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POLYMORPHIC VARIATIONS IN *GREENIDEOIDA CEYLONIAE* v. d. GOOT 1917 (FAMILY APHIDIDAE)

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(With 9 Figures)

INTRODUCTION

Polymorphism is a general rule in both holocylic and anholocyclic species of Aphididae. However, the degree and nature of polymorphism is rather dissimilar in various groups of aphids. Hille Ris Lambers (1966) presented a comprehensive account on this subject. Oriental genera of Greenideinae stand distinct from all other aphid groups in having fundatrix, oviparae, and males mostly alate and this may be attributed to the primitive characters in the ancestors of aphids which were alate amphigonic oviparous insects and from this condition the present day aphids have developed a system in which each species has at least one parthenogenetic viviparous morph and at least one wingless female morph.

Inspite of several works now available on polymorphism in aphids, tree-infesting greenideines remains neglected.

Greenideoida ceyloniae v. d. Goot, 1917 feeding exclusively on the foliage of *Mesua ferrea* of family Guttifereae, is endemic to Indian Sub-continent. In north-east India, this species occurs at least in two localities, Agartala in Tripura and Jorhat in Assam. This study records the morphological variations in males, oviparous females, fundatrix, alate viviparous females and apterous viviparous females and relate the sequences of their occurrence to the apparent host condition and the seasons.

MATERIALS AND METHODS

The study is based on periodic collections of available morphs of *G. ceyloniae* in the aforesaid localities and mounting the specimens for

their microscopic study following the method of Stroyan (van Emden 1972). Morphometric measurements were carried out under light microscopy and converted in to mm.

Results

A. Morphological variations

(i) Fundatrix (Fig. 1)

Smallest in length (± 2.49 mm) among all the morphs ; body stout, light green in life. Antenna 5-segmented, 0.50×body ; segment III bearing 8 secondary rhinaria ; processus terminalis (p. t.) 1.14×base of last antennal segment, in all other morphs p. t. much shorter than the base. Ultimate rostral segment 0.25 mm long and longer than in

