Bull. zool. Surv. India, 7 (1) : 49-58, 1985

DEVELOPMENTAL MORPHOLOGY OF *CERVAPHIS SCHOUTENIAE* v. d. Goot (HOMOPTERA : APHIDOIDEA)

BASANT K. AGARWALA AND S. SAHA

Department of Life Science, Calcutta University Post Graduate Centre, Agartala, India

A. K. GHOSH

Zoological Survey of India, Calcutta 700016

ABSTRACT

Distinct quantitative and qualitative changes in various morphological characters occur in the development of apterous viviparous females of *Cervaphis schouteniae* v. d. Goot, which specifically infest *Microcos paniculata* in Tripura, north east India. Descriptions and key for the identification of the developmental stages have been provided. Necessary diagrams exhibiting morphological variations have also been included.

INTRODUCTION

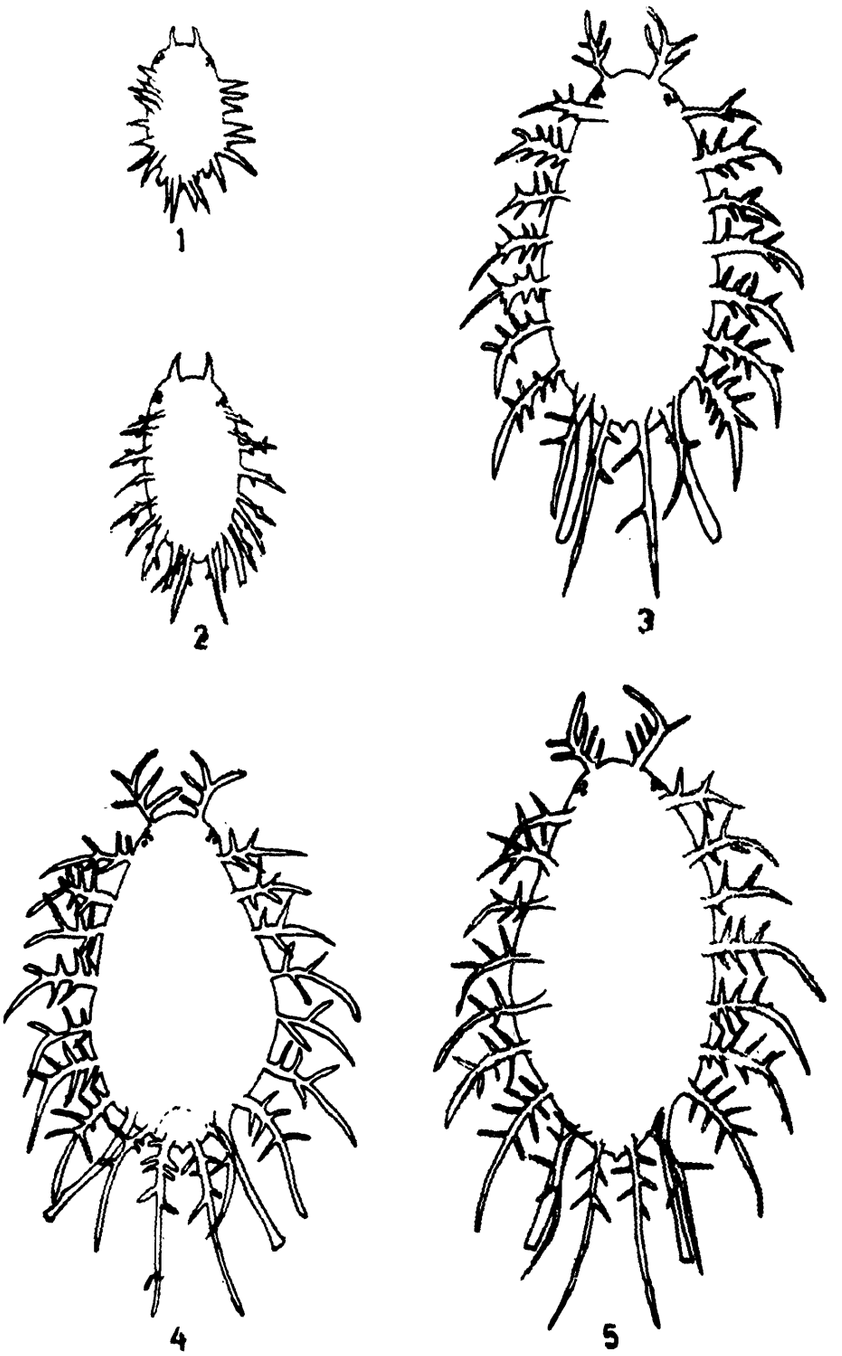
No attempt appers to have been so far made for a systematic study of the morphological variations of taxonomic importance in the developing stages of any cervaphidine aphids, which are highly restrictive in their geographical distribution and host association (Ghosh, 1982). Zoogeographically this aphid group is more prevalent in Asia, and India account for seven of the 17 species known from the world (Eastop and Lambers, 1976). Evidently, cervaphidine aphids deserve better study in this part of the world.

