

**MORPHOLOGY AND BIOLOGY OF MICROBRACON KHOKHARI, n. sp., AND M. GHANII, n. sp.
(HYMENOPTERA: BRACONIDAE) ECTOPARASITES OF SPOTTED BOLLWORMS***

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Abstract. *Microbracon* Ashmead is a well known genus of Braconid parasites all over the world. The species of the genus are ectoparasites in lepidopterous and coleopterous larvae. Two species of the genus *M. lefroyi* (D. and G.) and *M. kitcheneri* (D. and G.) are known to parasitise spotted-bollworms (*E. fabia* and *E. insulana*) apart from other lepidopterous larvae in Pakistan. Our investigations have revealed two other new species of the genus *khokhari*, n.sp., and *M. ghanii*, n.sp. parasitising the two bollworms species in Sind, Pakistan. In the present account has been given their morphology (females only), biology and life history.

Microbracon Ashmead is a large genus of the family Braconidae, with species occurring almost all over the world. The species usually parasitise a wide variety of Lepidopterous and Coleopterous larvae, some of which are highly significant pests. Taylor,¹¹ Harris,⁴ Glover,³ Pyne,⁹ Rao,¹⁰ Brues,² Munro,⁸ and Muesebeck⁷ and several other workers reared species of *Microbracon* on host larvae of the species *Chilo simplex*, *Ephestia kuhniella*, *Heliothis obsoleta*, *Cephus pygmaeus*, *Eublemma amabilis*, *Phycita infusella* and several others.

The species of *Microbracon* described from Indo-Pakistan, so far, after taking into consideration the synonymy of Ayyar¹ are *M. greeni* (Ashmead), and *M. asiaticus* (Szepliget) from Ceylon, *M. tachardiae* (Cameron) from North India, *M. quettensis* (Cameron) and *M. iridipennis* (Cameron) from Baluchistan, and *M. fletcheri* (Sylvestri) from Pusa, India. *M. lefroyi* (Dudgeon and Gouph) was described by the authors as a parasite of cotton bollworm from India. Later on Brues² and Hussain and Mathur⁵ redescribed the species *M. lefroyi*, as well as the species *M. kitcheneri* (Dudgeon and Gouph) as parasites of cotton bollworms. To date these are the only two species of *Microbracon* recorded parasitising cotton bollworm species in Indo-Pakistan.

During the present investigation by the author, in southern area of Sind, two more species of *Microbracon* were collected very frequently and are presently being described as new species *M. khokhari*, and *M. ghanii*.

Material and Methods

The initial material of *Microbracon* spp. was reared out of *E. fabia* and *E. insulana* infested with parasites in the field. The host material was mostly collected from districts, Hyderabad, Mirpurkhas and Thatta in the lower Sind. About 25 specimens of *M. khokhari*, n.sp., and 20 specimens of *M. ghanii*, n.sp., were recovered. Later on the adults of the two species were allowed to parasitise the host larvae in laboratory cages. The adults were fed on dilute honey, and the

host larvae concealed in bolls were presented for parasitisation. The details of biology and life history are based on a study of about one year, and mostly pertain to laboratory conditions. All the measurements are given in mm.

Microbracon khokhari, n.sp. (Fig. 1)

Morphology of Female. Length 2.8-3, head in front view subcircular, narrow behind the eyes; face strongly receding below; temples broad; malar space short; antennae shorter than the body, 26 segmented, with basal flagellar segment about twice as long as broad, following segments considerably longer than broad; face faintly punctate, clothed with small fine hairs; frons smooth and polished, interocellar region dark, prominently raised; ocelli black; eyes oval; mandible short and stout, with 2 teeth, dorsal one larger; maxillary palpi gradually becoming larger, with first two labial palpi equal, third one bigger, thorax rather robust, about twice as long as high, smooth and polished, with parapsidal furrows having scattered long hairs; propodeum smooth, polished, without distinct median longitudinal carina posteriorly, with a faint stub and a median ridge at apex; metapleura, sides of propodeum and posterior coxae clothed with long silken hairs; wings hyaline; second abscissa of 'R' 3 times longer than the first; 3rd

