

Taxonomic study of the Genus *Gandaca* Moore (Lepidoptera: Pieridae) from India

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ABSTRACT

In this present work, the external morphological features including genitalic attributes and distribution of *Gandaca harina* (Horsfield) have been discussed in detail. The genitalic attributes of both the subspecies under *Gandaca harina* (Horsfield) i.e. *Gandaca harina andamana* Moore and *Gandaca harina assamica* Moore have been studied, illustrated and compared for the first time. The diagnosis of the genus has been updated and key to subspecies has been formulated.

Key words: *Gandaca harina*, *Gandaca harina andamana*, *Gandaca harina assamica*, male genitalia, female genitalia

Introduction

Moore (1906) established the genus *Gandaca* with type species *Terias harina* Horsfield. It is a very small genus comprises two species i.e. *Gandaca harina* (Horsfield) and *Gandaca butyroasa* (Butler). *G. harina* (Horsfield) is widely distributed in the Oriental region whereas *G. butyroasa* (Butler) is distributed in New Guinea, South Philippines, Sulawesi, Waigeo and Aru. *G. butyroasa* (Butler) was regarded as conspecific with *Gandaca harina* (Horsfield) due to the resemblances in their external morphology (D'Abrera, 1971; Corbet and Pendlebury, 1978). Yata (1981) studied external morphological characters and male and female genitalia of both the species. The representatives of this genus were earlier reported as the members of subgenus *Terias* Swainson under genus *Eurema* Hubner. Moore (1906) studied the differences in their wing venation and wing-shape and on the basis of these differences he separated the species *harina* (Horsfield) from genus *Terias* Swainson and placed it under new genus *Gandaca* Moore. Klots (1931) illustrated and com-

pared the genitalic attributes of *Gandaca harina* (Horsfield) and the members of the genus *Eurema* Hubner and described them as closely related species.

Materials and Methods

During present studies the adults were collected by using sweeping net from different localities of Andaman and Nicobar Islands. The specimens were killed, stretched and preserved as per standard techniques in Lepidopterology. Each specimen was tagged with the labels of locality, date of collection, altitude, etc. The representatives were identified on the basis of their morphological characters by consulting literature such as Antram (1924), Bingham (1907), Evans (1932) and Talbot (1939). The collections lying in the National Museum, Zoological Survey of India, Kolkata were also studied. The images of dorsal and ventral sides of the specimens were obtained with a digital camera (Nikon D7000 18-105 mm). The genitalia dissections have been done by adopting the method proposed by Robinson (1976).

The photography of the male external genitalia has been accomplished by using Leica binocular microscope equipped with a photographic unit.

Abbreviations: Sc = Subcosta vein; R₁ = Radius vein 1; R₂ = Radius vein 2; R₃ = Radius vein 3; R₄₊₅ = Radius vein 4+5; Rs = Radial sector; M₁ = Median vein 1; M₂ = Median vein 2; M₃ = Median vein 3; Cu₁ = Cubitus vein 1; Cu₂ = Cubitus vein 2; 1A+2A = Anal vein 1+2; 3A = Anal vein 3; AED = Aedeagus; TG = Tegumen; UN = Uncus; VLV = Valva; VIN = Vinculum; SA = Saccus; DU.EJ = Ductus ejaculatorious; HRP = Harpe; VES = Vesica.

Observations and Discussion

Genus *Gandaca* Moore, 1906

Gandaca Moore, 1906; *Lepidoptera Indica* 7: 33. *Gandaca* Winhard, 2000; *Butterflies of the World* 10:13. *Gandaca* Vane-Wright & de Jong, 2003; *Zool. Verh. Leiden* 343: 96.

Type species: *Terias harina* Horsfield, 1829

Terias harina Horsfield, 1829; *Descr. Cat. Lep. Ins. Mus. East India Coy* (2): 137.

Diagnosis: Both wings lemon-yellow. Forewing with thin apical and marginal border. Hindwing without maculation. Uncus extremely short, broad dorso-ventrally to distal tip, projecting dorsad, dorsal margin highly arched; dorsal margin serrated; appendix bursae very large; signum in the form of ring at base of corpus bursae.

