves proportional to the size of larvae of different instars. Movement of individuals was observed and the number of solitary ones was recorded every 10 min. for an hour. the aggregative rates were calculated and analyzed with respect to instar and season.

2. The sense organs related to the aggregative behaviour

a) The role of vision

For this study, 10 replicates of second instar larvae were examined in darkness and under light.

b) The role of mutual reaction

The reaction of 50 second instar larvae against 50 model of paper and 50 dead larvae (second instar) was compared with the reaction among 100 alive larvae. The aggregative rate calculated was considered as a rate of mutual response.

c) The role of olfactory sense

Starch paste was applied at the site of antennae and the behaviour of treated second instar larvae was observed and compared with intact ones.

d) The role of contact sense

The individuals with their antennae covered were initialy kept in contact with each other and dispersal rate was compared with that of intact ones, which were also contacted in their initial site.

RESULTS

1. The behaviour patterns in different instars

a) First instar

The ratios of the average number of solitary individuals during one hr observation, throughout the instar, ranged from 7.2 to 36.3% in Spring 2000 and from 5.3 to 41.8% in **Winter 2001.** This shows that the aggregative rates of larvae were 64.5 to 93.1 and 59.2 to 95.7% in Spring and Winter, respectively.

In the first 30 min., the number of the solitary individuals rapidly decreased, and many small groups were scattered round one large group. During the second 30 min. some larvae of the small groups showed tendency to loose contact and combine another individual or group. However, the large group which contained no less than 41.6% of aggregated larvae, showed no further development (Fig. 1).

Fig. 1. The aggregation of hatched larvae.

It was observed that if an individual came in contact the other individual or group, swinging movement of the first body segments became less remarkable and the larvae became most immobile introducing akinetic position.

The aggregative rates of hatched larvae at the end of one hr observation were 91.1 and 67.6% in Spring and Winter, respectively. This rates decreased to reach its minimum at the middle period of instar duration then increased to the maximum of 98.8 and 99.3 in Spring and Winter, respectively when the duration was ended up (Fig. 2).

This peculair character in aggregation of the eri silkworm was found independent of seasons as the differences were not significant.

b) Second instar

The aggregative rates during one hr. observation were 52.4 to 71.3% and 55.1 to 75.8% in Spring and Winter respectively (Fig. 2). During the first 20 min., the number of aggregated larvae rapidly increased and large groupe containing 4 to 9 individuals were formed. These groups showed no further development in Spring irrespective to those of Winter. However, in both seasons the solitary larvae during their movement reached the other surfae of castor leaf and groups were sometimes formed there. The tendency for loosing contact and reconstruction of groups were more frequent than in the first instar during the late 40 min.

The aggregative rates at the end of one hr. observation during the periods of instar duration showed the same trend of the first instar, in both seasons (Fig. 2).

c) Third instar

The aggregative rates in the first 10 min. were 31.5 and 59.3% for spring and Winter, respectively. During the successive intervals the aggregative rates were increasing and decreasing to reach 37.6 and 42.1% in Spring and Winter respectively, at the end of 1hr. observation (Fig. 2).

The aggregative rates in the first day of duration at the end of 1 hr. observation were 20.7 and 32.8% for Spring and Winter respectively. This rates, irrespective to those of the first and second instars, increased to reach their maximum at the end of instar duration in both seasons (Fig. 2). Here again, the differences between seasons were not significant,

d) Fourth instar

The highest aggregative rates were encountered through 30 min. in Spring and 20 min. in Winter. Then, in both seasons, this rates were gradually decreased to reach a minimum at the end of one hr. observation (Fig. 2).

The aggregative rates in the first day of instar duration were 12.3 and 32.5% for Spring and Winter, respectively. This rates were decreased to the minimum of 5.3 and 21.7% at the third and fifth days in Spring and Winter respectively, then increasing to the maximum of 35.6 in Spring and 46.8% in Winter at the end of duration.

This tendency recalled the same trend deduced in the first and second instars (Fig. 2). It is worth noting that the differences in respect to seasons were significant.