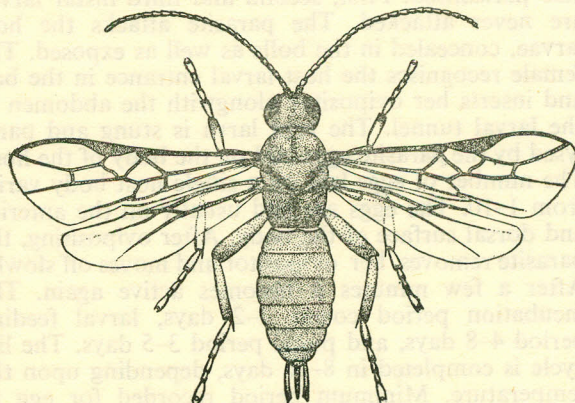


Fig. 1. *Microbracon khokhari*, n.sp., adult female.

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abscissa of 'R' longer than the 1st and 2nd abscissae combined, 'R' running up to apex; abdomen longer than the thorax; plate of first tergite more or less sculptured laterally and posteriorly; 2nd tergite slightly rugulose over a small basal middle area, very faintly punctate over most of the remainder of its surface; 3rd and the rest of tergites entirely smooth and polished; articulation suturiform, fine and smooth; ovipositor 1/4 of the abdomen, legs stout, fore legs with coxae somewhat flattened, produced posteriorly; femora stout; tibiae slender; middle legs similar; hind legs with coxae very stout; claws with a basal pointed lobe.

Colour. Head and thorax dark brown, antennae brown, mandibles dark brown, palpi yellowish or pale; abdomen ventrally light brown, dorsally usually brown; 1st and 2nd tergites dark brown with a blackish midtransverse edge; legs yellowish; bases of tibiae dark, ovipositor dark brown; male generally somewhat smaller than female and dark in colour. veins and stigma of wings dark brown.

Comparison. *M. khokhari*, n.sp. appears close to *M. lefroyi* in the overall length of female, which is between 2-3; the antenna being 25-27 segmented in *M. lefroyi* and 26 segmented in *M. khokhari*. The two species, however, differ in the shape and length of the ovipositor. The ovipositor is 1/4 the length of abdomen in *M. khokhari*, whereas the ovipositor is slightly longer than the abdomen in *M. lefroyi*. The differences of *M. khokhari*, n.sp. with other related species, e.g. *M. brevicornis* are more prominent.

Type and other Material. Holotype female, Thatta, Sind, Pakistan, 11.IX.70 (Ramzan), and 23 paratypes collected from Mirpurkhas, and Hyderabad, deposited in the Zoological Museum, University of Karachi, Karachi.

Biology

Microbracon khokhari, n.sp. is a parasite of spotted-bollworms of cotton *E. fabia* and *E. insulana* as well as some coleopterous and lepidopterous species. The larvae attacked by the parasite do not succeed in pupation, and are consumed almost completely by the developing parasite larvae.

Usually full grown larvae are preferred by the parasite for egg laying, but fourth instar larvae are also parasitised. First, second and third instar larvae are never attacked. The parasite attacks the host larvae, concealed in the bolls as well as exposed. The female recognises the host larval entrance in the boll and inserts her ovipositor along with the abdomen in the larval tunnel. The host larva is stung and paralysed by the parasite eggs laid on the body of the host. The number of eggs laid on a single host body varies from 1-10. The eggs are laid usually on the anterior and dorsal surface of the body. After ovipositing, the parasite removes her ovipositor and moves off slowly. After a few minutes it becomes active again. The incubation period covers 1-2 days, larval feeding period 4-8 days, and pupal period 3-5 days. The life cycle is completed in 8-16 days, depending upon the temperature. Minimum period recorded for egg to adult is 7-9 days in the species *Microbracon lefroyi* Ashm. and *Microbracon serinopae* Ramkr. in India.