Distribution: Aru, Borneo, Hainan, India, Java, Lombok, Myanmar, New Guinea, Peninsular Malaya, Singapore, South Philippines, Sulawesi, Sumatra, Thailand, Vietnam, Waigeo.

Gandaca harina (Horsfield, 1829)

Common name: Tree Yellow

(Plates: 1-4)

Terias harina Horsfield, 1829; *Descr. Cat. lep. Ins. Mus. East India Coy* (2): 137. *Gandaca harina* Yamauchi & Yata, 2000; *Ent. Sci.* 3(2): 333. *Gandaca harina* Vane-Wright & de Jong, 2003; *Zool. Verh. Leiden* 343: 97.

Adult (Male): Forewing dorsal surface lemon-yellow; apex and termen black, black margin becomes thin towards termen. Ventral surface light yellowish-white without any maculation. Hindwing dorsal

surface primrose-yellow without maculation. Ventral surface pale yellowish without maculation.

Adult (Female): Same as in male but light in color. Forewing dorsal surface light pale-yellowish; apex and termen black. Ventral surface light yellowish-white without maculation. Hindwing dorsal surface light pale-yellowish with thin short black margin. Ventral surface light yellowish-white without maculation.

Wing expanse: 30-45 mm.

Male Genitalia: Uncus extremely short, leaf-like, apex sharp, broad dorso-ventrally to distal tip, projecting dorsad, dorsal margin highly arched; half of the dorsal margin serrated; tegumen very short, sclerotized, somewhat squarish from lateral view; vinculum straight, narrow; saccus extremely long, slender, inclined, curved, rounded distal tip; juxta reduced; valva small, costa somewhat triangular, apex produced to form upturned sharp strong process; short, upwardly directed to form spine-like projection, pointed, weakly sclerotized distal tip, hirsute with small sized setae; aedeagus long, slender, rod-like, almost straight, subzone much smaller than suprazone, ductus ejaculatorious dorsad.

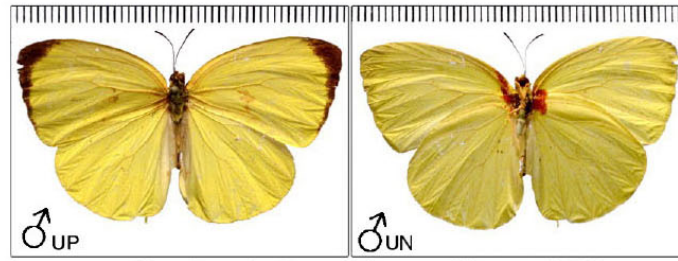
Female Genitalia: Corpus bursae elliptical; signum small, somewhat rectangular, present at the base of corpus bursae; appendix bursae pear-shaped, larger than corpus bursae; ductus bursae narrow, membranous; lamella postvaginalis posses anchor-like ridge; papilla analis somewhat semicircular, pilosed; posterior apophysis small, spine-like, sclerotized; anterior apophysis extremely small, weakly sclerotized, distal tips blunt.

Distribution in India: Andaman and Nicobar islands, Assam, Sikkim and West Bengal.

