

SOME ASPECTS OF POST-EMBRYONIC DEVELOPMENT OF PRAYING
MANTID [*EUANTISSA PULCHRA* (FABR.) : DICTYOPTERA :
MANTIDAE] WITH SPECIAL REFERENCE TO
MORPHOMETRICAL STUDIES

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ABSTRACT

Statistical analysis and graphical representation of morphometry, rate of growth and feeding, increase in weight and significance of colouration during the post embryonic development of *Euantissa pulchra* (Fabr.) were studied.

INTRODUCTION

The studies on the biology of mantids in the laboratory involve the difficult task of rearing them, because of lack of information on the food requirements just after hatching and nonavailability of the artificial food that could easily be provided in rearing them in the laboratory.

The present paper includes the results of the laboratory observation on the post-embryonic development of *Euantissa pulchra* (Fabr.) a small green mantid being commonly found in green shrubs. The green colour of its dorsal surface matches uniquely with the green leaves. In fact, the information on the post embryonic development of mantids in India is very limited except some fragmentary informations available in the works of Williams (1904), Mathur (1934), Mathew (1935) and Arora and Singh (1957). Mathew

(1935) and Nadkarny (1965) treated the species under the generic name *Evantissa* (?) which however does not appear in the monograph on mantidae by Giglio-Tos (1927).

The aim of the present observation is to obtain information on the duration of developmental stages, the morphometry, rate of feeding and growth in relation to weight in different instars under laboratory condition and with uniform food material.

MATERIAL AND METHODS

The material for the present study was a gravid female collected at Ranaghat, Dist. Nadia, W. Bengal, in the 3rd week of May, 1978. The female was kept in a specially built cage (8" × 6" × 9") the three sides of which contained alluminium seive and one side had glass. The top of the cage was provided with

a sliding glass cover to push in food. The cage was provided with a small amount of sandy soil and few leaves and twigs. *Drosophila* sp. was chosen during rearing in the laboratory as prey organism for all the developmental stages. The temperature and the relative humidity were recorded by a mercury thermometer and a dial hygrometer respectively. The nymphs were reared in separate cages to avoid cannibalism.

RESULTS

(I) Laying of Eggs and Formation of Oothecae

The captive female deposited three oothecae till death on the sixth day after its capture at an interval of four days, i.e. on 26.5.78, 30.5.78 and 3.6.78.

The oothecae were laid over the wooden frame on the top of the cage. The substance which formed the body and supported the oothecae appeared to be a sticky fluid pale yellow in colour. This froth like substance came out of an aperture just behind the lateral cerci below the last abdominal segment. The base was formed at first, then more fluid was deposited on the upper surface and somewhat less on the lower and lateral surfaces, which eventually formed a cavity. Inside such cavities the eggs were placed by large ventral valves. The movements of these valves also helped to spread the sticky fluid. The entire ootheca was constructed within three hours and it gradually hardened by coming in contact with air. The ootheca was dorsally convex and narrowed at both ends. The sides contained lateral vertical flaps (9-11 in number) and the spaces in between were filled up by a spongy material. About 20-22 round apertures were noted dorsally to faci-

litate the exit of the nymphs from the corresponding chambers. Each chamber was placed vertically but a little obliquely and remained closed by a valve like lid held by a silken thread.

A transverse section of the ootheca revealed the position of the chambers. There were usually cavities for four chambers. But, actually there existed two major chambers in the middle while two others were on the sides (one on each side). This was because the chambers were placed obliquely inwards towards their distal ends. In case of the unfertilised oothecae the chambers contained a fluid material unchanged after eight months. The structure of the ootheca of this species was more or less similar to that of *Creobroter apicalis* (Sauss.). The size of an ootheca was as follows :

Length—1.2-1.5 cm. ; Width—0.5-0.6 cm. ; Height—0.4 cm.

I (a) *Hatching of Oothecae* : The incubation period was 16 days. Altogether 62 nymphs emerged from the three oothecae, of which only 7 individuals could attain the adult stage. Incidentally all the 7 individuals were females on which the present observation was based. The hatching nymphs showed a consistent upward movement of the body and head. The nymphs came out by breaking the anterior end of the egg. After emergence of the abdomen but with the legs still inside the egg, the body experienced continuous forward and sidewise movements. The newly emerged nymphs were seen to aggregate around the ootheca for one and half hour and then to move about freely. The temperature and R.H. on the dates of hatching were given in Table 1.

TABLE 1. *Temperature and R.H. recorded in the laboratory.*

<i>Dates of hatching of nymphs</i>	<i>Max. Temp.</i>	<i>Min. Temp.</i>	<i>Max. R.H.</i>	<i>Min. R.H.</i>
11.6.78	96.6°F	82.6°F	90%	50%
15.6.78	95°F	75.0°F	97%	54%
18.6.78	97°F	82.1°F	96%	55%
Mean Temperature and RH during development	94.5°F	77.2°F	93.5%	53.2%

Developmental Stages and their Duration

The Table 2 showed the developmental time of different instars as well as the salient

characters of each instar. The total time taken for development in this study was 51 days. The time required from laying of

TABLE 2. *Development of E. pulchra (Fabr.): Age at successive moults of developments (in days) and their salient features.*

