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**STUDIES ON THE LIFE-HISTORY
AND DESCRIPTION OF THE IMMATURE FORMS
OF THE EGYPTIAN APHIDOPHAGOUS SYRPHIDS:**

II — *Paragus aegyptius* MACQ.

= *compeditus* Wied.

[Diptera : Syrphidae]

(with 5 Text-figures and 1 Table)

by M.F.S. TAWFIK, A.K. AZAB and K.T. AWADALLAH

Faculty of Agriculture, Cairo University

INTRODUCTION

Paragus aegyptius Macq. is an aphidophagous syrphid of a common occurrence in Egypt (Efflatoun, 1922). An intensive search of the literature failed to turn up a single reference dealing with the life-history of this syrphid. Thus, the present investigation deals with this aspect together with detailed description of the immature stages of this predator and its feeding capacity during the larval stage.

GEOGRAPHICAL DISTRIBUTION

No information concerning the geographical distribution of *P. aegyptius* in other countries could be obtained from the available literature. According to the card index of the Entomological Department of the ministry of Agriculture at Dokki, this syrphid was collected in Egypt from the following localities : Abu Rawwash, Borgash, Cleopatra, Dekheila, Dokki, Ezbet el Nakhel, Ghezireh, Kafr Hakim, Kerdasa, Koubba, Mansouriah, Shoubra, Wadi Hoff, Wadi Sayyal and Wadi um Girfan.

MATERIALS and METHODS

The methods followed for rearing the predator *Paragus aegyptius* in the laboratory were the same used by Tewfik *et al.*, (1974) for rearing the aphidophagous syrphid *Syrphus corollae*.

EMERGENCE

The way of emergence of adult *P. aegyptius* from its puparium resembles that already described in the case of *S. corollae* (Tawfik *et al.*, 1974) and thus it needs no further information.

COPULATION

The pre mating period lasts 7.5 (1-13) days at 25.9°C. and 62.8% R.H. Mating behaviour in the case of *P. aegyptius* slightly differs from that of *S. corollae*. When the male of the former species mounts the back of the female, his head becomes situated upon her mesothorax. After gaining copulation, the male was, occasionally, observed moving rapidly forward to knock the female's antennae several times with his forelegs before leaving her. Mating process lasts a short period of 5.7 (4-9) minutes. Average number of repeated copulation was 9.2 in association with a female life span that averaged 37.3 days (at 25.9°C. and 62.8% R.H.).

OVIPOSITION

Paragus female laid the first eggs after 11.3 (8-16) days at 25.9°C. and 62.8% R.H. Oviposition process in this case resembles that previously described in *S. corollae* (Tawfik *et al.*, 1974). The total number of eggs laid by the female of *P. aegyptius* (fed during the larval stage on *A. maidis*) varied individually within the range 8-56 eggs (28.2 on average) at 25.9°C. and 62.8% R.H. At these conditions the oviposition period lasted 22.7 (20-29) days while the postoviposition period ranged between 1 and 11 days with an average of 3.7 days. The daily number of eggs varied individually and in the same individual. However, the maximum daily number of deposited eggs ranged between 2 and 7 eggs; the lowest number was associated with a relatively long oviposition period (29 days).

EGG STAGE

When newly laid, the egg is yellowish white in colour and measures 0.66 (0.62-0.79) mm. long and 0.28 (0.22-0.32) mm. wide. Its general shape (Fig. 1) resembles that of *S. corollae* (Tawfik *et al.*, 1974) except for its anterior pole which is less sloped and slightly blunt. It also has the same type of ornamentation of the egg of *S. corollae* but the length of each elevation is smaller; being 34.8 micron on the average. The elevations are also thinner with less radiating branches compared with that of *S. corollae*.

The incubation period lasted 1.8 (1-2) days at 26.5°C. and 56.7% R.H. and 2.6 (2-4) days at 21.5°C. and 58.4% R.H.

