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Host Plant and Life History of Bamboo-feeding Sawfly, *Tenthredo nigropicta* (Hymenoptera, Tenthredinidae) in Japan

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Abstract Based on rearing experiments, *Pleioblastus chino* (Franch. et Sav.) Makino [Poaceae] is newly recorded as a host plant of *Tenthredo nigropicta* (Smith, 1874). Notes are given on the life history of the species and the larvae are illustrated for the first time. Current knowledge of the host plants and larvae of *Tenthredo* in Japan and the sawflies associated with bamboos is reviewed.
Key words: Tenthredininae, *Tenthredo nigropicta*, new host record, bamboos, *Pleioblastus chino*.

Introduction

Tenthredo Linné, 1758, is a huge genus of sawflies with over 80 species recorded in Japan (Yoshida, 2018). The immature stages and life history of the Japanese species are rather poorly known. We now know the host plants of 16 species of Japanese *Tenthredo* (Takeuchi, 1949; Okutani, 1954, 1956, 1959, 1967; Yamamoto, 1958; Inomata, 1967; Togashi, 1984; Naito, 1988), including the host record for one widely distributed Eurasian species, *T. colon* Klug, 1817, based only on the European literature (e.g., Taeger *et al.*, 1998).

Tenthredo nigropicta (Smith, 1874) is a conspicuous green and black sawfly distributed in Japan (Hokkaido, Kunashiri Is., Honshu, Shikoku, Kyushu), Korea and China (Takeuchi, 1933, 1937, 1940; Kim, 1963; Lee *et al.*, 2000; Sundukov & Lelej, 2012). It is probably the only species of *Tenthredo* occurring in a variety of habitats ranging from lowlands to subalpine regions in Japan. Okutani (1967) recorded a bamboo, "*Pleioblastus distichus* Muroi et H. Okam. var. *nezasa* Muroi et H. Okam." (= *Pleioblastus argenteostriatus* (Regel) Nakai f. *glaber* (Makino) Murata), as a host plant of this sawfly. He suggested that he had confirmed this relationship by rearing but he did not publish any information about the larvae and life history of the species.

In 2017, Ibuki succeeded in rearing *T. nigropicta* from eggs deposited by a female collected in Nakagawa Town, Tochigi Prefecture, Honshu, Japan. Here we report on the rearing and illustrate the larva for the first time.

Materials and methods

The female adult used for oviposition experiment was collected in Bato (N36°44′ E140°10′, about 140 m alt.), Nakagawa Town, Tochigi Prefecture, Honshu. Rearing was made in a room at Bambi Farm in Wami (N36°47′ E140°10′, about 240 m alt.), Nakagawa Town. The temperature and day length were not controlled in the room, but the light was usually on for about 16 hours a day. All the photographs were taken by Ibuki with a digital camera, Canon Power Shot S95. The digital images were processed and arranged

with Adobe Photoshop Elements 12 software. We followed Viitasaari (2002) for the larval morphological terminology and Yonekura and Kajita (2018) for plant names.

Results

Host plant. Poaceae: *Pleioblastus argenteostriatus* (Regel) Nakai f. *glaber* (Makino) Murata (Okutani, 1967; recorded as "*Pleioblastus distichus* Muroi et H. Okam. var. *nezasa* Muroi et H. Okam." with a comment "presumably feeding also on other bamboo species"). *Pleioblastus chino* (Franch. et Sav.) Makino (new record).

Rearing records. The female collected on May 22, 2017, was kept alive with fresh living leaves of *Pleioblastus chino* in a container. The female deposited a group of nine eggs in the tissue of the host leaf from the upper surface (Figs. 1, 2) on the same day. On June 1, seven eggs hatched (two other eggs did not hatch). The first instar larvae eclosed on the upper surface of the leaf, making holes (Fig. 3). The seven larvae molted five times, first on June 5 (Fig. 5), second on June 9–10, third on June 13, fourth on June 18 and fifth on June 22–26. When molting, the larva often went close to the tip of the stem or newly growing leaf (Fig. 5) and left the cast skin there after the molt. Four larvae matured on June 26, one larva on June 27 and two larvae on June 29. When matured, the larvae stopped feeding and became shorter and shinier with paler, more vivid coloration (Fig. 11). The mature larvae soon entered the soil. Each of them stayed in an earthen cell (Fig. 12), when examined on November 30. The cells were found at the bottom of the container with the soil about 4 cm deep.