<i>Stages of development</i>	<i>Mean of ages and S. D.</i>	<i>Range of ages</i>	<i>No. of observations</i>	<i>Salient features</i>
Moult I	11.57±1.39	10-14	7	Body colour black, measured 5.2 mm.
Moult II	6.00±1.51	4-7	7	Body colour dull, measured 8.3 mm.
Moult III	6.86±1.31	5-9	7	Dorsal and ventral surfaces of legs dark brown; general body colour dark reddish brown. Abdomen broader; measured 9.6 mm.
Moult IV	6.86±0.9	6-8	7	Dorsal surface of body reddish brown and ventral surface whitish. Legs pale brown, three black spots on abdominal sternites; measured 12.4 mm.
Moult V	7.43±9.40	7-8	7	Dorsal side greyish with green tinge; ventral surface of straw colour; lateral sides of abdomen and margin of eyes pinkish. Wing buds seen; measured 15.05 mm.
Adult	12.0±0.82	11-13	7	Dorsal surface pale green ventrally bright yellow, wings clearly visible. Legs light green; measured 17.8 mm.

ootheca to hatch was greater than the length of any other stage and the duration of the 1st and 6th instars were greater than any

other intermediate stages, as it was evident in the figure 1.

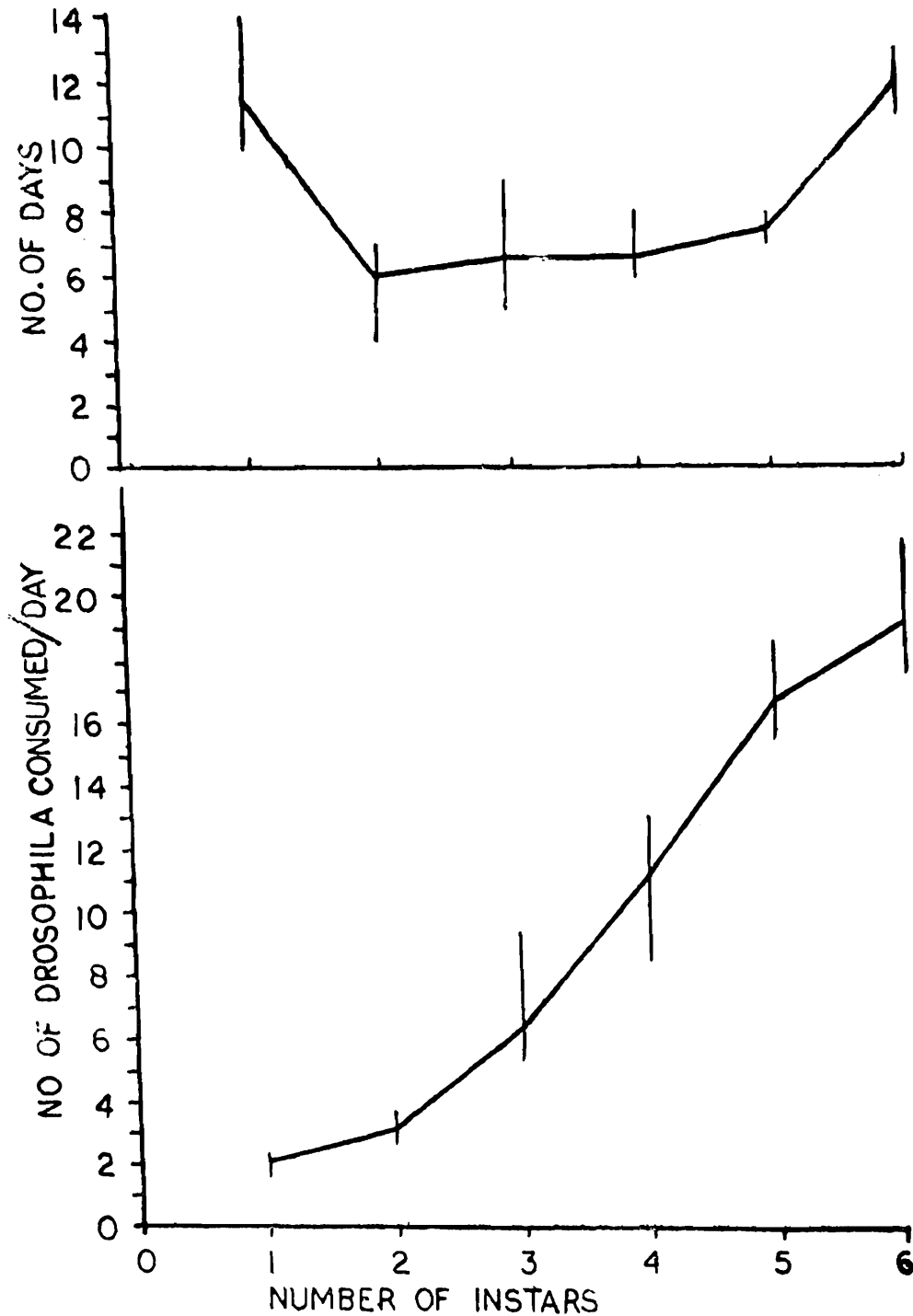


Fig. 1. Graph showing number of days taken for completion of different instars in *E. pulchra*.

Fig. 2. Graph showing consumption of *Drosophila* per day per instar of *E. pulchra*.

