

Four Species of Agromyzidae (Diptera) Intercepted by Japanese Import Plant Quarantine

Toshihisa Kamiji and Ren Iwaizumi

Research Division, Yokohama Plant Protection Station,
1–16–10, Shinyamashita, Naka-ku, Yokohama, 231–0801, Japan.

Abstract: Four species of Agromyzidae (Diptera), i.e., *Ophiomyia pinguis* (Fallén), *Melanagromyza hibisci* Spencer, *Liriomyza betae* (Coquillett), and *Napomyza cichorii* Spencer, were newly recorded in Japanese import plant quarantine. For these four species, literature-based accounts using photographs of whole body, head, thorax, leg, wing, abdomen, and male genitalia of adult flies, larva, puparium, and infested plants, and relevant information are presented to support identification in quarantine and pest control.

Key Words: *Ophiomyia pinguis*, *Melanagromyza hibisci*, *Liriomyza betae*, *Napomyza cichorii*, Japanese import plant quarantine.

Introduction

Agromyzidae (Diptera) includes many economically important groups, such genera as *Chromatomyia* and *Liriomyza*, and have frequently been intercepted by Japanese import plant quarantine (Kasugai *et al.*, 2001).

Careful examinations were made of agromyzid specimens intercepted on plants imported as air cargo at Narita International Airport from 2001 to 2011. As a result, four species of Agromyzidae, i.e., *Ophiomyia pinguis* (Fallén), *Melanagromyza hibisci* Spencer, *Liriomyza betae* (Coquillett), and *Napomyza cichorii* Spencer, were newly recorded in Japanese import plant quarantine.

There is much literature on the identification of agromyzid species. For example, Spencer (1973) wrote comprehensive diagnoses of many economically important species and Spencer (1990) presented both a list of species based on their host plants and figures showing the male genitalia of species worldwide.

For the aforementioned four species, diagnostic characters for *Ophiomyia pinguis* have been reported mainly by Dempewolf (2004) and Spencer (1972; 1973; 1976; 1990); for *Melanagromyza hibisci* by Dempewolf (2004) and Spencer (1973; 1990); for *Liriomyza betae* by Dempewolf (2004) and Spencer (1963; 1973; 1990); and for *Napomyza cichorii* by Dempewolf (2004) and Spencer (1973; 1990).

However, inexperienced persons would find it difficult to identify these species using the aforementioned literature because of the complexity of the terms describing the external morphology and male genitalia of the adult, larva, and puparium.

In this paper, explanations based on the literature on the four species using photographs and related information are provided for the purpose of identification by personnel concerned with plant quarantine and pest control who are inexperienced in diagnoses of agromyzid flies.

The authors wish to thank Mr. Akeo Iwasaki, Hokkaido Research Organization, Agriculture Research Department, Tokachi Agricultural Experiment Station, for his useful comments on the manuscript and identification of both *Liriomyza betae* and *Napomyza cichorii*. We also thank Mr. Yoshiaki Hoshino, Naoetsu Branch, Yokohama Plant Protection Station, for providing photographs of a plant infested by *Melanagromyza hibisci* and the staff members of the plant quarantine office at Narita International Airport for providing specimens.

Materials and Methods

Specimens of four species of agromyzid flies in two sub-families (Agromyzinae, *Ophiomyia pinguis*, *Melanagromyza hibisci*; Phytomyzinae, *Liriomyza betae*, *Napomyza cichorii*) intercepted on plants imported as air cargo at Narita International Airport from 2000 to 2011 were examined under the microscope.

For these four species, literature-based accounts using photographs of the whole body, head, thorax, leg, wing, abdomen, and male genitalia of the adult flies, larva, puparium, and infested plants, and related information are presented.

Abbreviations used in this paper are as follows: *acr*, acrostichal bristles; *dc*, dorsocentral bristles; *oh*, orbital setulae; *ori*, lower orbital bristles; *ors*, upper orbital bristles; *pfrl*, parafrontalia; *sctl*, scutellar bristles; *vte*, outer vertical

bristles; *vti*, inner vertical bristles.

In addition, shortened forms are also used as follows: *CGL*, common character of genus *Liriomyza*; *CGM*, common character of genus *Melanagromyza*; *CGN*, common character of genus *Napomyza*; *CGO*, common character of genus *Ophiomyia*; *CSA*, common character of subfamily Agromyzinae; *CSP*, common character of subfamily Phytomyzinae; *OO*, original observation.

Species Accounts and Information

Agromyzinae

Ophiomyia pinguis (Fallén)

(Plate 1)

(ADULT: male)

Wing length of the male is approximately 2.4 mm (original measurement).

General appearance (Figs. 1 and 2): Body is uniformly black.