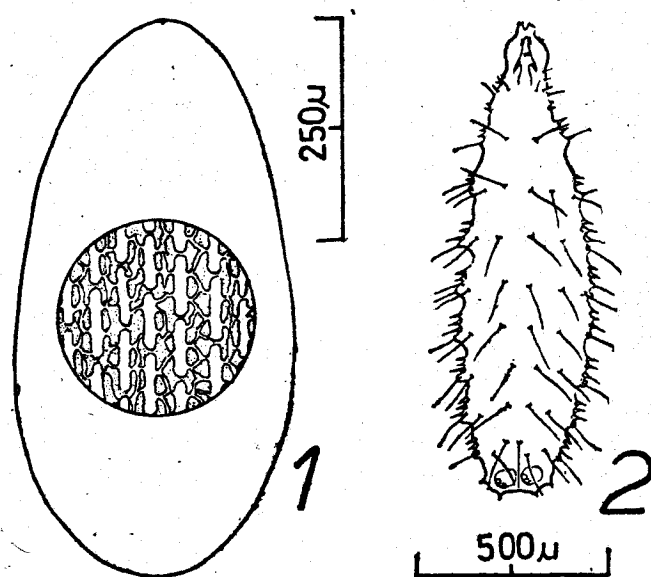


Fig. 1 : Egg of *P. aegyptius*; chorionic elevation highly magnified; Fig. 2 : First-instar larva of the same species.

LARVAL STAGE

First instar larva : the newly-hatched larva (Fig. 2) is 1.12 (1.00-1.19) mm. long and 0.31 (0.25-0.33) mm. at its greatest width and becomes 1.33 mm. long and 0.34 mm. wide when fully developed. Its colour starts with yellowish white, but after feeding on aphids, the contents of the gut gives the greenish middle portion of the larva a dark brown shade. The pulsating dorsal blood vessel could be seen through the translucent body wall. The bucco-pharyngeal armature also appears giving the anterior portion of the larva a greyish shade. It is 0.16 (0.14-0.17) mm. long and 0.080 (0.081-0.09) mm. wide, and its structure resembles that of *S. corollae*. The segmentation of the body is indistinct because of the integument being wrinkled and sparsely covered with minute scales. No pseudo-like projections are observed on the abdominal segments. The pseudocephalon is very small and is divided by a median groove into two lateral lobes to form the antenno-maxillary complex that resembles what has been described in *S. corollae* (Tawfik *et al.*, 1974). The posterior spiracles are of yellowish brown colour, each has spiracular plate of 0.04 mm. wide and with a structure similar to that of *S. corollae*. Chaetotaxy differs in some aspects from that shown in the first larva of *S. corollae*. In *P. aegyptius*, the head carries laterally two minute hairs, while

the prothorax has a dorsal transverse row of six hairs. On mesothorax, this row appears ventrally and has ten hairs; the two outer ones are the longest. The metathorax has eight dorsal hairs, and each of the first seven abdominal segments bears a transverse row of fourteen long hairs while the eighth segment has four small setae; two on either side. Setae located on middle line are the longest and those on posterior segments are longer than those on anterior ones. Each seta has a sharply pointed apex and uneven lateral sides and projects from a central cavity on a beady protuberance.

The first larval stadium lasted 2.4 (2-3) days at 26.5°C. and 56.7% R.H., while at 21.5°C and 58.4% R.H. this period increased to 3 (2-5) days.

Second instar larva : the newly-moulted second instar larva is 2.27 (1.74-2.60) mm. long and 0.67 (0.60-0.84) mm. wide. It is elongate oval in shape and somewhat flattened dorso-ventrally. The body attenuates gradually to the obtusely pointed anterior end and slightly to the truncate posterior one. Its colour is generally leaf green and turns to light grey on the head and thorax. The transparent integument shows clearly the dorsal blood vessel embedded in the fat body which has been developed during this stage in the form of an orange stripe extending from the first to the sixth abdominal segment. The mid-gut is also discerned with its black contents inducing black spots among this stripe.

The black buccopharyngeal skeleton is 0.42 (0.40-0.45) mm. long and 0.23 (0.22-0.24) mm. wide and has the same structure of the skeleton of *S. corollae* (Tawfik *et al.*, 1974). The prothoracic spiracles appear as two yellowish orange spots located in front of the prothoracic row of hairs. Each spiracle arises as a papilla projecting from a dorsolateral pit and ends in a circular opening of 0.02 mm. in diameter. The posterior spiracles consist of two spiracular plates that are similar to those of *S. corollae* but with fringed marginal hair-like processes shorter than those of *S. corollae*. Each spiracular plate is 0.064 (0.057-0.07) mm. in diameter. During the second stadium, the integument becomes tough with a beady surface lacking any sort of spines but pliable thrown into numerous transverse folds. The setae are relatively long and its colour turns to yellowish white instead of being black in the preceding stage. The cephalic setae are represented by a dorsal and a lateral one. Six papillae are located ventrally on the head; the marginal two are slightly longer than the remaining four. The thoracic setae still have the same number and arrangement as in the preceding instar. The seven rows of abdominal hairs are situated on the first seven segments of abdomen; each consists of twelve setae. The first abdominal pair of median hairs is approximately in one line with the dorsal and the dorso-lateral ones, while on the contrary, those of the following abdominal segments are situated slightly anterior to the remaining setae in the same row. The bases of the dorso-lateral prominences become

