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The *Liriomyza* (Agromyzidae: Schizophora: Diptera) of California

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Abstract

The Californian species of *Liriomyza* Mik are revised, including descriptions, illustrations, photographs and a key to species. Sixty-three species are now known to occur in the state, 12 of which are described here as new: *L. bispinula*, *L. conclavis*, *L. cunicularia*, *L. merga*, *L. miserabilis*, *L. nebulosa*, *L. parabella*, *L. phyllodes*, *L. projecta*, *L. salpingion*, *L. tricornis* and *L. trixivora*. *Liriomyza virginica* Spencer is included as a junior synonym of *L. helianthi* Spencer, and *L. similis* Spencer is included as a synonym of *L. artemisiae* Spencer. Two species are newly recorded in the United States: *L. equiseti* Meijere, previously known from Canada and Europe, and *L. montana* Sehgal, previously known from Canada. A number of specimens of *L. brassicae* (Riley) have been identified as potential new host “races” or species. Morphological characters are provided to diagnose the sister species *L. huidobrensis* (Blanchard) and *L. langei* Frick, previously recognizable only on the basis of molecular data. Numerous new state, county and host records are also presented, and hosts are compared for five of the most common North American agricultural pests: *L. brassicae*, *L. huidobrensis*, *L. langei*, *L. sativae* Blanchard and *L. trifolii* (Burgess). California contains the highest diversity of *Liriomyza* known to occur in North America, containing approximately 70% of all described species known from the lower 48 states.

Key words: Agromyzidae, *Liriomyza*, Diptera, California, agriculture, plant miners, plant hosts

Introduction

Liriomyza Mik (Agromyzidae: Diptera) is a diverse genus of minute acalyptrate flies encompassing hundreds of described species from all biogeographic regions. The larvae feed in the tissue of living plants as leafminers. A few species are known to mine in horse-tails (Equisetaceae), but the majority have been reared from monocots (15 families are known hosts) and/or dicots (all subfamilies attacked) (Spencer 1990, Benavent-Corai *et al.* 2005). While most species are host specialists (Scheffer *et al.* 2007), a fraction are known to feed across plant genera, or in some cases, across families, attacking dozens to hundreds of host species. Several of these polyphagous species are common on agricultural crops, not just in California but across North America and the rest of the World, and can cause significant economic damage. In California, these include *L. brassicae* (Riley), *L. langei* Frick, *L. sativae* Blanchard and *L. trifolii* (Burgess), all of which are found throughout the state, and *L. huidobrensis*, a worldwide pest of major concern that was collected in California approximately 40 years ago (see below). *Liriomyza huidobrensis*, a very close relative of *L. langei*, is unlikely to have become established since, but additional future introductions are to be expected considering California’s leading role in international agricultural trade and the apparent ease by which this pest has been introduced into other countries. Host genera are listed for these five species below (Table 1), separating previously confused records for *L. huidobrensis* and *L. langei*, which were treated as the same species in a number of publications.

The *Liriomyza* of California was last directly treated in Spencer’s (1981) revision of the Californian Agromyzidae, and although the entire agromyzid fauna of the lower 48 States was revised only five years later by Spencer & Steyskal (1986), no new Californian records were provided. The Californian *Liriomyza* included 48 species at that time. The Californian fauna is here represented by 63 species, including 12 species new to science and two species new to the United States. Thirty-two species—half of the Californian fauna—are known only from the state, although focused collecting in nearby states will almost certainly uncover at least some of these taxa elsewhere. California is currently the center of *Liriomyza* diversity in the North America, with approximately 70% of all described species known to occur in the lower 48 states. There is little doubt that additional species will be found in California, but most will likely prove to be infrequently encountered host specialists living at higher elevations. Described species may also contain cryptic or less easily identified taxa or specialized host “races”, as is outlined

below for *L. brassicae*, and previously illustrated by Scheffer & Lewis (2005, 2006) for *L. sativae* and *L. trifolii*. Furthermore, it is certain that numerous more species will be found to the east and north of California towards the midwestern and southeastern states (Lonsdale, pers. obs.; Scheffer, pers. comm.) where agromyzid collecting has traditionally been infrequent.

All Californian *Liriomyza* are here illustrated, keyed and described, and a discussion of hosts, distribution and potential importance is provided. The adult key provided below is more complicated than those previously constructed for the American fauna, as the examination of new material has revealed that the external morphology of these taxa is much more variable than previously assumed, and that many species overlap significantly in appearance. Because of this plasticity in external morphology, the more reliable structures of the male terminalia should be examined whenever possible so as to verify identifications. In the case of several species—including the common *L. sativae*, which is almost unique in the amount of colour variation exhibited, coming out in seven different places in the key—it is almost always necessary to examine the phallus for a reliable determination. In difficult cases (which are unfortunately relatively frequent within the genus), it is suggested that the male terminalia be matched to the included figures in order to come to a tentative determination, and to then use the species descriptions and comments to verify the identification and compare it to similar species. It must also be stressed that while host species can be used to aid in identification, knowledge of host use in *Liriomyza* (and the family in general) is far from complete, thereby making host data potentially misleading.

Host use. Host use by the Californian *Liriomyza* is not well known, with rearing data available for less than half of the state's 63 species, although the agriculturally significant taxa are better known. Six species occur on monocots, including the specialists *L. smilacinae* Spencer (Liliaceae) and the highly abundant *L. septentrionalis* Sehgal (Poaceae), although several other species including *L. graminaceae* Spencer, *L. montana* Sehgal and possibly *L. abnormis* Spencer are likely also Poaceae-feeders because they belong to a diverse clade specializing on that plant family (see comments for *L. graminaceae*). The remaining four species include the truly polyphagous *L. langei*, *L. huidobrensis*, *L. sativae* and *L. trifolii*, which feed on a broad array of vascular plant genera (see Table 1).

Liriomyza brassicae could also be considered polyphagous, feeding on many species in a number of families (Table 1), but most of these hosts are restricted to the Brassicaceae. Most other Californian species are known to feed exclusively on species within a single host family, although *L. stachyos* Spencer (primarily feeding on Lamiaceae) and *L. trifoliarum* Spencer (primarily on Fabaceae) have each been reared from a single species outside their "favoured" host family.

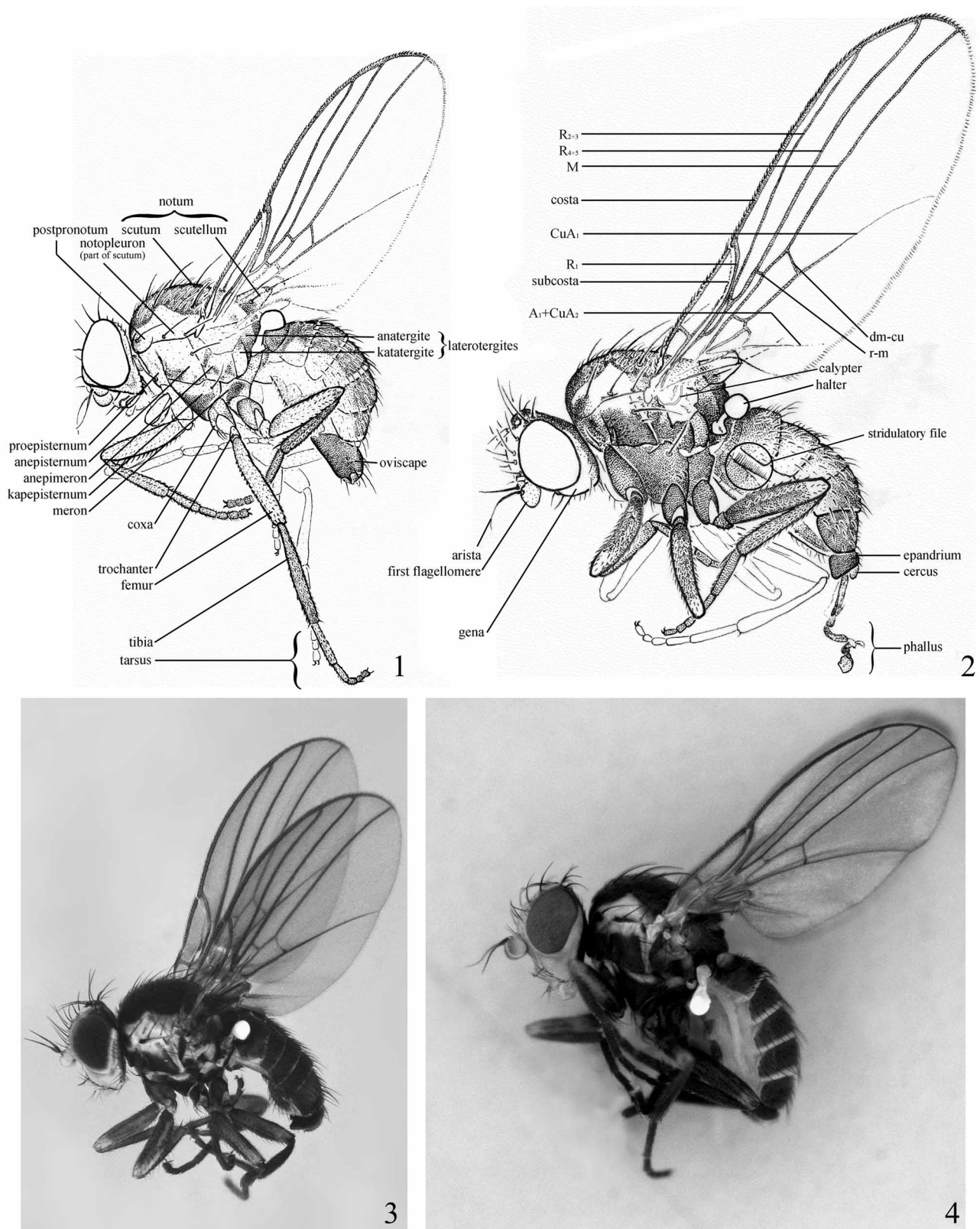
Not considering the polyphagous species, the Californian *Liriomyza* are most commonly found on Asteraceae, with 11 species reared from hosts in this family. The Fabaceae is the next most frequented family, fed upon by *L. fricki* Spencer, *L. lathyroides* (Spencer), *L. trifoliarum* and four lupine specialists: *L. baptisiae* (Frost), *L. lupinella* Spencer, *L. lupini* Spencer, *L. lupiniphaga* Spencer. *Liriomyza cunicularia* **spec. nov.** is known only from Solanaceae. More information on agromyzid feeding and host preferences is provided in Spencer (1990) and Scheffer *et al.* (2007). Dempewolf (2004) is recommended for references relevant to significant crop pests.

The status of misplaced holotypes. In their original descriptions in Spencer's (1981) Californian monograph, holotypes of the new species *L. admiranda*, *L. artemisiae*, *L. californiensis*, *L. lathyroides*, *L. nigrissima*, *L. paumensis*, *L. specifica* and *L. venegasiae* were noted as being deposited in the CASC. These types have been subsequently found in the USNM, and should be considered the property of that institution, having been sold to the Smithsonian by Spencer as part of his private collection.