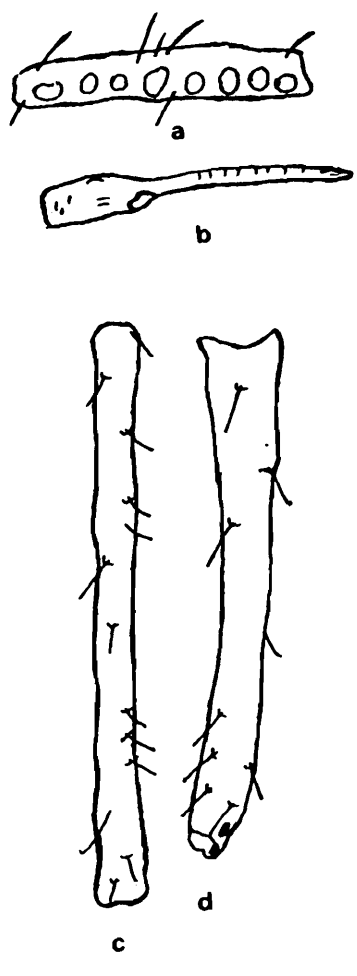


FIG -1

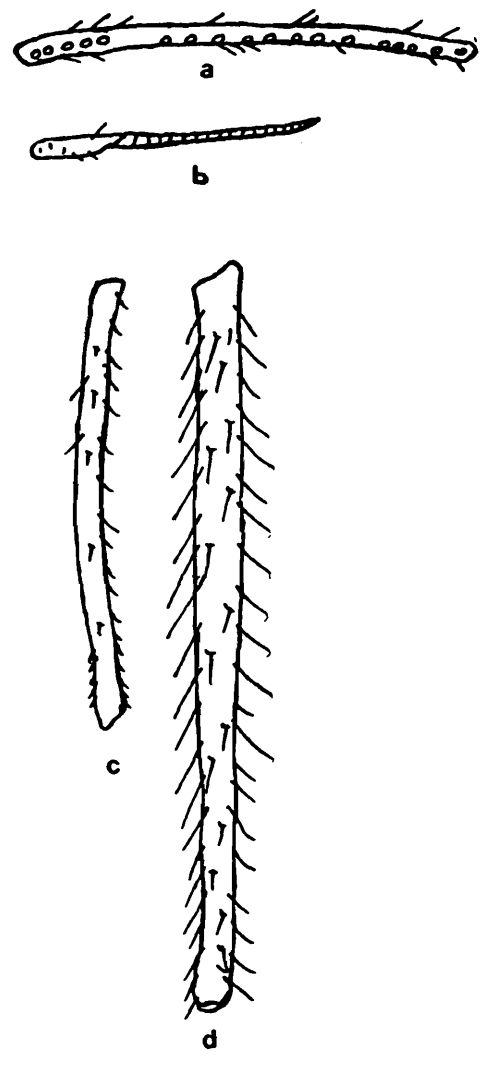


FIG • 2

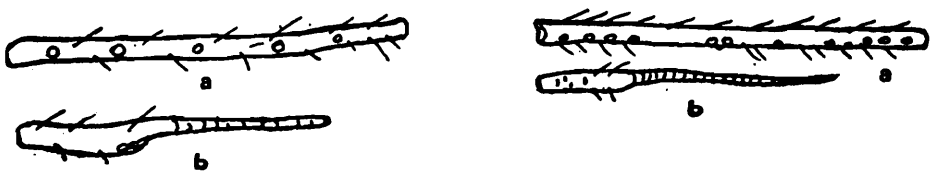
Figs. 1 & 2. 1. Alate fundatrix : a. antennal segment III, b. processus terminalis, c. hind tibia, d. siphunculus.

2. Alate Viviparous Female : a. antennal segment III, b. processus terminalis, c. hind tibia, d. siphunculus.

all other morphs. Siphunculi much shorter than in other alate morphs and slightly but distinctly bent at the apical-most portion. Dorsal hairs short, the longest one on antennal segment III 0.30 mm long.

(ii) Alate viviparous Female (Fig. 2)

Body slightly longer (± 2.92 mm) than antenna, yellowish green to green in life. Antenna light brown, 6-segmented, segment III bearing about 25 secondary rhinaria, highest in number among all the alate morphs; p. t. 0.40 × base of last antennal segment. Ultimate rostral segment 0.20 mm long, 1.40 × as long as second segment of hind



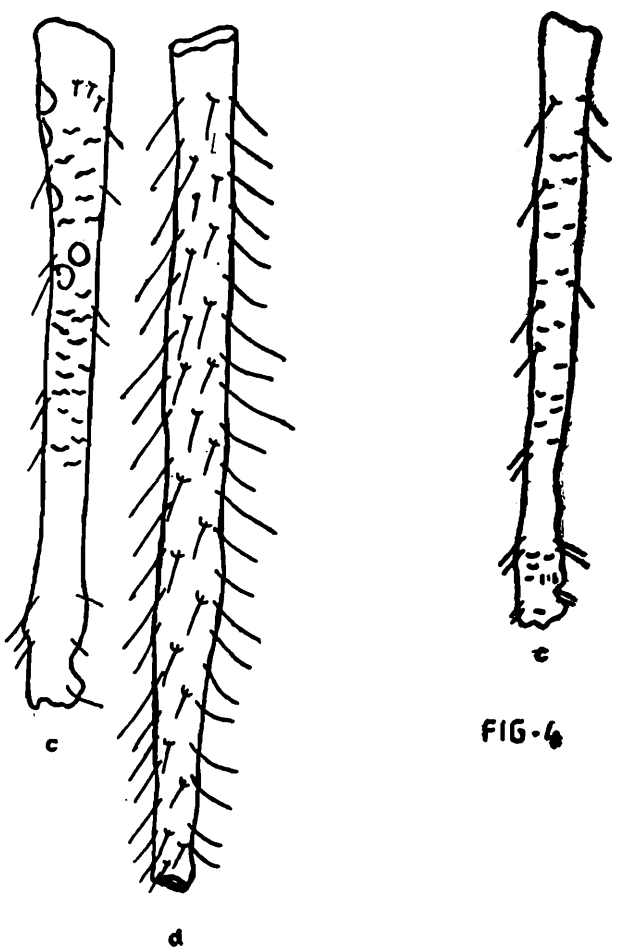


FIG · 3

FIG·4

Figs. 3 & 4. 3. Alate Oviparous Female : a. antennal segment III, b. processus terminalis, c. hind tibia, d. siphunculus.