Head (Figs. 3 and 4): In lateral view, *pfrl* protrudes distinctly beyond the margin of compound eye; ocellar triangle and frons are black; the male has 3 pairs of inclinate *ori* (*OO*), numerous proclinate *oh* and no *ors*; antennal bases are separated by almost globular facial protuberance (*CGO*); gena protrudes forward (Fig. 4-a) but vibrissa does not form a fasciculus even in the male; proboscis is elongated.

Thorax (Figs. 2 and 5): Mesonotum is glossy black with 2 pairs of *dc*; scutellum has 2 pairs of *sctl*; halteres are black.

Leg (Fig. 2): Legs are black.

Wing (Fig. 6): Vein Sc is developed coalescing with vein R₁ before reaching vein C (*CSA*); vein C reaches the end of vein M₁₊₂ (*CGO*); ultimate section (Fig. 6-a) of vein M₃₊₄ is shorter than the penultimate section (Fig. 6-b).

Abdomen (Fig. 2): Abdomen is glossy black.

(PUPARIUM) (Figs. 7 and 8): Body length is about 3.4 mm (original measurement); pupation occurs inside the plant tissue; the color is pale yellow; posterior spiracle is situated on a stalk-like structure with approximately 8 spiracular bulbs (*OO*) arranged in a radial pattern.

Specimens examined: 1 male, from Italy, intercepted on leaf of chicory (*Cichorium intybus*) in the larval stage, 20 January 2010, Y. Hoshino (first record in Japanese plant quarantine).

Host plants: Endive (*Cichorium endivia*), chicory, lettuce (*Lactuca sativa*), and *Leontodon* sp. (Dempewolf, 2004; Spencer, 1972; 1973; 1976; 1990).

Damage: This species is known as a pest of chicory (Dempewolf, 2004; Spencer, 1972; 1973; 1976).

Larvae frequently mine along the midribs or the petioles with red discoloration on the leaf base (Dempewolf, 2004; Spencer, 1972; 1973; 1990).

Distribution: India, Egypt, Europe, Russia, Tajikistan, and Uzbekistan (Dempewolf, 2004; Spencer, 1972; 1973; 1976; 1990).

Remarks: There is a sexual dimorphism in the chaetotaxy of *pfrl* (Dempewolf, 2004; Spencer, 1973; 1976). In the female, there are 2 pairs of both *ors* and *ori* as in the usual case of this species and *oh* are thinner. The head of female was illustrated by Spencer (1973; 1976).

Male genitalia was illustrated by Spencer (1973; 1976; 1990) and presented as photographic figures by Dempewolf (2004).

Ophiomyia cichorii and *Napomyza cichorii* are two feeder species observed on *Cichorium* (Spencer, 1990). *O. cichorii* is distinct from *O. pinguis* in having distinctly developed vibrissal fasciculus in male and reclinate *oh* (Spencer, 1964). *N. cichorii* is distinct from *O. pinguis* in both general appearance of adult fly and posterior spiracle of puparium (mentioned below).

Melanagromyza hibisci Spencer

(Plate 2)

(ADULT: male)

Wing length is approximately 2.7 mm (original measurement).

General appearance (Figs. 9 and 10): Body is generally black.

Head (Figs. 11–13): In profile, *pfrl* does not distinctly protrude beyond the margin of compound eye; apex of ocellar triangle (Figs. 11 and 12-a) reaches the level of bases of lower *ors*; 2 pairs of both reclinate *ors* and inclinate *ori* are present; the top of lunule (Figs. 11 and 12-b) extends beyond the level of the upper *ori*; *pfrl* widens (Figs. 11 and 12-c) near the level of lower *ori*; first flagellomere is round.

Thorax (Figs. 10, 14 and 15): Mesonotum and scutellum are metallic greenish black; 2 pairs of *dc* are present (*CGM*); 2 pairs of *sctl* are present (*OO*), squama and squamal fringe are white; halteres are black.

Leg (Fig. 10): Legs are black.

Wing (Fig. 15): Vein Sc develops coalescing with vein R₁ before reaching vein C (*CSA*); vein C reaches the end of vein M₁₊₂ (*CGM*); cross-vein r-m situates at about middle level of cell dm; ultimate section (Fig. 15-a) of vein M₃₊₄ is shorter than the penultimate section (Fig. 15-b).

Abdomen (Fig. 16): Abdomen is metallic greenish black.

Male genitalia (Fig. 17): In lateral view, aedeagus is bifurcated.

(LARVA AND PUPARIUM)

Larva (Fig. 18): Larva is nearly white.

Puparium (Figs. 19–22): Body length is approximately 3.9 mm (original measurement); pupation occurs inside the plant tissue (Figs. 19 and 20); the color is pale yellow; posterior

spiracle is surrounded by 9 spiracular bulbs (Fig. 22-c) (*OO*) and situated on a separate protuberance (Fig. 22-a) with a distinct central horn (Fig. 22-b) (*CGM*).