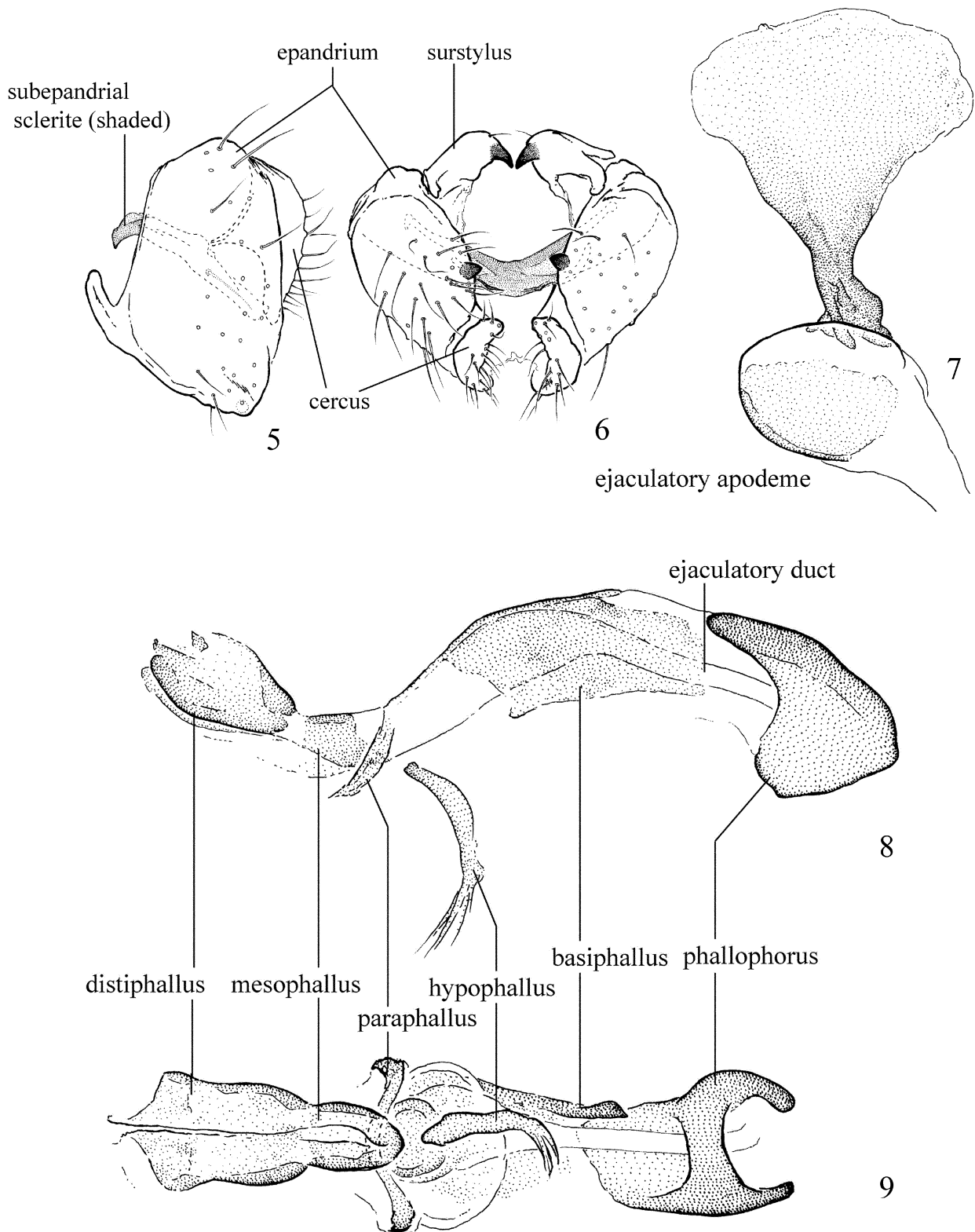
The following species described by Spencer in the same revision were also sold to the USNM as part of the same purchase: Agromyzinae: *Melanagromyza corralensis*; *M. urticella*; *Ophiomyia ambrosia*; *O. devia*; *O. fida*; *O. levata*; *O. maculata*; *O. melica*; *O. modesta* [= *O. texana*]. Phytomyzinae: *Amauromyza anomala*; *A. scleritica*; *Calycomyza enceliae*; *Cerodontha malaisei*; *C. paludosa*; *Phytomyza carbonensis* [depository not mentioned in description]; *P. clematisana*; *P. ligusticifoliae*; *P. minutissima*; *P. phaceliae*.

Similar genera. *Liriomyza* belongs to a putative, but generally accepted monophyletic group of genera that in North America includes *Galiomyza* Spencer, *Haplopeodes* Steyskal, *Phytoliriomyza* Hendel and *Metopomyza* Enderlein. While the predominantly black *Metopomyza* species can be identified in part by a medially yellow scutellum and a relatively pronounced brown orbital plate (both characters found in other genera), females of the remaining genera are wholly or partially indistinguishable from *Liriomyza* externally. *Haplopeodes* has no vein dm-cu (independently derived in some *Liriomyza*) and the phallus is clear and highly reduced. *Galiomyza* strongly resembles darker *Liriomyza* but the surstylus is reduced or fused to the epandrium (as in some *Liriomyza*), and

sometimes the surstylus and epandrium both have one pair of long, stout black processes (as in *G. turneri* Spencer; Figs 10–11).



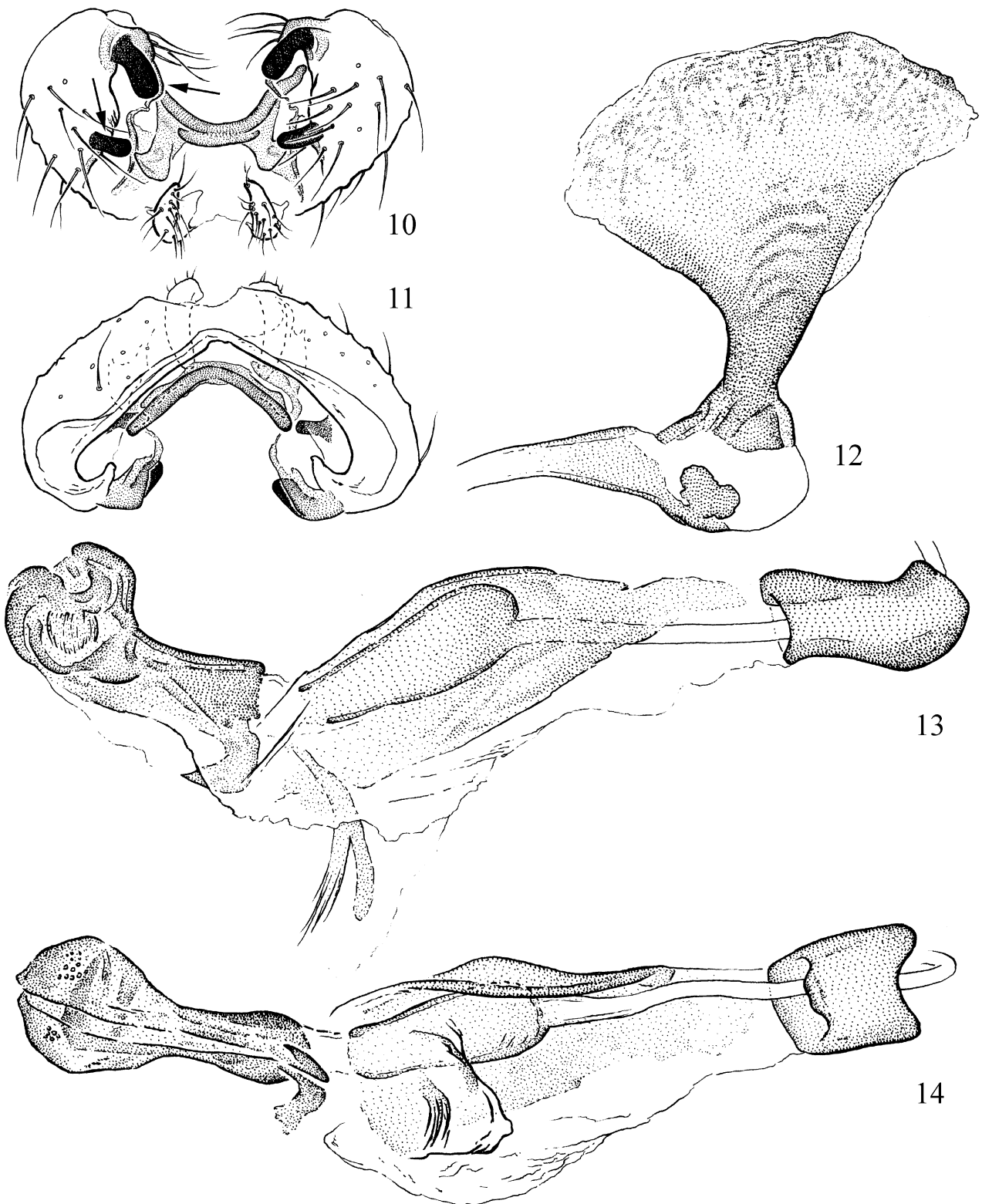
FIGURES 1–3. 1: *Liriomyza sativae* Blanchard, female. Fig. 2: *L. septentrionalis* Sehgal, male. Fig. 3: *L. nebulosa* spec. nov., male holotype. Fig. 4: *L. langei* Frick, male.



FIGURES 5–9. *Liriomyza sativae* Blanchard, male genitalia; 5: external components, left lateral; 6: external components, ventral; 7: ejaculatory apodeme; 8: phallus, left lateral; 9: phallus, ventral.

Some species of *Phytoliriomyza* are distinct in having a minutely setulose eye, proclinate orbital setulae, minute grey to brown pubescence on the frons, and a brown apical surface on the halter (*P. arctica* (Lundbeck) and its relatives, discussed as *Phytoliriomyza* “A” in Scheffer *et al.* (2007)), but most others must be diagnosed by examining characters of the male terminalia. The pattern of morphological variation within *Phytoliriomyza* is very sug-

gestive of non-monophyly when considering this overlap of external and male genitalic characters with the genera listed above—the complex arrangement of comb-like spines on the external terminalia of *Metopomyza* and those species related to *P. melampyga* (Loew), for example. The molecular results of Scheffer *et al.* (2007) provide further support for this non-monophyly, suggesting that generic limits within this genus group may have to be significantly reconsidered in the future.



FIGURES 10–14. *Galiomyza turneri* Spencer, male genitalia; 10: external components, ventral; 11: external components, anterior; 12: ejaculatory apodeme; 13: phallus, left lateral; 14: phallus, ventral.

Calycomyza Hendel is similar in appearance and likely forms the sister-group to these genera (the evolutionary history of the Agromyzidae is discussed in Scheffer *et al.* (2007)), but almost all species can be diagnosed by a whitish-yellow head and shoulders (postpronotum+notopleuron) with a black antenna and scutellum, although *C. obscura* Spencer & Stegmaier is entirely black. Several species of the distantly-related *Phytomyza* are also very similar in colouration, but these taxa have proclinate orbital setulae and a costa that only extends to vein R_{4+5} (not M_1).

Agromyzidae—diagnosis. Species in the family Agromyzidae are usually very small (1.5–3.5mm) with diverging postverticals and ocellars (uncommonly absent), usually one to several rows of orbital setulae lateral to the fronto-orbital bristles, one pair of well-developed vibrissae, a dorsobasal arista, a distinct lunule and in some genera a variably-sized “ocellar triangle” surrounding the ocellar tubercle. On the wing, the costa has a subcostal break, no humeral break, and the anal cell is distinct. Tibiae without preapical bristles; posterolateral bristle(s) sometimes present on fore and mid tibiae. Anepisternum with at least one posteromedial bristle; katepisternum with at least one posterodorsal bristle. Male sternites 6–8 are largely atrophied, forming a thin band anterior to the remaining terminalia that is only significantly sclerotized dorsally. The female has a distinct oviscape (Fig. 1) that is dark, heavily sclerotized and usually has the remaining segments telescoped within it; the membrane between segments 7 and 8 is densely covered with anteriorly directed denticles. All larvae feed in living plant tissue.