4. Alate male : a antennal segment III, b. processus terminalis, c, hind tibia.

tarsus (h. t. 2). Siphunculi broadest at base and somewhat narrow at the apex, 2.28 mm long and 0.78 × body.

(iii) Alate oviparous Female (Figs. 3, 8)

Longest body size (± 4.02 mm) among all the morphs, also true of hind tibiae and siphunculi. Colour in life yellowish green. Antenna 0.81 × body, segment III bearing 11 secondary rhinaria, p. t. 0.86 × base of last antennal segment. Dorsal hairs longer than in other morphs, longest one on antennal segment III 0.10 mm long. Female genitalia well-developed.

(iv) Alate male (Figs. 4,9)

Body somewhat shorter (±2.68 mm) than the alate viviparous morph. Colour in life reddish green. Antenna longest among all the morphs, 1.28 × body ; segment III bearing 11 secondary rhinaria ; p.t. 0.48 × base of last antennal segment. Hind tibiae longer than in the fundatrix and the alate viviparae but somewhat shorter than in oviparae. Male genitalia well-developed.

Three morphs of apterae seen to exist. Careful observation in successive three years revealed that all the morphs may occur simultaneously for part of their period of occurrence on the host. Green specimens with light green and long siphunculi were the first generation apterae which infest the young foliage. Second generation apterae were slightly brownish with central pale area and somewhat shorter and brown siphunculi. The third generation apterae infesting new leaves were much smaller, brown in colour and with siphunculi much shorter in length. These trimorphic apterae viviparae have been respectively designated as (a) long siphunculus morph, (b) intermediate morph and (c) short siphunculus morph depending on the length of their siphunculi.

(a) Long-siphunculus morph (Fig. 5)

Body 3.58 mm long. Antenna 6-segmented, 0.83×body ; p.t. 0.54× base of last antennal segment. Ultimate rostral segment 0.23 mm long, 1.42×h.t.$_2$. Hind tibiae and siphunculi much longer than in other two apterous morphs. Longest hair of antennal segment III 0.07 mm long. In most of the characters and in general appearence this morph is very close to alate viviparae. Occassionally intermediate alatoid morph with characters of apterae are noticed. Dorsum of abdomen with scattered spinules, more so on the pleuro-marginal areas. Siphunculi cylindrical, only slightly curved outward at the apex.

TABLE 1. Morphometric data of some characters in different morphs of *G. ceyloniae* (measurements in mm, average)**