Cervaphis schouteniae, v. d. Goot, 1917 is one of the four species of *Cervaphis* known from India. It is known by apterous and alate viviparous female morphs only (Agarwala, *in press*) and has been known to infest some plants of Meliaceae, Sterculiaceae and Tiliaceae in India (Raychaudhuri and Chatterjee, 1980).

Present study evalutes the morphological vrriations of taxonomic importance in the developing stages of apterous viviparous females of *C. schouteniae* in order to provide identifying characters of different nymphal instars which are more commonly found in the aphid colony. This study should also prove useful in the interspecific identification in such genera whose species very often exhibit overlapping of characters in the adult stages.

MATERIAL AND METHODS

The study was conducted at Agartala, forming part of west Tripura in north east India. Five potted plants of *M. paniculata*, the specific host of *C. schouteniae* in the study area, were planted in laboratory conditions and each plant was infected with one adult apterous viviparous female collected from the natural colonies. At the end of 48 hours, 11-14 first inster nymphs were found on each potted plant. At this stage, adult apterae were removed from the newly formed colonies and from one plant all the first instar nymphs were preserved in 70% alcohol. Each of the remaining four plants with first instar nymphs



Figs. 1. First instar nymph ;
2. Second instar nymph ;
3. Third instar nymph ;
4. Fourth instar nymph ;
5. Adult apterous viviparous female ;

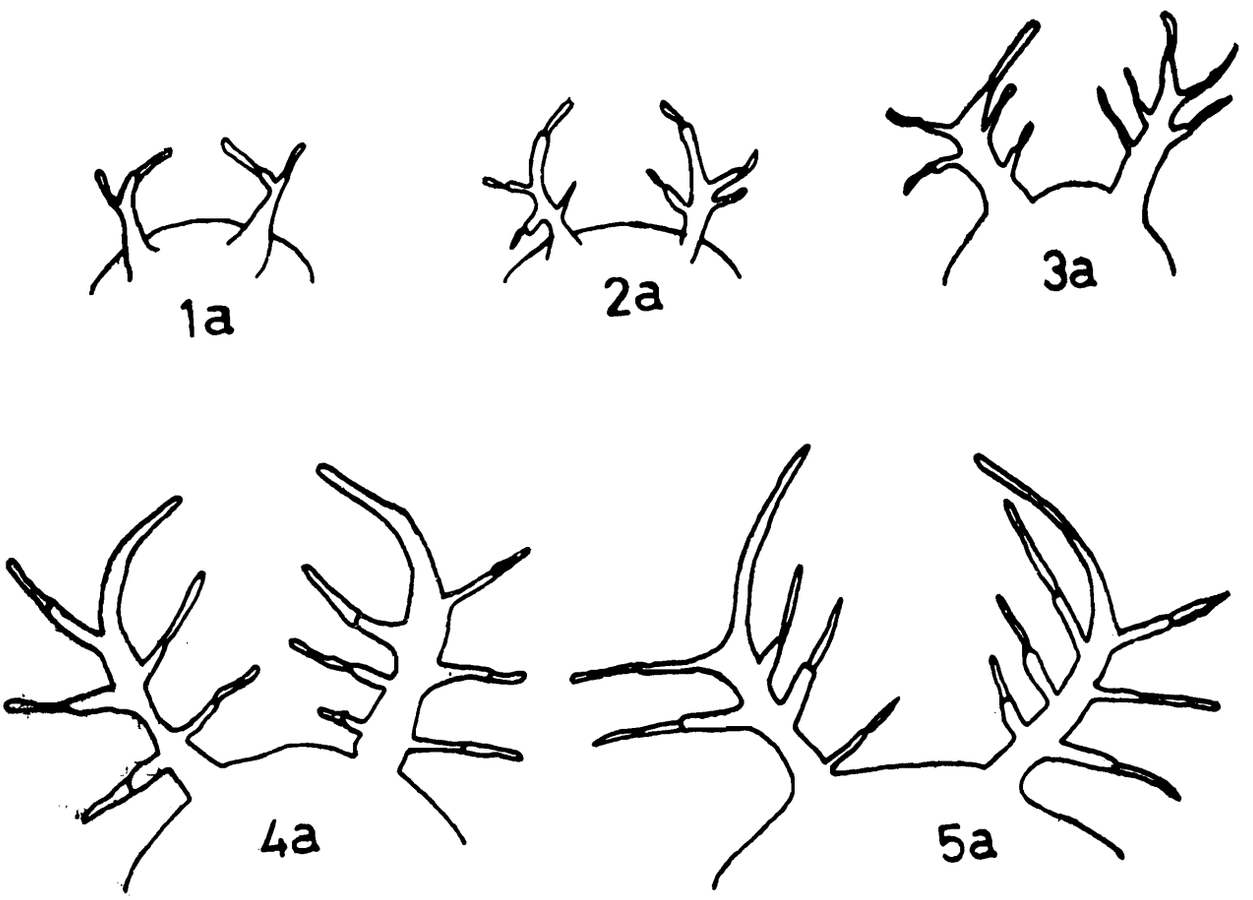
were kept undisturbed so as to study the second, third, fourth instar nymphs and adult apterae. Observations at 8 hr. intervals were taken to note the moulting of the aphids ; part of the specimens of each instar were removed and preserved in 70% alcohol.

