Biotaxonomic Study of *Apanteles Prodeniae* (Hymenoptera : Braconidae)

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Abstract : *The order Hymenoptera is extremely important from the view of Biological control of insect pests. Biology forms the basic information for the workers involved in biological control programmes for formulating mass rearing. The Apanteles is an old, well known genus, initiated by Foerster in 1862.*

Keywords : *Hymenoptera, Biological control, Apanteles.*

Materials and Methods : *30 females and 50 males, wings, antenna, legs were mounted and studied. 50 early second instars of Spodoptera litura were exposed to five mated females of Apantelesprodeniae. Parasitoid eggs and larvae were collected after 12h interval by dissecting parasitized host larvae in saline, solution.*

I. INTRODUCTION

The parasitic hymenoptera is an important component in biological control programme. Biological control and taxonomy are interrelated and interdependent. Taxonomists need for the identification of biological control agents, understanding their evolutionary history, compilation and to guide explorations for native and exotic parasitoids.The detailed taxonomical works on Indian species were those of Wilkinson (1928, 1929), Bhatnagar (1948), Rao (1961), Nixon (1967), Rao and Chalikwar (1970), and Sathe and Inamdar (1988, 1989). In assessments of parasitic hymenoptera a reliable approach would be to study their lifecycle stages. Biometrical data is helpful in separation of different instars of the species. Fulton (1940), Cardona and Oatman (1971), Rojas – Rouse and Benoit (1977), and Sathe and Nikam (1985) have attempted such type of studies. It is estimated that there are about 250,000 species of parasitic Hymenoptera in the world, of which only about 50,000 have been described (Gupta 1988). The family Braconidae having almost 40,000 species is divided into 21 subfamilies, some important among them are Euphorinae, Microgastrinae, Braconiae, etc.

The subfamily Microgastrinae is of economic importance because they breed from the lepidopterous hosts. It includes the three genera into which Foerster *Microgaster* Lateriella, *Microgaster*, *Microplitis*and *Apanteles*.

Apanteles genus was given by Foerster in 1862. Nixon (1965) divided this genus into 44 species groups. Some of these groups are very large like ater, ultor, etc: some groups, on other hand, have less than half a dozen species. Rao (1961) compared critically this genus with the help of all available literature and type specimens and divided *Apanteles* into two subgenera viz. *Areolatus* and *Carinatus*by presence or absence of propodeal areola as the main, valid and important character for the division. The catalogue of *Apanteles* Shenefelt (1972) lists 1118 valid species and nearly 200 more have been described since then for a total of about 1300 species. 2000 species have been included under this genus by Mason (1981) from different parts of the world.

II. BIOLOGY OF A. *PRODENIAE*

Egg (Fig 7) : The eggs are laid by female parasitoid inside the body of the host 1st instar caterpillar. Usually only one egg is deposited per host. At the time of oviposition, the eggs of *A. prodeniae* are stalked translucent, white, cylindrical, rounded. The cephalic end is slightly longer than the caudal end. The size of the eggs increase considerably at the time of hatching, homogenous, a deep yellowish zone appears along the central parts and outline of the embryo is also marked. The length of 20 eggs averaged 0.47mm (range 0.44-0.54mm)

and width 0.156mm (range 0.136-0.170mm). 3 days after oviposition eggs are characterized by an enlarged cephalic ends and the presence of a clearly discernible first stage larva within it.

Larva : There are 3 instars in this species, the first two are vesiculate and last is hymenopteriform.

First instar (Fig 4) : The early first instar has a translucent body consist of a quadrat head, 3 thoracic and 7 abdominal segments and smooth body surface. The tracheal system was not observed in this stage. The larval body is opaque, head is narrow. The caudal horn of the early stage has evolved to a large conspicuous, bladder like vesicle. As the larva grows in size the posterior end becomes broader and the segmentation become well marked. The full grown larval body is 1.21mm in length and 0.251mm in width, head capsule averaged 0.31mm in length and 0.1mm in width, mandibles averaged 0.040mm in length and 0.017mm in width while vesicle averaged 0.49mm in length and 0.17mm in width. The first instar lasts relatively longer, 3 days than other instars.

Second instar (Fig 2) : The second instar is hymenopteriform, with 13 body segments and anal vesicle. The second instar is found on the 7th day after oviposition. The body cavity is almost entirely occupied by the large gut. The paired salivary glands fills the major portion of the body cavity. Tracheal system of larvae has two longitudinal trunks, extending posteriorly through the entire length of larva and giving off dorsal and ventral branches in each of the 10 abdominal segments. The tracheal system is not seen in vesicles. Spiracles are absent. The integument is soft. The body length is 1.91mm and the width is 0.35mm. The head capsule length 0.5mm and the width is 0.258mm. The average length of mandibles was 0.066mm and width was 0.029mm. The length of vesicles was 0.62mm and width was 0.32mm. The second instar lasts for 2 days.