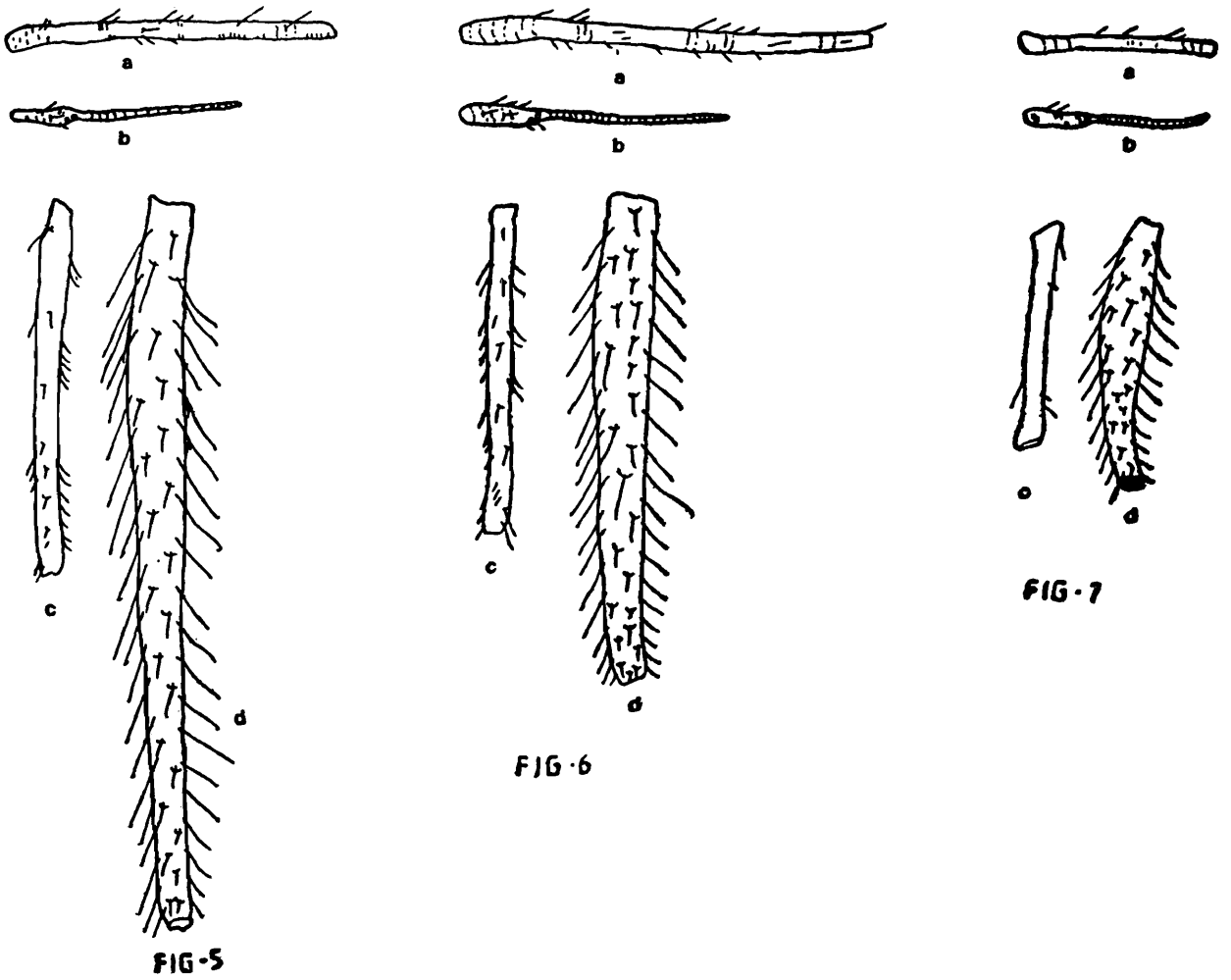
Characters	*Alt. Fundatrix*	*Alt. viviparae*	*Alt. oviparae*	*Alt. males*	Apt. viviparae		
					Long-siph.	*Intermediate*	*Short-siph.*
L. body	2.49	2.92	4.02	2.68	3.58	3.21	2.78
L. ant.	1.22	2.76	3.25	3.42	2.98	2.39	1.88
ant III	0.43	1.05	1.12	1.32	1.13	0.84	0.64
„ IV	0.22	0.30	0.51	0.37	0.29	0.26	0.14
„ V	0.20+0.22	0.36	0.51	0.48	0.42	0.29	0.24
„ VI base	—	0.65	0.45	0.68	0.57	0.52	0.54
„ VI p.t.	—	0.26	0.39	0.32	0.30	0.24	0.19
u.r.s.	0.25	0.20	0.24	0.20	0.23	0.19	0.19
h. t_2	0.15	0.14	0.19	0.16	0.16	0.15	0.14
Hind tibia	1.04	1.28	1.51	1.38	1.44	1.01	0.84
Siphunculus	0.75	2.28	2.58	*	2.05	1.45	0.95
Number Sec. rhin	8	25	11	11	—	—	—
L.h. ant. III	0.03	0.08	0.10	0.08	0.07	0.05	0.08
Ant./body	0.50	0.94	0.81	1.28	0.83	0.74	0.68
p.t./base	1.14	0.40	0.86	0.48	0.54	0.47	0.35
u.r.s./h.t.^{2}	1.67	1.40	1.30	1.26	1.42	1.29	1.31
Hind tib/body	0.42	0.44	0.37	0.51	0.40	0.31	0.30
Siph./body	0.30	0.78	0.64	*	0.57	0.45	0.34
Collection month	Sept.	Oct.-March	March	March	(Oct.	——to——	March)
**No. of Specimens	4	8	6	2	8	8	8