Life History

The Egg. The egg of the parasite is elongated in shape with rounded ends (Fig. 2A). The cephalic end is bluntly rounded and is the broadest part of the egg. Its colour is at first translucent white, then becomes milky white, except for a small area at caudal end. The chorion is smooth and shining. The developing embryo can be seen within the egg. The embryonic membrane remains behind, when hatching takes place. The eggs measure about 0.75×0.14 and remains sticking to the larval body.

First Instar. The larva, after hatching attaches itself to the host larva by means of its mouth parts, and starts feeding by suction (Fig. 2B). Usually, the larva remains fixed to the point where it starts feeding, till it is full fed, but may change the position and migrate to a new place. Generally the larvae are observed with their own body at right angles to the host.

The newly hatched larva has a distinct head and 13 well-differentiated body segments, including three thoracic and ten abdominal. The cuticle is shining. The newly hatched larva is translucent white, elongated in shape and broad in thoracic and anterior abdominal regions. From 6th abdominal segment, it gradually narrows to the last segment.

The mouth parts consist of a labrum, maxillae, ligular area and the mandibles. The mandibles are simple hymenopterous type. The labrum is bilobed and bears setae. Maxillary and labial palpi are absent. The mandibles are strongly chitinised; the basal portion is thickened and broad. The transverse tentorial bar is represented by a strut present on the posterior extremity of the hypostoma.

Each body segment possesses double row of spines arranged in semicircles on the dorsal and lateral surfaces. Each spine in the two rows on a segment alternates with spine in the other row. All spines are directed posteriorly. The rows of spines are nearly equidistant. The spines on the last 2 abdominal segments are

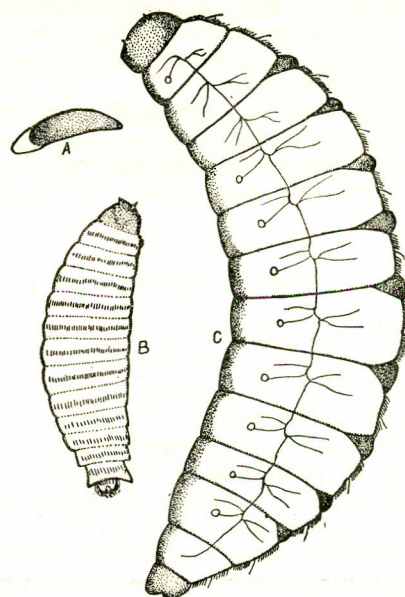


Fig. 2. *Microbracon khokhari*, n.sp., (A) egg; (B) larva, 1st instar, (C) larva, 5th instar,

less numerous, but much longer than the other segments. The last segment is very small as compared to the other abdominal segments. It is also invaginated posteriorly and covered with long hair-like processes. The larva measures about 0.85 in length and 0.2 in width. This stage lasts for 1–2 days.

Second Instar. The 2nd instar larva measures about 0.25 in width and about 0.9 in length. The head at this stage is clearly differentiated. There are no spines on its body. The prothorax and last 2 abdominal segments are white; the remaining segments with a greenish tinge.

Mandibles are stout and sharp. The antennae are more developed than previous instar. Mouth parts are similar to those of the first instar. Setae are dispersed irregularly on the body.

The tracheal system consist of a pair of lateral longitudinal trunk, connected by anterior and posterior commissures in the prothorax and 9th abdominal segment respectively. There are nine pairs of open spiracles, one on the prothorax and the others on first to eight abdominal segment. The main lateral trunk runs into the head, where it ramifies and supplies the anterior and ventral regions. The ventral trunk arises from the main longitudinal trunk. The lateral longitudinal trunks give off branches in the ninth abdominal segment, which supply the last abdominal segment. The larval instar lasts for 1–2 days.