Growth in Relation to Weight

Live weight in different stages : Weight of insects at different instars during the period of development is presented in the Table 3. It was evident that the rate of increase in weight was more or less double upto the 3rd

a steady increase from the 1st instar to the 6th instar. As regards the length of the head growth rate was very slow in comparison to other parts and it remained constant from the 1st to the 4th instar, then slightly increased (0.25 mm.) from the 5th instar to

TABLE 3. *Weight in different moults (in mg.).*

Instars	I	II	III	IV	V	VI
	2.1	5.0	9.0	13.5	25.0	70.0
	2.4	7.0	10.0	14.0	35.0	65.0
	2.3	6.0	10.0	13.5	35.0	70.0
	2.2	5.0	10.0	14.0	30.0	67.0
	1.9	6.0	9.0	13.5	28.0	68.0
	2.0	6.0	9.5	13.4	27.0	70.0
	2.2	6.0	10.0	14.0	35.0	70.0

instars. From 3rd to 4th the increase in weight was proportionately lower. Thereafter, from the 4th instar to the 6th instar, weight increased more than double to the previous instars.

Growth in Relation to Length

From the table 4, it was evident that the rate of growth of different parts of the body

the 6th instar. In case of antenna there was a steady growth in length from the 1st instar to the 6th instar. Head-width increased very slowly in the different instars (Table 4).

Growth in Relation to Food Consumption

It was clear from the figure 2, that the consumption of number of *Drosophila* individuals per day within the instar and from

TABLE 4. *Growth in different parts of body of E. pulchra (Fabr.) (in mm.).*

Instars	I	II	III	IV	V	VI
Total body length	5.2	8.3	9.78	12.4	15.5	17.8
Head width	1.2	1.7	2.0	2.3	3.4	3.5
Antenna length	3.1	5.8	6.46	8.8	10.0	11.25
Head length	0.5	1.0	1.0	1.06	1.25	1.5
Pronotum length	1.4	2.1	2.56	3.4	4.45	5.25
Abdomen length	3.3	5.2	6.18	8.0	9.35	11.05

appeared to be irregular. The total body length and the length of the abdomen showed

one instar to the other were varied. It ranged from 1.6 nos. to 2.25 nos. of

Drosophila in 1st instar, 2.66-3.66 nos. in 2nd instar, 5.3-8.2 nos. in 3rd instar, 7.5-13.0 nos. in 4th instar, 15.5-18.5 nos. in 5th instar, and 17.5-21.66 nos. in 6th instar. But the number of consumption of *Drosophila* steadily increased from the 1st instar to the 6th instar. The rate of consumption was about double from the 1st instar to the 2nd instar.

Statistical Analysis of Data

The data pertaining to growth and

different parts of the body during the period of development were subjected to statistical analysis for finding out regression co-relation within the parameters considered in the study. The regression lines were obtained by pulling together data for the entire study period. The regression lines along with the respective scattered diagrams were shown in figures 3-9. The co-relation co-efficient study (3rd column of table 5) showed existence of highly significant positive correlation between the parameters, except

TABLE 5. Relationship between body weight and number of *Drosophila* consumed and different parts of the body of *E. pulchra*

Parameters	Mean	Correlation coefficient between different parameters	Regression line of different parameters (Y=a+bx)
Y : Body weight	42.26		
No. of <i>Drosophila</i> consumed	5.98	0.86 ***	Y= 3.86+0.06x
Body length	13.15	0.91 ***	Y= 8.92+0.10x
Y : Body length	13.15		
Weight of food consumed	5.98	0.98 ***	Y= 3.08+0.69x
Antenna length	8.24	0.96 ***	Y= 1.67+0.50x
Head width	2.51	0.96 ***	Y= 0.67+0.14x
Head length	1.11	0.89 ***	Y= 0.5 +0.45x
Pronotum length	3.66	0.99 ***	Y= 0.04+0.27x
Length of abdomen	8.44	0.80 **	Y= -0.50+0.68x
Y : Length of Antenna	8.24		
Head width	2.51	0.49 *	Y= 2.18+0.04x
Head length	1.11	0.95 ***	Y= 0.29+0.10x
Pronotum length	3.66	0.97 ***	Y= -0.69+0.52x
Length of abdomen	8.44	0.93 ***	Y= -1.69+1.23x
Y : Head width	2.51		
Head length	1.11	0.94 ***	Y= .025+0.34x
Pronotum length	3.66	0.48 *
Length of abdomen	8.44	0.72 **	Y= -1.52+3.96x
Y : Head length	1.11		
Pronotum length	3.66	0.14 *
Length of abdomen	8.44	0.16 *
Y : Pronotum length	3.66		
Length of abdomen	8.44	0.41 *

* Insignificant ; ** Significant at 5% level ; *** Significant at 1% level.

between the length of antenna and head width, between head width and length of pronotum, between head length and length of pronotum, length of abdomen and between length of pronotum and length of abdomen which were insignificant but positively correlated.

pulchra, there occurred a gradual change in colour from black through brown to green. The first and second nymphs were black and very similar to black ants. During these two stages the colour was of protective type for the young helpless nymphs. In later stages the colour became brownish. The adult remained mostly in green shrubs. In adult the green colour of the body matched unquily with green leaves making it difficult to spot out. The colouration and