Specimens examined: 1 male, from Thailand, intercepted on peduncle of okra (*Abelmoschus esculentus*) in the larval stage, 25 January 2007, W. Yamamoto (first record in Japanese plant quarantine); 1 male, from Thailand, intercepted on peduncle of okra in the pupal stage, 30 January 2011, Y. Hoshino.

Host plant: Okra (Dempewolf, 2004; Rawat and Dhamdhare, 1981; Sasakawa, 2008; Spencer, 1973; 1990).

Damage: This species is known as a pest of okra. Stem, petiole, and pedicel have been reported as feeding sites for the larva. Larval mining inside the stem tissue produces gall-like swelling and longitudinal splitting (Dempewolf, 2004; Rawat and Dhamdhare, 1981; Spencer, 1973; 1990).

Distribution: India, Sri Lanka, and the Philippines (Dempewolf, 2004; Rawat and Dhamdhare, 1981; Sasakawa, 2008; Spencer, 1973; 1990).

In the present case, however, it was intercepted on the plants imported from Thailand where the distribution of this species had been unknown. This result implies that this species may also be distributed in Thailand.

Remarks: Detailed shapes of male genitalia were illustrated by Spencer (1973; 1990) and presented as photographic figures by Dempewolf (2004).

Only two species of genus *Melanagromyza* have been known to infest plants belonging to Malvaceae: *M. hicksi* on *Althaea* (North America) and *M. hibisci* (Spencer, 1990).

Phytomyzinae

Liriomyza betae (Coquillett)

(Plate 3)

(ADULT)

Wing length is approximately 1.3–1.8 mm (original measurement).

General appearance (Figs. 23–25): Body is black with partially yellow.

Head (Figs. 26 and 27): Bases of both *vti* and *vte* are usually situated on yellow ground (*OO*); frons and *pf₁* are yellow; occiput is black; 2 pairs of reclinate *ors* and 1–2 pairs of inclinate *ori* (*OO*) are present; *oh* are sparse and reclinate; antennal segments are all yellow; first flagellomere is round; the ratio of the height of the jowl (Fig. 27-a) to the compound eye is approximately 2–5.

Thorax (Figs. 25 and 28): Mesonotum is usually matte black; 1–3 rows of *acr* (*OO*) and 4–7 pairs of *dc* (*OO*) are present; anterior *dc* is usually shorter than the posterior (*OO*); both hind angles (Fig. 28-a) of mesonotum are yellow

(*OO*); scutellum is yellow in the central part (Fig. 28-b) and black on both sides (Fig. 28-c); 2 pairs of *sctl* are present (*CGL*); anepisternum is almost yellow with a dark patch (Fig. 25-a) at anterior lower corner; halteres are yellow (*OO*).

Leg (Fig. 25): Femora are almost yellow; tibiae and tarsi are brown.

Wing (Fig. 29): Weak vein Sc reaches vein C and does not coalesce with vein R₁ (*CSP*); vein C reaches the end of vein M₁₊₂ (*CGL*); cross-vein m-m is absent.

Abdomen (Figs. 25 and 30): Abdominal tergites are dark except yellow on posterior margin and on both sides.

Male genitalia (Fig. 31): Distiphallus is large; ejaculatory apodeme is fan-shaped and very wide.

(PUPARIUM) (Figs. 33 and 34): Body length is approximately 1.5–1.8 mm (original measurement); pupation occurs outside the plant tissue; body is brownish orange-yellow; posterior spiracle has 3 spiracular bulbs.

Specimens examined: 1 male, from New Zealand, intercepted on leaf of spinach (*Spinacia oleracea*) in the larval stage, 27 July 2000, T. Koganezawa (first record in Japanese plant quarantine); 1 female, from Australia, intercepted on leaf of chard (*Beta vulgaris*) in the larval stage, 27 October 2004, M. Takanashi; 3 male, 1 female, from Australia, intercepted on leaf of chard in the larval stage, 31 October 2004, T. Matsuzawa; 2 male, 1 female, from Australia, intercepted on leaf of chard in the larval stage, 5 November 2006, S. Sekimoto.

Host plants: Chard, *Cerastium glomeratum*, wallflower (*Cheiranthus cheiri*), lambsquarters (*Chenopodium album*), *Coronopus didymus*, *Silene* sp., spinach, and *Stellaria media* (Coquillett, 1900; Dempewolf, 2004; Spencer, 1963; 1973; 1990).

Damage (Fig. 32): Larval feeding produces a white linear mine on the upper surface of the chard leaf (Dempewolf, 2004; Spencer, 1963; 1973).