Liriomyza—diagnosis. Most species of *Liriomyza* can be identified in the field by a yellow frons and “shoulders” (postpronotum+notopleuron), as well as a broad yellow medial stripe on the scutellum that strongly contrasts the dark brown to black background. In reality, the genus is much more difficult to diagnose, as a number of species do not have the bright yellow thoracic patches, and species of other genera are similar externally and sometimes genitally. Visible under the microscope are reclinate orbital setulae, a costa that extends to vein M_1 (Fig. 2), usually a well-developed vein dm-cu, the surstylus is separate from the subepandrial sclerite and the apical section of the ejaculatory duct is swollen; a stridulatory organ is also sometimes visible in some males of a number of species, if specimens are well preserved. As a result, dissections are often necessary to examine structures of the male terminalia, which are necessary for proper identification (see below under definition for a discussion of these characters) (Figs 5–9).

With regards to immature stages, the larvae and puparia of *Liriomyza* and *Phytomyza* Fallén, the most commonly encountered phytomyzine genera, were discussed by Dempewolf (2004). There are no larval characters that can reliably identify the genus, although the puparium of *Liriomyza* differs from that of *Phytomyza* as follows: pupation usually occurs outside of the mine (although several species remain inside, including the new species *L. trixivora*); there are often three posterior spiracular bulbs (never three in *Phytomyza*) with the hind bulb often elongate; a spiracular sense organ is usually present next to the spiracles; the bulbs on the anterior spiracles are usually arranged in a row (rare in *Phytomyza*); subspiracular processes are usually present (absent in *Phytomyza*).

Liriomyza—definition. Like almost all other Phytomyzinae, *Liriomyza* has the subcostal vein either incomplete distally or reaching the costa as a thin fold, remaining separate from R_1 , which is usually straight (Fig. 2). Externally, there are four dorsocentral bristles (usually decreasing in length anteriorly with anterior bristle presutural), often four fronto-orbitals (two inclinate anterior ori and two reclinate posterior ors), the orbital setulae are reclinate, the scutellum is almost always yellow medially, and the notopleuron and postpronotum are usually yellow with a thin dark sublateral line on the notopleuron and a small dark anteromedial spot on the postpronotum; these yellow sclerites, however, are sometimes entirely dark or there is only a vestige of the yellow pigment remaining. The surstylus is usually small, lobate and directed inwards with a single apical or subapical spine, although the surstylus and/or its spine is sometimes vestigial or absent, and there are multiple spines present in a few species; if well developed, the surstylus has no direct attachment to the subepandrial sclerite. The epandrium, like the surstylus, usually has a single, small anteroventral spine on the inner margin (Fig. 6), but this spine is sometimes absent or duplicated; in both the epandrium and surstylus, the spines are never arranged in rows or discreet clusters as seen in other genera. The subepandrial sclerite (typical of many Phytomyzinae) usually has one pair of stout dorsal arms attached to a transverse medial bar that is ventrally produced as one pair of thin plates extending over one pair of long posteroventral bristles (shaded sclerite added to Figs 5, 6, 10, 11, 55, 57). The basiphallus is usually sclerotized along the left lateral and dorsoapical surfaces (Figs 8, 9), and there is often a small membranous lobe on the left distal margin; the apical section of ejaculatory duct is swollen, elongate and pigmented; the ejaculatory apodeme always has a transverse bar or sclerotization along the basal bulb (= *pileus ejaculatorius*) that is sometimes produced, truncated and more heavily sclerotized at each end. The epiphallus is divided

into two folding sclerites (as in other Agromyzidae) —a proepiphallus and a metepiphallus, the latter of which usually has one pair of small anterodistal horns in *Liriomyza* (Fig. 169).

Previously used to define the genus was a stridulatory file on the anterior membranous portion of the abdomen (Figs 2–4) and a corresponding “scraper” on the hind femur of the male (the latter is distinct in some females)—see Tschirnhaus (1972). These structures are unique to *Liriomyza* in the Agromyzidae (although similar structures occur in the males of a few *Cerodontha*), but they are not always present (even for an entire species) and often difficult to locate when developed, particularly in poorly preserved pinned specimens, making their use in definition and diagnosis problematic. For example, *Praspedomyza galiivora* Spencer remained in *Galiomyza* for years until it was transferred to *Liriomyza* by Spencer & Martinez (1987) (attributed to Tschirnhaus), who only later discovered the species’ stridulatory mechanism.

Recognizing this difficulty in defining the genus, Zlobin (1996) provided three replacement male genitalic features to characterize *Liriomyza* that are paraphrased as followed: 1) The inner process of the hypandrial lobe is always lacking and the metepiphallus (“aedeagal hood”; the basal sclerite in a two-part folding epiphallus) is connected to the tip of the postgonite. 2) The surstylus is of variable shape, being fully reduced to completely fused to the epandrium (Figs 113, 206); if the surstylus is well-developed (Figs 6, 55, 57), then it has no direct connection to the subepandrial sclerite (well-developed with direct connection to subepandrial sclerite in other genera), instead having a weak connection to the hind margin of epandrium below the base of the cerci. 3) The ejaculatory duct is dilated before the mesophallus past the phalophorus; this structure also appears to be quite noticeably darkened in most species examined (Fig. 23, arrow). After examination of most Nearctic species in the “*Phytoliriomyza* group” of Spencer (1990), however, the first of these three characters also appears to be characteristic of *Metopomyza* at least, and only partially developed or secondarily lost in some *Liriomyza* (see Fig. 169, for example). The second appears consistent for those *Liriomyza* examined, and although it has been independently derived elsewhere in the subfamily (in whole or in part), it can be useful for diagnosis. In contrast to the other characters provided, the structure of the ejaculatory duct is consistent among species of *Liriomyza* and of high diagnostic value; the only other taxon sharing this feature is *Galiomyza* (Figs 13, 14), supporting either a sister-group relationship, or as is much more likely, synonymy of the latter genus; synonymy is further supported by larval features, with Dempewolf (2001) finding no significant morphological differences between the two taxa, which were distinct from congeners. The end of the ejaculatory duct is somewhat similar in *Haplopeodes*, with the duct gradually dilating past the phalophorus to the end of the phallus, but the genitalic reduction characteristic of the genus makes it difficult to establish homology.

In light of these reevaluated characters, if a stridulatory organ is not visible, *Liriomyza* can be diagnosed by an apically swollen ejaculatory duct in the absence of the modified external terminalia characteristic of *Galiomyza* (Figs 10–14; surstylus reduced and/or fused to epandrium, and large, black, easily recognized processes sometimes present on epandrium and surstylus). Future redefinition of the genus is clearly warranted, particularly if it is desirable to consistently diagnose genera in the *Phytoliriomyza* group using external characters, but that falls outside the scope of the present study.

Material and methods

Material was examined from, or deposited in the following collections: California Academy of Sciences, San Francisco (CASC); Canadian National Collection, Ottawa (CNC); California State Collection of Arthropods, California Department of Food and Agriculture, Sacramento (CSCA); University of Guelph Insect Collection, Guelph (DEBU); University of California, Essig Museum of Entomology, Berkeley (EMEC); Universidad Nacional de La Plata, Museo de la Plata, Argentina (MLPA); Santa Barbara Museum of Natural History, Santa Barbara (SBMN); Bohart Museum of Entomology, University of California, Davis (UCD); University of California, Riverside (UCR); National Museum of Natural History, Washington, D.C. (USNM). The majority of material examined was from California, although specimens of Californian species found outside of the state were also included in the study. Most specimens were pinned, either air-dried, prepared in a critical-point drier or dried using HMDS (hexamethyldisilazane), including all type material; Kerr & Lonsdale Malaise-derived material was collected into a propylene glycol/ethanol mixture and transferred directly into 95% ethanol (See Brown (1993)). Male genitalia were prepared by macerating the abdomen in hot potassium hydroxide (10% solution) for approximately five to ten min-

utes, followed by washing in glacial acetic acid and deionized water. Genitalia are stored in glycerin in microvials pinned with the specimen.

All new host, state and county (California only) records are indicated by an asterisk in the host and distribution fields. Host plant classification was taken from the Integrated Taxonomic Information System (ITIS, 2009). Biological data are taken from the original descriptions unless otherwise indicated; information on the location and form of leafmines of described species can be found in Spencer (1981) or Spencer & Steyskal (1986). Species synonymies only include references to North American revisions, excluding references to relevant treatments of non-Nearctic taxa, including major Palaearctic revisions.

Terminology for external structures (Figs 1, 2) largely follows that outlined in McAlpine (1981) with the following exceptions: the fronto-orbitals have been divided into the inclinate anterior “ori” (inferior orbital setae) and the reclinate to slightly inclinate posterior “ors” (superior orbital setae); the “ocellar triangle” is the sclerotized region surrounding the ocellar tubercle (often not much larger than the tubercle in *Liriomyza*). Gena height and eye height are measured vertically from the lowest point of the eye in lateral view; the “squama” of previous agromyzid authors is here treated as the calypter [actually the “upper calypter”, as discussed in McAlpine (1981)]; rows of acrostichal setulae are counted at the transverse suture. Genitalic terminology follows Steyskal (1969) (Figs 5–9); the “phallus” is composed of the phallophorus, basiphallus, hypophallus, paraphallus (one pair), mesophallus and distiphallus; if the mesophallus is fused to, and indistinguishable from the distiphallus, the composite structure is called the distiphallus. The “external” male terminalia (cerci, subepandrial sclerite, surstylus and epandrium) are shown smaller than scale in the composite genitalic plates. Genitalic illustrations of species described in Spencer (1981) are included when new illustrations cannot be made with the material available. Plant family names follow Benavent-Corai *et al.* (2005).