Some interesting Features during the Development of Mantid

(a) *Significance of Colouration* : In *E.*

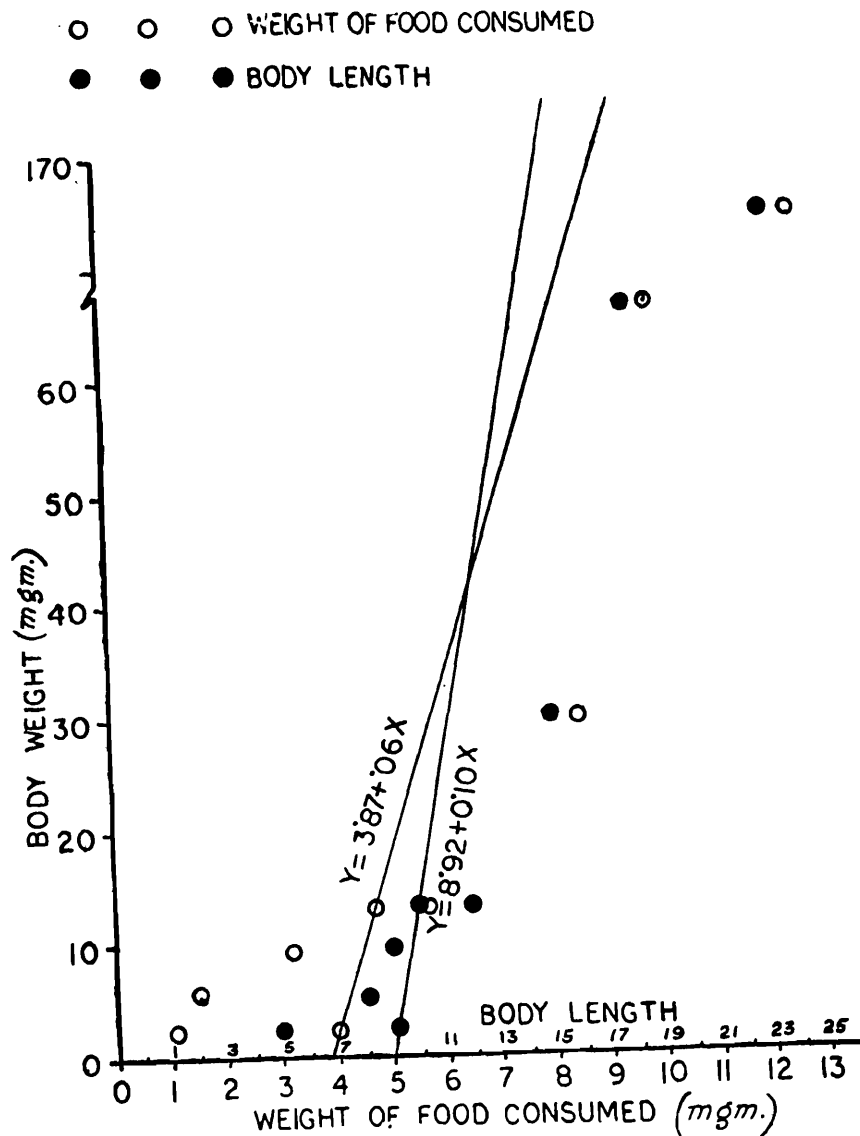


Fig. 3. Showing relationship between body weight and weight of food consumed and body length during the period of development of *E. pulchra*.

mimicry as found here might be illustrated as follows :

Stages	Colour
I & II	Black-Animate object (i.e. ants)
III to V	Dark brown-Inanimate object (i.e. bark)
VI	Light brown
VII	Green...Inanimate object (i.e. leaves)

The above findings perhaps signified that the gradation in colour was deceptive and was very important in the completion of the life cycle of mantid by exploiting the

natural surroundings. A similar observation was made by Mathew (1935) on a deceptive resemblance with the black ants *Camponotus compnessus* and in a bug *Riptortus pedestris*.

(b) *Moulting* : Generally, it took place early morning, but some nymphs moulted in the afternoon between 2-4 P.M. The nymphs became sluggish 24-36 hours before moulting. They took rest on the bottom of the cages and rarely consumed any food. During moulting, the skin splitted along the dorsomedian line of the body and the thorax came out dorsally through this slit like a loop. At this time the head was bent ventro-poste-

