Notes on Galls Induced by Daphnephila (Diptera: Cecidomyiidae) on Machilus bombycina (Lauraceae) in Assam, India

TOKUDA, Makoto
Laboratory of Systems Ecology, Faculty of Agriculture, Saga University

BHUYAN, Mantu
CSIR North East Institute of Science & Technology

MISHIMA, Misako
The Kyushu University Museum, Kyushu University

SUYAMA, Chika
Faculty of Education, Gifu University

他

https://doi.org/10.5109/6610215

出版情報：ESAKIA. 55, pp.23-27, 2022-12-20. Entomological Laboratory, Faculty of Agriculture, Kyushu University
バージョン：
権利関係：

ESAKIA, (55): 23–27. December 20, 2022

Notes on Galls Induced by *Daphnephila* (Diptera: Cecidomyiidae) on *Machilus bombycina* (Lauraceae) in Assam, India

Makoto TOKUDA[1, 2, 3] *, Mantu BHUYAN[4], Misako MISHIMA[5], Chika SUYAMA[6], Kazunori MATSUO[7], Tatsuya IDE[8], Pranab R. BHATTACHARYYA[4], and Junichi YUKAWA[9]

1) Laboratory of Systems Ecology, Faculty of Agriculture, Saga University, Saga 849–8502 Japan
2) The United Graduate School of Agricultural Sciences, Kagoshima University, Kagoshima, 890–0065 Japan
3) Center for Research and Advancement in Higher Education, Kyushu University, Fukuoka, 819–0395 Japan
4) CSIR-North-East Institute of Science & Technology, Jorhat, Assam, 785006 India
5) The Kyushu University Museum, Kyushu University, Fukuoka, 812–8581 Japan
6) Faculty of Education, Gifu University, Gifu, 501–1193 Japan
7) Faculty of Social and Cultural Studies, Kyushu University, Fukuoka, 819–0395 Japan
8) National Museum of Nature and Science, Tsukuba, Ibaraki, 305–0005 Japan
9) Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, 819–0395 Japan
** E-mail: tokudam@cc.saga-u.ac.jp*

Abstract. Galls induced by *Daphnephila* gall midges on *Machilus bombycina* King ex Hook.f. (= *Percea bombycina* (King ex Hook.f.) Kosterm.) and *Machilus gamblei* King (Lauraceae) were respectively surveyed in Assam and West Bengal, India. On each plant, one leaf and one stem gall were found. The leaf and stem gall inducers on *M. gamblei* have been known as *Daphnephila haasi* Kieffer and *D. glandifex* Kieffer, respectively. However, because shapes of both leaf and stem galls were different between *M. bombycina* and *M. gamblei*, gall inducers associated with *M. bombycina* are probably different species from *D. haasi* and *D. glandifex*. Although the leaf galler on *M. bombycina* was identified as a species of *Asphondylia* in some previous studies, gall midge features as well as gall morphology clearly indicate that the inducer is a member of the genus *Daphnephila*.

Key words: Asphondyliini, gall midge, Muga silk, *Daphnephila haasi*, *Daphnephila glandifex*, *Machilus gamblei*.

Introduction

Daphnephila (Diptera: Cecidomyiidae) is an oriental and eastern Palearctic genus associated with Lauraceae (Tokuda & Yukawa 2007; Gagné & Jaschhof 2021). Kieffer (1905) erected the genus with the following three species distributed in West Bengal, India: *D. haasi* Kieffer, the type species of the genus, induces slender urn-shaped leaf galls on *Machilus gamblei* King; *D. glandifex* Kieffer induces subglobose stem galls on *M. gamblei*; and *D. linderae* Kieffer, which is only known species associated with plants other than *Machilus*, induces globose leaf galls on *Lindera pulcherrima* Benth. (Kieffer 1905; Mani 2000; Gagné & Jaschhof 2021). The type locality of these gall midges is vicinity of Kurseong, West Bengal, but type materials are considered to have been lost (Kieffer 1905; Gagné & Jaschhof 2021). After that, *D. machilicola* Yukawa was described from Japan (Yukawa 1974) and six species were from Taiwan (Tokuda *et al*. 2008; Pang *et al*., 2015). In addition, many undescribed species are still present in East and Southeast Asian countries (Docters van Leeuwen-Reijnvaan & Docters Van Leeuwen 1926; Yukawa 1974; Yang *et al*. 1999; Yang *et al*. 2000; Yukawa *et al*. 2005; Tokuda & Yukawa 2007; Tung & Yang 2018).

