

## A new species of gall midge (Diptera: Cecidomyiidae) attacking hazels, *Corylus* spp. in China

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Hazels, *Corylus* spp. (Betulaceae) are planted extensively in North and Southwest China as nut-bearing trees. *Dasineura heterophylla* Jiao & Bu, **sp. n.**, a new species of gall midge that induces galls on leaves, leaf buds and bracts of young fruits of hazels in North China, is described and illustrated based on materials from Tieling, Liaoning, China. This new gall midge is univoltine and pupates in the topsoil. Larvae reduce nut production of hazels, especially in *Corylus heterophylla*.

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### 1. Introduction

Hazels are deciduous trees and large shrubs native to the northern hemisphere that are planted extensively in North and Southwest China as nut-bearing trees (Wang *et al.* 2007). Barnes (1951) recorded 12 species belonging to 11 genera of cecidomyiid pests associated with hazels. According to Gagné (2004), 8 nominal species were considered to be feeding on *Corylus* spp., namely *Clinodiplosis corylicola* Shinji, *Clinodiplosis corylifolia* Felt, *Contarinia coryli* Kaltenbach, *Contarinia cybelae* Kieffer, *Contarinia squamulicola* Stebbins, *Dasineura corylina* Rübtsaamen, *Lauthia coryli* Felt and *Mikomya coryli* Kieffer, among which *L. coryli* with *Corylus americana* Walt. was probably a wrong association and requires further studies (Gagné 1989), but none

above has become a pest to cause serious consequences for fruitage of hazels.

The gall-midge fauna of China has not been sufficiently studied. Only about one hundred cecidomyiid species have been reported. Trotter (1917) recorded galls of swollen hazel catkins on *Corylus heterophylla* Fisch. *ex* Trautv. induced by *C. coryli* in China. From 2005 to 2008, an outbreak of a gall-midge (Diptera: Cecidomyiidae) attacking hazels in Liaoning province, China was recorded. In 2007 alone, this new pest reduced fruit set of hazels by over 40% and caused considerable economic losses in Tieling, Liaoning, China, rendering the control of the gall-midge extremely urgent.

The galls are found on leaves, leaf buds, and bracts of young hazel fruits. They are complex, amorphously swollen, and covered by long, red-

tipped white hairs. We consider this gall midge to be a new species of the genus *Dasineura* Rondani, described here as *Dasineura heterophylla* sp. n. Only one other species of *Dasineura*, i.e. *Dasineura corylina* Rübtsaamen, is known from *Corylus*, but this species is reportedly an inquiline in galls of *C. coryli*, which induces galls in catkins of *Corylus avellana* L. and *Corylus tubulosa* Willd. in Europe (Barnes 1951; Gagné 2004).

## 2. Material and methods

The specimens reported in the present paper were collected in Tieling, Liaoning, China in 2007 and 2008 by Chunjing Liu and her colleagues of the Tieling City's Research Institute of Forestry. Adults were collected by cuvette when they emerged from pupae, pupae after mature larvae pupated in the topsoil of terrarium and larvae by dissecting galls. The specimens were kept in vials with 70% alcohol in the field as soon as collected. The adults were dissected into four parts, head, thorax, abdomen and wing, and mounted separately in Canada balsam on a microscopic slide, and the mature larvae were wholly mounted on a microscopic slide.

Morphological terms follow Gagné (1981). Figures 1–4 are line drawings by K. Jiao, and Figure 5 is photographed by C. Liu. Figures 1, 2 and 3a are based on the holotype, Figures 3b, 3c, 3d, 4 and 5 on the paratypes.

Type specimens are deposited in the Institute of Entomology, College of Life Sciences, Nankai University, Tianjin, China (NKUM).

## 3. Genus *Dasineura*

*Dasineura* Rondani, 1840: 17.

Citation list after 1840 in Gagné (2004).

*Type species. Tipula sisymbrii* Schrank, 1803, subs. des. (ICZN 1998).