Third instar (Fig 1) : The third and last instar is hymenopteriform appeared on the 9th day after oviposition. The cephalic structure is well developed and sclerotized. The mandibles are well sclerotized and show a marked differentiation between anterior and posterior processes. The head is small compared with the rest of the body. Third instar was 2.70mm in length and width 0.76mm. The length and width of mandible was 0.108mm and 0.038mm. The length of head capsule was0.624mm and width was 0.42mm. The vesicle was smaller in size than second instars. The mean length and width were 0.06mm and 0.012mm. The third instar lasts 2 days.

III. BIOMETRY

Biometric studies of different instars of *A. prodeniae* showed there is increase in length and width of larval form as well as in head capsule, mandible **(Table 1).** The results obtained clearly indicate that there exists a co–relationship between the age of the larval instar and the size which was tested with regression analysis. The statistical results are tabulated in (**Table 2 a, 2 b).**

Cocoon (Fig 8) : After emergence the last instar of parasitoid form a silvary white, densely spin, cylindrical cocoon. The mean length and width was 3.3mm and 1.21mm respectively.

Prepupa : the prepupal period is one day initially; it has the same color as the mature last instar and is filled with fat globules. The fat globules later disappear and become crescent shaped with blackish spots and distinct segmentation of the body i.e. head, thorax and abdomen. The length and width was measured 3.1mm and 1.0mm.

Pupa (Fig 6) : The pupa is light yellow initially except for the blackish eyes and brown ocelli. The pupal period lasts for 7 days. The length and width of 20 individuals were averaged 3.0mm and 1.2mm.

Emergence (Fig 9) : Emergence of adults from cocoons takes place about 30 minutes. If food is available, feeding could occur immediately. The sex ratio of male: female is 1:0.53.

Adult (Fig 3) : The length of female is 3.24mm. The length of ovipositor is 0.30mm and is thick, curved, strongly tapering from base to apex. Apical segment of the front tarsus with an inconspicuous hardly differentiated spine, basal area of tergite only about half as long as the rest of the segment beyond it.

Table 1

Biometrical measurement of the larval instars of *A. prodinae*

Larval body structure		Larval instars		
		First	**Second**	**Third**
1.	**Larval body**			
	Length	1.21	1.91	2.70
	Width	0.251	0.45	0.76
2.	**Mandible**			
	Length	0.040	0.066	0.108
	Width	0.017	0.029	0.038
3.	**Head capsule**			
	Length	0.11	0.20	0.44
	Width	0.009	0.19	0.42
4.	**Vesicle**			
	Length	0.49	0.62	0.06
	Width	0.173	0.32	0.012

Measurements in millimeters

Table 2a

Statistics of Linear Regression Relationship of Larval Age and Length of *A. prodinae*

Sr. no.	Age in days X	X^2	Larval length Y	Y^2	XY	Expected values Y
1	3	9	1.29	1.464	3.63	1.1975
2	5	25	1.91	3.648	9.55	1.9425
3	7	49	2.70	7.29	18.7	2.6875
	15	83	5.82	12.402	32.08	

Mean : X = 5, Y = 1.94, a = 0.08, b = 0.3725, r = 0.416, t = 0.898, p < 0.01

Table 2b

Statistics of Linear Regressioon Relationship of Larval Age and Width of *A. prodinae*

Sr. no.	Age in days X	x^2	Larval width Y	y^2	XY	Expected values Y
1	3	9	0.221	0.0630	0.753	1.705
2	5	25	0.35	0.1225	1.75	1.959
3	7	49	0.760	0.5776	5.32	2.213
	15	83	1.361	0.7631	7.823	

Mean : x = 5, y = 0.4536, a = 1.324, b = 0.127, r = 0.9493, t = 1.223, p < 0.30

IV. TAXONOMY

Female : 3.24mm long.

Head : Head is rectangular, 0.30 mm long and 0.96mm broad; vertex smooth, shiny with very shallow punctures laterally; interorbital space is 0.96 mm; ocelli in a triangle, ocellocular space equal to inverocellar space; frontcellar space is 0.32 mm; frons smooth, shiny; face slightly convex, medially elevated, shallowly punctuate, pubescen; supraclypealfavae deeply impressed, smooth, shiny with long setae. Antenna shorter than body, 3.09 mm long, 16 segmented, preapicalsegments about longer than wide.

Thorax : 1.40 mm long , dark in color pronotum deeply punctuate with distinct dorsal and lateral furrows; mesotonum 0.6 mm long; black with white setae, scutellar furrow with suicitegula round, black with white setae; mesopleuron punctuate, propodeum 0.84 mm long, 0.54 mm broad, dark in color, rectangular in shape. Fore wing 3.20mm long; costa 1.60 mm, hairy; medius 1.20mm long; stigma faint brown , 0.60 mm long, hairy; Hind wing: 2.60 mm long, vannal lobe convex, hairy, outer margin hairy, colorless. Hindleg: 3.50 mm

long, apical segment of front tarsus poorly developed in comparison with the spines occurring in expulsus.