* Missing in macerated specimens

Abbreviations used in the Table : L. body—Length of body, L. ant.—Length of antenna, L. ant. III, IV, V—Length of antennal segments III, IV, V, L. ant VI—Length of base of antennal segment VI, L. ant p.t.—Length of processus terminalis, u.r.s.—Ultimate rostral segment, h.$t._2$—Second segment of hind tarsus, Number Sec. rhi.—Number of Secondary rhinaria on antennal segment III.

(b) Intermediate morph (Fig. 6)

Body 3.21 mm long. Antenna 6-segmented, 0.74×body ; p.t. 0.47× base of last antennal segment. Ultimate rostral segment 0.19 mm long, 1.29×h.t.$_2$. Hind tibiae and siphunculi shortest among all apterous morphs. Longest hair on antennal segment III 0.05 mm long. Dorsum



Figs. 5-7. 5. Apterous Viviparous Female ; Long Siphunculus Morph : a antennal segment III, b. processus terminalis, c. hind tibia, d. siphunculus.

6. Apterous Viviparous Female : Intermediate Morph : a. antennal segment III, b. processus terminalis c. hind tibia, d. siphunculus.

7. Apterous Viviparous Female : Short Siphunculus Morph : a. antennal segment III, b. processus terminalis, c. hind tibia, d. siphunculus.

of abdomen deep brown with nodular impressions on the pleuro-marginal sides ; spinules present but sparse. Siphunculi stout, curved, bears less hairs than in long-siphunculus morph.

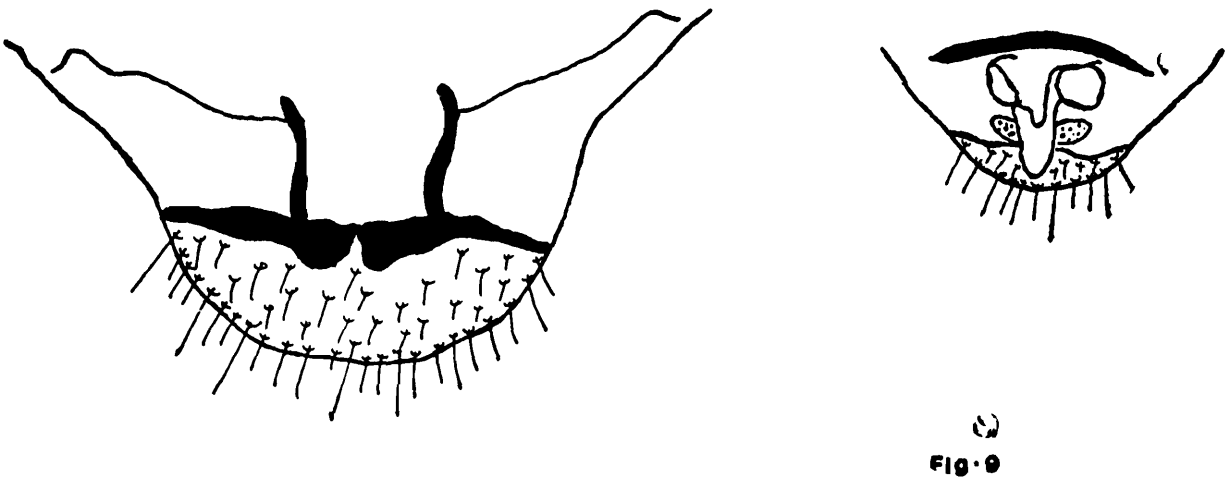
(c) Short-siphunculus morph (Fig. 7)

Body 2.78 mm long. Antenna 6-segmented, 0.68×body ; p.t. 0.33× base of last antennal segment. Ultimate rostral segment 0.19 mm long, 1.31×h.t.$_2$. Hind tibiae and siphunculi shortest among the apterous morphs. Longest hair on antennal segment III 0.88 mm long. Dorsum of abdomen deep brown with nodular impressions on pleuro-marginal

sides ; spinules present but sparse. Siphunculus stout, curved outward, bears less hairs than in long-siphunculus morph.