The cosmopolitan genus *Dasineura* includes more than 460 species until now, belonging to Dasineurini, Lasiopteridi (Gagné 2004). There are phytophagous and inquiline species in this catchall genus which is the largest in the tribe Dasineurini with tarsal claws toothed,  $R_5$  joining

C at least slightly before the wing apex, male genitalia with mediobasal lobe gradually thinning to apex and almost as long as aedeagus, female 8<sup>th</sup> tergite tending to divide longitudinally, ovipositor protrusile with cerci fused (Gagné 2004), any of which above may not be considered as synapomorphy of the genus *Dasineura*. A further revision for this genus is to be expected.

## 4. Description of *Dasineura heterophylla* Jiao et Bu, sp. n.

*Type material.* Holotype: male, China, Liaoning, Tieling city, Liqianhu Town, Zhanglouzi Village, Wenquangou (42.19° N, 123.86° E), 20–26.V.2007, Chunjing Liu leg., deposited in NKUM. Paratypes: 6 males, 11 females, same data as holotype; 23 males, 11 females, 2 pupae, 70 larvae, China, Liaoning, Tieling city, Pingdingbao Town, Xiaohongshi Village (42.35°N, 123.96° E), IV–V.2008, Chunjing Liu leg..

*Distribution.* Liaoning, China. The suspected areas of distribution in China are Hebei, Heilongjiang, Inner Mongolia, Jilin and Shandong, where some gall midges attacking hazels were recorded.

*Etymology.* The species name refers to the specific name of the host plant, *Corylus heterophylla*.

### 4.1. Adult

Body. Yellowish, length 1.4–1.6 mm in male ( $n = 6$ ), 1.8–2.2 mm in female ( $n = 6$ ).

Head. Eye bridge 2 facets wide at vertex. Palpus (Fig. 1a) sparsely setose, 4+1-segmented (including palpiger), last three segments longer than first segment, palpiger small. Male antenna with 11 flagellomeres, female antenna with 13 flagellomeres; pedicel subglobose, smaller than scape; all flagellomeres subcylindrical, somewhat broadened subbasally, neck distinctly short, 0.050–0.067 times length of node in male (Fig. 1b) and 0.040–0.067 times length of node in female (Fig. 3b); each node with 2 (last one with 1 in male, Fig. 1c) horizontal, appressed, band-shaped circumfila, and 2 whorls of long, strong and irregular setae, one basal and one subapical;