Key to the California *Liriomyza*

1. Scutellum entirely dark, rarely with yellowish tint medially 2
- Scutellum distinctly yellow medially 5
2. Orbital plate entirely or predominantly yellow, at most with lateral margin brown. Scape, pedicel, and at least base of first flagellomere yellow. Knees entirely dark. Wing length 1.4–1.6mm. Vein dm-cu sometimes absent. Two rows of acrostichal setulae. Distiphallus with paired ventral tubules that become broader and clear past dark base (Figs 169, 170). *L. nigriscutellata* Spencer
- Orbital plate dark brown with inner margin sometimes with thin yellow line. Antenna dark, sometimes with first flagellomere entirely yellow. Apices of femora, and sometimes base of tibiae yellowish. Wing length 1.6–2.2mm. Vein dm-cu always present. Four rows of acrostichal setulae. Distiphallus without tubules, or with one pair of dark tubules. 3
3. First flagellomere yellow. Scutellum, notopleuron and postpronotum with yellow tint. Length of ultimate section of vein CuA₁ divided by penultimate section 2.7. Surstylus bifid (Fig. 204). Hypophallus broad, plate-like and V-shaped. Distiphallus elongate conical, pale (Figs 204, 207) *L. salpingion* **spec. nov.**
- First flagellomere dark brown. Scutellum dark brown; notopleuron and postpronotum dark brown or yellow. Length of ultimate section of vein CuA₁ divided by penultimate section 2.0–2.3. Surstylus undivided (Fig. 177). Hypophallus thin, or lateral sclerotized region weakly-sclerotized. Distiphallus dark with one pair of long or very short fringed apical structures. 4
4. Three ori. Notopleuron and postpronotum yellow. Frons distinctly yellow medially, sharply contrasting orbital plate. Apices of femora yellow. Wing length 2.2–2.3mm. Epistoma large and pronounced. Parafacial and orbital plate projecting. Epandrium without spine (Fig. 133). Distiphallus with one pair of long apical tubules (Fig. 132). *L. lathyroides* (Spencer)
- One ori. Notopleuron and postpronotum dark brown, sometimes with small portions slightly yellowish or reddish. Frons mostly brown. Apices of femora dark. Wing length 1.7mm. Epistoma very small and thin. Parafacial and orbital plate very slightly projecting. Epandrium with small dark anterodistal spine. Distiphallus stout with sides parallel past base and apically tubules not emerging from surrounding enclosure (Figs 175, 176). *L. nigrissima* Spencer
5. Scutum yellow immediately in front of scutellum; sometimes yellow with dark stripes 6
- Scutum brown in front of scutellum with posterolateral corners often yellow. 9
6. Thorax entirely yellow. Paraphallus and hypophallus absent. Distiphallus bifid and not longer than basiphallus (Fig. 92). *L. flavicola* Spencer
- Thorax with spots on pleuron and stripes on notum. Paraphallus and hypophallus present. Distiphallus extremely elongate if bifid 7
7. Four rows of acrostichal bristles. Phallus relatively straight and without basal collar (Figs 48, 49). ... *L. parabella* **spec. nov.**
- Two rows of acrostichal bristles. Phallus, if with elongate tubules, curved and with minute ventrobasal collar (Fig. 46, arrow). 8
8. Stripes along dorsocentral rows separate from medial stripe; scutum often with additional posteromedial stripe that sometimes meets anterior stripe. Tibiae, tarsi and base of femora brown. Abdomen brown dorsally. Clypeus dark brown. Length of ulti-

- mate section of vein CuA₁ divided by penultimate section 2.7–5.9. Distiphallus short and cup-like; swollen portion of duct long and narrow (Figs 22, 23) *L. admiranda* Spencer
- Dorsocentral stripes fused to medial stripe; scutum never with posteromedial stripe. Legs entirely yellow with distal tarsomeres brownish to brown. Female abdomen yellow with oviscape and sometimes small paired spots on tergites 1 and 6 dark; male abdomen often brown dorsally with complete yellow medial stripe. Clypeus yellow. Length of ultimate section of vein CuA₁ divided by penultimate section 1.9–2.0. Distiphallus extremely long and bifid; swollen portion of duct short and abruptly widened (Figs 45, 46) *L. bella* Spencer
9. Vertical bristles with yellow spot at base if surrounding region brown. Abdomen dark with lateral margin of tergites yellow, with yellow margin very broad and easily viewed dorsally on tergites 1–3 (Fig. 2). If lateral margin of tergites only narrowly yellow, then antenna entirely yellow and legs dark with knees yellow. Wing length usually 2.3–3.5mm, but rarely as small as 1.5mm. Length of ultimate section of vein CuA₁ divided by penultimate section 1.7–2.4. Distiphallus with curved basal stem and apical bowl (Figs 114, 164, 216) 10
- Region around vertical bristles either entirely yellow or brown spot touching base of bristle(s). Abdomen completely brown or with yellow lateral margin that may become wider posteriorly (Figs 1, 2, 4). Remaining characters variable, but wing length usually less than 3.0mm and legs usually much paler (rarely entirely dark). Distiphallus various, but rarely as above and apical bowl never as large as stalk if present (exception being *L. abnormis*, with large fringes emerging from bowl). 12
10. Femora yellow with dorsal base of at least hind femur brown. Clypeus brown to yellow. Wing length 2.0–2.7mm. Distiphallus thinner, with apical bowl barely wider than basal stem (seen ventrally); without scaled membrane (Fig. 163). Uncommon. *L. montana* Sehgal (in part)
- Femora usually brown with knees yellow, but sometimes more extensively yellow; rarely as above. Clypeus brown. Wing length 1.5–3.5mm. Distiphallus with larger apical bowl 11
11. Orbital plate projecting anterodorsally. Surstylus without long apical bristle (Fig. 113). Apical bowl of distiphallus almost as long as straight basal portion of curved stalk (Fig. 114). Uncommon. *L. graminaceae* Spencer
- Orbital plate not projecting. Surstylus with long apical bristle (Fig. 214). Distiphallus with apical bowl as long as basal stalk; base usually flanked by scaly membrane (Fig. 216). Common *L. septentrionalis* Sehgal
12. Pleuron predominantly or entirely dark, at most with dorsal 1/5 of anepisternum and katapisternum yellow; questionable specimens with first flagellomere almost entirely dark. Femora usually entirely dark with tips of femora sometimes variably yellow (Figs 2, 3) or fore femur yellowish distoventrally (Fig. 4). First flagellomere sometimes entirely dark and palpus sometimes brownish 13
- Pleuron at least with dorsal ¼ of anepisternum yellow (Figs 1–4). Femora usually predominantly yellow, sometimes dark with knees variably yellow. First flagellomere infuscated on distal half at most. Palpus yellow (brownish to brown in *L. lupini*). 39
13. First flagellomere yellow, at least in part, often with distal half or distal margin infuscated (Fig. 4), but sometimes lightly infuscated with only basal margin yellow. Femora sometimes with yellow mottling on dorsoventral 1/3 or more. Palpus yellow. 14
- First flagellomere entirely brown. Femora dark, sometimes with knees and/or distoventral surface of fore femur yellowish. Palpus usually light brown to brown. 31
14. Face distinctly brown, at least medially. 15
- Face entirely pale, at most with nearly indiscernable brownish tint 17
15. Venter of gena with faint, sometimes incomplete brownish stripe. Dorsal margin of anepisternum entirely yellow. Distiphallus bifid (Fig. 130). Ejaculatory apodeme relatively small. *L. langei* Frick (in part)
- Venter of gena with distinct dark stripe. Dorsal margin of anepisternum only yellow anteriorly. Distiphallus entirely united along length. Ejaculatory apodeme well-developed with broad blade 16
16. First flagellomere entirely pale. Femora predominantly yellow-dark basally and sometimes with dorsal mottling on basal half. Eye 4.0–5.3 times higher than gena. Distiphallus dark and cylindrical (Fig. 36). Surstylus C-shaped (Fig. 34). *L. baccharidis* Spencer
- First flagellomere apically infuscated, rarely entirely yellow. Femora dark with knees, and often pale streaking or distal half yellow. Eye 3.8–4.0 times higher than gena. Distiphallus pale and flattened-globose (Figs 136, 137). Surstylus simple, linear (Fig. 133). *L. lupinella* Spencer (in part)
17. Vein dm-cu absent. 18
- Vein dm-cu present 19
18. Wing length 1.5mm. Lateral yellow band on scutum fading above wing base. Distiphallus pronounced ventrally and more abruptly widened past base (Figs 96, 97) *L. frickella* Spencer
- Wing length 1.2–1.3mm. Yellow lateral band on scutum only with light brownish mottling postsuturally. Distiphallus desclerotized ventrally and only gradually widening past base (Figs 102, 103) *L. frigida* Spencer
19. First flagellomere infuscated on distal 2/3 or less, sometimes entirely yellow. 20
- First flagellomere brown to light brown with thin yellow margin at base (ie. less than 1/3 length of segment—variable and ambiguous species will key in both directions) 26
20. Eye 4.4–5.8 times higher than gena. Distiphallus as in Figs 8, 9, with apical, basal and ventral surfaces more well-sclerotized, forming weak C-shape in profile. *L. sativae* Blanchard (in part)
- Eye 2.1–4.2 times higher than gena. Distiphallus not as above 21
21. Wing length 1.3–1.7mm. Distiphallus undivided. Surstylus with one small to large apical spine. Uncommon. 22
- Wing length 1.6–2.3mm. Distiphallus usually bifid, rarely flattened-globose. Common. Surstylus with one or two small subapical spines 23
22. Orbital plate entirely yellow. Femora with extensive dorsal streaking. Surstylus with small subapical tubercle (Fig. 154). Distiphallus as wide as long, with narrow base and slight dorsoventral compression (Figs 152, 153). Mesophallus twice length of

- distiphallus *L. minor* Spencer (in part)
- Orbital plate infuscated to base of anterior ors. Streaking on femora limited if present. Surstylus with single long curved apical spine (Fig. 156). Distiphallus and mesophallus widely separated, cylindrical and subequal in size (Fig. 155). *L. monoensis* Spencer
23. First flagellomere entirely yellow. Lateral margin of frons dark to level of anterior ori. Distiphallus flattened-globose (Figs 136, 137) *L. lupinella* Spencer (in part)
- First flagellomere often infuscated along anterior margin or uniformly orange to brownish (excluding base), being significantly darker than frons; occasionally as above. Lateral margin of frons usually only darkened to level of anterior ors. Distiphallus bifid. 24
24. Surstylus with two spines (Fig. 236). Paraphallus triangular with apex dark; hypophallus indistinct; basiphallus and mesophallus nearly touching (Figs 238, 239). Femora usually predominantly yellow with base and light dorsal mottling brown, sometimes as below. Only posteroventral margin of gena with thin brownish stripe. *L. trifoliarum* Spencer (in part)
- Surstylus with one spine. Paraphallus clear and faint to indistinct; hypophallus long, thin and curved; basiphallus and mesophallus widely separated by membranous space. Femora usually predominantly brown with knees and distoventral surfaces yellow, at least on fore leg, but sometimes as above (paler in most *L. huidobrensis* and some *L. langei*). Ventral margin of gena usually with complete faint brownish band, but sometimes variably faded. 25
25. Two to three rows of acrostichal setulae, sometimes four; usually sparsely arranged. Wing length 1.9–2.6mm (♂), 2.1–2.7mm (♀). Eye 2.5–4.3 times higher than gena. Lateral margin of frons dark to level of posterior ori or less; rarely to level of anterior ori. Gap present between base of hypophallus and sclerotized section of ejaculatory duct; swollen portion of ejaculatory duct usually parallel-sided and not bulging ventrobasally. Distiphallus and mesophallus relatively dark with thick walls, and distal half of distiphallus and basal half of mesophallus bulging. Ejaculatory apodeme with relatively broad, rounded blade that is weakly to very strongly sclerotized; margin well-sclerotized (Figs 125–127) *L. huidobrensis* (Blanchard) (in part)
- Four rows of acrostichal setulae, rarely three; densely arranged. Wing length 1.6–2.2mm (♂), 1.9–2.3mm (♀). Eye 3.5–4.2 times higher than gena. Lateral margin of frons dark to level of anterior or posterior ori. No gap present between hypophallus and sclerotized section of ejaculatory duct; swollen portion of ejaculatory duct widening towards base and slightly bulging ventrobasally. Mesophallus and distiphallus usually relatively weakly-sclerotized, pale and narrow, with distal half of distiphallus not much wider than basal half and parallel-sided; rarely as above. Ejaculatory apodeme with narrow, weakly-sclerotized blade; margin usually unsclerotized (Figs 129–131). *L. langei* Frick (in part)
26. Orbital plate entirely yellow. Orbital plate and parafacial sometimes projecting 27
- Orbital plate infuscated lateral to fronto-orbital bristles. Orbital plate and parafacial not projecting 29
27. First flagellomere sometimes highest past midpoint. Three or four fronto-orbital bristles. Mesophallus thin, black and nearly twice length of distiphallus (Fig. 152) *L. minor* Spencer (in part)
- First flagellomere small, ovate and highest at or before midpoint. Four or five fronto-orbital bristles. Mesophallus barely evident if present 28
28. Orbit and parafacial strongly projecting. Dorsal margin of anepisternum with relatively broad, irregular yellow margin. Fore and mid femora yellow with base and light dorsal streaking brown. Epandrium with posteroventral margin strongly projecting (Fig. 185). Paraphallus absent. Distiphallus globular with medial swelling (Fig. 187). *L. projecta* **spec. nov.**
- Orbit and parafacial not projecting. Dorsal margin of anepisternum at most with thin yellow band. Fore and mid femora brown with apex and often anteroventral surface yellow. Epandrium with posteroventral margin shallowly rounded (Fig. 178). Paraphallus present. Distiphallus wide and bowl shaped (Fig. 180). *L. paumensis* Spencer
29. First flagellomere relatively large, subquadrate and highest subapically. Dorsal margin of anepisternum with relatively large irregular yellow margin. Dark brown posterolateral region on frons broadly enclosing vertical bristles. Femora yellow with base and broad stripe on fore femur brown. Surstylus with two spines (Fig. 73). Distiphallus with dark cylindrical base and wide apical dome (Figs 74, 75). *L. conclavis* **spec. nov.**
- First flagellomere small and ovate. Dorsal margin of anepisternum with thin yellow stripe. Inner vertical bristle on margin of dark posterolateral region. Femora brown with knees, and sometimes anteroventral surface yellow. Surstylus with one spine. Distiphallus pale and cup-shaped 30
30. Scutum with complete lateral yellow band. Femora dark with knees, and sometimes anteroventral surface yellow. Distiphallus broad and bell-shaped in ventral view, only significantly narrowing at base (Figs 30, 31). Paraphallus thin along length. *L. artemisiae* Spencer (dark specimens)
- Scutum brown posterolaterally. Femora yellow anteroventrally. Distiphallus narrow and tapered to base, broadening apically (Figs 69–71). Paraphallus relatively broad with apex expanded. *L. californiensis* Spencer (non-types)
31. Pedicel and scape yellow, sometimes slightly brownish. Distiphallus usually pale, sometimes small, but never as below. ... 32
- Pedicel and scape as dark as first flagellomere or only barely lighter. Distiphallus dark, relatively large and clavate or rounded. 36
32. Five ori. Epistoma pronounced, approximately as high as wide. Inner margin of surstylus and epandrium with numerous spines, hypophallus hairy and distiphallus very stout, bifid and entirely divided (Figs 194–199). ... *L. quadrisetosa* (Malloch)
- Three or fewer ori. Epistoma barely evident. Male genitalia never as above. 33
33. Base of vertical bristles surrounded by, or touching brown. First flagellomere small, not longer than high. 34
- At least base of inner vertical bristle surrounded by yellow. First flagellomere large, slightly longer than high and sometimes as high as gena. 35
34. Face yellow. Papus yellow. Distiphallus bifid (Fig. 127). *L. huidobrensis* (Blanchard) (in part)
- Face brown, at least medially. Palpus brownish. Distiphallus not divided (Fig. 143) *L. lupiniphaga* Spencer
35. Base of outer vertical bristle surrounded by brown. Scutum brownish posterolaterally. Sometimes only three fronto-orbitals