As a result of this practice more then 10 specimens of each nymphal instar and adult apterae were obtained which formed the basis of this study. All the aphids were processed and mounted on the slides by the usual method and subjected to microscopic study for morphological and morphometric variations. All the measurements were converted 5 mm.

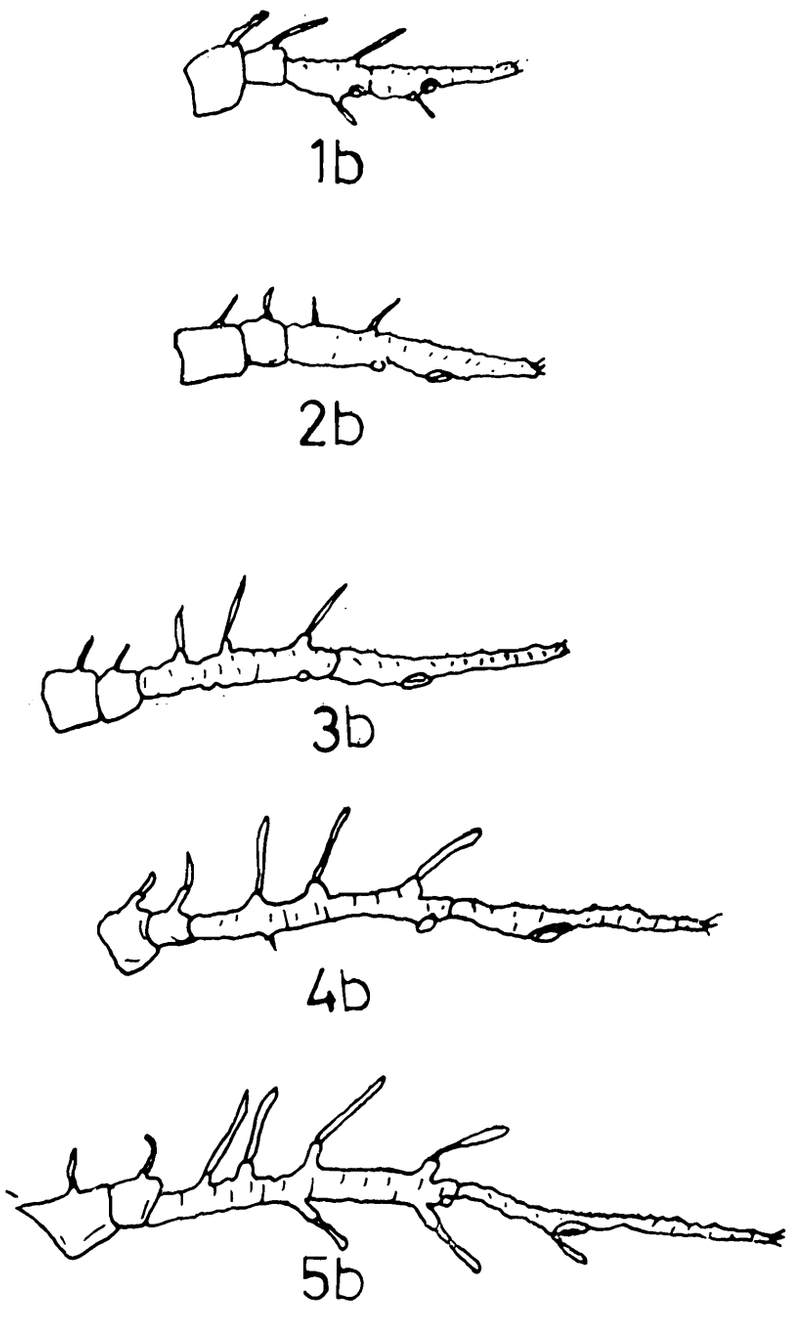
RESULTS

FIRST INSTAR NYMPHS (Figs. 1a-e)

Body pale, 0.59-0.66 mm. long and 0.26-0.3 mm. as maximum width. Head and prothorax fused (Fig. 1). Head with 3 pairs of long hairs with nearly blunt apices, placed in a row on each side of the mid-dorsal region, first two pairs have normal bases and the third pair placed on high tuberculate bases ; paired frontal processi present on each side of antennal segments 1, each processi with a broad base and a narrowing apex bearing one dagger-shaped hair directed inwards (Fig. 1a). Eyes 3-faceted. Antennae 4 segmented (Fig. 1b), 3rd and 4th segments indistinctly separated, 0.24-0.27 mm. long ; processus terminalis 0.66× bgse of last segment ; antennal hairs long with blunt apices, the longest one on segment III ; 0.05-0.06 mm. long ; primary rhinaria round and ciliated. Rostrum reaching upto middle of abdomen ; ultimate rostral segment pointed, 0.15-0.16 mm. long, twice the length of second segment of hind tarsus and without any accessory hairs. Pro-, meso- and meta-thoracic segments with two marginal processi on each



Figs. 1a-5a. Head with frontal processi : 1a-5a first instar to adult stages.