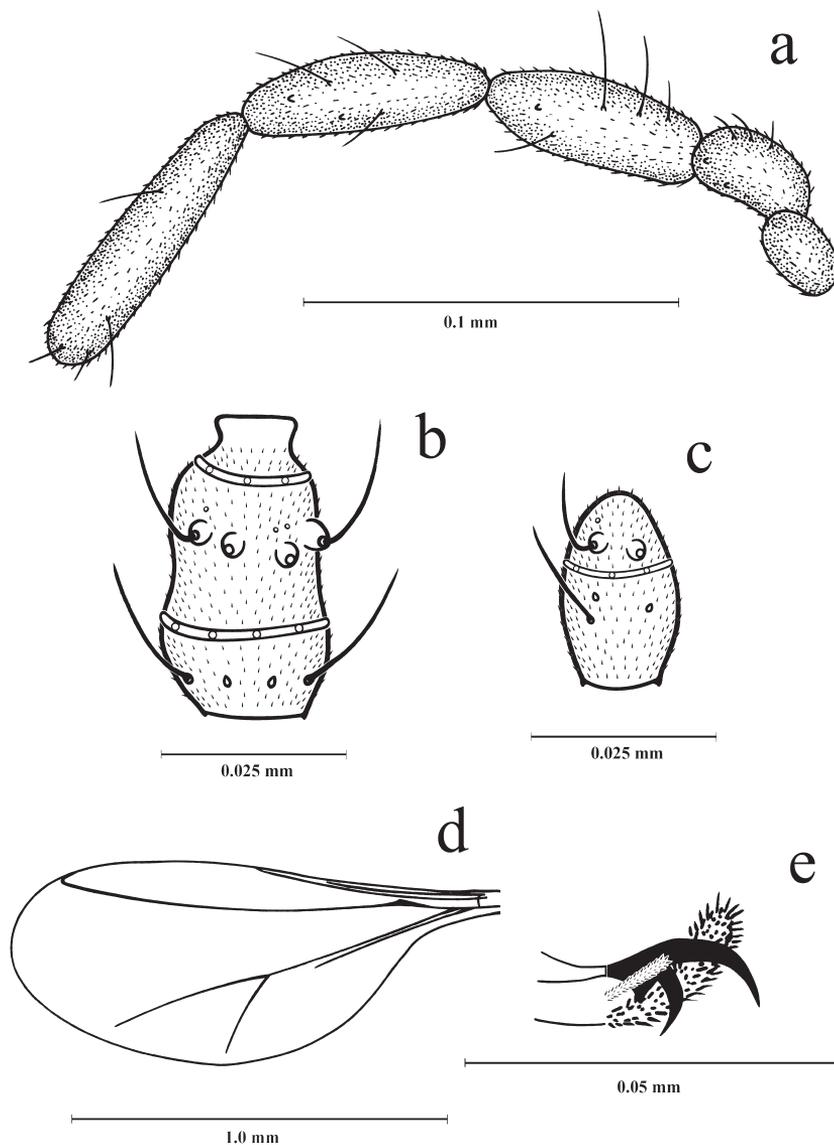


Fig. 1. *Dasineura heterophylla* sp. n. – a. Palpus including palpiger. – b. Male 3<sup>rd</sup> flagellomere. – c. Male 11<sup>th</sup> flagellomere. – d. Male wing. – e. Fore acropod.

flagellomeres progressively shorter, first and second flagellomeres fused; male terminal flagellomere rounded apically, as in Fig. 1c; female terminal flagellomere prolonged and rounded apically, as in Fig. 3c.

Thorax. Wing (Fig. 1d) hyaline, setose, sparsely covered by narrow scales. Length: 1.3–1.4 mm in male ( $n=6$ ), 1.5–1.6 mm in female ( $n=6$ ). Wing width: 0.48–0.52 mm in male ( $n=6$ ), 0.65–0.70 mm in female ( $n=6$ ). Vein Rs weak, C, R<sub>1</sub> and R<sub>5</sub> strong and densely setose; R<sub>1</sub> joining C before mid-length of wing, R<sub>5</sub> arched, joining C far before wing apex; vein M absent; vein Cu

forked at a 45 degree angle, vein PCu approximately parallel to Cu. Legs densely covered by narrow scales and sparse setae; femur of fore- and midlegs approximately as long as tibia, femur of hindleg 0.85 length of tibia in male, 0.80 in female; second tarsomere of fore-, mid- and hindlegs 0.65, 0.70 and 0.80 as long as tibia in male, and 0.70, 0.70 and 0.90 as long as tibia in female, respectively. Tarsal claws (Fig. 1e) toothed on all legs; empodia as long as claws; pulvilli cylindrical, 1/2 length of claws.

Male abdomen. First through sixth tergites entire, rectangular with a single, posterior row of

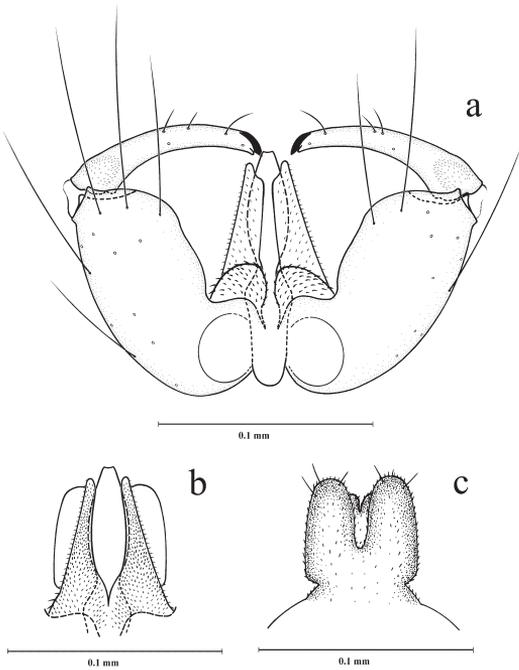


Fig. 2. *Dasineura heterophylla* sp. n. – a. Male genitalia (dorsal view, cerci and hypoproct removed). – b. Aedeagus with mediobasal lobes and cerci (ventral view). – c. Male cerci and hypoproct (dorsal view).