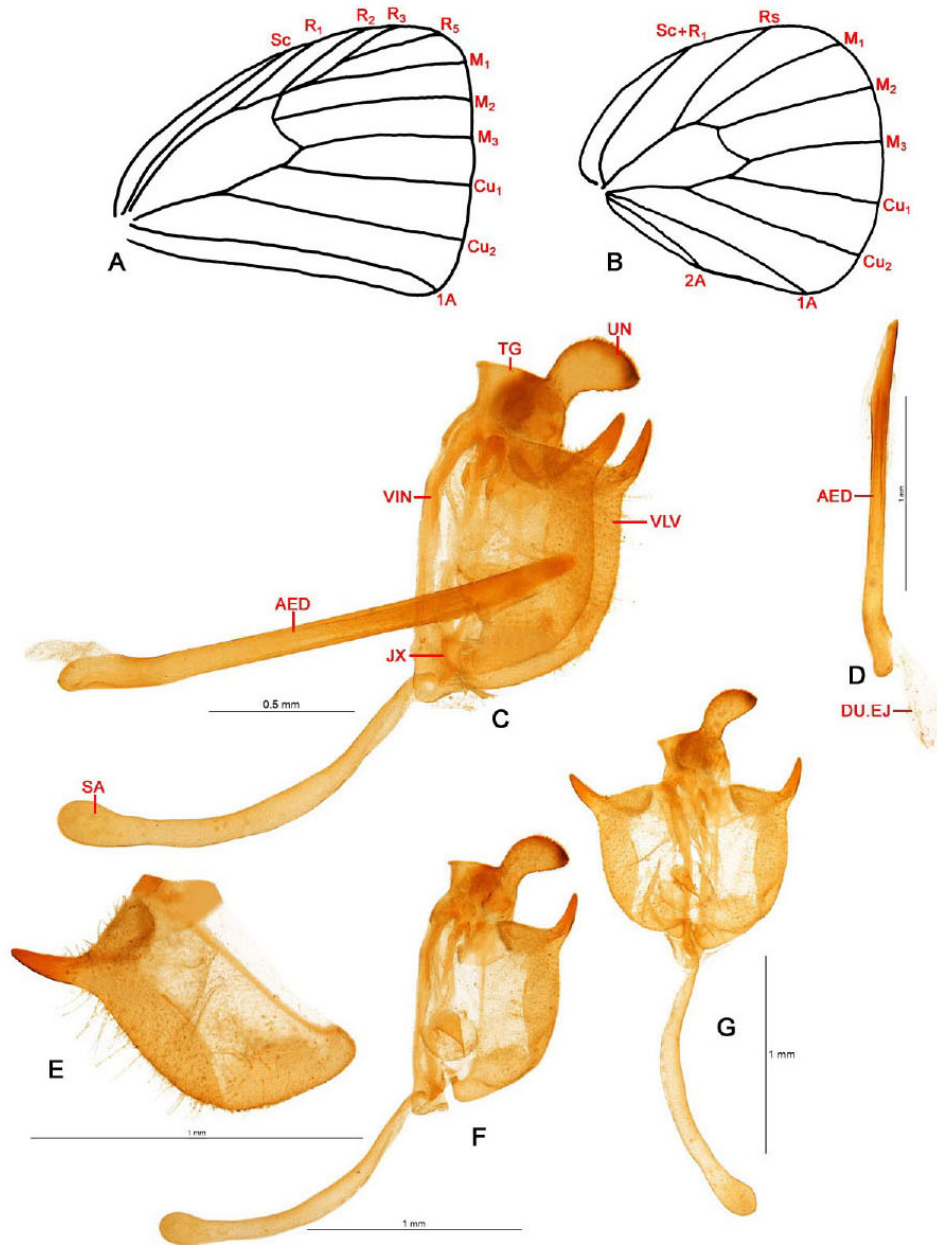
Global Distribution: Aur, Babi, Banggai, Borneo, Hainan, Java, Kangean, Langkawi, Lombok, Mindoro, Myanmar, Pagi, Panaon, Peninsular Malaya, Philippines, Siberut, Simuk, Singapore, Sipora, Sula, Sumatra, Thailand, Tioman, Vietnam.

Remarks: *Gandaca harina* (Horsfield) is a common species and known from the mentioned localities. Talbot (1939) described its morphological attributes along with its subspecies. A total number of 22 subspecies have been recorded under this species and out of these, two subspecies i.e. *Gandaca harina andamana* Moore and *Gandaca harina assamica* Moore