Third Instar. The larva is similar in shape to previous instar larva, except that it is bigger in size. It is about 1.75 in length and 0.38 in width, and feeds lying curved over the body of the host larva. The head is more chitinized and prominent. Urate granules are also visible. Head, prothorax, mesothorax and metathorax are narrow. First five abdominal segments are equal in breadth; 6th, 7th and 8th are narrower; 9th and 10th segments are very small. The body is tapering at both ends and broader in the middle.

The tracheal system, mouth parts, and setae as in previous instar. The antennae and mandibles are bigger. This stage lasts for 1–2 days.

Fourth Instar. It measures about 2.20 in length and 0.6 in width. It is more or less spindle-shaped, being broadest in the middle. The body segments are distinct, and body wall is transparent, thin and smooth. The trachea and fat cells are seen through it. The larva is similar to that of 3rd instar except in size. Urate granules are more prominent. The arrangement of the tracheal system is also the same. The head is more chitinized; antennae more squat and bigger and mouth parts similar to that of 3rd instar. The transverse tentorial bar runs internally across the head, connecting on each side with the posterior end of hypostoma. Setae are present all over the body. This stage lasts for 1–2 days.

Fifth Instar. The larva measures about 3.5–4 in length and about 1.2–1.5 in width (Fig. 2C). The head is small but clearly defined. Mouth parts are yellowish or light brown. Greatest breadth of the larva is in the region of first four abdominal segments. Lateral folds present on 2nd to 10th segment. The antennae are narrow and prominent. The mouth parts are more chitinized, labrum, overlying the pleurostoma, and mandibles. The anterior arms of the tentorium are very poorly developed.

The tracheal system is the same as in 4th instar larva. The 1st pair of spiracles open near the middle of prothorax and the remaining eight are present on the 1st eight abdominal segments. It lasts for 1–3 days in July and August and 3–4 days in December.

The Cocoon. It measures about 3.2 in length and 1.00 in breadth. The pupa is enclosed in dull white silken-capsule. The surface has a mat like appearance, consisting of white, smooth silken-threads. Shortly after completing the cocoon, the larva starts to pass meconium. The larva after sometime becomes inactive and enters prepupal stage. The thoracic segments appear expanded. The width of the abdomen decreases, and eye spots appear.

In the late prepupa, the thorax is noticeably expanded, wing pads and appendages can be seen lying below the cuticle. In case of female prepupa, the ovipositor can be seen under the larval cuticle. The pupa is of hymenopterous type and is free within the cocoon. The pupa is at first whitish and then becomes gradually darker. The eyes appear as red brown spots. Antennae are curved down and reach the 6th abdominal segment. This stage lasts for about 3–5 days. The adult parasite comes out by cutting a circular hole in the anterior end of the cocoon.

Microbracon ghanii, n.sp. (Fig. 3)

Morphology of Female. Length 3.00–3.58, head distinctly though sparsely hairy; malar space short, less than half the transverse diameter of the opening between clypeus and mandibles; face and frons closely and minutely punctate and opaque; vertex faintly punctate; vertex and temple broad; eyes small, oval; ocellar space raised; antennae 27 segmented, flagellar segments longer than broad, first segment twice as long as broad; mesonotum and scutellum faintly punctate; propodeum and posterior coxae evenly punctate; forewing with 'R' near apex, second abscissa of 'R' $2\frac{1}{2}$ times longer than first, third abscissa equal to first and second combined; third to sixth tergites in female and third to fifth tergite in male granulated; ovipositor slightly longer than abdomen.