In India, a cecidomyiid species inducing leaf galls on som tree *M. bombycina* King ex Hook.f.

Received 30 March 2022, accepted 20 August 2022

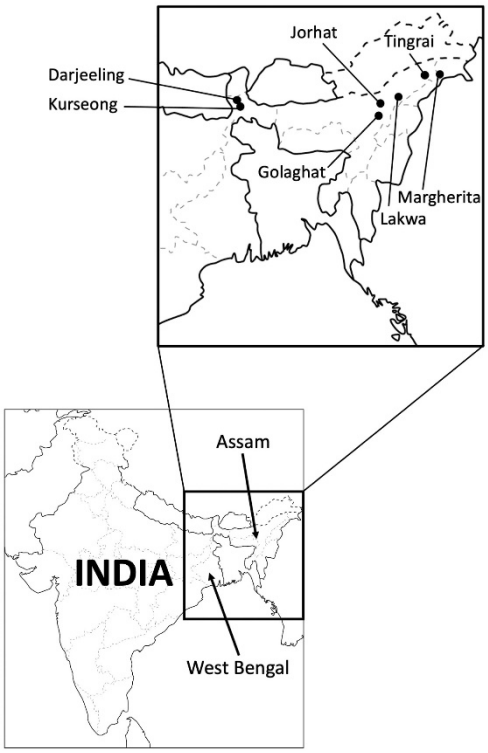


FIGURE 1. Map of census sites in Assam and West Bengal, India.

(= *Percea bombycina* (King ex Hook.f.) Kosterm.) has been identified as *Asphondylia* sp. (Singh *et al*., 2013; Baruah, 2020; Sahu *et al*., 2020) or erroneously as a parasitoid *Ormyrus* sp. (Hymenoptera: Ormyridae) (Gogoi *et al*., 2013). However, the shape and structure of galls strongly suggest that the gall is induced by a species belonging to *Daphnephila*.