long setae, no lateral setae, uniformly covered by scales, with anterior pair of trichoid sensilla; seventh tergite slightly narrower than sixth, eighth tergite considerably narrower than seventh, both reduced in size, bare except for anterior pair of trichoid sensilla; second through seventh sternites rectangular with irregular but mostly two posterior rows of long setae and two middle rows of long setae, and anterior pair of closely set trichoid sensilla; eighth sternite with irregular but mostly two posterior rows of long setae, and elsewhere evenly covered scattered, long setae; seventh and eighth sternites reduced. Genitalia (Figs. 2a, 2b, 2c, 3a): Gonocoxite robust with mediobasal lobe divided into 2 parts, a short, rounded dorsobasal sublobe and an elongate ventral sublobe sheathing aedeagus, and covered by long setae; gonostylus long and slender, gradually tapering from base to apex, covered by few sparse setae subapically and setulose at basal quarter, toothed apically, distal half pigmented; cerci deeply separated, rounded apically with a few long, apical setae; hypoproct slightly shorter than cerci, with shallow, narrow notch, forming two

rounded lobes apically, each with a few short setae; aedeagus elongate, truncate, slightly longer than gonocoxite.

Female abdomen. First through sixth tergites as in male, except sixth tergite slightly narrower than fifth; seventh tergite (Fig. 3d) 0.08–0.09 mm long, sub-rectangular, with a single, posterior row of long setae and anterior pair of trichoid sensilla, evenly covered by scales, much narrower than sixth tergite; eighth tergite (Fig. 4a) 0.20–0.22 mm long, 2.54–2.57 times length of seventh and considerably narrower, divided longitudinally into two separate sclerites, with anterior pair of trichoid sensilla and several scales; second through sixth sternites as in male; seventh sternite reduced, covered by several scattered lateral setae and long posterior setae, with anterior pair of closely set trichoid sensilla. Eighth segment attenuate, covered by sparse, long setae on distal half. Ovipositor (Fig. 3e) long and protrusible; ninth segment 0.52–0.55 mm long ( $n = 6$ ), 17.8–22.0 times as long as wide, covered by sparse, long setae distally, with 2 thin dorsolateral sclerites along its length; fused cerci elongate, 3.7–3.8 times as long as wide in mid part, 0.137–0.140 times length of ninth segment, covered by microtrichia distally and few sparse, long setae; hypoproct slender, 8.5–8.6 times as long as wide, 0.42–0.43 times length of cerci.

#### 4.2. Pupa

Antennal bases rounded; cephalic seta filiform, strikingly long and thin. Prothoracic spiracle obtuse, long and stout, gradually narrowing to apex, somewhat curved distally.

#### 4.3. Larva

First instar: Whitish-hyaline, body ovoid, 0.1–0.5 mm ( $n = 10$ ) long. Second instar: White, body 2.0 mm long, elongate ovoid. Third instar: Whitish-yellow, body 3.0–4.0 mm long ( $n = 8$ ), elongate ovoid. Antennae tapered, 2.8–2.9 times as long as wide; sternal spatula (Fig. 4b) triangular with 2 anterior teeth, 3.8–3.9 times as long as wide. Abdominal segment 9 (Fig. 4c) with four setiform terminal papillae on either side.