Distribution: Australia and New Zealand (Coquillett, 1900; Dempewolf, 2004; Spencer, 1963; 1973; 1990).

Remarks: Spencer (1973) reported that the bases of both *vti* and *vte* are usually situated on dark ground or *vti* just on yellow; head has a pair of inclinate *ori*; mesonotum has 4 pairs of *dc*. In the present materials, bases of both *vti* and *vte* are usually situated on yellow ground; head has 1–2 pairs of inclinate *ori*; mesonotum has 4–7 pairs of *dc*.

Detailed shapes of male genitalia were illustrated by Spencer (1973; 1990) and presented as photographic figures by Dempewolf (2004).

Liriomyza caulophaga, like this species, has been recorded from chard as a host, from both Australia and New Zealand, and does not have cross-vein m-m. However, this species can be distinguished from *L. caulophaga* by black coloration of

occiput, rounded first flagellomere, and pupation outside plant tissue (Dempewolf, 2004; Spencer, 1963; 1973; 1990).

Phytomyza betae Coquillett, *Haplomyza chenopodii* Watt, *Haplomyza imitans* Malloch, and *Liriomyza chenopodii* (Watt) are synonyms of this species (Dempewolf, 2004; Spencer, 1963; 1973; 1990).

***Napomyza cichorii* Spencer**

(Plate 4)

(ADULT)

Wing length is approximately 2.4–3.1 mm (original measurement).

General appearance (Figs. 35–37): Body is gray with partially yellow.

Head (Figs. 38 and 39): In profile, *pfrl* distinctly protrudes beyond the margin of compound eye (*CGN*); *oh* are proclinate (*CGN*); *vte* are situated on dark ground and *vti* on the boundary between yellow and dark (*OO*); usually 2 pairs of reclinate *ors* and 2–4 pairs of inclinate *ori* are present; frons and *pfrl* are pale yellow; antennal segments are all dark; in profile, first flagellomere is truncate.

Thorax (Figs. 37 and 40): Mesonotum is gray with 4 pairs of *dc* and has approximately 2 rows of *acr*; scutellum has 2 pairs of *sctl* (*OO*); upper margin of anepisternum is yellow; halteres are yellow (*OO*).

Leg (Fig. 37): All legs are mostly dark brown and both apices of femora and bases of tibiae are yellow.

Wing (Fig. 41): Vein Sc neither develops nor reaches vein C or R₁ (*CSP*); vein C reaches the end of vein R₄₊₅ (*CGM*); cross-vein m-m is located close together to cross-vein r-m (*CGM*).

Male genitalia (Figs. 42–44): Aedeagus has the angle in profile and narrow mesophallus in ventral view.

(PUPARIUM) (Figs. 45 and 46): Body length is approximately 3.4–4.6 mm (original measurement); pupation occurs inside the plant tissue; body color is white–pale brown; posterior spiracle has 20–24 bulbs in 2 rows.

Specimens examined: Following specimens were all intercepted on leaf of chicory.

1 male, from Italy, in the pupal stage, 18 March 2005, H. Sakai (first record in Japanese plant quarantine); 1 female, from the Netherlands, in the pupal stage, 10 January 2010, Y. Hoshino; 1 male, from the Netherlands, in the larval stage, 3 February 2010, M. Yoneyama; 1 male, from the Netherlands, in the larval stage, 14 February 2011, T. Hiramoto; 1 male, from the Netherlands, in the larval stage, 21 February 2010, Y. Hoshino; 1 female, from the Netherlands, in the pupal stage, 24 March 2010, Y. Hoshino; 1 male, from the Netherlands, in the larval stage, 4 April 2010, H. Hattori.

Host plants: Endive, chicory, lettuce, and *Sonchus* sp. (Dempewolf, 2004; Spencer, 1973; 1990).

Damage: This species is a serious pest of chicory. Leaf, stem, and root have been reported as the feeding sites of the larva. The leaf mine shows reddish discoloration. The larva feeds in the center of the chicory heads, on that occasion, the damage may be invisible. (Dempewolf, 2004; Spencer, 1973; 1990)

Distribution: Armenia, Europe, Russia, and Tunisia (Dempewolf, 2004; Spencer, 1973; 1990; Zlobin, 2001)

Remarks: This species is usually larger than those in major agromyzid pests such as *Chromatomyia horticola* and *Liriomyza huidobrensis*, which have been frequently intercepted in Japanese plant quarantine to date (Kasugai *et al.*, 2001).

This species as well as *Ophiomyia pinguis* mentioned above is known as a pest of chicory (Dempewolf, 2004; Spencer, 1973; 1990). However, this species is easily distinguishable from *O. pinguis* by coloration of adult fly and the presence of larger number of spiracular bulbs on posterior spiracle of puparium.