PLATE - 1



Gandaca harina andamana Moore, 1906

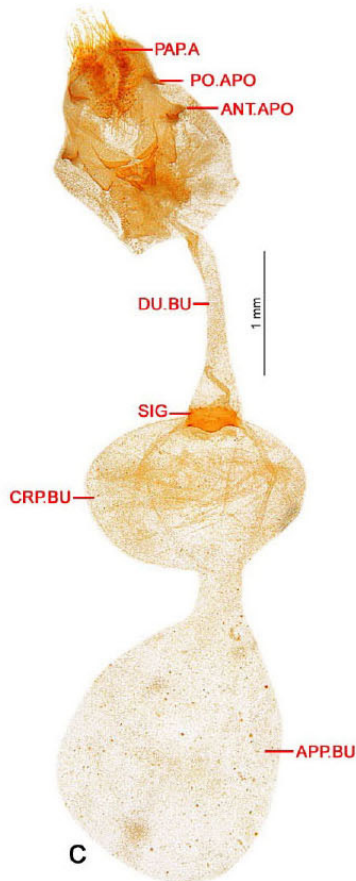
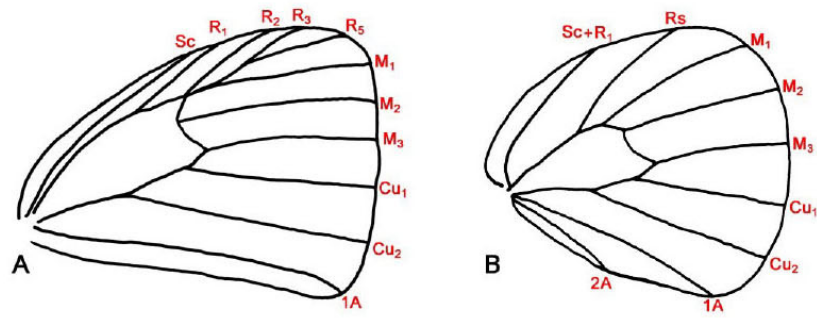


A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Valva, F. Male genitalia (Lateral view), G. Male genitalia (Lateral view).

PLATE - 2



Gandaca harina andamana Moore, 1906



A. Forewing, B. Hindwing, C. Female genitalia, D. Papilla Analis

have been reported from India. Klots (1931) illustrated the genitalic characters of male of *Gandaca harina* (Horsfield). In this present work, the morphological and genitalic attributes of both the subspecies under *Gandaca harina* (Horsfield) have been studied, illustrated and compared for the first time. The morphological and genitalic attributed of *Gandaca harina* (Horsfield) and the members of the genus *Eurema* Hubner have also been compared.

Key to subspecies of *Gandaca harina* (Horsfield)

1. Forewing dorsal surface apex and termen slightly broad black upto vein C u 2
.....
harina andamana (Moore)
- Forewing dorsal surface apex and termen extremely thin black upto vein C u 1
.....
harina assamica (Moore)

***Gandaca harina andamana* Moore, 1906**
Common name: Andaman Tree Yellow

(Plate: 1-2)

Gandaca andamana Moore, 1906; *Lepidoptera Indica* 7: 35. *Gandaca harina andamana* Yamauchi & Yata, 2000; *Ent.Sci.* 3 (2): 335.

Adult (Male): Forewing apex and termen black upto vein Cu₂, black margin becomes thin at vein Cu₂.

Adult (Female): Forewing dorsal surface apex and termen broadly black than male, the black margin reaches upto tornus.

Wing expanse: 30-45 mm.

Material examined: ZSI, Kolkata, National Museum Collections. 1♂, 11.iii. 1923, Andaman; 1♀, 1♂ vi.1924, Andaman; 1♀ vi.1925, Andaman; 1♂, 30.xii.2017, Wandur, Andaman, (Coll. Manpreet Kaur); 1♂•2.i.2018, Diglipur, Andaman, (Coll. Manpreet Kaur).

Distribution in India: Andaman.

Remarks: *Gandaca harina andamana* Moore, 1906 is an endemic subspecies in India and common in dif-

ferent areas of Andaman islands. Evans (1932) devised a key for this subspecies on the basis of its morphological features and distribution. Talbot (1939) described its morphological attributes. In this present work, the morphological characters including genitalic attributes of *G. harina andamana* Moore have been studied, illustrated and compared with the members of *Eurema* Hubner. It has been observed that they are morphologically similar but their genitalic attributes are completely different. *Gandaca harina* (Horsfield) and the members of the genus *Eurema* Hubner are almost same size with wing expanse between 30-45 mm. Their wing shape is also similar. Both can be differentiated on the basis of their slight differences in ground color and black marginal border. In *Gandaca harina andamana* Moore, the ground color is lemon-yellow with thin apical and marginal border whereas in representatives of *Eurema* Hubner the ground color is dark-yellow with broad black marginal border. Their genitalic attributes are completely different and shows remarkable differences. In *Gandaca harina andamana* Moore, the uncus is broad and projected dorsally with strongly arched dorsal margin, tegumen broad, saccus extremely long and concave and the valve is somewhat quadrate with distal end protrudes to form spine-like process whereas in the members of *Eurema* Hubner, the uncus is extremely small and in some species it is bifid, tegumen narrow, saccus moderately long and the valve is leaf-like four harpe varying size and shape. In female genitalia, the signum and anterior and posterior apophysis are small in *Gandaca harina andamana* Moore whereas in the members of the genus *Eurema* Hubner, the signum is longer and anterior and posterior apophysis are thin and long.