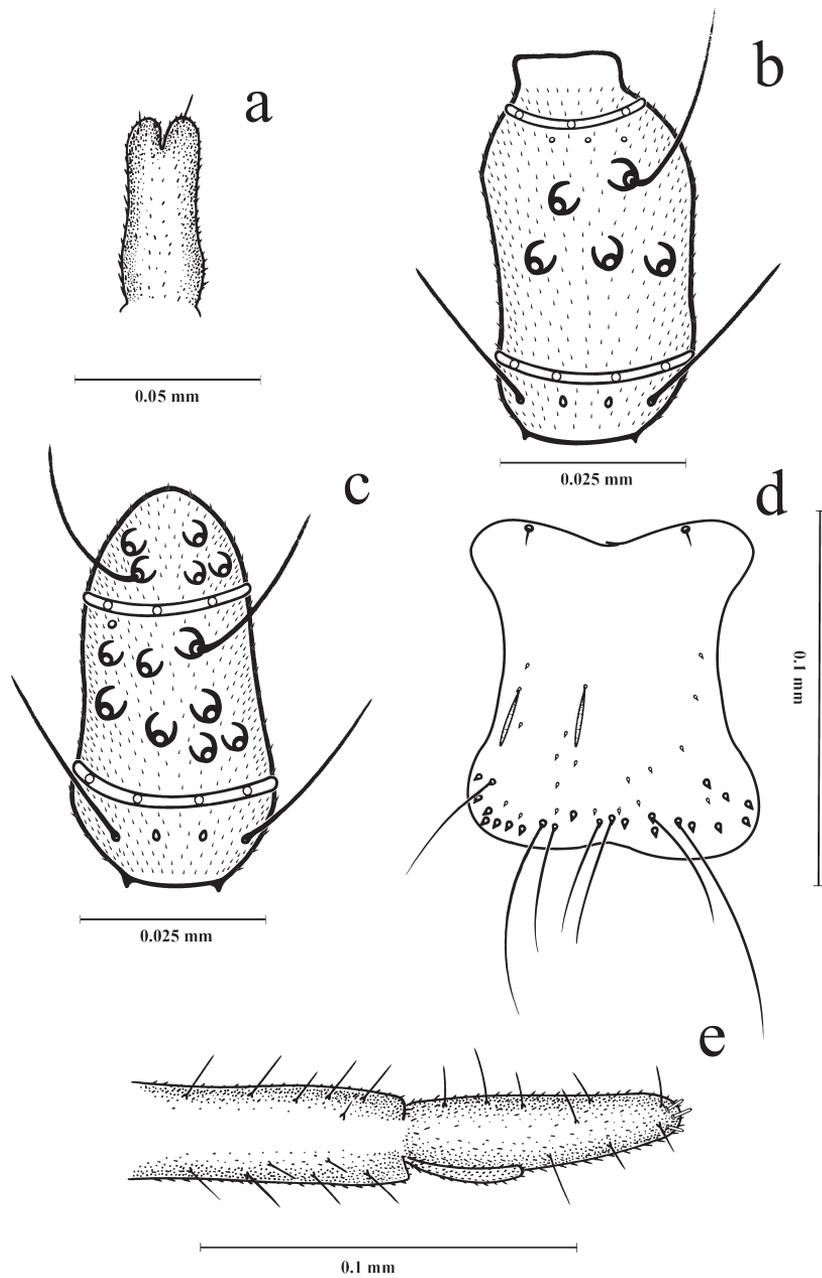


Fig. 3. *Dasineura heterophylla* sp. n. – a. Male hypoproct (dorsal view). – b. Female 3<sup>rd</sup> flagellomere. – c. Female 13<sup>th</sup> flagellomere. – d. Female 7<sup>th</sup> tergite (dorsal view). – e. Tip of ovipositor (lateral view).

**4.4. Gall**

Galls amorphous, densely covered by long, red-tipped white hairs, amorphously swollen and distributed on the underside of leaves (Fig. 5a), leaf buds (Fig. 5b) and bracts of young fruits (Fig. 5c). A galled leaf usually with 5 to 12, but sometimes up to 28 galls. Galls found singly or merged with other galls, vary in shape and size. Each gall con-

tains one elongate-ovoid chamber (Fig. 5e) with 1 to 3 larvae (mostly 1).