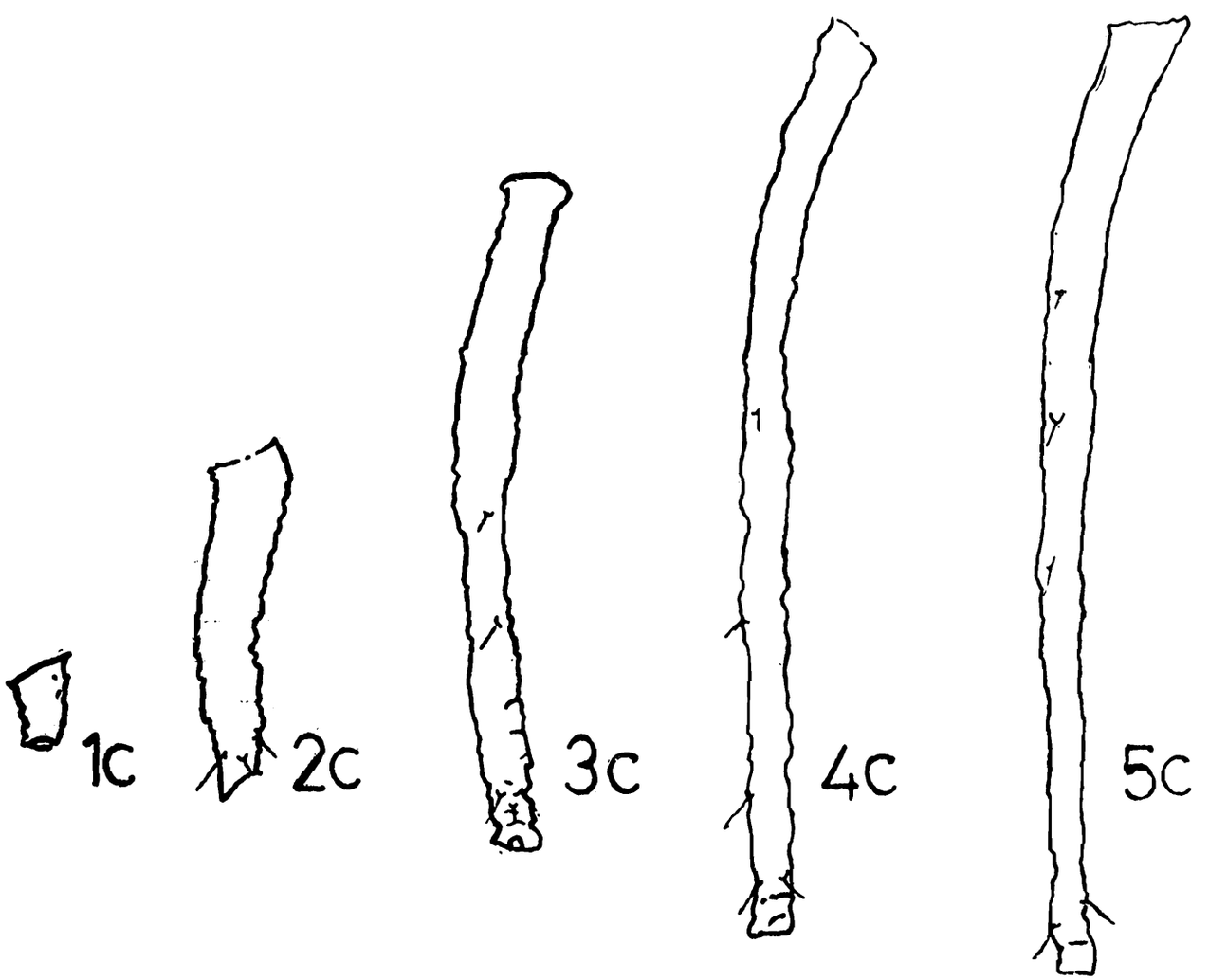
Figs. 1b-5b. Antenna : 1b-5b : first instar to adult stages.

side directed outward, each processi with a short, apical hair bifurcated at the tip. Abdominal dorsum pale and membranous ; pre-siphuncular segments with 4 pairs of marginal processi directed outward and one pair of pleural processi directed inward and downward ; post-siphuncular segments with 2 pairs of marginal processi only, the last pair longest and placed one on each side along the mid-dorsal axis of the body (Fig. 1d) ; each of the abdominal processi with a short apical hair having a bifurcated tip ; all processi with margins serrated and their surface bearing scattered spinules ; pre-siphuncular tergites each with 3-4 dorsal hairs arising from tuberculate base and deeply