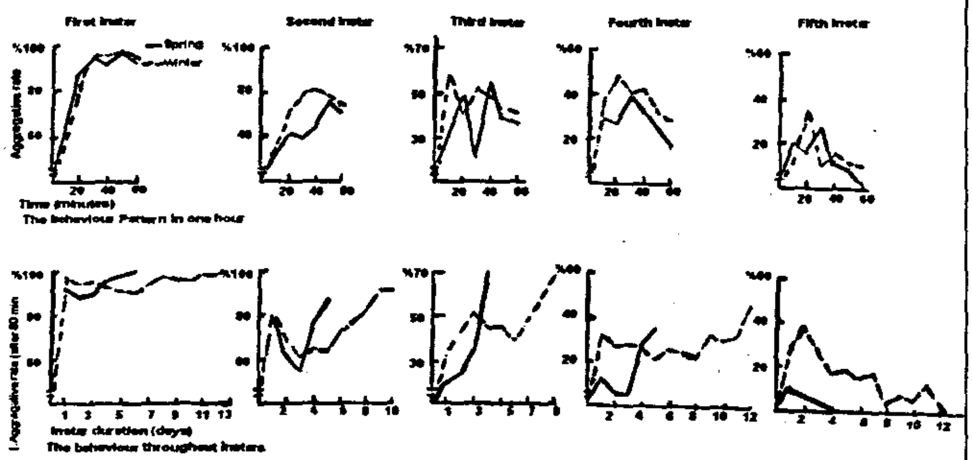

Fig (2): The behaviour patterns in one hour throughout the different instars.

e) Fifth instar

The highest aggregative rates resulted after 30 min. in Spring and after 20 min. in Winter. During the successive intervals, dispersion prevailed and this rates reached the minimum of 3.4 and 11.7% in Spring and Winter, respectively, at the end of 1 hr. observation (Fig. 2).

The aggregative rates at the end of one hr. observation were higher in Winter than in Spring and the differences were significant. This rates were highest in the first few days of instar duration in both seasons and gradually vanished, where solitary existence prevailed through the late days of duration (Fig. 2).

2. The sense organs related to the aggregative behaviour

a) The role of vision

No shift in aggregative rate during one hr. was found, being 73.7% in light and 69.5% under darkness and the differences were not significant (Fig. 3).

b) The role of mutual reaction

The response of larvae to the dead models was significantly lower than in the case of mutual reaction among the live larvae. The aggregative rates were 26.3, 30.6 and 70.4% for pieces of paper, dead larvae and alive ones, respectively (Fig. 3).

c) The role of the olfactory sense

The significance of olfactory sense was analyzed. The larvae with their antennae covered with starch paste showed an aggregative rate (after 60 min.) of only about 29.6%. The behavioural conduct was different from that of intact ones which showed a significantly higher aggregative rate of 69.4% after 60 min. (Fig. 3).

d) The role of contact sense

It was found that individuals with their antennae covered did not show remarkable tendency to loose contact if they had been kept in contact with each other from the beginning. They were less dispersed from initial site even after 60 min. However, the differences were not significant (Fig. 3).

DISCUSSION

The aggregative behaviour patterns were changed throughout larval life of the eriworm *Philosamia ricini* Hutt. The aggregative rates through 1 hr observation showed that the organic changes of successive larval stages were associated with characteristic aggregation variations. The older individuals were more active than younger ones, former fell into aggregation more rapidly but the dispersion was even more rapid and oftener than latter.

The aggregative rates decreased gradually to reach its minimum in the fifth instar. This behavioural conduct was found independent of seasonal variations in the first three instars, while in the fourth and fifth instars the differences were significant. Such behaviour was found by **Long (1955), Okui (1963),** and observed by **Eid (1967),** and used as a character for selection in *B. mori* L. by **Petkov *et al* (1998).**

Throughout the first four instars, these rates decreased to reach its minimum at the middle period of instar duration then increased to its maximum when the durations were ended up, showing akinetic position prerequiste for fasting and moulting. Irrespectively, were those of the fifth instar as the rates were highest in the first few days of instar duration and gradually vanished, where solitary existence prevailed through the late days. Thus introducing new condition prerequisite for climbing and nesting for spinning cocoons. These results are in accordance with the findings of many workers as the internal factors which determine the motivations in an insect can change during the course of its ontogeny **Tribhuwan and Singh (1998), and Kause *et al* (1999).**

For the spontaneous expression of behaviour, receptors have in many instances been held responsible, which