**4.5. Diagnosis**

This new species is similar to *Dasineura corylina* (Rübsaamen, 1912), but differs from the latter as follows: antenna with 11 flagellomeres in male

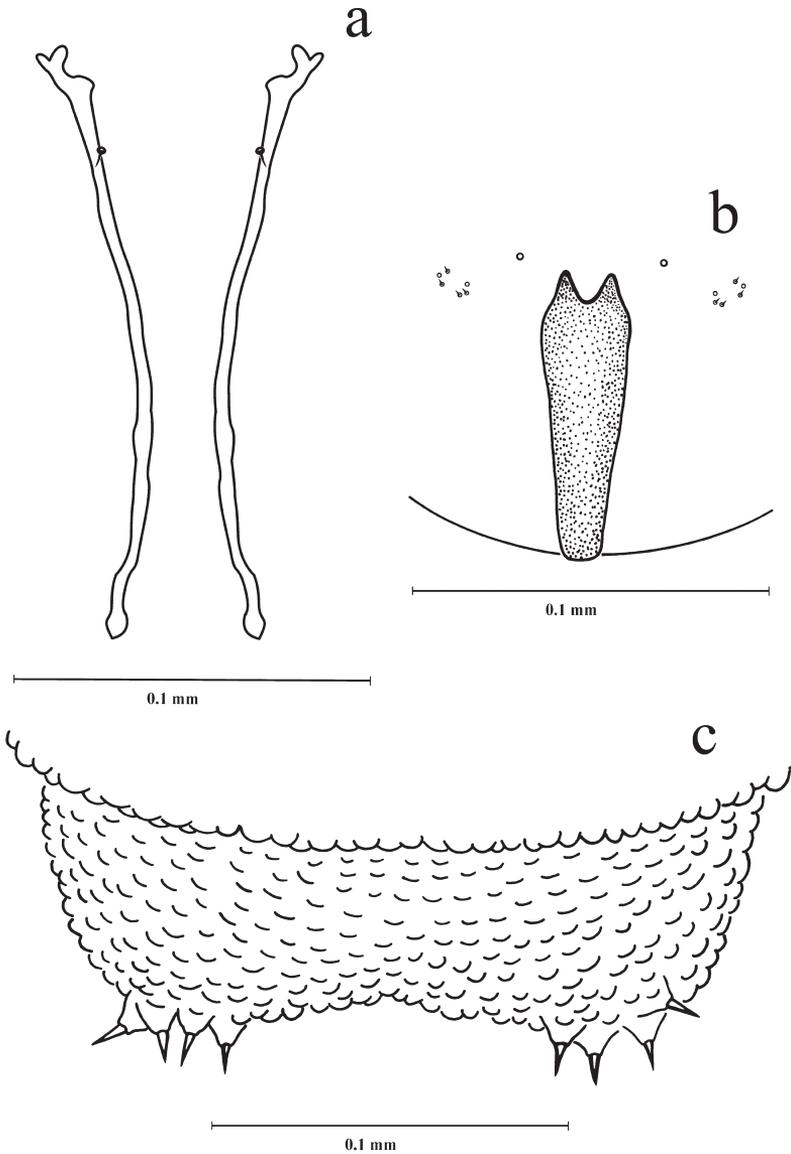


Fig. 4. *Dasineura heterophylla* sp. n. – a. Female 8<sup>th</sup> tergite (dorsal view). – b. Sternal spatula of third instar larva. – c. Abdominal segment 9 of third instar larva (ventral view).

and 13 in female, necks of flagellomeres in male much shorter and galls induced densely covered with long, distal-red and white pluses on *Corylus* spp., while *D. corylina* with antenna having 16–17 flagellomeres in both sexes, long necks of flagellomeres in male and as an inquiline in swollen catkins of *Corylus avellana* L. induced by *Contarinia coryli* Kaltenbach.

Yang & Tang (1991) described *Dasineura citrigemina* and *Dasineura citrigemmia* inducing galls on spring buds of *Citrus* sp. (Rutaceae) in Guangdong province, China. The two species above are similar to the new species by having the

divided mediobasal lobe of male genitalia, but differ from the new species as follows: antenna with 14 flagellomeres in both sexes and gonostylus of male genitalia a little shorter than half of gonocoxite, while *D. heterophylla* sp. n. with less flagellomeres and gonostylus much longer than half of gonocoxite. In immature stages, *D. citrigemina* is distinguishable from *D. citrigemmia* and *D. heterophylla* sp. n. by larval sternal spatula with one pair of prominences at two sides, while larval sternal spatulas of *D. citrigemmia* and *D. heterophylla* sp. n. without prominences at two sides.