- present on one side of frons. Mesophallus long, dark, cylindrical and separate from distiphallus (Figs 152, 153). *L. minor* Spencer (in part)
- Base of outer vertical bristle and eye completely surrounded by yellow. Scutum with complete lateral yellow band. Four fronto-orbitals on both sides of frons. *L. artemisiae* Spencer (former *L. similis* paratype ♀, possibly non-conspecific)
36. Parafacial and orbital plate distinctly projecting. Paraphallus thin, and base of distiphallus broad and somewhat truncated. Femora entirely dark brown 37
- Parafacial and orbital plate barely visible laterally. Paraphallus never as thin as above, and distiphallus more narrowed to base. Knees usually yellowish to distinctly yellow, at least on fore leg (entirely dark in some *L. baptisiae*). 38
37. Frons, notopleuron and postpronotum yellow. Wing length 2.0–2.5mm. Surstylus with one spine and epandrium without spines. Distiphallus narrowest basally, and in ventral view, truncated apically with sides subparallel (Figs 41, 42). *L. bellissima* (Spencer)
- Body entirely dark excluding centre of scutellum. Wing length 1.5mm. Epandrium and surstylus with two spines on each side. Distiphallus narrowest apically, ovate in ventral view (Figs 52, 53). *L. bispinula* **spec. nov.**
38. Apex of fore femur only slightly yellowish. Eye 3.2–5.5 times higher than gena. Base colour of head dark yellow to light brown. Scutum entirely brown to light brown laterally behind transverse suture. Vein dm-cu and anterior ori always well-developed. Surstylus with one subapical spine. Paraphallus possibly homologous with dark, confluent lobes ventral to base of distiphallus. Distiphallus not tuberculate, only significantly narrowed at base (Figs 38, 39). Ejaculatory apodeme without stem (Fig. 40). *L. baptisiae* (Frost)
- Fore knee distinctly yellow. Eye 2.9–4.0 times higher than gena. Base colour of head light yellow. Scutum sometimes marginally yellow behind transverse suture laterally. Vein dm-cu sometimes partially atrophied and anterior ori sometimes highly reduced to absent. Surstylus with two subapical spines. Paraphallus present. Distiphallus without ventrobasal lobes or dorsoventral plates; distal surface minutely tuberculate and base gradually narrowing (Figs 222, 223). Ejaculatory apodeme with short stem (Fig. 221). *L. stachyos* Spencer
39. Base of both vertical bristles surrounded by yellow 40
- At least base of outer vertical bristle surrounded by brown 48
40. Scutum distinctly grey or matt, or at least with light dusting (not visible in liquid-preserved specimens). Two to four rows of acrostichal setulae 41
- Scutum glossy to slightly subshining, never with dusting of pruinosity. Four rows of acrostichal setulae 46
41. Calypter margin and hairs yellow to white. Parafacial and orbital plate pronounced, forming distinct ring around eye. 42
- Calypter margin and hairs grey to brownish. Parafacial and orbital plate usually not strongly projecting 43
42. Distiphallus very large, bulbous and without long apical tubules (Fig. 81) *L. smilacinae* Spencer
- Distiphallus not more than twice width of mesophallus and with one pair of long apical tubules (Figs 145, 146). *L. merga* **spec. nov.**
43. Vein dm-cu usually absent (present in specimens from Modoc Co.). Frons entirely pale excluding ocellar tubercle. Mesophallus cylindrical and dark, longer than distiphallus and strongly arched dorsally (Figs 226, 227). *L. togata* (Melander)
- Vein dm-cu always present. Posterolateral corner of frons usually with small pale marking lateral to vertical bristles. Mesophallus not longer than distiphallus and directed apically 44
44. Eye 2.1–3.0 times higher than gena. Posterolateral region of frons usually with stripe reaching posterior margin of eye. Posterior margin of anepimeron usually brown. Two to four rows of acrostichal setulae. Distiphallus very small, clear and gracile (Figs 234, 235) *L. trifolii* (Burgess)
- Eye 3.3–4.0 times higher than gena. Posterolateral region of frons entirely yellow or with faded brown spot on posterior margin. Posterior margin of anepimeron always yellow. Always four rows of acrostichal setulae. Distiphallus large and stout. . 45
45. One ori. Posterolateral margin of frons entirely yellow. Brown region on scutum broadly joined to scutellum. Femora entirely yellow. Distiphallus globose, minutely textured and divided between two hemispherical lobes (Figs 106, 107). *L. fricki* Spencer
- Two ori. Posterolateral margin of frons with faint brown spot. Brown region on scutum narrowly joined to scutellum. Femora with faint brown dorsobasal spot, and sometimes with dorsoapical mottling. Distiphallus elongate and bifid (Figs 149, 150). *L. cunicularia* **spec. nov.**
46. Wing length 2.2–2.3mm. Clypeus yellow to slightly brownish. Surstylus and epandrial spine absent. Distiphallus strongly bent dorsally, with long curved base and small apical bowl (ie. pipe-shaped) (Figs 163, 164). Ejaculatory apodeme with elongate pointed ends on *pileus ejaculatorius*. *L. montana* Sehgal (in part)
- Wing length 1.3–2.3mm. Clypeus dark brown. Surstylus and epandrial spine present. Distiphallus various, never pipe-shaped. Ejaculatory apodeme with ends of *pileus ejaculatorius* not produced as above. 47
47. First flagellomere often long-haired apically and slightly enlarged. Vein dm-cu sometimes absent (present in all California specimens). Anterior ori absent to minute. Anterodistal margin of epandrium produced as long point (Fig. 190). *L. ptarmicae* de Meijere
- First flagellomere uncommonly haired apically and always small and ovate. Vein dm-cu present. Anterior ori well-developed, reduced in some *L. sativae*. Anterodistal margin of epandrium rounded, not produced (Fig. 5). 48
48. Acrostichal setulae extending to level of second dorsocentral. Femora sometimes brown dorsobasally. Anterior ori sometimes reduced. One spine on surstylus. Distiphallus with apical, basal and ventral surfaces more well-sclerotized, forming weak C-shape in profile; width only slightly more than that of mesophallus (Figs 8, 9). Paraphallus distinct. *L. sativae* Blanchard (in part)
- Acrostichal setulae narrowly extending to level of posterior (first) dorsocentral. Femora entirely yellow. Anterior ori comparable in size to posterior ori. One or two spines on surstylus. Distiphallus bell-shaped with lateroventral walls thick and dark at