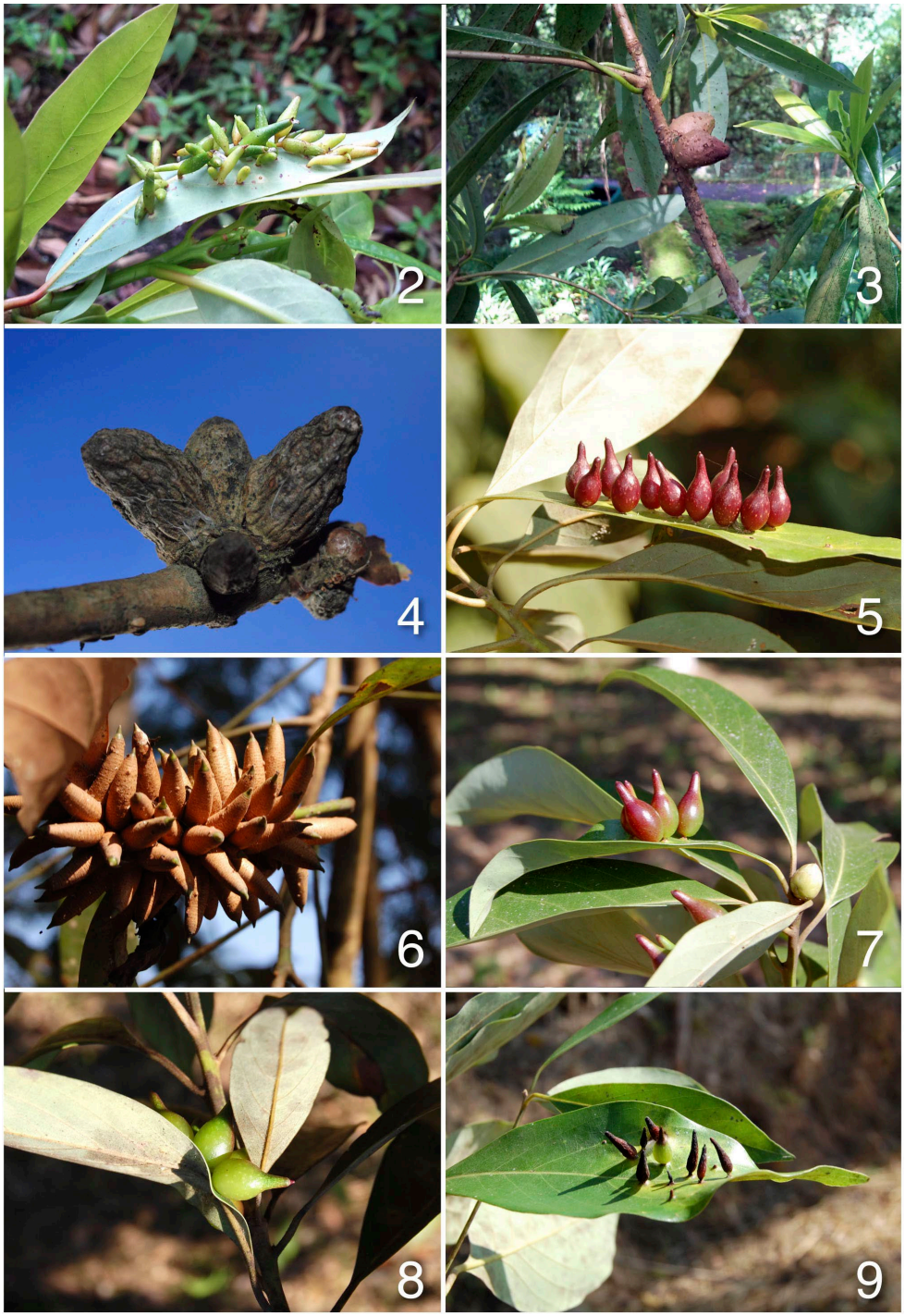
This gall midge is known as a pest of *M. bombycina*, which is a primary host plant of Muga silkworm, *Antheraea assamensis* Helfer (Saturniidae), an endemic and economic silk-producing insect of Assam, North Eastern India (Sahu *et al*. 2020). In this region, the silk production is a major industry (Gogoi *et al*. 2017; Borah & Borgohain 2018) and not only the silkworm *Bombyx mori* L. (Bombycidae), but also several saturniid moths including the Eri silkworm *Samia ricini* (Donovan) (= *Phylosamia ricini*), Muga silkworm *Antheraea assamensis* Helfer (= *A. assama*), and Tassar silkworm *A. paphia* (L.) have been cultivated. Among them, *A. assamensis* feeds on *M. bombycina* and produces golden yellow silk locally known as 'Muga' silk (Chakravorty *et al*. 2010; Ahmed *et al*. 2015).

Prior to the species identifications of gall midges associated with *M. bombycina* in Assam, we compared the morphology of galls induced by *Daphnephila* on *M. bombycina* with that of known congeners associated with *M. gamblei* in West Bengal.

TABLE 1 Galls induced by *Daphnephila* species on *Machilus* in West Bengal and Assam, India

Locality*	Date	Host Plant	Galled position	Investigator**
West Bengal				
Lloyd's Botanical Garden, Darjeeling	27 May 2011	*Machilus gamblei*	Stem (incl. old ones)	MT, MB, CS, TI
Dowhill Park, Kurseong	28 May 2011	*M. gamblei*	Leaf	MT, MB, CS, TI
Assam				
NEIST plantation, Jorhat	9 Jan 2010	*Machilus bombycina*	Leaf & Stem	MT, MB, MM, CS, KM, PRB, JY
Lakwa plantation, Sivasagar	10 Jan 2010	*M. bombycina*	Leaf & Stem	MT, MB, MM, CS, KM, PRB, JY
Golaghat	11 Jan 2010	*M. bombycina*	Leaf	MT, MB, MM, CS, KM, PRB, JY
Central Eri Muga Res Inst., Jorhat	12 Jan 2010	*M. bombycina*	Leaf	MT, MB, MM, CS, KM, PRB, JY
Assam Agr. Univ., Jorhat	16 Jan 2010	*M. bombycina*	Leaf	MT, MB
Amtolia, Selenghat, Jorhat	17 Jan 2010	*M. bombycina*	Leaf	MT, MB
Matabeel, Margherita, Tinsukia	20 Jan 2010	*M. bombycina*	Leaf & Stem	MT, MB
Tingrai, Tinsukia	21 Jan 2010	*M. bombycina*	Leaf & Stem	MT, MB

*Abbreviations are as follows; NEIST: North East Institute of Science & Technology.
**Investigators are as follows; CS: Chika Suyama, JY: Junichi Yukawa, KM: Kazunori Matsuo, MB: Mantu Bhuyan, MM: Misako Mishima, PRB: Pranab R. Bhattacharyya, and TI: Tatsuya Ide.