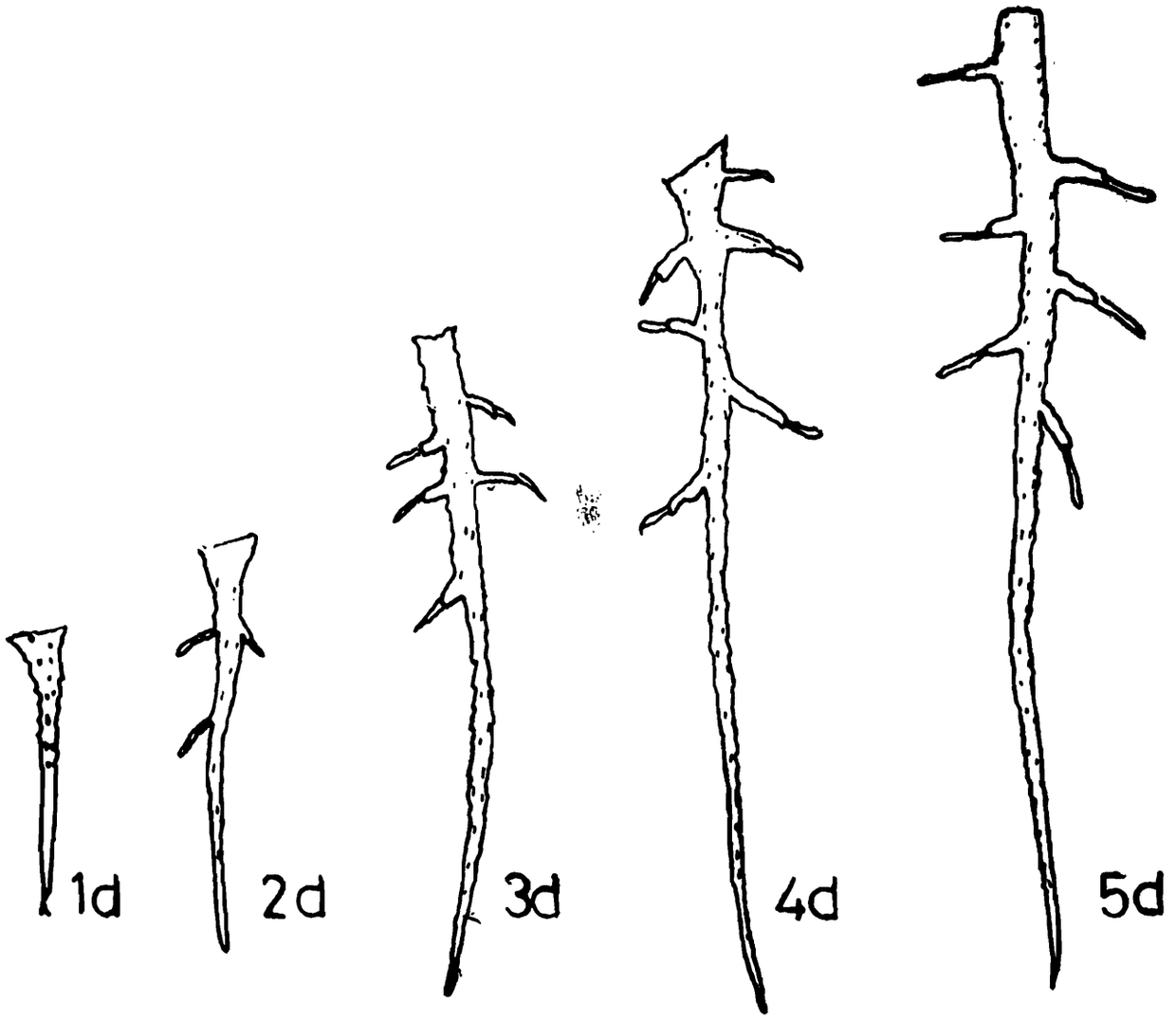
bifurcated, the bifurcated arms being directed to opposite sides (Fig. 1e). Siphunculi barrel-shaped (Fig. 1c), margins smooth, without any hair or flange, 0.06 mm. long. Caudu broadly oval with a dorsal hump. Subanal plate sub-divided and bearing a few bifurcated hairs, blunt at apices. Legs pale and stout, first tarsal chaetotaxy 2, 2, 2.

SECOND INSTAR NYMPH (Figs. 2a-e)

Body 0.68-0.74 mm. long and 0.29-0.37 mm. as maximum width. Frontal processi branched, each branch terminating in a dagger-shaped hair (Fig. 2a). Antennae 4-segmented, the separation between 3rd and 4th segments appear still indistinct (Figs. 2b), 0.28-0.30 mm. long ; p. t. about 1.90×base of last antennal segment. Ultimate rostral segment 0.14-0.16 mm. long, without any accessory hair. Each of the thoracic segments with two pairs of marginal processi, outer one of the two processi on each side directed outward and inner one directed inward and downward ; dorosal thracic hairs arising from high tuberculate bases, swollen of flattened at apices (Fig. 2e). Abdominal dorsum pale, dorsal hairs similar to the one of the thoracic tergum. Siphunculi cylindrical (Fig. 2c), 0.20-0.22 mm. long, with inner margin smooth and outer margin somewhat rugose,



Figs. 1c-5c. Siphunculus : 1c-5c : first instar to adult stages.



Figs. 1d-5d. Posterior most body processi : 1d-5d : first instar to adult stages.

bearing an apical flange and a few hairs on pre-apical portion. First tarsal chaetotaxy 4, 4, 4. Otherwise as in first instar nymph.