	base; width twice that of mesophallus (Figs 202, 203). Paraphallus absent.	<i>L. sabaziae</i> Spencer (pale form)	
49.	Femora entirely yellow, sometimes with scraper on hind femur pigmented.		50
-	Femora variably patterned, at least with faint dorsobasal marking on fore femur		61
50.	Scutum with complete yellow lateral band to base of scutellum. Common		51
-	Lateral margin of scutum entirely dark lateral to scutellum, sometimes with yellow mottling. Uncommon.		60
51.	Veins dm-cu and r-m nearly level with each other. Anepisternum with brown markings nearly absent. Paraphallus leaf-like. Distiphallus longer than swollen apical section of ejaculatory duct, narrow, only slightly broader apically and angled dorsally (Figs 157, 158)	<i>L. miserabilis</i> spec. nov.	
-	Distance between dm-cu and r-m at least 2/3 length of dm-cu. Anepisternum at least with distinct anteroventral spot. Paraphallus thin and straight. Distiphallus not shaped as above and not sharply angled dorsally		52
52.	First flagellomere usually relatively large, nearly quadrate, and with dorsal margin to dorsal half of outer face infuscated; rarely small, rounded and entirely yellow. Clypeus light brown with centre yellow. Surstylus with two spines (Fig. 242).		
-	First flagellomere small and ovate; dark on anterior or anterodorsal margin (if pigmented). Clypeus dark brown. Surstylus usually with one spine (two present in <i>L. specifica</i> and <i>L. venegasiae</i>). Only males can be identified past this point.	<i>L. trixivora</i> spec. nov.	53
53.	Distiphallus relatively elongate, dark, barrel-shaped (Figs 59, 60). Ejaculatory apodeme large and broad with corners pointed.	<i>L. brassicae</i> (Riley) (in part)	
-	Distiphallus pale and bell-shaped or with apical tubules. Ejaculatory apodeme relatively narrow with corners rounded.		54
54.	Distiphallus with broad bowl-shaped base and long apical tubules (Figs 90, 91)	<i>L. equiseti</i> de Meijere	
-	Distiphallus pale, clear and cup-like with narrow base.		55
55.	Paraphallus broadest apically (Fig. 122, arrow). Distiphallus fused to mesophallus, forming thin basal stem, and with small apical chamber (Figs 122, 124).	<i>L. helianthi</i> Spencer (in part)	
-	Paraphallus thin with width nearly equal along length. Distiphallus small and separate from mesophallus		56
56.	Base of distiphallus broad, dark and truncated when seen in ventral view. Surstylus darker than epandrium.	<i>L. eupatorii</i> (Kaltenbach) (in part)	
-	Base of distiphallus narrow, pale and rounded. Surstylus as pale as epandrium.		57
57.	Surstylus with single subapical spine		58
-	Surstylus with two subapical spines		59
58.	Abdominal tergites brown dorsomedially (Fig. 1). Distiphallus darkest along ventral surface; base thin, gradually narrowed, pale and fused to mesophallus in ventral view (Figs 8, 9). Left distolateral margin of basiphallus not produced. Note—smaller Washington male of <i>L. sabaziae</i> keys here	<i>L. sativae</i> Blanchard (in part)	
-	Abdominal tergites with longitudinal yellow stripe centrally. Distiphallus darkest basally and dorsally; base broadly rounded, dark and separate from mesophallus in ventral view (Figs 208, 209). Left distolateral margin of basiphallus clear and strongly produced	<i>L. schlingeri</i> Spencer	
59.	Three ori. Dorsal third of katepisternum yellow, broadly enclosing bristle. Fore tibia as dark as other tibiae. Distiphallus elongate, cup-shaped, constricted medially and with one pair of dark, oblique dorsal lines.	<i>L. specifica</i> Spencer (in part)	
-	Two ori. Dorsal margin of katepisternum yellow and with small yellow emargination behind bristle. Fore tibia light brown. Distiphallus with subspherical apical chamber enclosing paired fringes structures.	<i>L. venegasiae</i> Spencer	
60.	Wing length 1.7mm. Dorsal margin of first flagellomere infuscated, becoming darker to base of arista. Clypeus dark brown. Distolateral margin of basiphallus produced as sclerotized process. Paraphallus well developed and strongly upcurved apically. Distiphallus broadly rounded along ventral surface (Fig. 24).	<i>L. arnaudi</i> Spencer	
-	Wing length 1.2–1.5(?)mm. First flagellomere entirely yellow. Clypeus yellowish. Distolateral margin of basiphallus undeveloped. Paraphallus not well developed. Distiphallus subconical in lateral view with ventral surface relatively straight (Fig. 110).	<i>L. frommeri</i> Spencer	
61.	Acrostichal setulae entirely absent. Male genitalia as in Figs 82, 83	<i>L. denudata</i> Spencer	
-	At least two rows of acrostichal setulae present		62
62.	First flagellomere entirely and evenly yellow.		63
-	First flagellomere darker apically, with distal margin to distal half orange to brownish; sometimes dorsal margin darker or distal half yellow, but distinctly darker than pale basal half.		83
63.	Femora with dorsal mottling in addition to brown basal spot, at least on fore leg		64
-	Femora only brown at base		76
64.	Three fronto-orbital bristles (posterior ors absent). Eye 5.0 times higher than gena. Surstylus with two spines in membranous ventrobasal region. Distiphallus as in Figs 212, 213.	<i>L. tricornis</i> spec. nov.	
-	Four or five fronto-orbital bristles. Eye 2.8–5.8 times higher than gena. Surstylus usually with one spine, but if two present, these situated in sclerotized subapical region.		65
65.	Five fronto-orbital bristles.		66
-	Four fronto-orbital bristles		69
66.	Wing with very faint infuscation and calypter margin dark brown. Orbital plate lightly infuscated to base of fronto-orbitals (Fig. 3). Face brownish with sides darker. Only dorsomedial margin of katepisternum yellow. Phallus extremely elongate (Figs 167, 168)	<i>L. nebulosa</i> spec. nov.	
-	Wing membrane completely clear on and calypter margin grey to brown. Orbital plate entirely yellow. Face yellow. Dorsal margin of katepisternum entirely yellow. Phallus not elongate as above		67
67.	First flagellomere with slight anterodorsal angle. Ventral 2/3 of anepisternum brown. Mid femur only narrowly brown at base. Surstylus with two spines (Fig. 117). Paraphallus pointing apically (Figs 118, 119).	<i>L. helenii</i> Spencer (in part)	

- First flagellomere rounded. Ventral stripe on anepisternum less than half of sclerite's surface area. Mid femur with dorsal streaking. Surstylus with one spine. Paraphallus directed ventrally or anteroventrally 68
68. Eye 4.0–5.3 times higher than gena. Parafacial and orbital plate not produced. Epistoma minute. Wing length 1.3–1.6mm. Lateral margin of frons brown to level of anterior ori. Scutum subshining. Mesophallus indistinct. Distiphallus with narrow, dark basal section and rounded, expanded apical section (Figs 122–124). *L. helianthi* Spencer (in part)
- Eye 1.8 times higher than gena. Parafacial and orbital plate produced, easily visible laterally. Epistoma large. Wing length 2.1mm. Lateral margin of frons yellow. Scutum with dusting of pruinosity. Mesophallus thin and stem-like. Distiphallus broad and globose (Figs 76, 77). *L. chemsaki* Spencer
69. Fore femur, and sometimes hind femur with additional brownish streaking. Abdomen yellow laterally along tergites. Katepisternal bristle surrounded by yellow. Coxae yellow with base brown. Yellow lateral stripe on scutum sometimes strongly overlapping with yellow medial band on scutellum. 70
- Femora often dark on basal 2/3, at least dorsally, but sometimes only faintly mottled. Abdomen usually entirely brown laterally. Katepisternal bristle touching, or surrounded by brown. Coxae brown with tip to distal 1/2 of fore coxa (and sometimes mid coxa) yellow. Yellow portions of scutum and scutellum narrowly overlapping at most. 74
70. Distiphallus fused to mesophallus, sometimes cup-shaped. Wing length 1.2–1.8mm. Lateral margin of frons sometimes with thin brown stripe to posterior ori; base of ors surrounded by thin brownish spot. Two ori. Vein dm-cu always present. 71
- Distiphallus cup-shaped; separate from mesophallus. Wing length 1.3–2.2mm. Lateral margin of frons variable, but ors never surrounded by small, isolated brownish spot. Sometimes three ori on one side of frons. Vein dm-cu rarely absent. 72
71. Lateral band on scutum wide and yellow. Only fore femur with brown striations. Paraphallus small and narrow. Distiphallus dark and barrel-shaped (Figs 59, 60). *L. brassicae* (Riley) (in part)
- Lateral yellow band on scutum thin and with brown mottling. Mid and hind femora sometimes with light striations. Paraphallus broad and clavate. Distiphallus with narrow, dark basal section and rounded, expanded apical section (Figs 122–124). *L. helianthi* Spencer (in part)
72. Wing length 1.3–1.8mm. Scutum with complete yellow lateral stripe. Eye 4.4–5.8 times higher than gena. Distiphallus as in Figs 8, 9, with apical, basal and ventral surfaces more well-sclerotized, forming weak C-shape in profile. Ejaculatory apodeme relatively small and pale (Fig. 7). *L. sativae* Blanchard (in part)
- Wing length 1.7–2.2mm. Posterolateral corner of scutum sometimes with brownish mottling. Eye 2.0–3.8 times higher than gena. Distiphallus not as above. Ejaculatory apodeme relatively well developed. 73
73. First flagellomere small, ovate and tapering apically. Lateral margin of frons sometimes brown. Surstylus with one spine. Paraphallus directed anteroventrally (Figs 86, 87). Distiphallus abruptly truncated at base (ie. subrectangular) and much higher than mesophallus. Ejaculatory apodeme with stem thin and short (Fig. 85). *L. eupatorii* (Kaltenbach) (in part)
- First flagellomere relatively large and subquadrate, with anterodorsal margin slightly angulate. Lateral margin of frons entirely yellow. Surstylus with two spines (Fig. 117). Paraphallus pointing apically (Figs 118, 119). Distiphallus gradually rounded basally and as high as mesophallus. Ejaculatory apodeme with stem stout and longer than blade (Fig. 116). *L. helenii* Spencer (in part)
74. Wing length 1.6–2.3mm. Length of ultimate section of vein CuA₁ divided by penultimate section 1.8–2.7. Eye 3.5–4.2 times higher than gena. Scutum brown immediately lateral to scutellum. Distiphallus bifid (Fig. 130). *L. langei* Frick (in part)
- Wing length 1.4–1.8mm. Length of ultimate section of vein CuA₁ divided by penultimate section 2.9–3.3. Eye 4.4–5.8 times higher than gena. Scutum yellow lateral to scutellum. Distiphallus undivided 75
75. Femora yellow with base and dorsal mottling brown, sometimes almost entirely brown dorsally. Ejaculatory apodeme small and pale (Fig. 7). Distiphallus gradually narrowing to base (Figs 8, 9). *L. sativae* Blanchard (in part)
- Femora brown with venter yellowish. Ejaculatory apodeme large, with blade very broad and dark. Base of distiphallus truncated (Fig. 244). *L. pictella* (Thompson)
76. Wing length 2.5mm. Base of distiphallus with broad basal collar; large apical bowl with single inner-marginal row of stout spines (Fig. 17) *L. abnormis* Spencer
- Wing length 1.2–2.1mm. Distiphallus various, but not as above 77
77. Wing length 1.2–1.8mm. Surstylus almost always with one spine—some *L. brassicae* with two, including specimens with brown face. Paraphallus directed ventrally or anteroventrally. Males only past this point. 78
- Wing length 1.8–2.1mm. Surstylus with two spines and face never brown. Paraphallus absent or directed apically. 81
78. Face rarely brown. Surstylus usually with one large spine, rarely two (Figs 55–58). Distiphallus relatively elongate, dark, and barrel-shaped (Figs 59, 60). Ejaculatory apodeme large and broad with corners pointed (Fig. 54). *L. brassicae* (Riley) (in part)
- Face never brown. Surstylus always with one spine. Distiphallus relatively short, pale and cup-like. Ejaculatory apodeme relatively narrow with corners rounded 79
79. Paraphallus broad and clavate. Mesophallus indistinct. Distiphallus with relatively long, dark base and broad rounded apex (Figs 122–124) *L. helianthi* Spencer (in part)
- Paraphallus thin with width nearly equal along length. Distiphallus pale, not much longer than wide, bell-shaped and separated into distinct basal and distal sections (ie. mesophallus and distiphallus). 80
80. Eye height divided by gena height 2.6–3.0 (normally 4.4–5.8 for this species). Hypophallus as long as distiphallus plus mesophallus. Distiphallus as in Figs 8, 9, with apical, basal and ventral surfaces more well-sclerotized, forming weak C-shape in profile. Width of ejaculatory apodeme usually significantly more than half length (Fig. 7). *L. sativae* Blanchard (in part)
- Eye height divided by gena height 3.6. Hypophallus nearly as long as distiphallus. Distiphallus stout, more globose in outline (Figs 247, 248). Width of ejaculatory apodeme slightly more than half width and (Fig. 245). *L. venturenensis* Spencer
81. Eye 2.8–4.0 times higher than gena. Only base of hind coxa brown. Paraphallus distinct, directed apically. Distiphallus not