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和 文 摘 要

日本の輸入植物検疫で発見されたハモグリバエ4種

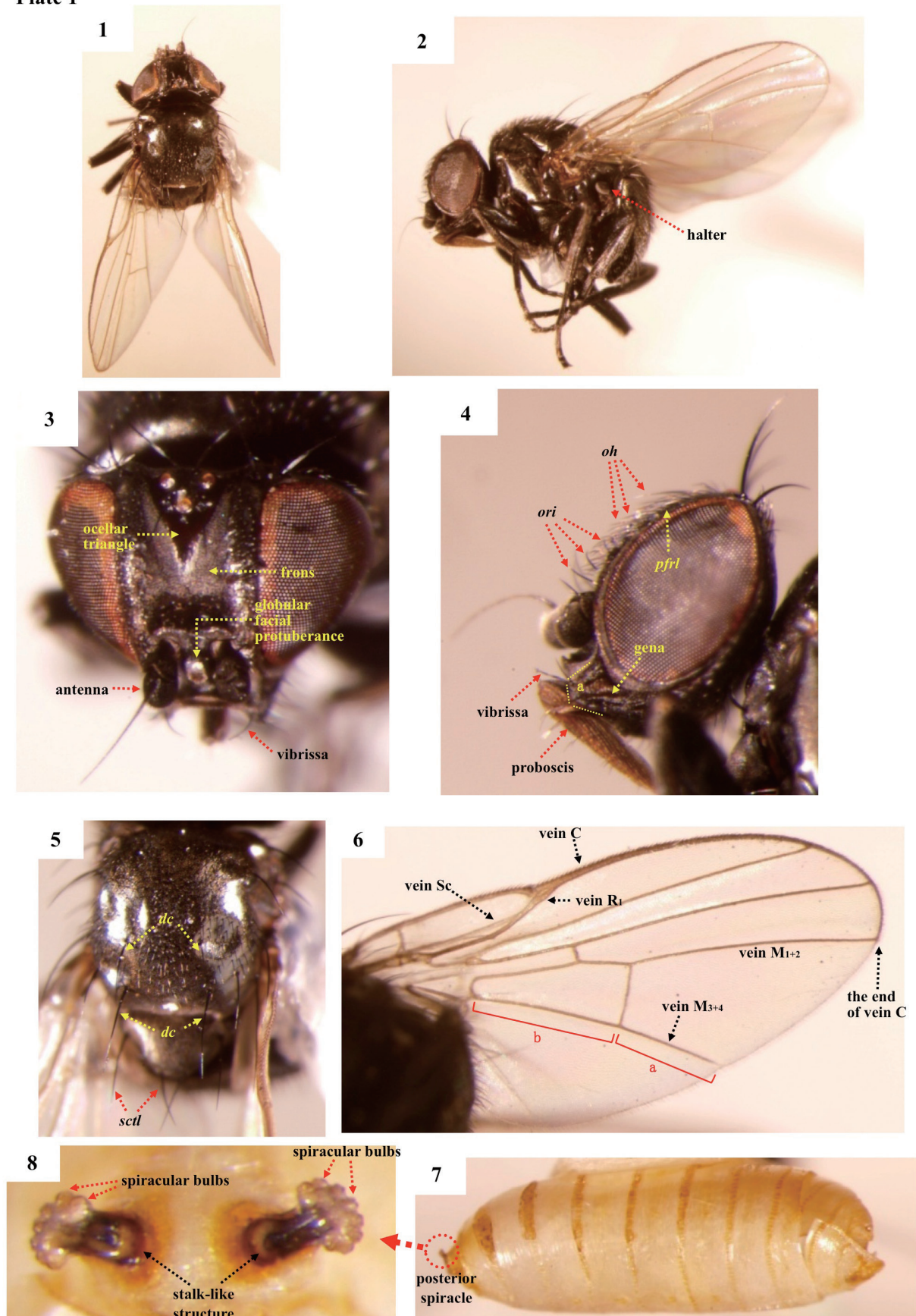
上地俊久・岩泉 連

横浜植物防疫所調査研究部

ハモグリバエ科（ハエ目）の4種、*Ophiomyia pinguis* (Fallén)、*Melanagromyza hibisci* Spencer、*Liriomyza betae* (Coquillett) 及び *Napomyza cichorii* Spencer が日本の輸入植物検疫で新しく記録された。

植物検疫及び病害虫防除における同定に資するため、これら4種に係る成虫外観、頭部、胸部、脚、前翅、腹部、雄交尾器、幼虫、蛹殻及び被害を受けた植物体の画像を用いた文献に基づく診断法並びに関連する情報が示された。