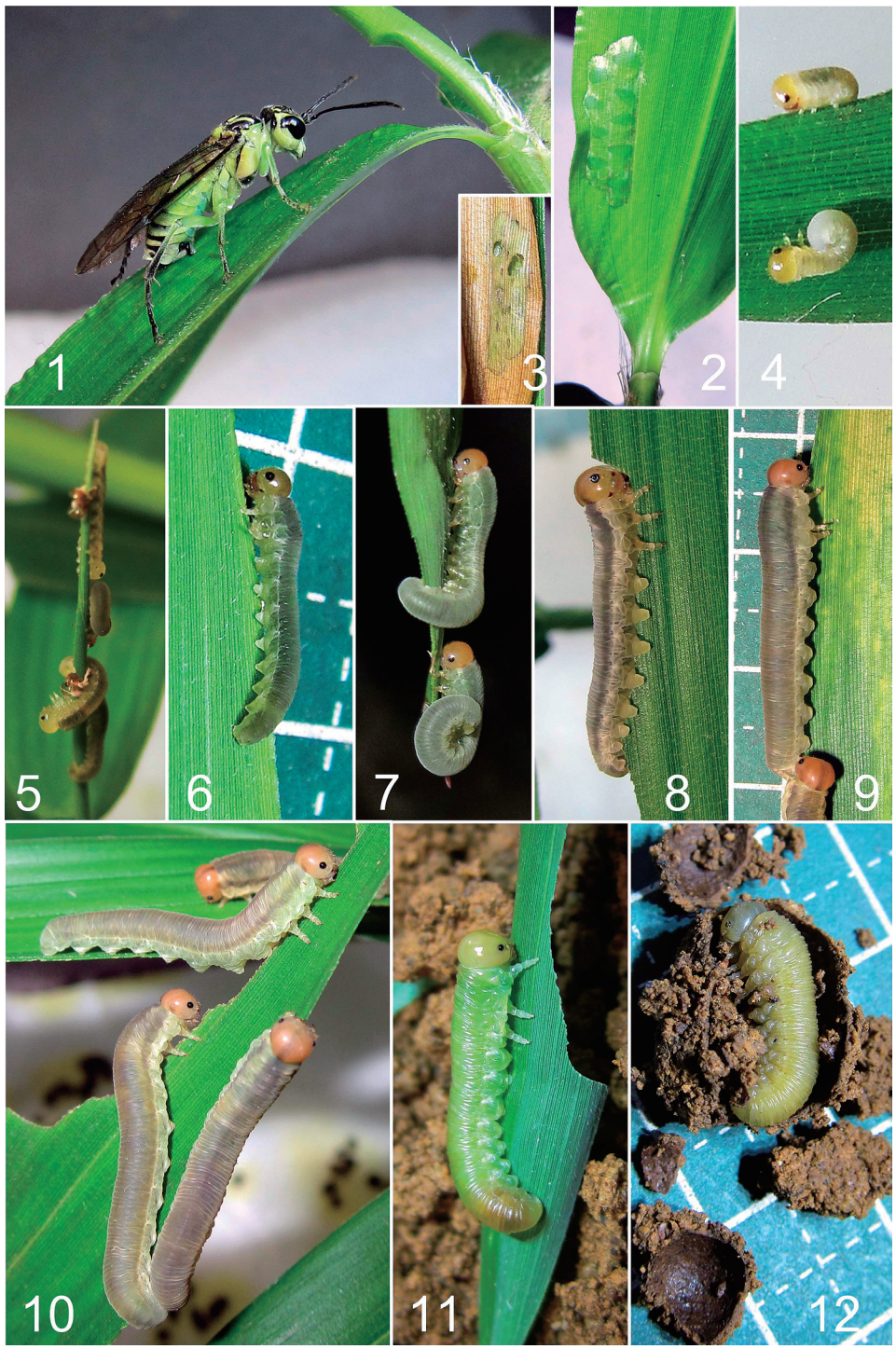
Larva. *First instar* (Fig. 4): Head translucent pale brownish yellow, shiny, with ocularium and stemmatum black and mouthparts blackish brown; trunk translucent opaque white, dorsal half tinted with olive green. Solitary, curling abdomen at rest. *Second and third instars* (Figs. 6, 7): About 10 mm in second instar; head pale orange, shiny, with ocularium and stemmatum black and mouthparts partly blackish brown; trunk translucent pale olive green, opaque, with thoracic legs faintly brownish and ventral part and prolegs paler, almost colorless. *Fourth to sixth instars* (Figs. 8–10): About 28–32 mm in sixth instar; head pale orange to pale reddish brown, shiny, with ocularium and stemmatum black and mouthparts partly blackish brown; very vague dark areas along coronal suture and near posterior end of each vertical furrow; trunk pale olive dorsally and sordid greenish or brownish white ventrally, opaque. In all instars, head pale green just after molting (Fig. 5). *Mature larva* (Fig. 11): Head very pale olive yellow, shiny, with ocularium and stemmatum black; trunk very pale vivid green, shiny.

Earthen cell (Fig. 12). Length about 17 mm; without fiber and rather easily broken with fingers; inside wall smooth.