FIGURES 2-9. Galls induced by *Daphnephila* gall midges on *Machilus* (Lauraceae) in Assam and West Bengal, India. 2: Leaf galls induced by *D. haasi* on *M. gamblei* in Dowhill Park, Kurseong, West Bengal; 3: Stem galls induced by *D. glandifex* on *M. gamblei* in Lloyd's Botanical Garden, Darjeeling, West Bengal; 4: Old stem galls induced by *D. glandifex* on *M. gamblei* in Lloyd's Botanical Garden; 5: Leaf galls induced by *Daphnephila* sp. on *M. bombycina* in North-East Institute of Science & Technology (NEIST), Jorhat, Assam; 6: Stem galls induced by *Daphnephila* sp. on *M. bombycina* in NEIST; 7-8: Color variations of leaf galls induced by *Daphnephila* sp. on *M. bombycina* in Tingrai, Assam; and 9, leaf galls induced by *Daphnephila* sp. on *M. bombycina* in Tingrai, which have withered probably due to fungal infection.

Methods

Field surveys were conducted from 26 to 29 May 2011 in West Bengal and from 8 to 21 January 2010 in Assam (Fig. 1). In West Bengal, galls induced by *D. haasi* and *D. glandifex* were surveyed. In Assam, galls induced on *M. bombycina* were surveyed in *Machilus* plantations and other *Machilus* growing areas. Materials are managed by MB and kept in North-East Institute of Science & Technology, Jorhat, Assam, India.

Results and Discussion

Throughout the field surveys in West Bengal, we found leaf galls induced by *D. haasi* in Dowhill Park, Kurseong, and stem galls induced by *D. glandifex* in Lloyd's Botanical Garden, Darjeeling (Table 1, Figs 2–3). Although longitudinal wrinkles were illustrated in stem galls induced by *D. glandifex* in a figure of Kieffer (1905), they were not observed in fresh ones. However, such wrinkles were visible on old galls found in the same locality (Fig. 4).

In Assam, leaf and stem galls were found on *M. bombycina* in several localities shown in Table 1 (Figs 5–6). The leaf gall is drop-shaped and thicker than the gall induced by *D. haasi* on *M. gamblei*. The stem gall is subcylindrical and slenderer than the gall induced by *D. glandifex*. The leaf gall found at an *M. bombycina* plantation in North-East Institute of Science & Technology, Jorhat was reddish purple (Fig. 5), but that at natural vegetation was more or less varied, from pale reddish purple to green (Figs 7–8). Notably, the leaf galls found in Assam were produced on the upper surface, unlike other known leaf galls of *Daphnephila*, which are usually induced on the lower leaf surface (Kieffer, 1905; Yukawa, 1974; Tokuda *et al*., 2008; Pang *et al*., 2015). This is probably owing to the difference in oviposition behavior of females. Some galls were withered possibly caused by fungal infection (Fig. 9). The stem gall was hard and usually dozens of galls were clustered on a twig, sometimes causing death of apical part of the shoots (Fig. 6). The difference in gall shape suggests that *Daphnephila* species associated with *M. bombycina* are different from *D. haasi* and *D. glandifex*, as in other cases of *Daphnephila* gall midges that are associated with certain host plants and inducing species-specific shapes of gall (Tokuda *et al*., 2008; Pang *et al*. 2015).

Acknowledgments

This study was partly supported by JSPS KAKENHI Grant no. JP21405011 to MM and JSPS Researcher Exchange Program to MT. We thank Dr P. G. Rao, then Director of NEIST, Jorhat, and J. Mech for their support in surveys.

References

Ahmed SA, Singh NI & Sarkar CR, 2015. Role of forest biodiversity in conservation of non-mulberry (vanya) silk in in India. *Munis Entomology & Zoology*, **10**, 342–357.