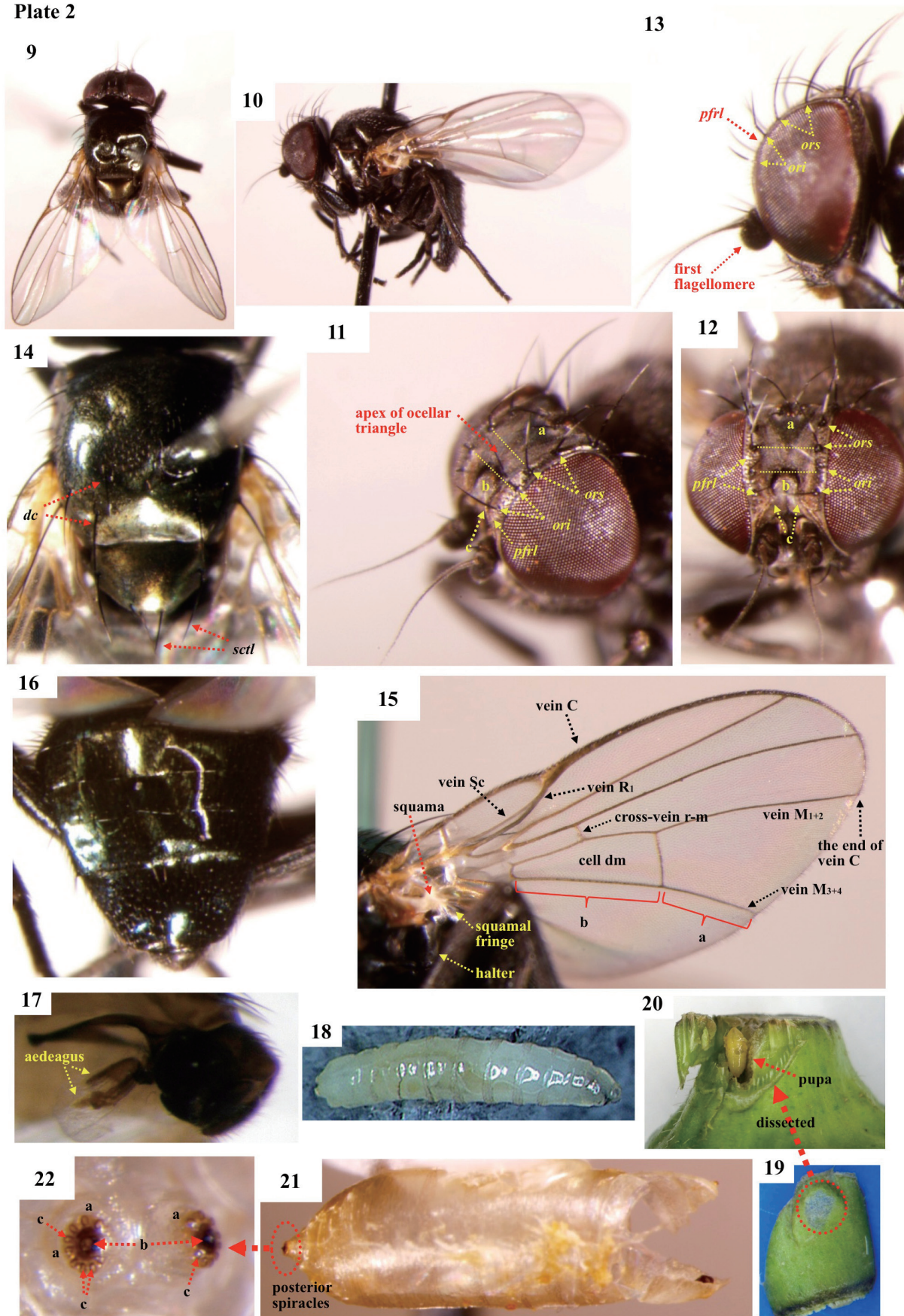
Plate 1



Figures 1-8. *Ophiomyia pinguis* (Fallén), male.

1, Dorsal view. 2, Left lateral view. 3, Head in frontal view. 4, Head in left lateral view. 5, Thorax in dorsal view. 6, Left wing. 7, Puparium. 8, Posterior spiracles of puparium.