***Gandaca harina assamica* Moore, 1906**

Common name: Assam Tree Yellow
(Plate: 3-4)

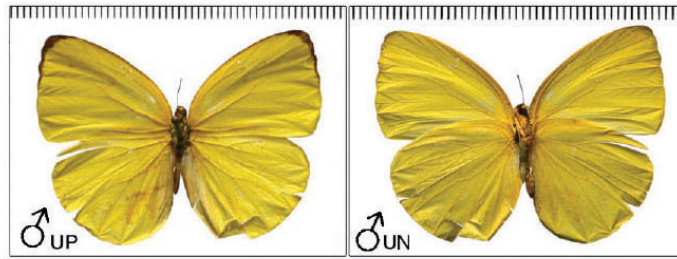
Gandaca assamica Moore, 1906; *Lepidoptera Indica* 7: 33.

Gandaca harina assamica Yamauchi & Yata, 2000; *Ent.Sci.* 3 (2): 335.

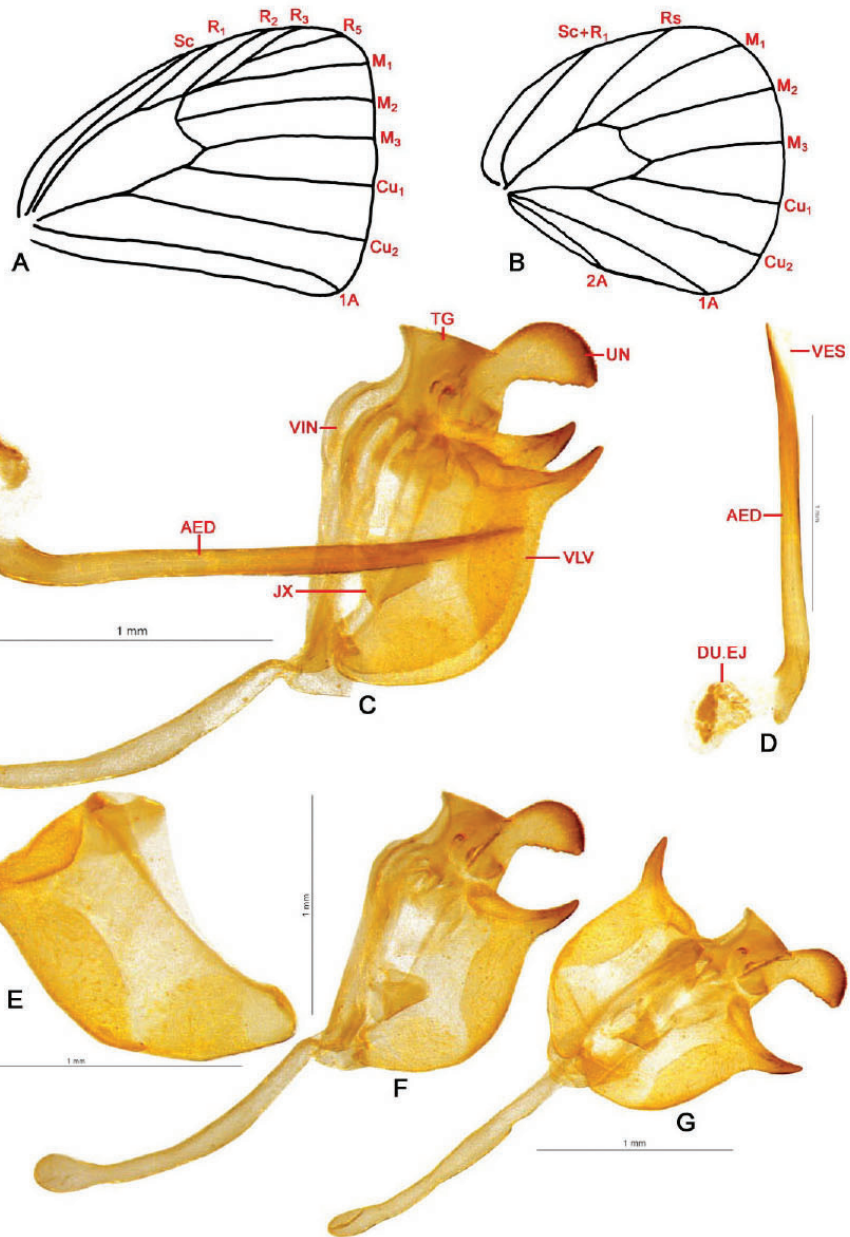
Adult (Male): Forewing apex and termen extremely thin black upto vein Cu₁.