- much longer than mesophallus (Figs 118, 119). *L. helenii* Spencer (in part)
- Eye 4.0–5.4 times higher than gena. Hind coxa more extensively pigmented. Paraphallus absent. Distiphallus approximately 50% longer than mesophallus 82
82. Scutum sometimes subshining. Surstylus with both spines positioned near mid-ventral surface (Fig. 201). Hypophallus small and thin with several apical hairs. Basiphallus narrow apically. Distiphallus twice width of mesophallus (Figs 202, 203). *L. sabaziae* Spencer (in part)
- Scutum glossy. Surstylus with spines positioned along posteroventral margin (Fig. 251). Hypophallus long, broad, dark, flat and bare. Distolateral margins of basiphallus flared laterally and wing-like. Distiphallus not much wider than mesophallus (Figs 254, 255) *L. zinniae* Spencer
83. Posterolateral corner of scutum brownish or completely dark 84
- Posterolateral corner of scutum yellow. 86
84. Distiphallus bifid and separate from mesophallus (Figs 129, 130). Basiphallus and mesophallus separated by long membranous space. Paraphallus vestigial. Face sometimes partly brown. Lateral margin of frons often dark with thin extension reaching base of posterior ori. Femora predominantly dark with distoventral surface yellow. *L. langei* Frick (in part)
- Distiphallus cylindrical and fused to mesophallus. Basiphallus and mesophallus closely spaced. Paraphallus flat and leaf-like or thin and subrectangular. Face yellow. Base of posterior ori always surrounded by yellow. Femora yellow, sometimes with sparse mottling. 85
85. First flagellomere infuscated with basal margin yellow. Abdomen brown. Length of ultimate section of vein CuA₁ divided by penultimate section 2.3. Paraphallus thin. Distiphallus with broad apical chamber enclosing one pair of processes (Figs 69–71). *L. californiensis* Spencer (holotype)
- First flagellomere only infuscated along distal margin. Lateral margin of abdominal tergites yellow and tergites 1 and 2 with thin medial yellow line. Length of ultimate section of vein CuA₁ divided by penultimate section 4.3. Paraphallus broad and ovate. Distiphallus narrow apically and without distinct paired structures (Figs 182, 183). *L. phyllodes* **spec. nov.**
86. Abdominal tergites entirely dark brown (intersegmental membrane sometimes appearing as yellow posterior margin on tergites). Orbital plate sometimes brown laterally. 87
- Abdominal tergites yellow along lateral and posterior margins. Orbital plate entirely yellow. 91
87. Wing length 1.3–1.6mm. Lateral margin of frons with faint brown band to level of anterior ori, enclosing base of ors. Katatergite yellow. Distiphallus bell-shaped and undivided (Figs 30–32). *L. artemisiae* Spencer (in part)
- Wing length 1.8–2.5mm. Lateral margin of frons sometimes dark to base of posterior or anterior ors. Katatergite brown ventrally. Distiphallus bifid. 88
88. Parafacial and anterior margin of orbital plate projecting. First flagellomere relatively large and quadrate; only dorsal margin with brown pigment. Two irregular rows of acrostichal setulae. Distiphallus with long apical membranous tubules (Fig. 231). Ejaculatory apodeme large and heavily sclerotized, with ends of *pileus ejaculatorius* produced and heavily sclerotized (Fig. 229) *L. tubula* Spencer
- Parafacial and orbital plate barely visible laterally. First flagellomere small and ovate; anterior margin darkly pigmented. Four rows of acrostichal setulae. Distiphallus very short. Ejaculatory apodeme small and pale, without produced *pileus ejaculatorius*. 89
89. Surstylus with two spines (Fig. 236). Paraphallus triangular with apex dark; hypophallus indistinct; basiphallus and mesophallus nearly touching (Figs 238, 239). Femora often predominantly yellow with base and light dorsal mottling brown. Mid coxa brown. Brownish ventral band on gena only present posteriorly. Vein dm-cu always present. *L. trifoliarum* Spencer (in part)
- Surstylus with one spine. Paraphallus clear and faint to indistinct; hypophallus long, thin and curved; basiphallus and mesophallus widely separated by membranous space. Femora usually predominantly brown with knees and distoventral surfaces yellow, at least on fore leg (paler in most *L. huidobrensis* and some *L. langei*); sometimes as above. Mid coxa sometimes yellow apically. Ventral margin of gena usually with complete faint brownish band, but sometimes variably faded. Vein dm-cu sometimes broken or absent 90
90. Two to three rows of acrostichal setulae, rarely four; usually sparsely arranged. Wing length 1.9–2.6mm (♂), 2.1–2.7mm (♀). Eye 2.5–4.3 times higher than gena. Lateral margin of frons dark to level of posterior ori or less; rarely to level of anterior ori. Gap present between base of hypophallus and sclerotized section of ejaculatory duct; swollen portion of ejaculatory duct usually parallel-sided and not bulging ventrobasally. Distiphallus and mesophallus relatively dark with thick walls, and distal half of distiphallus and basal half of mesophallus bulging (Figs 126, 127). Ejaculatory apodeme with relatively broad, rounded blade that is weakly to very strongly sclerotized; margin well-sclerotized (Fig. 125). *L. huidobrensis* (Blanchard) (in part)
- Four rows of acrostichal setulae, rarely three; densely arranged. Wing length 1.6–2.2mm (♂), 1.9–2.3mm (♀). Eye 3.5–4.2 times higher than gena. Lateral margin of frons dark to level of anterior or posterior ori. No gap present between hypophallus and sclerotized section of ejaculatory duct; swollen portion of ejaculatory duct widening towards base and slightly bulging ventrobasally. Mesophallus and distiphallus usually relatively weakly-sclerotized, pale and narrow, with distal half of distiphallus not much wider than basal half and parallel-sided; rarely as above (Figs 129, 130). Ejaculatory apodeme with narrow, weakly-sclerotized blade; margin usually unsclerotized (Fig. 131). *L. langei* Frick (in part)
91. Wing length 1.3–1.8mm. Space between vertical bristles paler than region lateral to outer bristle. Fifth fronto-orbital sometimes present. Distiphallus cup-shaped with base gradually tapering. 92
- Wing length 1.7–2.2mm. Space between vertical bristles usually dark brown. Only four fronto-orbitals. If distiphallus small and cup-like, more darkly-pigmented with base abruptly narrowed (Figs 86, 87) 93
92. Surstylus with one spine (Fig. 6). Distiphallus with narrow ventral suture (Fig. 9). *L. sativae* Blanchard (in part)
- Surstylus with two spines (Fig. 220). Distiphallus with broad ventral suture (Fig. 218). *L. specifica* Spencer (in part)
93. Lateral margin of frons entirely yellow. Femora yellow with brown base. Distiphallus broad, clear and circular with central

- sclerotized rod (Figs 139, 140) *L. lupini* Spencer
 - Orbital plate with thin brownish margin. Femora yellow with brown base and light dorsal mottling. Distiphallus small, pigmented and cup-shaped (Figs 86, 87) *L. eupatorii* (Kaltenbach) (in part)

***Liriomyza* Mik**

Agrophila Liroy 1864. Type species *Agromyza strigata* Meigen 1830 (as *Agromyza exilis* Meigen 1830), by subsequent designation (Coquillett 1910). Preoccupied by Boisduval 1840 [Noctuidae]. Syn. Frick (1952a).

Liriomyza Mik 1894: 289. Type species: *Liriomyza urophorina* Mik 1894, by monotypy. Spencer & Steyskal 1986: 107; Zlobin 1996: 277, 1999: 129.

Antineura Melander 1913: 249. Type species: *Antineura togata* Melander 1913: 249, by original designation. Preoccupied by Osten Sacken (1881) [Platystomatidae].

Haplomyza Hendel 1914: 73. Type species: *Antineura togata* Melander 1913: 250, by automatic designation. Replacement name for *Antineura*. Syn. Steyskal (1980).

Praspedomyza Hendel 1931: 77. Type species: *Dizygomyza approximata* Hendel 1920: 135, by original designation. Syn. Nowakowski 1962: 96.

Craspedomyza. Misspelling. Enderlein 1936: 181.

Triticomyza Blanchard 1938: 356. Type species: *Triticomyza cruciata* Blanchard 1938: 356, by original designation. Syn. Spencer (1982).

Species descriptions (alphabetical order)

Unless otherwise specified, all *Liriomyza* species described below are characterized as follows: orbital plate and parafacial not projecting; first flagellomere small and ovate with very short pubescence (ie. not long-haired); arista pubescent; epistoma absent or very thin, with little space between venter of face and clypeus; postpronotum yellow with small dark anteromedial spot and notopleuron yellow with dark thin sublateral stripe; scutellum yellow with lateral corner brown; four dorsocentrals, decreasing in length anteriorly, with anterior bristle presutural; surstylus small, movable, directed inwards, usually pivoting at two points; epandrium with small anteroventral spine on inner margin; basiphallus sclerotized along dorsal and left lateral surfaces, and with small membranous lobe on left apical margin; apical section of ejaculatory duct swollen, elongate and pigmented; ejaculatory apodeme with transverse *pileus ejaculatorius* along basal bulb; oviscape dark brown and heavily sclerotized.

***Liriomyza abnormis* Spencer**

Figs 15–18

Liriomyza abnormis Spencer 1981: 209. Spencer & Steyskal 1986: 131.

Description. Wing length 2.5mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.6. Eye height divided by gena height: 5.0. Scutum shining.

Chaetotaxy: Two ori on right side, one on left, two ors. Acrostichal setulae in four rows.