Discussion

Previous studies on the host plants and larvae of Japanese Tenthredo

The first reference to the host plants of Japanese *Tenthredo* is Takeuchi (1949), who listed host plants of two species, *Tenthredella ferruginea* (Schrank, 1776) (= *Tenthredo ferruginea* Schrank, 1776) and *Tenthredina flavida* (Marlatt, 1898) (= *Tenthredo smithii* Kirby, 1882). Okutani (1954, 1956, 1959, 1967) reported on the host plants or described the larvae of 13 species. His works are particularly important, because he reared by himself almost all species treated. Unfortunately, details of the rearing and the life history data for each species were left unpublished. Yamamoto (1958) showed a photograph of the larva of "*Propodea fentoni*" (= *Tenthredo fentoni* (Kirby, 1882)) and Inomata (1967) reported on the biology of *T. okamotoi* Inomata, 1967, with a photograph of the larva. Togashi (1984) observed oviposition of "*T. dentina* Enslin, 1920" (= *T. ferruginea* Schrank, 1776), and Naito (1988) referred to Inomata's discovery of the host plant and peculiar larval behavior of *T. flavomandiblata* Matsumura, 1912. In conclu-



Figs. 1–12. *Tenthredo nigropicta*, all photographed in Bato, Nakagawa, by S. Ibuki in 2017. 1, Adult female ovipositing on a leaf of *Pleioblastus chino*, May 22; 2, group of nine eggs in the tissue of the leaf, seen from below; 3, same leaf after hatching of the eggs, seen from above; 4, first instar larvae, June 1; 5, first molt, June 5; 6, second instar larva, June 6; 7, third instar larvae, June 10; 8, fourth instar larva, June 14; 9, fifth instar larva, June 21; 10, sixth instar larvae, June 23; 11, mature larva, June 26; 12, prepupa and broken earthen cell, November 30.

sion, our information of the host plants of *Tenthredo* is limited to less than one-fifth of the species known in Japan.

Descriptions or photographs of the larvae have been published only for six species, *T. fentoni* by Yamamoto (1958), *T. mortivaga* Marlatt, 1898, *T. smithii*, *T. providens* (Smith, 1874) and *T. gifui* Marlatt, 1898, by Okutani (1959), and *T. okamotoi* by Inomata (1967). Apart from the short notes on the last four species by Okutani (1959) and Inomata (1967), almost no information about the life history of the Japanese *Tenthredo* has been available.

Life history and larva of Tenthredo nigropicta

Tenthredo nigropicta apparently has a univoltine life cycle with the adult emergence in spring. In the Malaise trap sampling in the Imperial Palace (ca. 20 m above sea level), central Tokyo, which was operated from June 2009 through September 2011, all the specimens of *T. nigropicta* were obtained in late April to late May in 2010 and 2011 (Shinohara, 2014). Observations given above shows that the adults of *T*, *nigropicta* occur in late May in Bato area (ca. 140 m above sea level). On higher mountains, the adults of this species have been found in July to August (e.g., Togashi, 1961). According to our rearing records, the incubation period is 10 days, the larval first instar about five days, the second instar four or five days, the third instar three or four days, the fourth instar five days, the fifth instar four to eight days, the sixth instar three or four days and the total larval feeding stage 25 to 28 days.

The eggs are laid in a group (nine eggs in our observation) in the tissue of the leaf from the upper surface (Figs. 1, 2). The oviposition from the upper surface of the leaf may be characteristic of this species, because the eggs are laid from the under surface of the leaf in the four Japanese species of *Tenthredo* treated by Okutani (1959). The eggs of *T. mortivaga*, *T. providens* and *T. gifui* are deposited in a group (Okutani, 1959), as in *T. nigropicta*. Making earthen cells underground may be a common character for the genus, because all the four *Tenthredo* species treated by Okutani (1959) made earthen cells in the soil.

As mentioned above, the larvae have been described or illustrated for only six Japanese species of the genus (Yamamoto, 1958; Okutani, 1959; Inomata, 1967). The late instar larva of *T. nigropicta* is easily distinguished from those of the six species by the almost uniformly pale orange to pale reddish brown head and the uniformly pale olive dorsal part of the trunk, besides the clear differences in the host plants.

Sawflies associated with bamboos

Larvae of sawflies utilize variety of plants as diets but the sawflies known to feed on bamboos (Poaceae: Bambusoideae) are very few. Hoffmann (1936) was the first to report on the bamboo-feeding sawfly larvae in Canton (= Guangdong), China. He mentioned that "sawfly larvae have been found attacking at least four different kinds of bamboo on Lingnan University campus, from the middle of April to the middle of June" (p. 108) but he did not examine the adults and the sawfly was left undetermined. Also in China, two species of the blennocampine genus *Eutomostethus*, *E. nigritus* Xiao, 1990, and *E. deqingensis* Xiao, 1993, both described from Zhejiang Province (Deqing County), are associated with bamboos (Xiao, 1990, 1993; Xiao *et al.*, 1992; Wang *et al.*, 2002). Besides *T. nigropicta*, which is treated in this paper, these are the only bamboo-feeding sawflies known so far. Bamboos are diverse and common plants in East Asia and many more bamboo-feeding species of sawflies probably await discovery, as suggested by the images of undetermined sawfly larvae seemingly feeding on bamboos posted on various websites (e.g., Anonymous, 2018a, b).

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