Plate 2



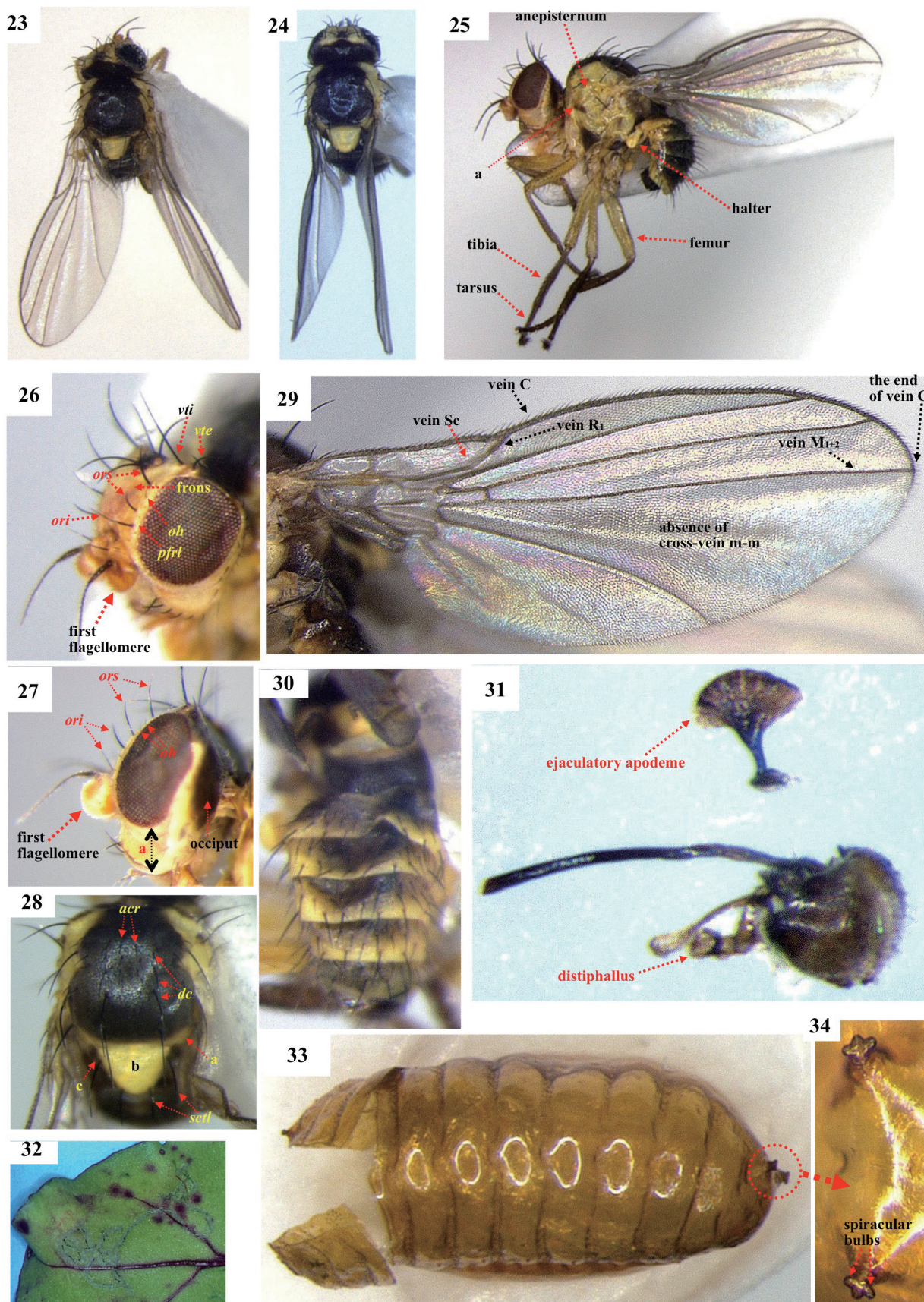
Figures 9–22. *Melanagromyza hibisci* Spencer, male.

9, Dorsal view. 10, Left lateral view. 11, Head. 12, Head in frontal view. 13, Head in left lateral view. 14, Thorax in dorsal view.

15, Left wing, squama and halter. 16, Abdomen in dorsal view. 17, Aedeagus in left lateral view. 18, Last-instar larva.

19, Peduncle of okra infested by this species. 20, Pupa in the peduncle. 21, Puparium. 22, Posterior spiracles of puparium.

Plate 3



Figures 23–34. *Liriomyza betae* (Coquillett)

23 and 24, Dorsal view, 23, Male. 24, Female. 25, Female in left lateral view. 26, Head of female. 27, Head of male in left lateral view. 28, Thorax of female in dorsal view. 29, Left wing of female. 30, Abdomen of male in dorsal view. 31, Genitalia of male in left lateral view. 32, Upper surface of chard leaf infested by this species. 33, Puparium. 34, Posterior spiracles of puparium.