Abdomen : 1.04 mm long; horizontal surface of tergite I is smooth and plished; basal area of tergite (2+3) polished and smooth except

for frons of sculpture towards sides; tergite (2+3) only about half as long as the rest of the segments beyond it; ovipositor 0.30 mm long, very thick, curved, strongly tapering from base to apex, with an apical attenuation, equal to the fourth segment of the hind tarsus.

Host : *Spodoptera litura*

Discussion : The braconids attack the immature stages of host, most commonly with notable exceptions of Euphornae, which oviposit in the imago. However, some of the Euphorinae species reported to be attacking the adult, pupa or larva which typically occurring in the same habitat (Clausen, 1940; Loan, 1963). No braconids are known which oviposit in host pupae more than sporadically (Berisfordet. 1970; Sluss 1968).*A. prodinae* total duration of the life cycle was 17-18 days, the egg hatching period was 3 days, first instar lasted 3 days. Second instar 2 days, third instar 2 days, prepupa 1 day and pupa 6-7 days.

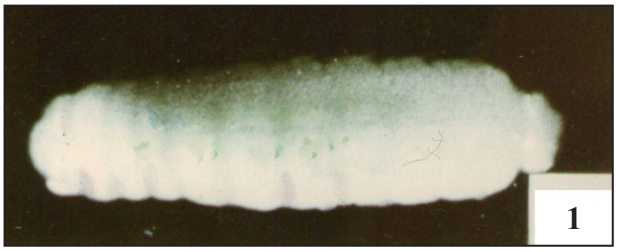
In the present study, biometric measurements were taken, considering the structures like head capsule, mandibles, spiracles of the larvae. As the instar progresses the size of head capsule, mandibles increased. These findings are in an agreement with the general principal of moulting and growth: observations thus, indicate that the highly chitinised parts like mandible and head capsule increases in size only after moulting. The application of regression analysis to the data obtained on the measurements of the body length, width of the instars showed significant corelationship with the larval age and their length and width. (Table 2 a, 2 b).

Key to the species of *Apanteles*Foerster 1862:

1. Propodeum never with median longitudinal carine and with a well-defined areola and costulae, ovipositor sheath long, always hairy through, arising near or apex of valvifer, rarely as short as half of the hind tibia.

2. Horizontal surface of tergite I greater part smooth and polished; basal area of tergite polished and smooth except for trace of sculpture towards sides. Apical segment of the front tarsus with an inconspicuous hardly differentiated spine basal area of tergite only about half as long as the rest of the segment beyond it; setae of the median cell colorless; ovipositor very thick, curved, strongly tapering from base to apex but with an apical attenustion equal to the fourth segment of the hind tarsus. Propodeum with "U" shaped areola, stigma colorless except upper border is brown.

3. Ovipositor sheath is smooth, hairless, brown; vanal lobe convex and densely hairy; tergite I bearing median apical through; tertite III longer than tertite wider than long, smooth; tertite I, L/W=1.7 mm long; tibial spurs unequal; basitarsus densely hairy.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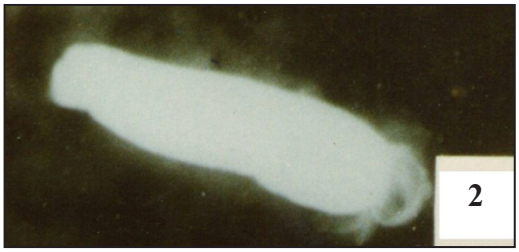
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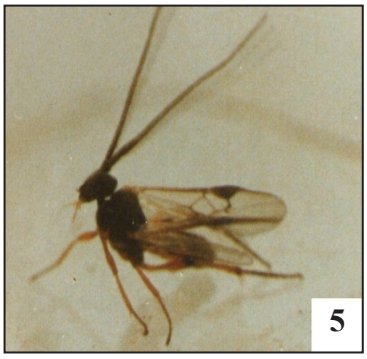
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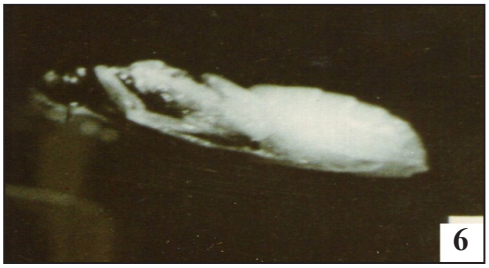
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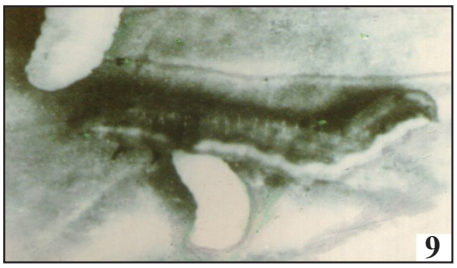
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Adult female - fig 3, **Egg** - fig 7, **First instar** -fig 4, **Second instar** - fig 2, **Third instar** - fig 1, **Emergence of Parasitoid larva** - fig 9**, Cocoon**- fig 8, **Pupa** - fig 6, **Adult Male** - fig 5

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