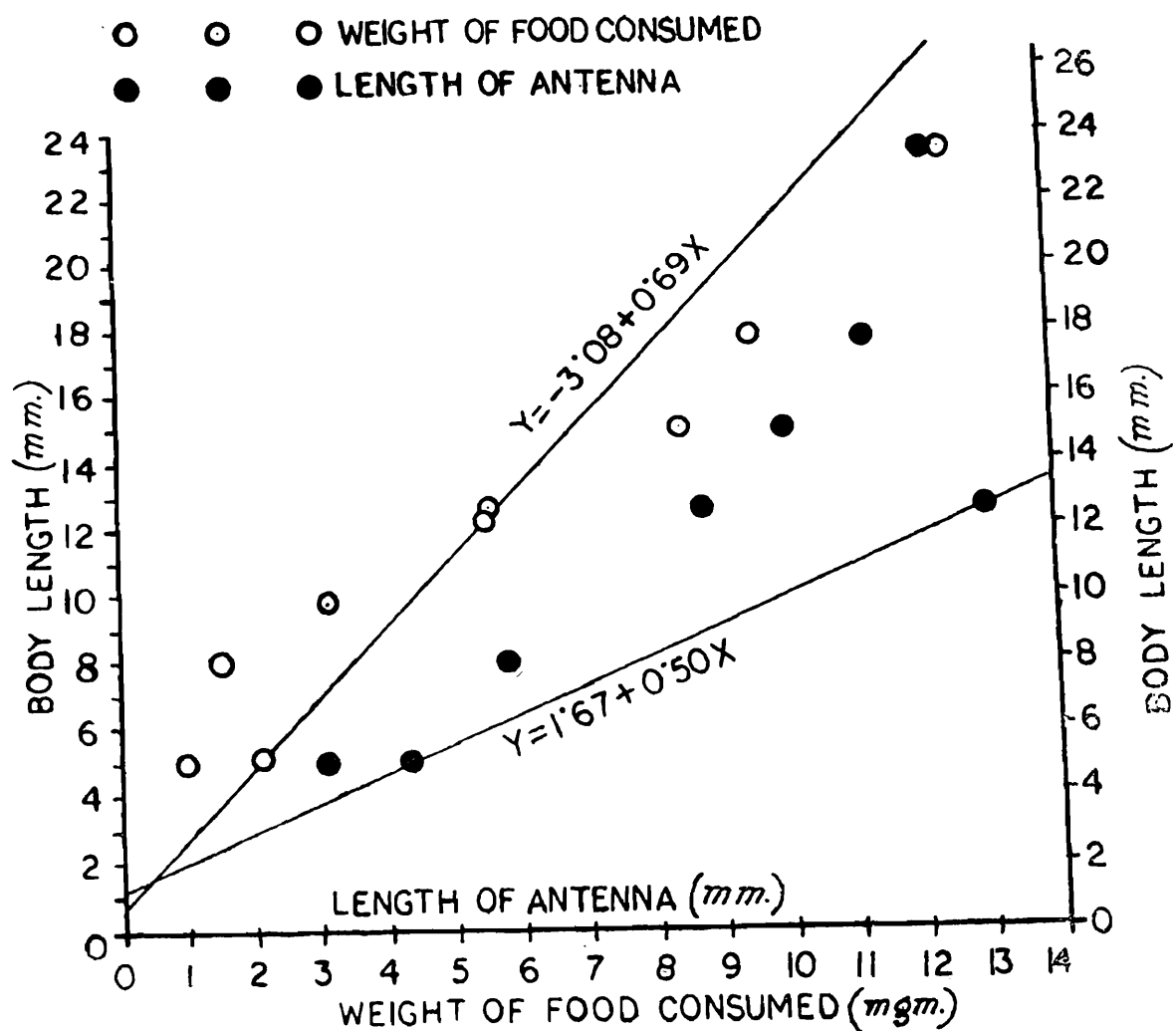


Fig. 4. Showing relationship between body length and weight of food consumed and length of antenna during the period of development of *E. pulchra*.

riorly which then started freeing itself from the exuviae. Then the antenna was drawn out of its covering. The legs were made free one after another after which the abdomen was drawn a little forward and swollen to make it free from the casting.

not die in general. The rate of mortality in the laboratory approximated to 35%. The reason seemed to be the failure to catch the prey. The newly emerged nymphs without proper food died within 24 hours. The first nymphs could thrive well on fine sugars

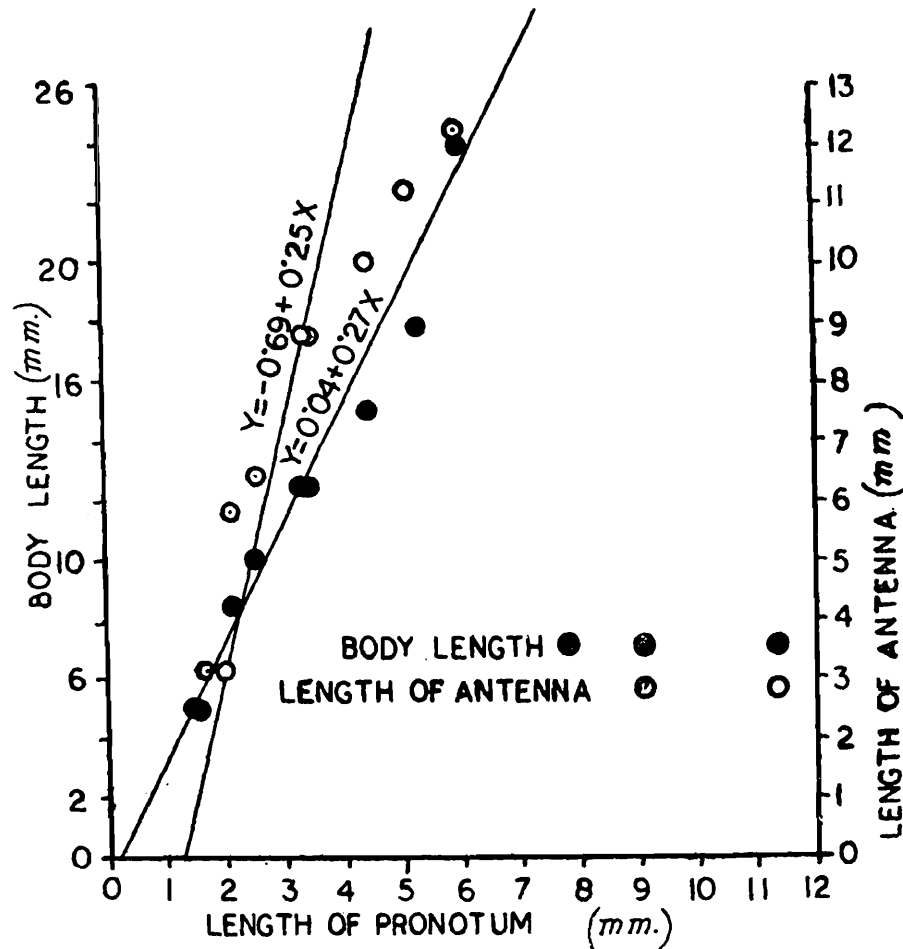


Fig. 5. Showing relationship between body length and length of pronotum and between the length of antenna and length of pronotum during the period of development of *E. pulchra*.