Adult (Female): Forewing dorsal surface apex and termen black upto vein Cu₁ Hindwing dorsal surface with extremely thin short black margin.

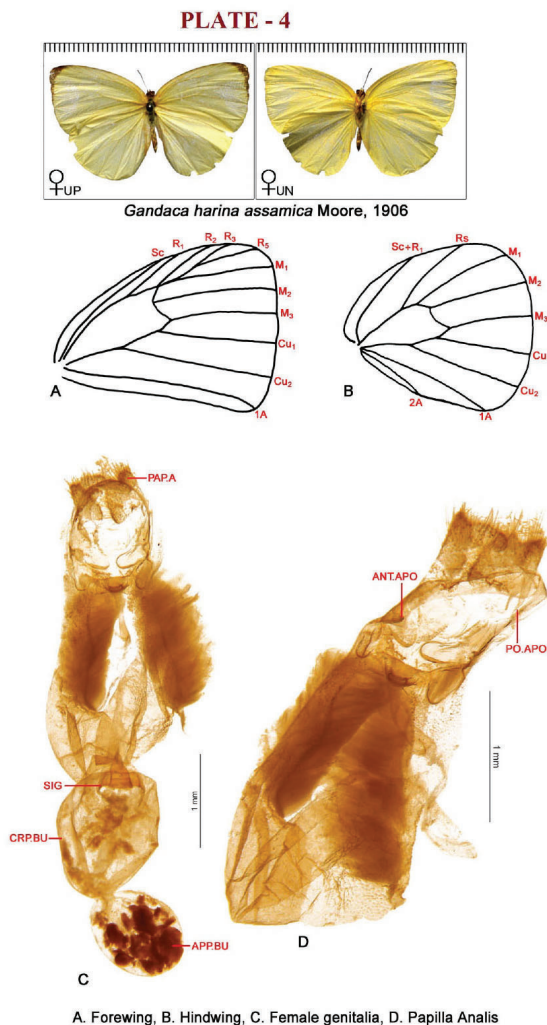
PLATE - 3



Gandaca harina assamica Moore, 1906



A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Valva, F. Male genitalia (Lateral view), G. Male genitalia (Lateral view).



Wing expanse: 30-45 mm.

Material examined: ZSI, Kolkata, National Museum Collections.

1♂, 1♀, 3.v.1966, Tipi, Kameng, (Coll. A.N.T. Joseph); 1♀, 18. v. 1966, Tamen, Subansiri, (A.N.T. Joseph); 1♂, 3.xii. 1969, Wakro, (J.M. Julka).

Distribution in India: Assam, Sikkim, Uttarakhand, West Bengal.

Remarks: *Gandaca harina assamica* Moore is a mainland subspecies of *Gandaca harina* (Horsfield) and is endemic to India. Evans (1932) devised a key for this subspecies on the basis of its morphological features and distribution. Talbot (1939) described its mor-

phological attributes. This subspecies is recently reported for the first time from Nandhaur Wildlife Sanctuary, Uttarakhand by Sondhi in 2017. In this present work, all the morphological characters including genitalic attributes have been studied, illustrated and compared. *G. harina assamica* Moore differs slightly externally from island subspecies whereas their genitalic structures are same. In *Gandaca harina assamica* Moore the apex and termen are extremely thin black upto vein Cu_1 whereas in *Gandaca harina andamana* Moore the apex and termen is slightly broad and then it narrows upto vein Cu_2 . The genitalia of both the subspecies have slight variations and thus cannot be considered as independent species.

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