Plate 4

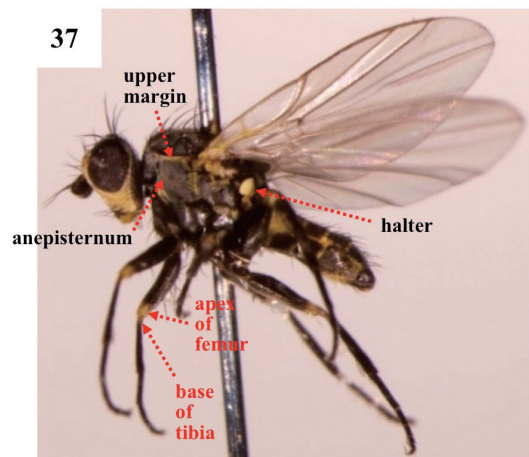
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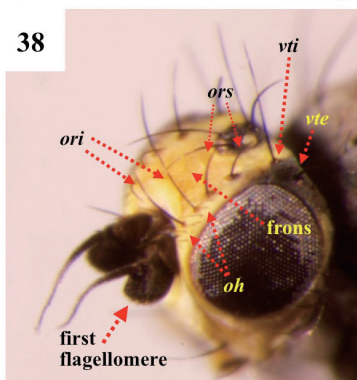
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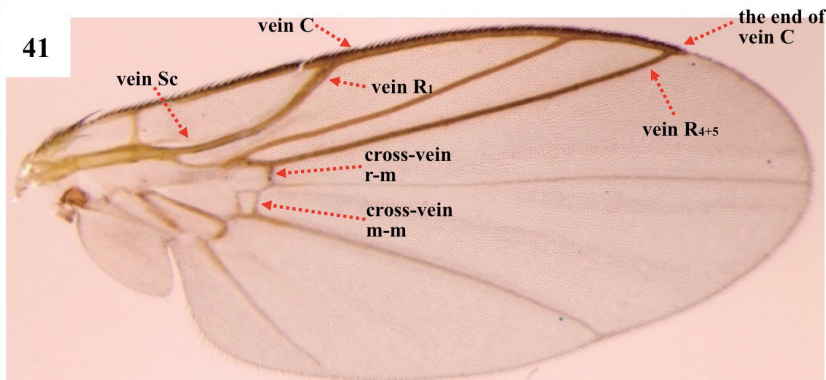
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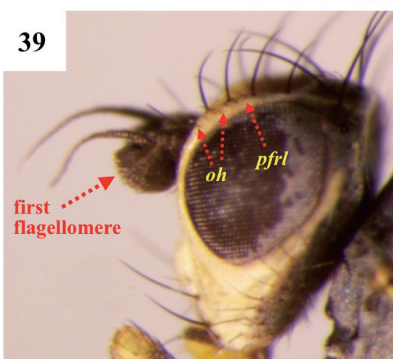
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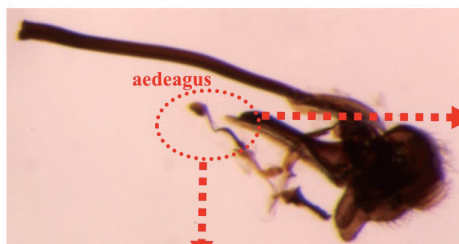
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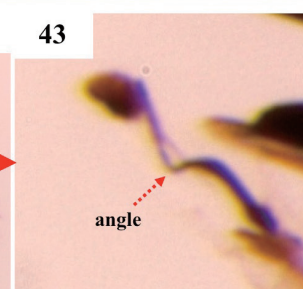
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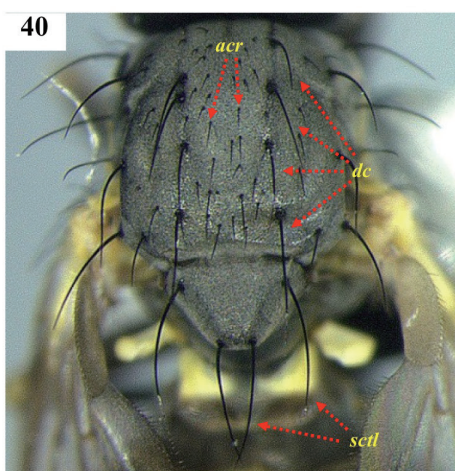
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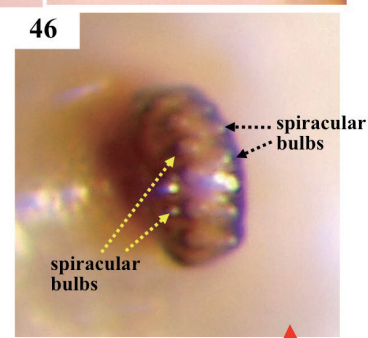
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Figures 35–46. *Napomyza cichorii* Spencer

35 and 36, Dorsal view, 35, Male. 36, Female. 37, Male in left lateral view. 38, Head of male. 39, Head of male in left lateral view. 40, Thorax of female in dorsal view. 41, Left wing of male. 42, Genitalia of male in left lateral view. 43, Aedeagus in left lateral view. 44, Aedeagus in ventral view. 45, Puparium. 46, Right posterior spiracle of puparium.