Half an hour after the completion of moulting, the newly hatched nymphs become very hungry and moved about actively. Its abdomen which was somewhat rounded finally became boat-shaped.

(c) *Mortality* : It was higher before the first moult after which the nymphs did

for 3-4 days. The high mortality, non-availability of proper food in different stages and lack of proper vegetation hindered their population in nature.

DISCUSSION

Several attempts had previously been

made to study the biology of mantids (Kramer 1960; Holling 1966; Gelperin 1968; Robinson 1969 and Kumar 1973) in different parts of the globe. In this species the major role in the formation of oothecae was played by the ventral valves. Perrier

taken in this study from the deposition of ootheca to hatching was 11 days in contrast to the finding of Kumar (1973) in *Phyllocarania paradoxa*. The cause of hatching within short period in this study might be due to the prevalence of high temperature

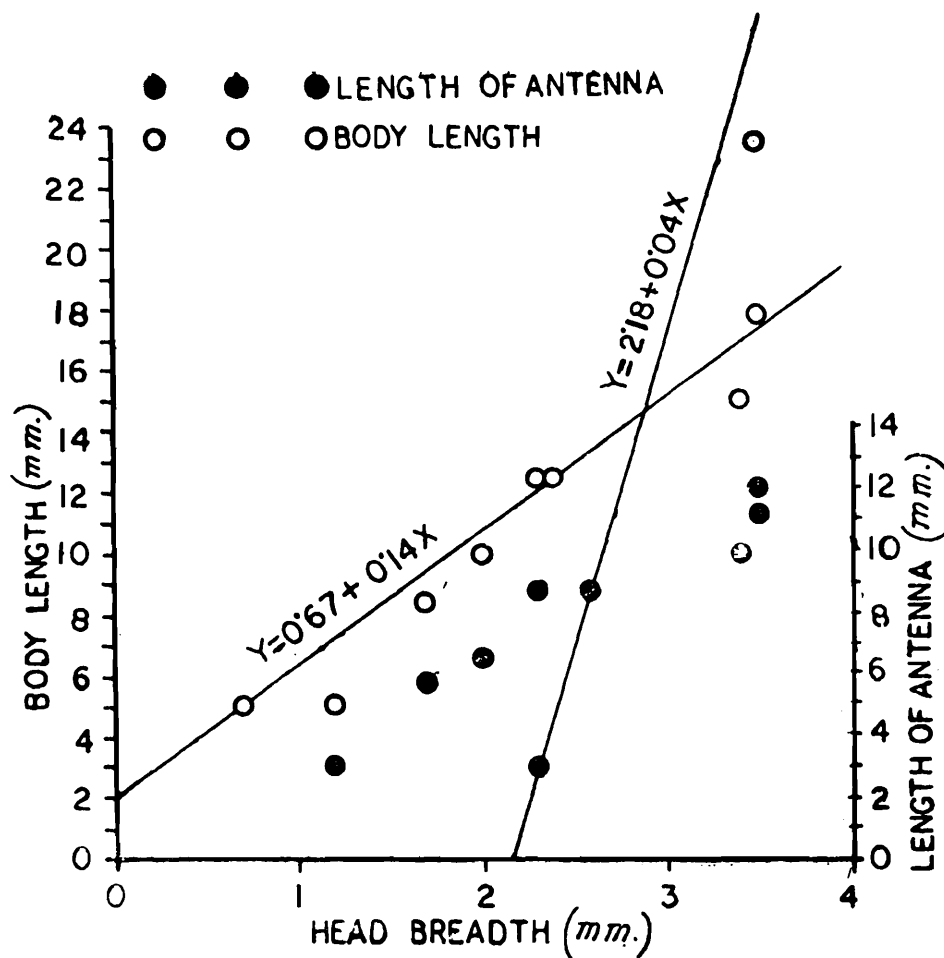


Fig. 6. Showing relationship between body length and head breadth and between length of antenna and head breadth during the period of development of *E. pulchra*.

(1870) reported in case of *Tenodera superstitiosa* the assistance of wings in the formation of oothecae, but in this investigation on such assistance was observed. The time

in the laboratory (Table 1). The total time for the development of *T. Superstitiosa* and *S. Lineola lineola* as given by Kumar (1973) were 238 and 228-295 days respectively.

According to Mathew (1955) in *Evantissa pulchra*, the time taken for the development was 70 days. The corresponding period in the present work for *E. pulchra* was 51 days.

that the weight of consumption of food was directly proportional to the body weight and body length. The similar observation was made in case of grasshopper *Eyprepocne-*