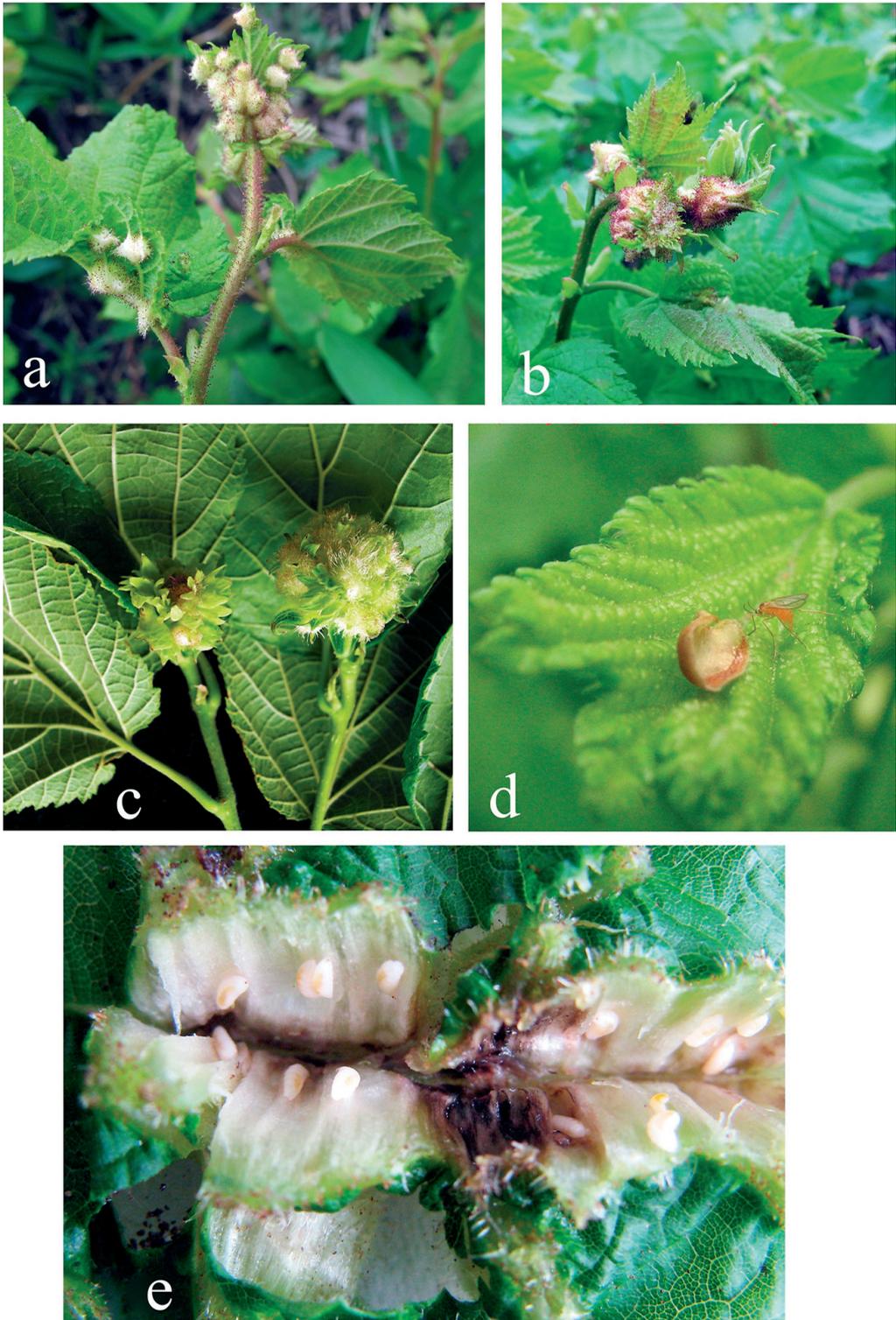


Fig. 5. *Dasineura heterophylla* sp. n. on *Corylus heterophylla*. – a. Galls on leaves. – b. Galls on leaf buds. – c. Galls on bracts of young fruits. – d. Female laying eggs. – e. Chambers of larvae in galls (galls cut open to show chambers).