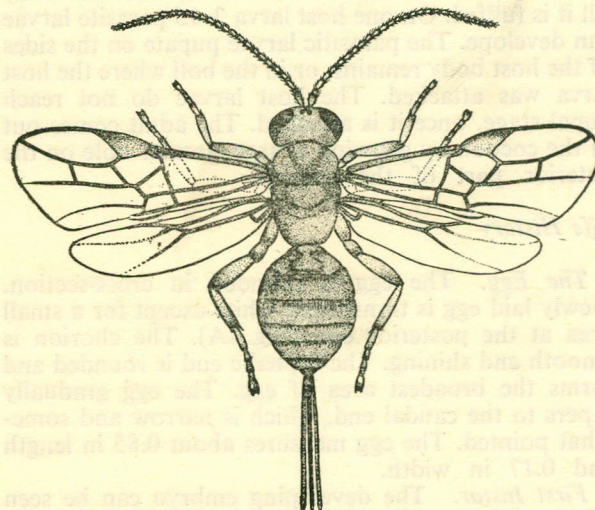


Fig. 3. *Microbracon ghanii*, n.sp., adult female.

Colour. Light brown to yellowish brown; legs and lateral sides of abdomen yellowish, base of antenna dark brown; wings hyaline; veins and stigma dark brown; head and thorax subopaque; scutellum smooth and shining.

Comparison. The species *M. ghanii*, n.sp. is close to the species *M. lefroyi* and *M. khokhari* in general, but differs in the combination of characters. It is longer than the other two species, being 3–3.58 long; and the length of ovipositor being much more than in *M. khokhari*.

Type and other Material. Holotype female, Mirpurkhas, Sind, 5.IX.70 (Ramzan), and paratypes collected from Thatta and Hyderabad, in the Zoological Museum, University of Karachi, Karachi.

Biology

Microbracon ghanii, n.sp. is also a fairly common ectoparasite of the spotted-bollworms of cotton in Sind and has habits nearly identical to *M. khokhari*. Usually full grown larvae are preferred for egg laying. Fourth instar larvae also attacked by the parasite. The adult parasitises larvae both concealed in the bolls as well as exposed. It recognises the host even few millimeter away and stings the larva to paralysis and then lays eggs on the body of the host. The number of eggs laid on a single host varies from 1 to 16. The eggs are laid usually on the anterior part of the host body like *Microbracon khokhari*, but may also be found anywhere on the host body. After oviposition, the parasite removes its ovipositor and moves off slowly. After a few minutes it again becomes active.

The female starts egg laying soon after the emergence. A newly emerged parasite does not lay more than 10 eggs per day but the egg laying capacity increases with age. Total eggs laid by a single female, as observed in the laboratory were 200 in its life time and the minimum egg number was 65. Parthenogenetic progeny is all males.

The newly hatched larva becomes attached to the body of the host by its mandibles and begins to suck the body fluids. It remains attached to the host body till it is fullfed. On one host larva 3–15 parasite larvae can develop. The parasitic larvae pupate on the sides of the host body remains, or in the boll where the host larva was attacked. The host larvae do not reach pupal stage, once it is attacked. The adult comes out of the cocoon by gnawing a large circular hole on the anterior part of the cocoon.

Life History

The Egg. The egg is rounded in cross-section. Newly laid egg is translucent white except for a small area at the posterior end (Fig. 4A). The chorion is smooth and shining. The cephalic end is rounded and forms the broadest area of egg. The egg gradually tapers to the caudal end, which is narrow and somewhat pointed. The egg measures about 0.85 in length and 0.17 in width.

First Instar. The developing embryo can be seen within the egg (Fig. 4B). When larva hatches, the embryonic membranes remain behind. The larva

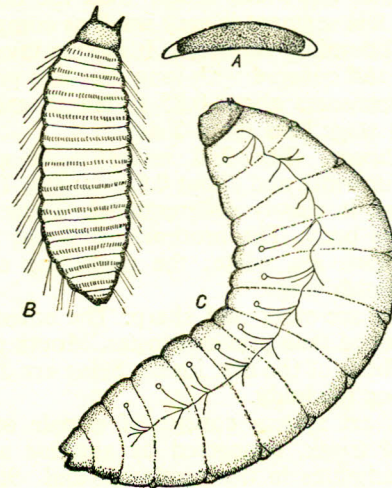


Fig. 4. *Microbracon ghanii*, n.sp., (A) egg, (B) larva, 1st instar, (C) larva, 5th instar.

attaches itself to the body of the host larva by its mouth parts, and starts feeding by suction. It may remain at the original point of attachment for the whole instar. More usually it feeds for sometime and then attaches at a new place. It usually remains in lying position on the body of the host, while feeding. Larvae are observed with their mouth parts attached to the body of the host, and their bodies at right angles to the host.