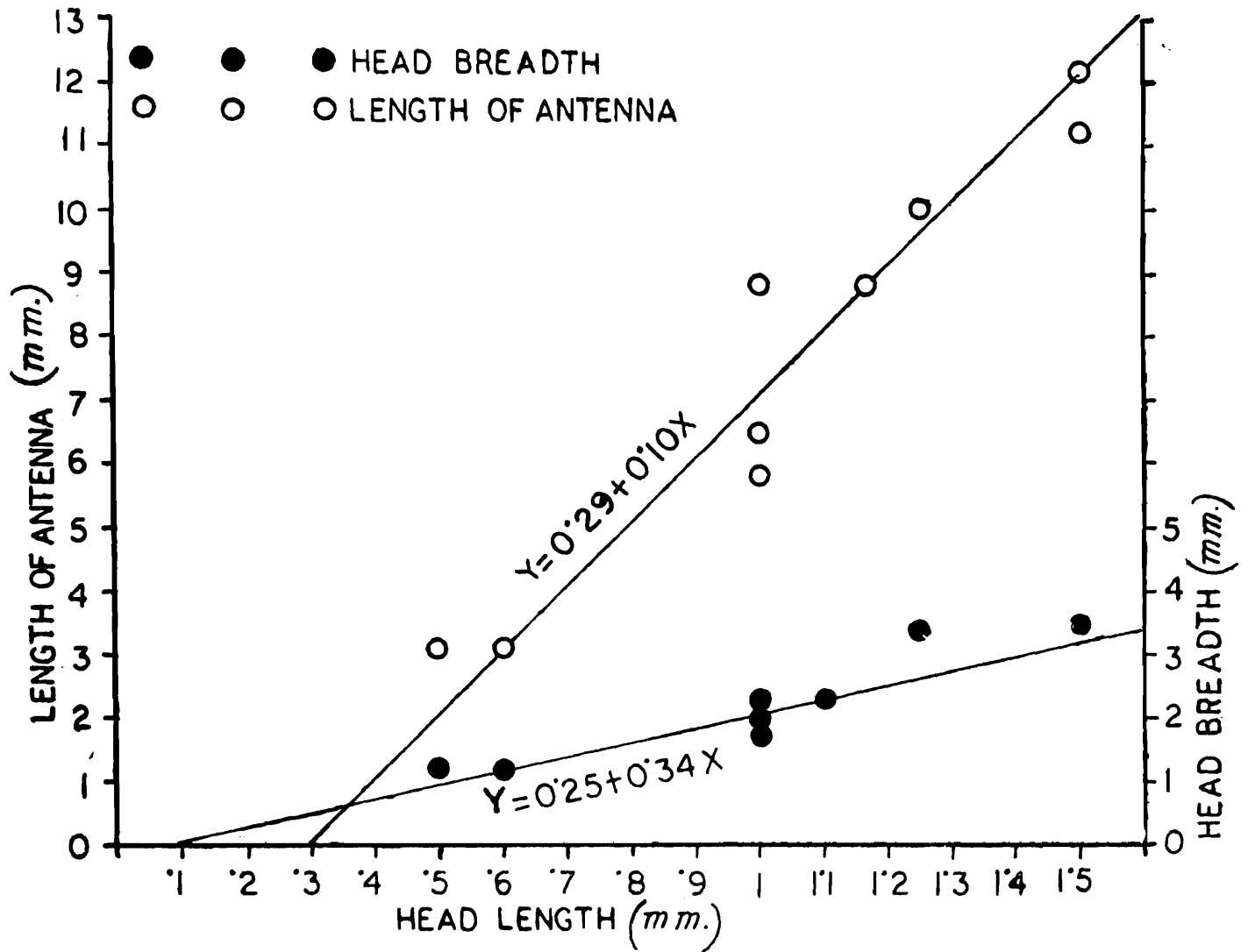


Fig. 7. Showing relationship between length of antenna and head length and between head breadth and head length during the period of development of *E. pulchra*.

The much shorter period recorded in the present study might be due to the high temperature and low relative humidity (Table 1). From the figure 3 it was evident

mis alacris alacris (Muralirangan and Ananthakrishnan 1977). The present investigation indicated that the weight of *E. pulchra* increased from instar to instar varying

between 2.20 mg. and 67.40 mg. The weight increased steadily upto the final nymphal instar.

parts of the body except in a few cases (Figs. 3-9). Further it was evident that only the head length remained constant from the 2nd