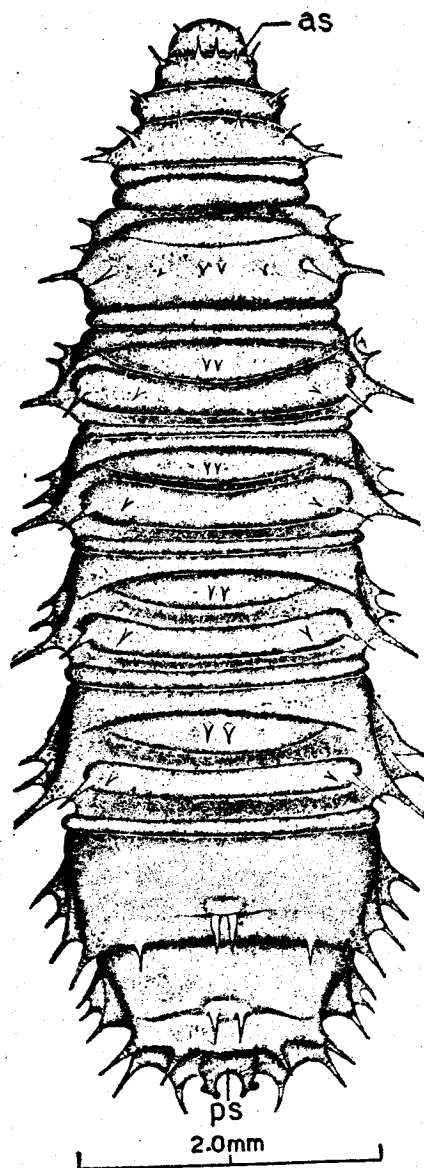


Fig. 3 : Third instar larva : as, anterior spiracle; ps. posterior spiracles.

close to each other; forming a distinct carina along lateral side of the larval body. The lateral prominences make a similar underlying carina which is less pronounced than the former one. The small ventrolateral setae are situated on projecting folds antero-ventral to the laterals. The eighth abdominal seg-

ment has four small setae; two on each side, in addition to the posterior spiracles which is deep brown in colour.

The second larval stadium lasted 1.7 (1-2) days at 26.5°C. and 56.7% R.H. and 2.4 (1-4) days at 21.5°C. and 58.4% R.H.

Third instar larva : (Fig. 3) when newly-moulted, the larva measures 5.35 (4.16-5.71) mm. long and 1.49 (1.29-1.56) mm. wide. Prior to pupation, it becomes 7.13 (6.23-8.42) mm. long and 2.10 (1.87-2.29) mm. wide. The general colour of the body is yellowish green, but on the head, the thorax and the terminal segment this colour turns to very light grey. The black buccopharyngeal armature appears through the skin which also shows the mid-dorsal vessel and the fat body that takes the shape of a stripe extending mid-dorsally between the dorsal setae. This stripe has a red colour on the fifth to the sixth abdominal segments and becomes creamy on other areas especially between the dorsal and the dorso-lateral abdominal setae. Its colour again turns to white beneath the protuberances of the dorso-lateral, the lateral and the ventro-lateral abdominal setae. The black contents of the gut induces black scattering on the fat body.

The cephalopharyngeal armature measures 0.733 (0.732-0.84) mm. long and 0.56 (0.52-0.57) mm wide and has the same structure as that of *S. corollae*. The prothoracic spiracle is orange in colour and with an opening (of 0.03 mm. in diameter) provided with marginal hairy processes. The posterior spiracles are situated on a tubular 'respiratory' process (Fig. 3 and 4). This process is deep brown in colour and measures 0.37 (0.32-0.41) mm. long and 0.32 (0.30-0.38) mm. wide. It originates from two cylindrical processes fused proximally and separated apically at one-fourth of its total length. The dorso-lateral sides of the fused portion of this process are roughly papillose. Its strongly sclerotized distal part, on the other hand, is preceded by a constriction; about half way the total length of the process. Two long pointed setae are located dorsally on the respiratory process; each arising between the spiracular I opening and the scar. Another two setae are situated ventrally; each one on an elevation near the spiracular opening III. The three pairs of spiracular openings are curved and are located on well-developed carinae at the distal end of the respiratory process; openings II and III are diverging by 90°C. The two perispiracular glands have four channel-less openings on the surface; one of these is of a double nature. The scar is pear-shaped and feebly sclerotized.