THIRD INSTAR NYMPH (Figs. 3a-e)

Body 0.90-1.12 mm. long and 0.48-0.85 mm. as maximum width. Antennae 4-segmented, 0.37-0.42 mm. long ; 3rd and 4th segments distinctly separated (Figs. 3b), p. t. 2.0×base of last antennal segment. Ultimate rostral segment 0.16-0.19 mm. long, without any accessory hair. Dorsal hairs on thorax and abdomen on high tuberculate bases and with spatulate apices (Fig. 3e) ; hairs on marginal processi on thorax and abdomen, dagger-shaped or swollen or flattened at apices. Siphunculi cylindrical, directed outward (Fig. 3c), 0.35-0.42 mm. long, with an apical flange and 1-2 rows of inter-connecting striae bearing a pre-apical ring of 3-4 hairs besides a few others on distal half. First tarsal chaetotaxy 5, 5, 5. Otherwise as in second instar nymph.

FOURTH INSTAR NYMPH (Figs. 4a-e)

Body 1.41-1.65 mm. long and 0.72-0.96 mm. as maximum width. Antennae 4-segmented. 0.49-0.54 mm. long ; p. t. about

2.10× base of last antennal segment (Fig. 4b). Ultimate rostral segment 0.17-0.18 mm. long, without any accessory hair. Dorsum of each thoracic and abdominal segments with numerous hairs having high tuberculate bases and swollen or spoonshaped at apices (Fig. 4e). Siphunculi 0.53-0.61 mm. long, cylindrical on basal half, coustricted near the distal 1/3rd, and swollen apicad with a flange bearing several hairs (Fig. 4c). First tarsal chaetotaxy 5, 5, 5. Otherwise as in third instar nymph.

ADULT APTEROUS VIVIPAROUS FEMALE (Figs. 5a-e)

Body 1.49-1.74 mm. long and 0.77-0.93mm. as maximum width. Antennae 5-segmented (Fig. 5b), 0.56-0.61 mm. long ; p. t. 1.33-1.60× base of last antennal segment ; flagellum finely imbricated, more so towards the apical region ; flagellar hairs long, having slightly swollen to bluntish apices, the longest one on third segment 0.06-0.07 mm. long. Ultimate rostral segment 0.18-0.20 mm. long, without any accessory hair. Hairs on dorsum of thorax and abdomen numerous, arranged in a radiating fashion, this being more prominent in the middle region of each tergite ; each hair giving out a baloon-like projection from its blunt tip (Fig. 5e). Siphunculi 0.62-0.67 mm. long, about 1.23-1.26× the length of last pair of abdominal processi, directed outward and with a prominent apical flange (Fg. 5c). Cauda broadly oval, bearing many hairs. Legs pale, femora and tibiae smooth ; hairs on legs with fine to slightly blunt apices ; first tarsal chaetotaxy 5, 5, 5.

Key to the Identification of the developmental stages of **C. schouteniae**

1.	Antennal segments III and IV not distinctly separated ; first tarsal chaetotaxy 2,2,2 or 4,4 4 ; average body length less than 1 mm.	2
	Antennal segments II and IV distinctly separated ; first tarsal chaetotaxy 5,5,5 ; average body length more than 1 mm.	3
2.	First tarsal chaetotaxy 2,2,2 ; siphunculi 0.06 mm. long, without any flange ; posteriormost processi 3.14-3.50 × length of siphunculi. ...	First instar nymph.
	First tarsal chaetotaxy 4,4,4 ; siphunculi 0.20-0.22 mm. long, with an apical flange ; posterior most processi 1.44-1.54× length of siphunculi. ...	Second instar nymph
3.	Dorsal hairs on pre-siphuncular tergites sparsely placed, never more than 20 hairs per tergite ; length of frontal processi, posteriormost body processi, antennae and siphunculi 0.20-0.26 mm., 0.37-0.42 mm., 0.35-0.42 mm. respectively. ...	Third instar nymph
	Dorsal hairs on pre-siphuncular tergites densely placed, always more than 20 hairs per tergite ; frontal processi, posteriormost body processi, antennae and siphunculi much longer.	4
4.	Antennae, siphunculi and posterior-most body processi 0.49-0.54 mm., 0.53-0.61 mm. and 0.67-0.74 mm. long respectively ; 4th segment of rostrum 0.125-0.133 mm. long. ...	Fourth instar nymph

Antennae, siphunculi and posterior most body processi 0.56-0.61 mm., 0.62-0.67 mm. and 0.77-0.18 mm. long respectively ; 4th segment of rostrum 0.133-0.148 mm. long. ... Adult apterous viviparous female

Discussion

An analysis of the morphological development from the first nymphal instar stage to the adult stage reveals a gradual transition in shape, size and number of different characters. The transition, both qualitative and quantitative, in most cases have been distinct and easy to distinguish in the preceding and succeding stages (Table 1 and Fig. 6).