The larva has a prominent head, and three thoracic and ten abdominal well-differentiated segments. The colour of larva on hatching is white. It is broadest in the vicinity of the first six abdominal segments. From the 7th abdominal segment, the body tapers towards the posterior end. There is a pair of prominent antennae on the head, placed in dorsolateral region.

The mouth parts (Fig. 5A) consist of a labrum, maxillae, ligular area and the mandibles. The labrum is slightly bilobed. The labrum forms the anterior border of the preoral cavity. The ligular area defines the posterior border of the preoral cavity, and maxillae define the lateral border. Maxillary and labial palpi are absent. Mandibles are strongly chitinised. The basal portion is thickened and broad. The mandibles bear apparently five slightly curved teeth as in *M. brevicornis*.

The body segments, except the last abdominal, are encircled dorsally and laterally by stout spines placed roughly in two rows. The spines are placed close together. The rows of spines are almost equidistant. Setae are present on the whole body surface except the ventral side. There is no trace of tracheal system; no spiracle is present.

Second Instar. The larva at this stage is about 0.95 long and about 0.3 in broad. The head is clearly differentiated and is white. The cuticle is without spines. The prothorax and the last two abdominal segments are white, the remaining segments showing a green tinge due to the colour of the contents of the alimentary canal. Urate granules are visible scattered over the anterior abdominal segments.

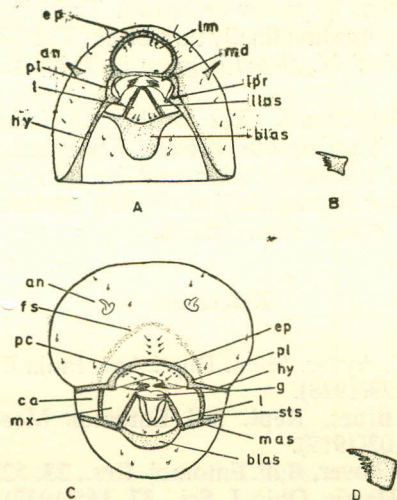


Fig. 5. *M. ghanii*, n.sp., (A) head, 1st instar larva; (B) mandible, 1st instar larva; (C) head, full grown larva; (D) mandible, full grown larva.

The tracheal system is present at this stage, and consists of a pair of lateral longitudinal trunks connected by anterior and posterior commissures in the prothoracic and 9th abdominal segments respectively. The main lateral trunks run into the head, where they ramify to supply the anterior and ventral regions. The ventral trunk arises from the main lateral longitudinal trunks. There are nine pairs of open spiracles, one in the prothorax and eight pairs on the first to eighth abdominal segments. Mandibles are more stout and sharp. The antennae are more squat than the previous instar. Mouth parts are similar to those of first instar. The transverse tentorial bar is represented by a small strut at the posterior extremity of the hypostoma. It is joined to its fellow of opposite side by a fine bar. Setae are present on the body segments.

Third Instar. It is similar to 2nd instar larva in all respects, except that it is bigger in size. It is about 1.80 long and 0.42 broad. It feeds lying curved on the body of the host. Its head is more chitinized, but less prominent. The cuticle is colourless. Head, prothorax and mesothorax are narrow; metathorax and first eight abdominal segments are equally broad, 9th and 10th abdominal segments are narrow, making the body appearance tapering on both the ends and broader in the middle.

The tracheal system is the same as in previous instar. The antennae are about the same size, except that they are much broader basally. Mouth parts are also similar. Mandibles are bigger in size. The transverse tentorial bar is similar to 2nd instar; the strut being, however, more prominent. Setae are present on all the body segments.