Chaetotaxy still has the same pattern of the preceding stage. Each seta is sharply pointed and awl-shaped. It is born on the summit of a fleshy elevation and a pit is present at its base. However, each of the setae belonging to the meso- and metathorax has two pits; one smaller than the other.

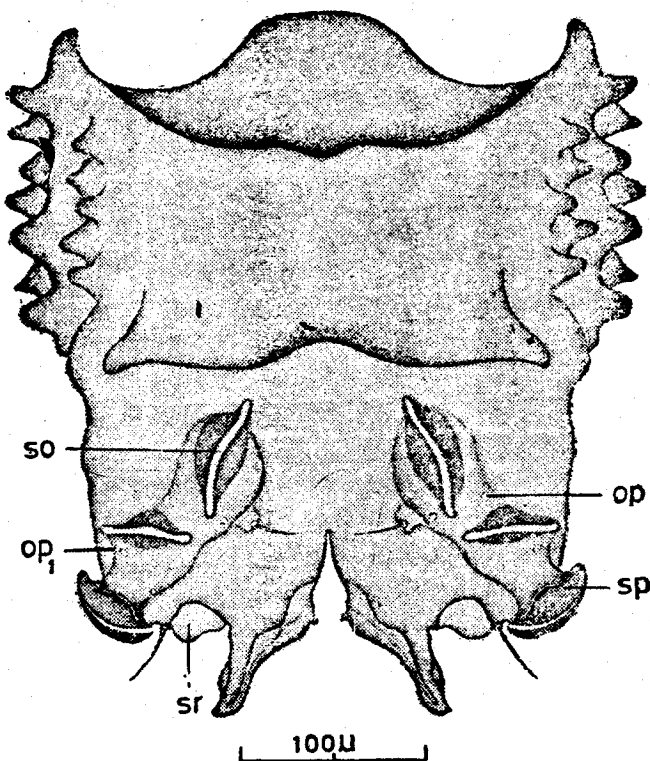


Fig. 4 Ventral view of the posterior respiratory process of third instar larva :
 op, opening of the perispiracular gland; op₁, double opening of the perispiracular gland;
 so, spiracular opening; sp, spiracle; sr, spiracular scar.

The third larval stadium lasted 3.2 (2-4) days at 26.5°C and 56.7% R.H. and 4.5 (3-6) days at 21.5°C and 58.4% R.H.

The total larval period of *P. aegyptius* was attained in 7.3 (6-8) days at 26.5°C. and 56.7% R.H. and 12.8 (11-15) days at 21.5°C. and 58.4% R.H.

Efficiency of the larva : larvae of *P. aegyptius* are frequently associated with the colonies of *Brevicoryne brassicae* on Cabbage, Brussels prouts and Cauliflower plants, with those of *Aphis gossypii* on Okra, Squash, Kenef and cotton plants and with those of *Aphis maidis* on Maize plants. The feeding capacity of the larva of this predator was estimated, as seen on Table 1, in association with the first prey at two different thermal conditions.

TABLE I

Number of aphids (of *B. brassicae*) consumed by the larva of *P. aegyptius* at two different temperatures and humidities.

	No. of aphids consumed at							
	26.5°C and 56.7% R.H.				21.5°C and 58.4% R.H.			
	Min.	Max.	Aver.	A.*	Min.	Max.	Aver.	A.*
First	5	19	10.73	2.40	7	21	12.75	2.93
Second	10	38	23.55	1.67	13	69	26.89	2.43
Third	22	97	73.82	3.20	92	104	94.37	4.54
Total	94	125	113.91	7.31	115	153	128.75	12.80

*A : average larval duration in days.

This table clearly shows that the increase in the number of aphids at the lower temperature (21.5°C.) increases with the increase in the larval duration. It is also noticed, that at any condition, the feeding capacity greatly increases as the larva becomes older.