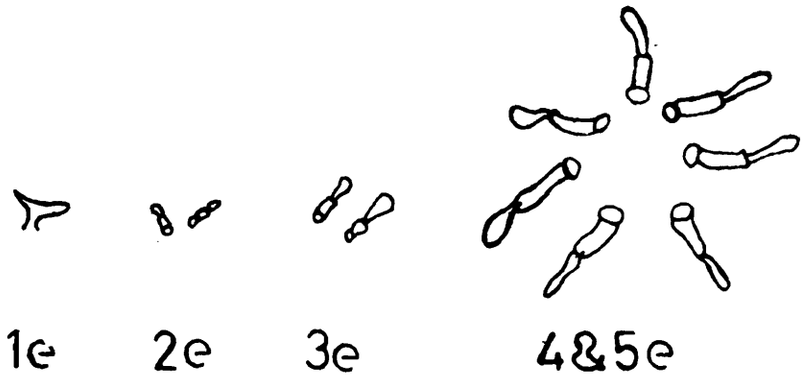
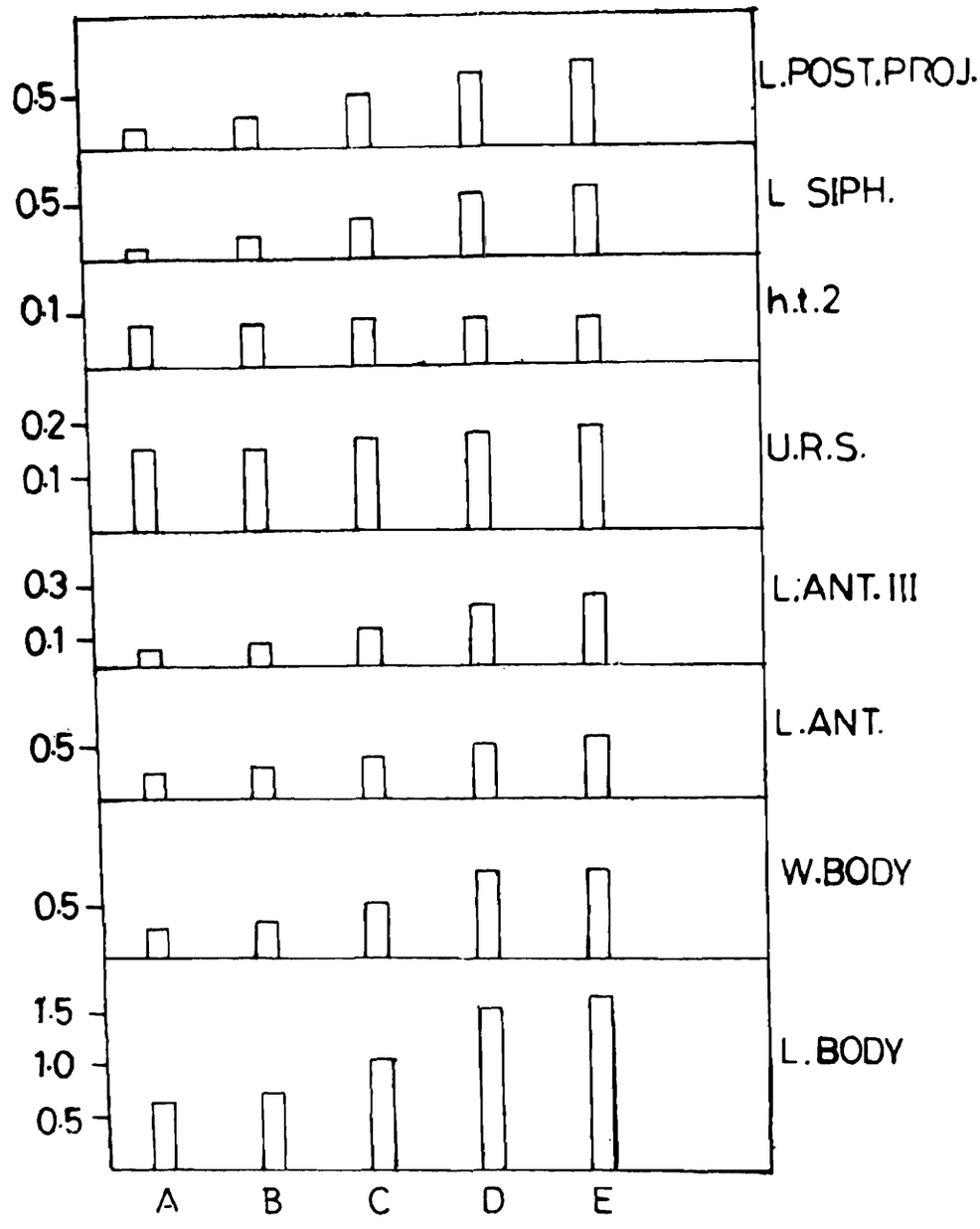


Fig. 1e-5e. Hairs on presiphuncular tergites : 1e-5e : first instar to adult stages.

TABLE 1. Measurements (average of 10 specimens) of some morphological characters of *C. schouteniae* v. d. Goot (in mm.)