Fourth Instar. It measures about 2.5 in length and 0.8 in width. The larva is very much similar in shape to the 3rd instar larva, but it is bigger in size. The cuticle is smooth, shining and devoid of spines. The tracheal system is also similar to the previous instar.

The antennae are more squat than in the 3rd instar, and bigger in size. The mouth parts are also similar

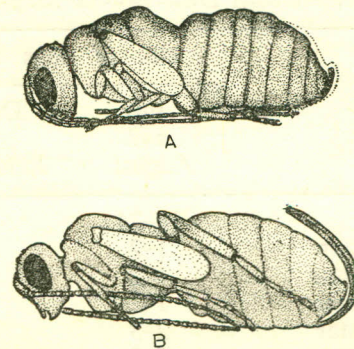


Fig. 6. Pupa (A) *M. khokhari*; (B) *M. ghanii*.

to that of 3rd instar larvae. The transverse tentorial bar runs internally across the head, connecting at each side with the posterior end of hypostoma.

Fifth Instar. The larva is about 3.8–4.2 long and about 1.2 broad (Fig. 4C). The head is clearly defined, small, broader than long. The mandibles are more stout and light brown; other mouth parts are also brownish. Greatest breadth is in the region of first four abdominal segments; 5th and 6th are of nearly equal breadth, 7th, 8th and 9th tapering, 10th small, translucent, colourless and slightly bifid at the posterior end. Cuticle is colourless. The contents of the alimentary canal give the larva a greenish or yellowish appearance according to the host larva and its conditions. Lateral folds also present on the first eight abdominal segments and thoracic segments. The antennae are narrow, but the basal portion is broad. The mouth parts (Fig. 5C) at this stage are clearly defined. The labrum is forming the dorsal border of the preoral cavity, and overlies the pleurostoma and mandibles. The ligular sclerom being rather unusual in shape. The mandibles are similar to those of 4th instar. The tentorium is represented by the transverse tentorial bar.

The tracheal system is similar to that of the previous instar. The dorsal and ventral trunks branch more profusely and a number of tracheoles arise from all the main trunks. Setae are present on all the body segments and are irregularly placed.

The Cocoon. It measures about 3.5–4.00 in length and 1.00–1.5 in breadth (Fig. 5A). The pupa is enclosed in a whitish silken-capsule. Its surface has a mat-like appearance, consisting of whitish silken-threads. No cap is formed but the eclosion occurs through a circular hole with serrated edges, which is bitten by the adult, about to emerge. The cocoons are formed at the side or below the host remains. Shortly after completing the cocoon, the larva starts passing the meconium.

The larva after sometime becomes inactive and enters the prepupal stage. The thoracic segments are expanded. The width of the abdomen decreases in size due to extrusion of the excreta. As the prepupal stage advances, the eye spots appear.

In the late prepupa, the thorax is noticeably swollen, wings and appendages can be seen lying below the cuticle. In case of female prepupae, the ovipositor

TABLE 1. LIFE HISTORY DURATION OF *M. ghanii*, n.sp.

Stage	No. of days required	
	July and August	December and January (days)
Egg	18-24	1-2
1st larval instar	1-2	1-2
2nd larval instar	1-2	1-2
3rd larval instar	1-2	1-2
4th larval instar	2-3	2-3
5th larval instar	2-3	2-3
Pupal stage	4-6	7-10
Total	12-17	15-24

can be distinguished under the larval cuticle in the abdominal region.

The Pupa. The pupa is of common hymenopterous type and is free within the cocoon (Fig 6B). It measures about 2.3-3 in length and 1.00-1.2 in breadth. It is at first translucent white. The eyes are originally white and rapidly change from yellow to yellow brown, deep brown, and finally from deep crimson to black. The ocelli are originally white, but pass through similar stages rather slowly. The head and thorax change through pale yellow to brown and yellowish brown. The abdomen at 1st creamy

white, deepens to yellow or brown. The wing sheaths take a grey tinge first finally turn black. The life history duration of *M. ghanii* is given in Table 1.

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