The distinctly short necks of flagellomeres present in male of the new species, which may evolve from ones in female by substitution of antennae, is not very common in genus *Dasineura*, neither is the distinctly long gonostylus. In addition, widely distributed galling is unusual in *Dasineura* too.

No other *Dasineura* sp. has been found to induce similar galls on *Corylus*. Therefore, we describe it as a new species. We consider the particular gall as an extended phenotype, and recognition of the species is based more on characters of the galls than on morphological characters of adults, pupae and larvae.

#### 4.6. Biology

In Tieling, Liaoning province, China, there is one generation per year. The mature larvae drop to the soil beginning from early June and form cocoons below the litter layer in the topsoil, less than 100 mm deep. Larvae pupate when hazel buds burgeon the following year, and the pupal period lasts 13–15 days. Adults begin to emerge during the last third of April and are no longer seen during the middle third of June, with peak eclosion in mid May.

Females mate a short time after eclosion and each lays 50–90 eggs (Fig. 5d) on the surface of young leaves, the base of veins on the underside of leaf buds, and on the surface of bracts of young fruits. The proportions of egg numbers on these three plant parts are 18%, 30% and 52%, respectively. In rare cases eggs are also laid on stigmas. The egg stage lasts 5 to 7 days. Eggs begin to hatch during the middle third of May and the larvae feed on plant tissues and induce the galls. Galls appear 6 to 10 days after oviposition and larvae leave the galls 15 to 20 days later. Galled fruit cannot develop normally and will wrinkle and drop earlier than normal fruit. The upper side of young leaves with galls changes its colour to yellowish green.

In June 2007, the proportion of trees damaged by this gall midge was found to be up to 80% on average between different sites in Tieling. Proportions of damaged fruits varied from 80% to 16% in descending order on *Corylus heterophylla*, *Corylus avellana*, hybrids of *Corylus heterophylla* × *Corylus avellana* and *Corylus mandshurica*, reflecting the host preference of the gall midge.

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#### References

- Barnes, H. F. 1951: Gall Midges of Economic Importance Vol. V: Gall Midges of Trees. — Crosby Lockwood & Son, Ltd., London. 270 pp.
- Gagné, R. J. 1981: Cecidomyiidae. — In: McAlpine, J. F., Peterson, B. V., Shewell, G. E., Teskey, H. J., Vockeroth, J. R. & Wood, D. M. (eds.), Manual of Nearctic Diptera. Vol. 1: 257–292. Research Branch, Agriculture, Canada, Ottawa. 674 pp.
- Gagné, R. J. 1989: The Plant-Feeding Gall Midges of North America. — Cornell University Press, Ithaca, N.Y., 356 pp.
- Gagné, R. J. 2004: A catalog of the Cecidomyiidae (Diptera) of the world. — Memoirs of the Entomological Society of Washington, 25, Allen Press, Lawrence, USA. 408 pp.
- Rübsaamen, E. H. 1912: Ueber deutsche Gallmücken und Gallen. — Zeitschrift für wissenschaftliche Insektenbiologie 8: 284–289.
- Trotter, A. 1917: Miscellanea cecidologica. — V. *Marcellia* 16: 147–151.
- Wang, Y. M., Ma, T. X. & Zhai, M. P. 2007: Research Progress on Genetic Improvement of hazelnut. — *Nonwood Forest Research* 25(1): 70–74.
- Yang, C. & Tang Z. 1991: Two new species of the genus *Dasineura* injurious to citrus flush (Diptera: Cecidomyiidae). — *Journal of the South China Agricultural University* 12: 74–79.