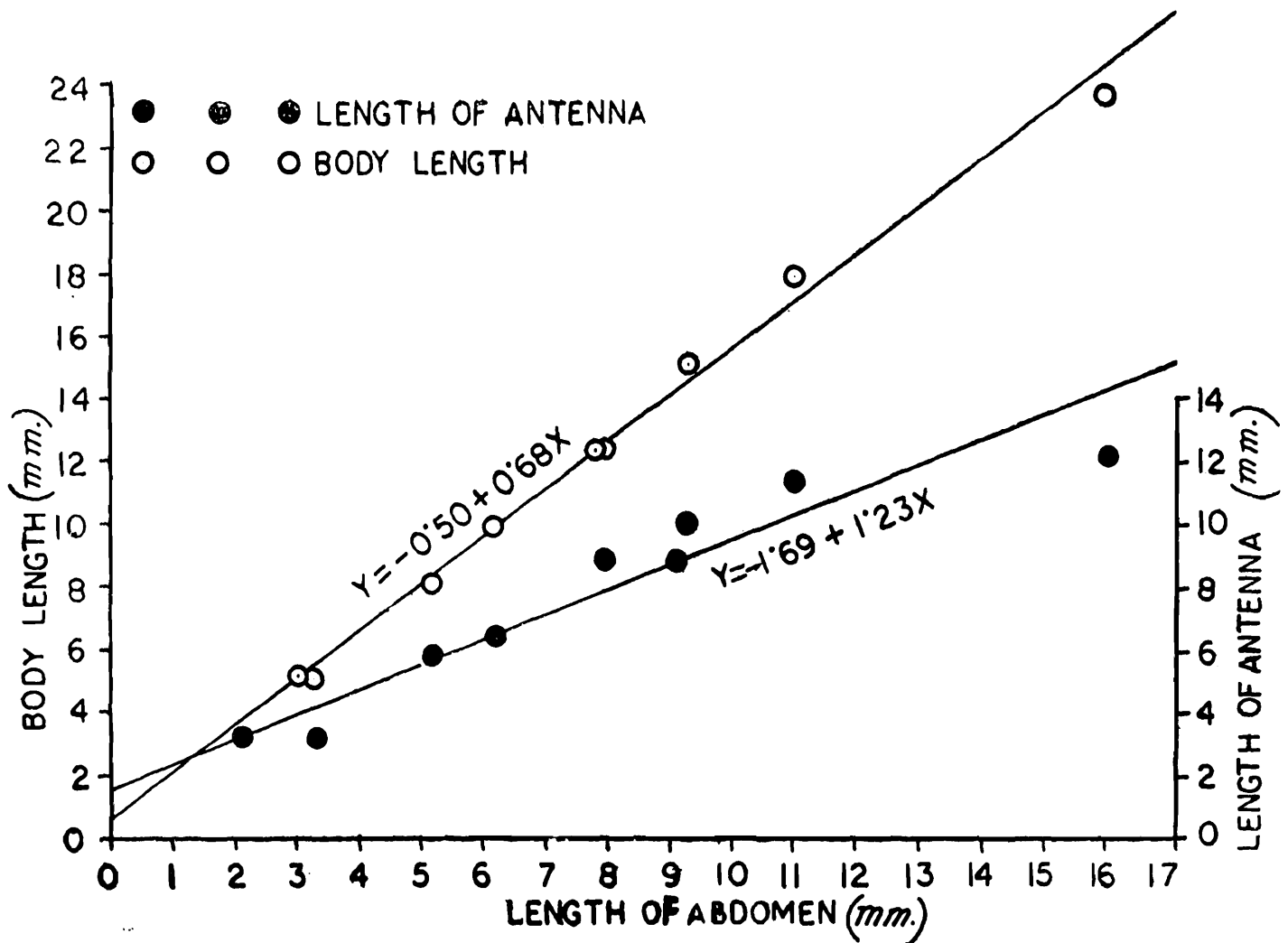


Fig. 8. Showing relationship between body length and length of abdomen and between length of antenna and length of abdomen during the development of *E. pulchra*.

The morphometrical studies showed that there existed a strong positive and highly significant correlation among the different

to the 4th nymphal instars, but in the rest of the body parts the length increased in different nymphs.

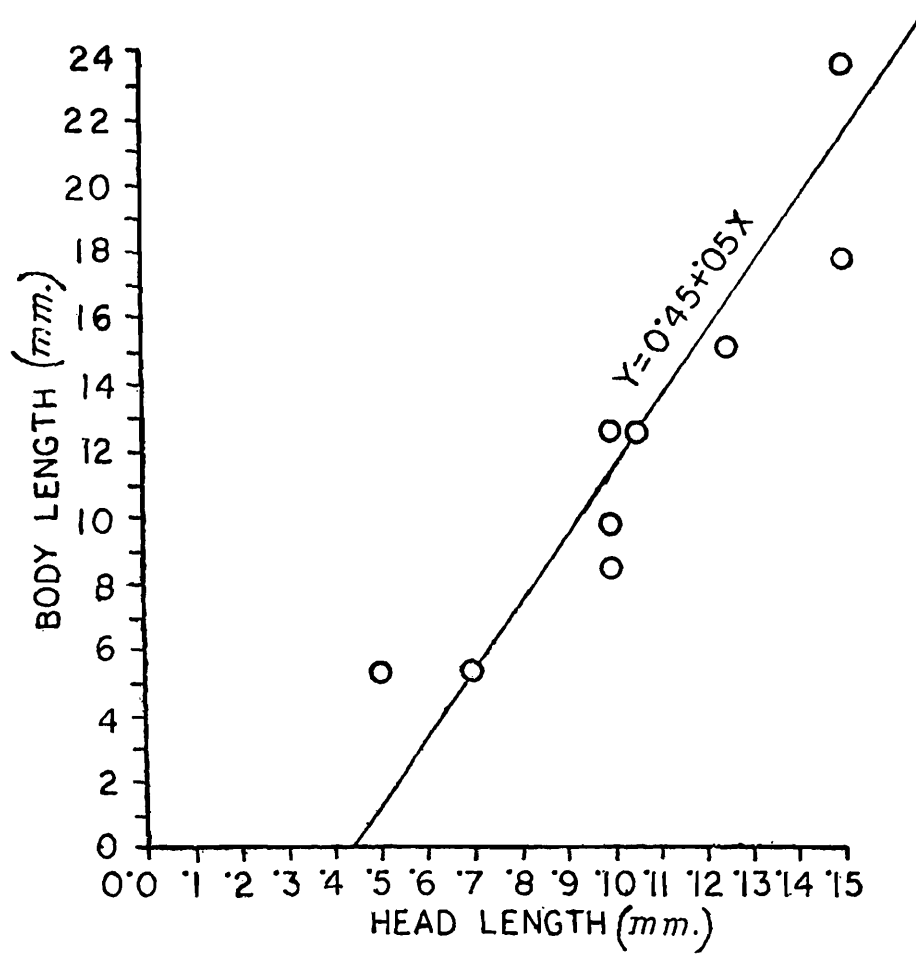


Fig. 9. Showing relationship between body length and head length during the period of development of *E. pulchra*.

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* Original not seen.