Baruah JP, 2020. Gall insect in Muga silkworm (*Antheraea assamensis*) host plants, Som (*Machilus bombycina*) and Soalu (*Litsea polyantha*): *A review. International Journal of Development Research*, **10**, 39705–39706.

Borah MB & Borgohain A, 2018. Statte and Muga silk industry in independent Assam. *International Journal of Social Science and Economic Research*, **3**, 495–504.

Chakravorty R, Dutta P & Ghose J, 2010. Sericulture and traditional craft of silk weaving in Assam. *Indian Journal of Traditional Knowledge*, **9**, 378–385.

Docters van Leeuwen-Reijnvaan J & Docters van Leeuwen WM, 1926. The Zoocecidia of the Netherlands East Indies. Drukkerij de Unie, Batavia, 601 pp.

Gagné RJ & Jaschhof M, 2021. A Catalog of the Cecidomyiidae (Diptera) of the World. 5th edition. Digital version 4. – USDA, Washington D.C., 813 pp.

Gogoi D, Bhattacharjee J & Battacharyya B, 2013. Phenology of galls on Persea bombycina along with record of a new gall forming insect *Ormyrus* sp. nov. (Hymenoptera: Ormyridae) in *Assam. Journal of Entomological Research*, **37**, 345–346.

Gogoi M, Gogoi A & Baruah B, 2017. Exotic muga silk: Pride of Assam. *International Journal of Applied Home Science*, **4**, 72–78.

Kieffer JJ, 1905. Etude sur de nouveaux insectes et phytoptides gallicoles du Bengale. *Annales de la Société scientifique de Bruxelles*, **29**, 143–200.

Mani MS, 2000. Plant Galls of India Second Edition. Science Publishers, Inc., Enfield and

Plymouth, 477 pp.

Pang LY, Tung TC, Weng YC, Chen WN, Hsiao SC, Tokuda M, Tsai CL & Yang MM (2015) Taxonomy and biology of a new ambrosia gall midge *Daphnephila urnicola* sp. nov. (Diptera: Cecidomyiidae) inducing urn-shaped leaf galls on two species of *Machilus* (Lauraceae) in Taiwan. *Zootaxa*, **3955**, 371–388.

Sahu BK, Samal I & Boruah J, 2020. Gall diversity, causal agents, their adaptive significance and gall infestation in sericultural host plant. *Journal of Entomology and Zoology Studies,* **8**, 1288–1292.

Singh RN, Bajpeyi CM, Tikader A & Saratchandra B, 2013. Muga Culture, pp. 198–351. A.P.H. Publishing Corporation, New Delhi, pp.198-351.

Tokuda M & Yukawa J, 2007. Biogeography and evolution of gall midges (Diptera: Cecidomyiidae) inhabiting broad-leaved evergreen forests in Oriental and eastern Palearctic Regions. *Oriental Insects*, **41**, 121–139.

Tokuda M, Yang MM & Yukawa J, 2008. Taxonomy and molecular phylogeny of *Daphnephila* gall midges (Diptera: Cecidomyiidae) inducing complex leaf galls on Lauraceae, with descriptions of five new species associated with *Machilus thunbergii* in Taiwan. *Zoological Science*, **25**, 533–545.

Tung GS & Yang MM, 2018. Let's gall Taiwan – A guidebook on insect galls. Forestry Bureau C. O. A, Taipei, 247 pp.

Yang SY, Yang JT & Chen MY, 1999. Preliminary notes on the three Cecidomyiidae (Diptera) galls on *Machilus thunbergii* Hayata (Lauraceae) in the Guandaushi forest of central Taiwan. *Botanical Bulletin of Academia Sinica*, **40**, 153–158.

Yang SY, Chen MY & Yang JT, 2000. Plant galls in Taiwan. Taiwan Counsil of Agriculture, Taipei, 127 pp. (In Chinese)

Yukawa J, 1974. Descriptions of new Japanese gall midges (Diptera, Cecidomyiidae, Asphondyliidi) causing leaf galls on Lauraceae. *Kontyû*, **42**, 293–304.

Yukawa J, Uechi N, Tokuda M & Sato S, 2005. Radiation of Gall Midges (Diptera: Cecidomyiidae) in Japan. *Basic and Applied Entomology*, **5**, 453–461.