PUPAL STAGE

The puparium of *P. aegyptius* (Fig. 5 A and B) is elongate, nearly perfect oval and arched from above and depressed down posteriorly to attach with the pupation site. Its narrow posterior end carries the protruded respiratory process while its anterior end is almost nicely rounded. The female puparium, being 4.53 (4.46-4.88) mm. long and 2.08 (1.97-2.39) mm. wide, is slightly larger in size than that of the male which measures 4.42 (4.16-4.67) mm. long and 1.97 (1.87-2.08) mm. wide. These dimensions include the posterior respiratory process. When newly-formed, the puparium retains the colouration of the third instar larva and as the pupa develops the colour of the puparium shows marked changes. A day before the emergence (Fig. 4 A) the reddish brown head of the adult appears, through the wall of the puparium, where it is seen marked posteriorly by short lines of a deeper colour. The dark brown thorax and wings are also discerned together with the abdomen which is mottled with alternative orange and light brown stripes. Remaining areas of the body appear yellowish brown. Ventrally, (Fig. 4 B), the black cephalo-pharyngeal skeleton is seen embedded in a yellowish brown area which is suffused with red marginally. The remaining parts of the ventral surface is yellowish brown and darkens on the area fixed to the substratum. Dark spots are seen scattering dorsally and ventrally.

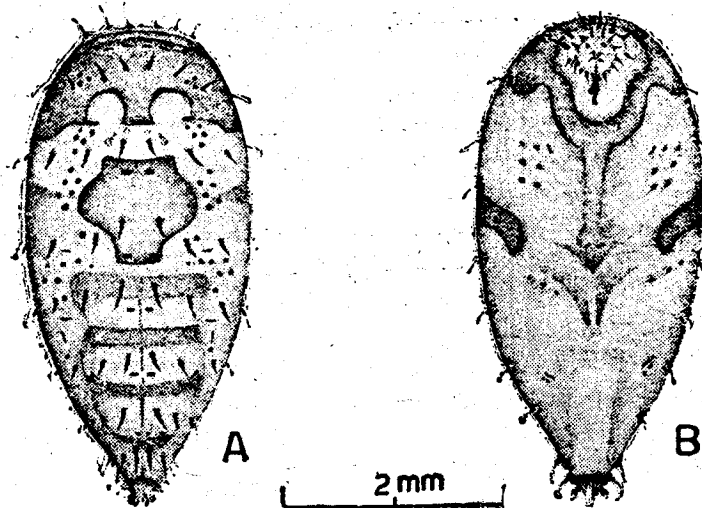


Fig. 5 : Dorsal (A) and ventral (B) view of puparium (drawn prior to emergence).

The duration of the pupal stage, at 26.5°C. and 56.7% R.H., was attained in 8.5 (7-9) and 8.2 (6-9) days in the case of male and female, respectively. At 21.5°C. and 58.4% R.H., the respective durations increased to 15 (13-16) and 14 (13-15) days.

ADULT LIFE-SPAN

Under similar conditions the female lives longer than the male. At 25.9°C. and 62.8% R.H., former lived 37.3 (29-46) days and the latter lived 22.2 (17-32) days.

NATURAL ENEMIES

It was found during the present investigation that the larvae of *P. aegyptius* are parasitized by the ichneumonid *Diplazon laetatorius* Fab. and the encyrtid *Syrphophagus* sp.

SUMMARY

The present paper deals with the morphology of immature stages and some biological notes on the aphidophagous syrphid *P. aegyptius*. The biological processes have been described in detail. The incubation period lasts 1.8 days at 26.5°C. and 56.7% R.H. and 2.6 days at 21.5°C. and 58.4% R.H. The durations of the three larval instars are attained in 2.4, 1.7 and 3.2 days

at 26.5°C. and 56.7% R.H., respectively during which they devour 10.7, 23.5 and 73.8 individuals of *B. brassicae*, respectively. Under these conditions the total consumption rate is 113.9 aphids during a larval period of 7.3 days. At low temperature (21.5°C. and 58.4% R.H.), this rate increases; being 12.7, 26.9 and 94.4 aphids in the three instars, that last 2.9, 2.4, 4.5 days, respectively and the total consumption rate reaches 128.7 aphids in a total larval period of 12.8 days. The pupal period averages 8.5 and 8.2 days at 26.5°C. and 56.7% R.H. in males and females, respectively while the averages are 15 and 14 days in both sexes at 21.5°C. and 54.4% R.H. The life-span of the males averages 22.2 days at 25.9°C. and 62.8% R.H. while that of the female is 37.3 days during which she deposits 28.2 eggs on the average. Two hymenopterous parasites; i.e., *Diplazon laetatorius* Fab. and *Syrphophagus* sp. attack the predator during its larval stage and emerge from its puparium.

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