B. HOST CONDITION AND SEASONALITY

Appearence of fundatrix coincides with the budding of the host which corresponds to post-monsoon or autumn season (September-October) in the study area. Individual fundatrix was seen feeding on the growing bud. Not all the trees under observation show infestation by the fundatrix although later gneration of aphids infest most of the trees to a variable extent. Fundatrix lived for less than a month.



Figs. 8 & 9. 8. Alate Oviparous Female : Female genitalia.
9. Alate Male : Male genitalia.

Alate viviparae appear about 16 days after the first appearence of the fundatrix and exclusively infest the young leaves. Climatic condition remain the same i. e. post-monsoon or autumn (October). First apterous morph to appear have long-siphunculus. This morph is produced on the young leaves and remain there through out the winter even when the leaves become mature. Alate viviparae and this apterous morph occur together and seldom move to young foliage even when the leaves become heavily infested.

Intermediate apterous morph preferably colonise such mature leaves which are not earlier colonised by any morph. Although no alate viviparae is noticed in its association, presumably some of the alate viviparae and the apterous morph with long siphunculus contribute in the production of this morph, which occur during the months of November to March.

Occurrence of the apterous morph with short siphunculus coincide with the sprouting on the basal part of the tree-canopy and soon these

invade the emerging new red leaves. This morph can produce dense colony in a short period but this condition do not last long and diminishes well before the disappearance of other apterous morphs.

With the onset of spring in March, most of the apterous morphs began to produce alatoid offsprings and the resulting adult-alate viviparae leaves the trees and the locality. During the same months sexuales, both males and oviparae, could be found in another locality (Jorhat) alongwith some viviparous alates possibly representing gynoparae. Males appear ±15 days of first appearence of the oviparae.

Discussion

Each morph in the life cycle of an aphid is a short-lived unit, each being present in a particular time of the year and influenced by seasonal changes and habitat-quality. Thus each morph bears the testimony of specificity in its function and timing. Host-alternating aphids exhibit greater changes between their morphs than non-host alternating ones, however even in these species differences could be noticed.

Alate fundatrix, alate viviparae, alate oviparae and alate males of *G. ceyloniae* are easily distinguishable in their key morphological characters and occupy almost exclusive periods in the total time-table of infestation. Shorter body, 5-segmented antennae, fewer secondary rhinaria and shorter hind tibiae and siphunculi separates fundatrix from other alate morphs. Both oviparae and males are characterised by much longer antennae, equal number of secondary rhinaria (11 each) and longer hind tibiae and siphunculi. Alate viviparae are distinguishable in possessing higher number of secondary rhinaria (25) and p.t. 0.40× base of last antennal segment. Trimorphic apterous morphs seen to be an unusual feature in this greenideine aphid although such instances are not rare in other aphid groups as reviewed by Hille Ris Lambers (1966).

Dixon (1974) noted the changes in the length of the appandages and the number of rhinaria in successive generations of sycamore aphid. Dixon and Wellings (1982) attributed much of the changes in the morphs due to reproductive strategies in the biology of aphids based on advance anticipation of host condition and seasonal changes. Harrweijn (1978) postulated that the production of different morph can be connected with succession and of generation. It is complex seasonal phenomenon influenced by number of intrinsic and extrinsic factors.

Although much of the present study is based on preliminary investigation on the polymorphic trends in this greenideine aphid, this study is a definite pointer towards the interesting phenomenon involved in the generation-succession of different morphs and associated morphological changes.

SUMMARY

Polymorphism in *G. ceyloniae* comprises of Alate funcatrix ; Alate viviparous female ; apterous viviparous females which may be trimorphic with long siphunculi, intermediate and with short siphunculi ; alate male and alate oviparous female. Distinct morphological and morphometric variations are noticeable among the morphs and these are elaborated. Sexuales are produced in late spring and eggs are laid which oversummer. Alate fundatrix is produced in early autumn. Parthenogenetic generations occurs throughout the autumn, winter and early spring or summer. Occurrence of trimorphic apterous viviparous females is an unusual phenomenon in this greenideine species.

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