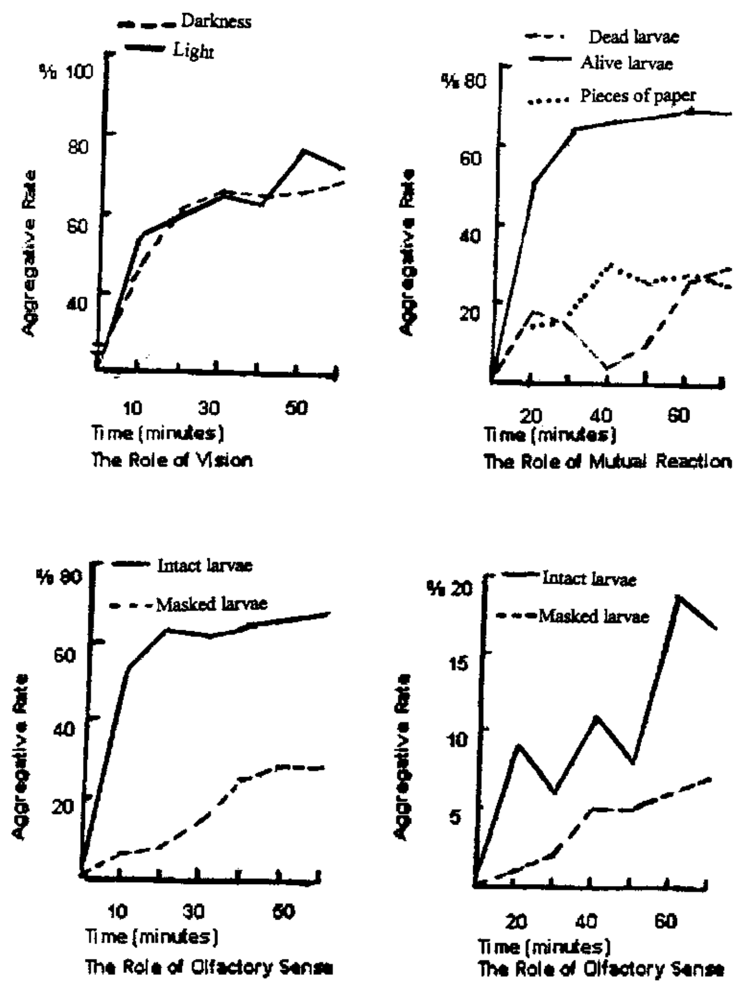

Fig (3): The Role of Sense in The Aggregative Behaviour react to conditions within the body and thereby activate the central nervous system. From the experiments of sense organs related to the aggregative behaviour in the eriworm, it is evident that largae are aware of the presence of their neighbours. And this form of recognition will no doubt have a sensory basis. Vision sense was not of great consequence. The interaction between larvae proved to be depndent on mutual reaction. There are convincing results of olfactory sense significance in the mechanism of this aggregative behaviour. It is likely that the eriworms recognize each other by means of olfactory sense and come in contact, to induce an aggregative state which differ in its intensity with different instars. the intensity of contact, is possibly controlled by the contact sense that plays major role in the aggregative behaviour.

It was found by many workers that the external factors can act not only to release behaviour but also to influence motivation as found in silkworm by **Kariavonov (1988), and Haque and Hossain** (1991). In locusts visual **(Chauvin, 1941)** and olfactory stimuli **(Norris, 1954)**, for both together with mechanical stimuli **(Ellis, 1953, 1963)**, as well as hormones **(Loher 1960, 1961)** cause a specific aggregation tendency, in which the stimuli are first motivational and, later on, releasing as well. Similar results were found in *B. mori* by **Okui (1963a); Vineet *et al* (1995); Tribhuwan and Singh (1998) and Mishra *et al* (1998)**. The studies of the mechanism of crowding in aphids suggested that the interaction between aphids is dependent on touch and involve the exchange of a phermone transmitted by contact **(Bonnemaison, 1951; Slifer *et al* 1964 and Johnson 1965)**.

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السلوك الحركى ليرقات دودة الحرير الخروعية

[٦٩]

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تم تسجيل الملاحظات خلال فترة حياة يرقات دودة الحرير الخروعيـــة ، التـــى وضعت فى البداية منعزلـــة . هـــذا وقـــد لوحظ حركة الأفراد وتـــم تســـجيل عـــدد الأفراد الانعزالية كل عشر دقائق ولمـــدة ساعة كاملة . وقد وجد أن الاختلافات فى السلوك التجمعى كان مرتبطاً بـــالتغيرات التى تحدث فى الأعمار المختلفة للطـــور اليرقى ، حيث تبدى الأفراد صغيرة العمر سلوكاً تجمعياً أعلى فى معدله منـــه فـــى حالة الأفراد كبيرة العمر . هذا المعـــدل يصل الى الحد الأدنى فى نهايـــة العمـــر الخامس .

وقد وجد أن هذا السلوك غير مرتبـــط بالاختلافات الموسمية . ومـــن التجـــارب الخاصة بأعضاء الحس المرتبطة بالسلوك التجمعى فقد لوحظ أن أعضاء الرؤية فـــى الغالب ليست مرتبطة بـــهذه الميكانيكيـــة السلوكية وكانت لأعضاء الشم الأهمية فـــى هذا المجال ، كما أنه مـــن المحتمـــل أن تلعب أعضاء اللمس الدور الرئيسى فـــى حالة السلوك التجمعى .

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