Characters	First Instar			Second Instar			Third Instar			Fourth Instar			Adult apterae		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
L. Body	0.59	0.66	0.63	0.68	0.74	0.72	0.90	1.12	1.05	1.41	1.65	1.65	1.49	1.74	1.64
W. Body	0.26	0.30	0.28	0.29	0.37	0.33	0.48	0.85	0.53	0.72	0.96	0.83	0.77	0.93	0.84
L. Frontal Processi	0.11	0.14	0.13	0.15	0.16	0.16	0.20	0.26	0.23	0.31	0.37	0.34	0.32	0.38	0.36
L. Antenna	0.24	0.27	0.26	0.28	0.30	0.29	0.37	0.42	0.40	0.49	0.54	0.52	0.56	0.61	0.58
L. Ant. III	0.05	0.06	0.06	0.08	0.09	0.08	0.14	0.15	0.14	0.20	0.23	0.22	0.24	0.27	0.26
L. p. t.	0.07	0.07	0.07	0.07	0.08	0.08	0.10	0.11	0.11	0.11	0.13	0.12	0.12	0.14	0.14
L. base of last ant. segment.	0.05	0.06	0.05	0.05	0.06	0.06	0.06	0.08	0.07	0.08	0.10	0.09	0.09	0.10	0.09
U. R. S.	0.15	0.16	0.15	0.14	0.16	0.15	0.16	0.19	0.17	0.17	0.18	0.18	0.18	0.20	0.19
h. t. 2	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.08	1.00	0.09	0.08	1.00	0.09
L. Siph.	0.06	0.06	0.06	0.20	0.22	0.21	0.35	0.42	0.37	0.53	0.61	0.57	0.62	0.67	0.65
L. Post. Processi	0.18	0.22	0.20	0.29	0.31	0.31	0.43	0.53	0.48	0.67	0.74	0.70	0.77	0.83	0.83.

L. body-length of body ; W. body-width of body ; L. Ant. -lenth of antenna ; L. Ant. III-length of antennal segment III ; U. R. S.-length of ultimate rostal segment ; h. t. 2-length of second segment of hind tarsus ; L. Siph.-length of siphunculus ; L. Post. Proj.-length of posterior most body processi.



6

Fig. 6. Histograph showing developmental variations in some morphological characters from first instar to adult stages.

Change in shape :

It includes siphunculi, body-processi and body hairs. Siphunculi in the first instar is barrel-shaped, without any hair or flange ; in the second instar, the shape becomes more cylindrical, an apical flange starts to appear in the form of a rim and also a few apical hairs appear ; in third instar, cylindrical siphunculi appear to be directed outward, the flange becomes more prominent and 1-2 rows of interconnecting striae develop ; in the fourth instar, the distal portion of the siphunculi becomes somewhat swollen and the flange distinctly protrudes from the apical membranous joint ; number of hairs on the pre-apical region also increases, the

shape of the siphunculi of fourth instar becomes more prominent in the adult apterae. Similarly, body processi in the first instar stage remain unbranched but these gradually become branched and in the adult stage almost bilateral symmetry exists in the number and position of projecting arms of each of the processus. First instar nymph bears small hairs, mostly with bifurcated apices. In later instars bifurcation is replaced by dagger-shaped or swollen apices or flattened tips of the hairs.

Change in size :

This includes length of body, width of body, lengths of antennae, siphunculi, frontal processi and posterior most body processi (Table 1). Among these characters, the siphunculi increases in length from first instar to adult by 11×, whereas other characters increased in length by a factor of 2.5-5.0.

Change in number :

Important among these are antennal segments, body hairs and first tarsal chaetotaxy. In the first and second instars, antennae are 4-segmented and 3rd and 4th segments remain indistinctly separated ; in the third and fourth instars, separation becomes distinct and in the adult apterae, antennae becomes 5-segmented. Body hairs are much fewer in the first and second instars and distributed irregularly on the dorsum ; from third instar stage, body hairs not only gradually increase in number but also start orienting in a radiating fashion. As a result, the adult apterae have numerous hairs on each segment and they are strongly oriented in radiating fashion, more so in the middle of the segment (Fig. 1e-5e). First tarsal chaetoraxy is 2, 2, 2 in first instar, 4, 4, 4 in the second instar and 5, 5, 5 in third and fourth instars and in the adult apterae.

The gradual but distinct qualitative and quantitative changes of different morphological characters in the developing stages of *C. schouteniae* can be projected in a histogram (Fig. 6) and are of practical use in the perfect identification of different stages of a species, particularly such species where overlapping in characters at interspecific or intraspecific level is a common phenomenon.

ACKNOWLEDGEMENT

The authors are thankful to the Head, Deptt. of Life Science, P. G. Center, Agartala, Tripura (BKA, SS) and Dr. B.K. Tikader, Director, Zoological Survey of India (A. K. G.) for providing working facilities.

REFERENCES

AGARWALA, BASANT K. Hitherto unknown alate viviparous female of *Cervaphis schouteniae* v. d. Goot from India. *Entomon* (In press).

EASTOP, V. F. AND HILLE RIS LAMBERS, D. 1976. Survey of the world's aphids. Dr. W. Junk b. v. Publishers. The Hague, 1-573.

GHOSH, A. K. 1982. Cervaphidini (Homoptera : Aphidoidea) of the world. *Oriental Ins.* **16** : 77-97.

RAYCHAUDHURI, D. N. AND CHATTERJEE, M. 1980. Subfamily Greenideinae (p. 315-358) in "Aphids of North East India and Bhutan". The Zoological Society, Calcutta, 1-522.