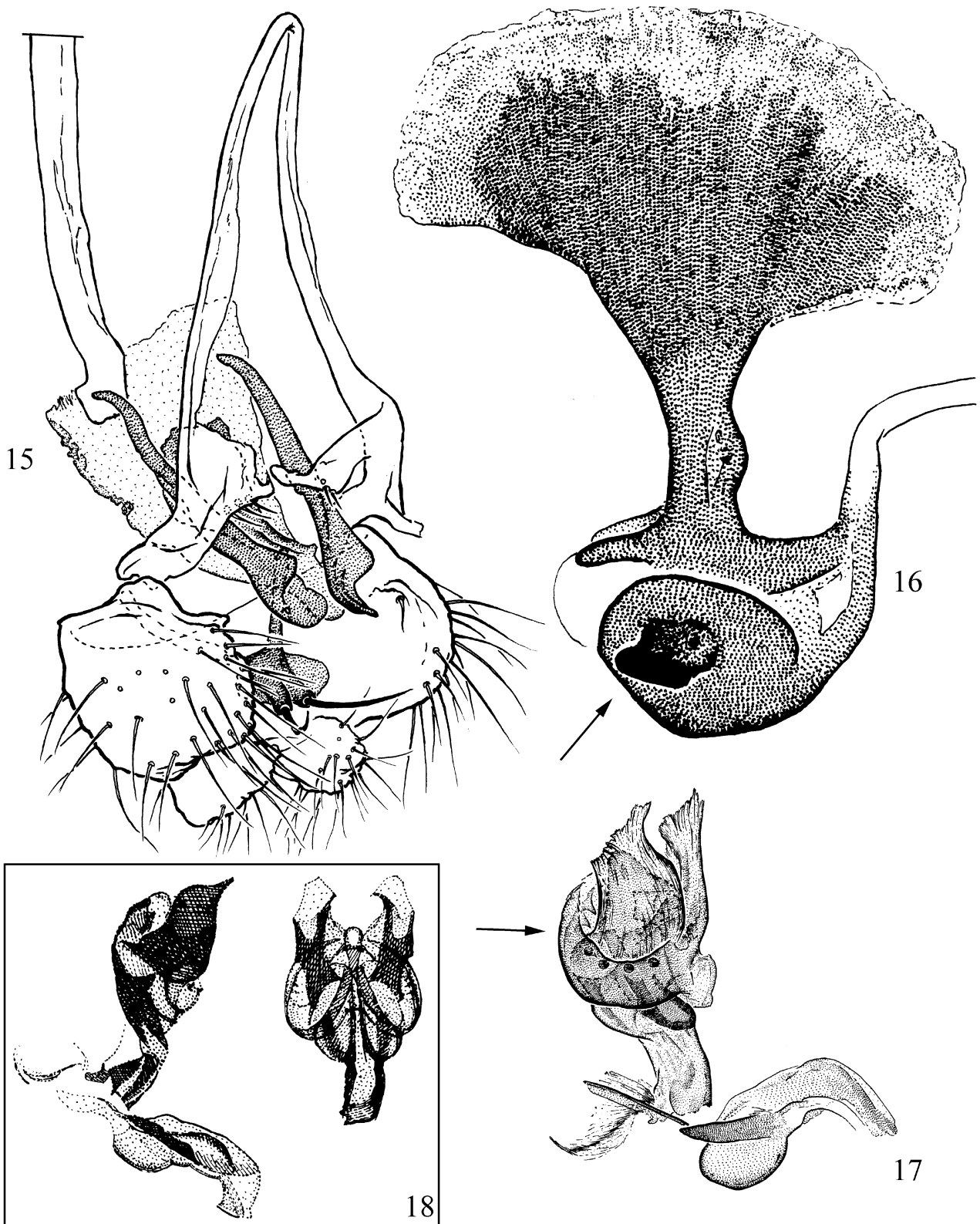
Colouration: Calypter margin and hairs brownish-grey. Head yellow with first flagellomere darker yellow, ocellar tubercle, back of head and clypeus dark brown; posterolateral corner of frons dark to base of outer vertical bristle, and slightly lighter to base of inner vertical bristle. Scutum with complete yellow lateral stripe; katatergite yellow with ventral margin brownish; anatergite dark below scutellum, and with lateral section paler with postero-dorsal corner yellowish. Anepisternum with large irregular brown subventral stripe; anepimeron with brown mottling; meron brown with dorsal margin yellow; ventral ¾ of katepisternum brown (bristle surrounded by yellow with brownish mottling to rear). Legs yellow with base of fore and mid coxa brown, basal third of hind coxae brown, base of femora narrowly brown dorsally, and tibiae and tarsi brown. Abdomen colour unknown.

Genitalia: Figs 15–18. Surstylus absent. Epandrium without spines. Basiphallus strongly bent medially; left anterior margin produced as long, dark, pointed process. Paraphallus extremely thin. Hypophallus ill-defined, haired along length. Apical swelling of ejaculatory duct nearly spherical. Distiphallus with long, medially bent stem and large apical bowl; bowl large, globose, with inner marginal row of thick spines, and enclosing paired

fringed structures. Ejaculatory apodeme with ends of *pileus ejaculatorius* dome-like and terminating in thick, dark process; base of duct dark; blade broad, darker than stem, and with pale marginal and subapical band.

Host. Unknown, probably Poaceae.

Range. USA. California [Alameda].



FIGURES 15–18. *Liriomyza abnormis* Spencer, male holotype genitalia; 15: external components and hypandrial complex excluding phallus and ejaculatory apodeme; 16: ejaculatory apodeme; 17: phallus, left lateral; 18: phallus, left lateral and ventral, from original figures in Spencer (1981).

Type material. Holotype, **USA. California:** Alameda Co., Berkeley Hills, 1400', NE of Oakland, 8.iv.1964, P. Rude, Type No. 14058 (1♂, CASC).

Comments. *Liriomyza abnormis*, still known only from the holotype, is a relatively large species with male terminalia similar to those of other grass-feeders such as *L. septentrionalis* (see comments of *L. gramineae* for discussion), except that the paraphallus is present, the apical bowl of the distiphallus is extremely large, and the enclosed processes are large, pale and fringed (not smooth, short and dark).

Liriomyza admiranda Spencer

Figs 19–23

Liriomyza admiranda Spencer 1981: 211. Spencer & Steyskal 1986: 110.

Wing length 1.3–1.4mm (♂), 1.8mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 3.4–5.9. Eye height divided by gena height: 3.0–3.8. Scutum dusted with greyish pruinosity.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in two rows.

Colouration: Calypter margin and hairs white. Head light yellow with back of head, clypeus and ocellar tubercle brown; posterolateral corner of frons brownish along posterior margin; anterior margin of first flagellomere sometimes appearing darker along anterior margin. Scutum yellow, with dark anteromedial stripe extending past midpoint of scutum, one pair of separate lateromedial stripes (swollen presuturally) and one pair of thinner posterolateral stripes (partially fused to lateromedial stripes in holotype); usually with shorter posteromedial stripe (absent in UCD male) that sometimes fuses to anteromedial stripe; katatergite yellow; anatergite dark below scutellum, and with lateral section paler with posterodorsal corner yellowish. Pleuron pale with anteroventral section of anepisternum dark (excluding corner), anterior half of anepimeron streaked and posterior margin brownish, and ventral 3/4 of meron and katepisternum brown (katepisternal bristle surrounded by yellow). Legs yellow with base of coxae brown, femora with base, dorsal spot at 3/4 length and dorsal striation on fore femur brown, and tibiae and tarsi dark brown. Abdominal tergites brown with posterior margin yellow (widest on posterior segments); tergite 2 sometimes with thin medial longitudinal yellow line.

Genitalia: Figs 19–23. Surstylus bare, with single subapical spine. Basiphallus weakly sclerotized. Paraphallus short, thin, ill-defined posteriorly. Hypophallus thin with reduction of apical hairs. Mesophallus very short, nearly indistinct and fused to distiphallus ventrobasally. Distiphallus pale, cup-shaped, slightly tapered at base, and with nearly indistinct internal spinulose processes. Ejaculatory apodeme relatively broad, marginally pale and with light transverse annulations.

Variation: Modoc County male differs as follows: length of ultimate section of vein CuA₁ divided by penultimate section 2.7; anterior ors inclinate (resembling ori); eye height divided by gena height 4.4; posterolateral region of frons entirely yellow; femora pale distally, with only vestige of spot remaining on fore femur; tibiae and tarsi light brown; tergites 4–6 with two yellow posterior emarginations (deeper on posterior segments); epandrium only brown laterally.

Host. Unknown.

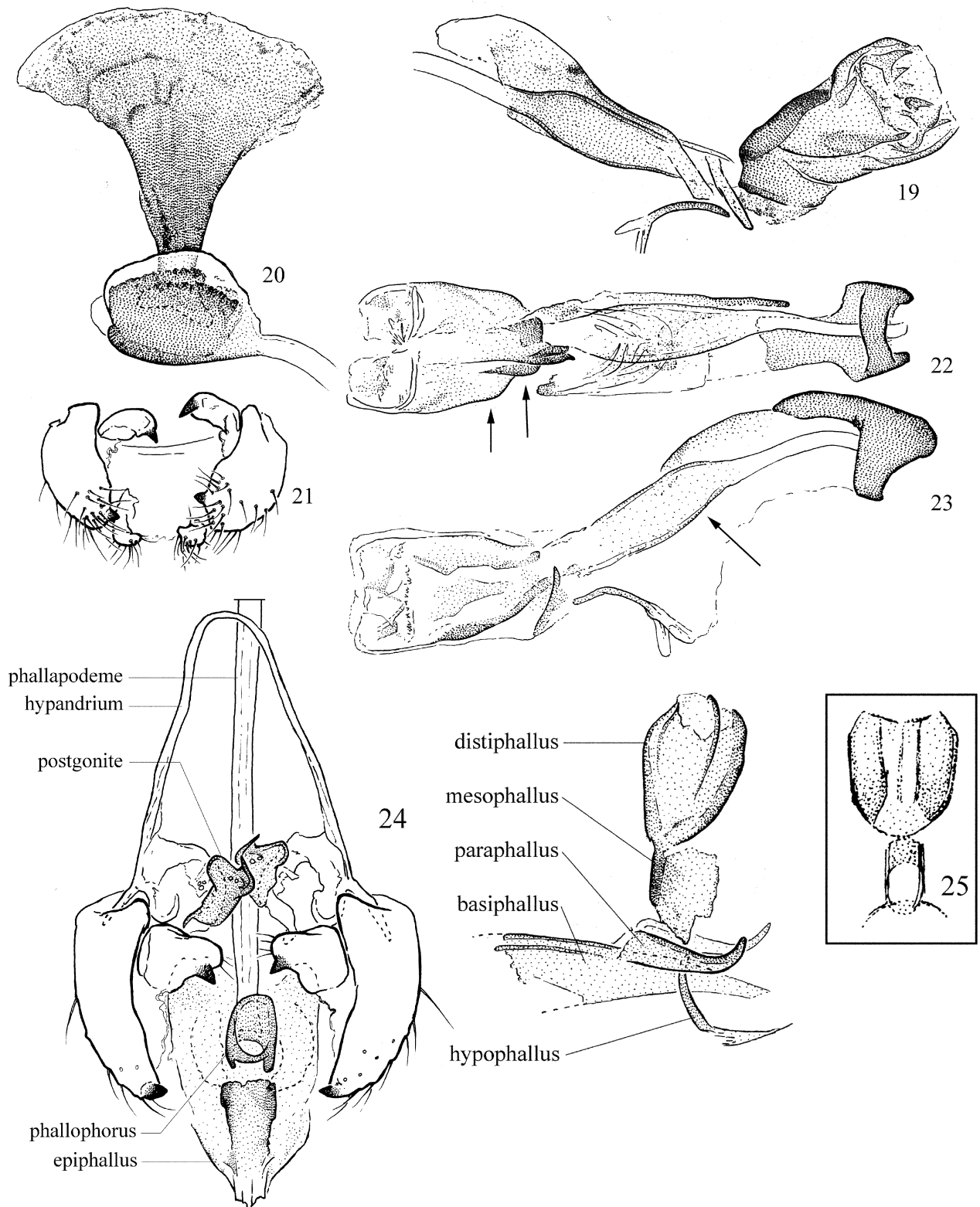
Range. **USA.** Arizona*, California [Contra Costa*, Inyo*, Modoc*, Riverside, San Diego*, Stanislaus*]. Mexico*.

Type material. Holotype, **USA. California: Riverside Co.,** roadside at Keen Camp summit, 4700', 23.iv.1977, K.A. Spencer (1♂, USNM).

Additional material examined. **MEXICO.** Baja Calif., Norte: San Felipe, 7.iii.1963, P.H. Arnaud, Jr. (1♀, CASC). **USA. Arizona:** Tucson, 4.v.1942, A.L. Melander (5♂ 1♀, USNM), **California: Contra Costa Co.,** Russelman Park, Mt. Diablo, 7.v.1960, W.E. Simonds (1♂, CSCA), **Inyo Co.,** Cartago, 2mi N, 15.vii.1953, E.I. Schlinger (1♀, UCD), **Modoc Co.,** Cedar Pass Campground, 11.viii.1967, 1800m, P.H. Arnaud, Jr. (1♂, CASC), **San Diego Co.,** Borrego-Clark L.N. End, 23.iii.1978, Wasbauer, Slansky & Adams (1♂, CSCA), **Stanislaus Co.,** Frank Raines Co. Park, Del Puerto Canyon, 15.v.1971, Malaise trap, M. Wasbauer (1♀, CSCA).

Comments. *Liriomyza admiranda* is externally similar in appearance to *L. bella*, but the calypter is entirely white (not marginally grey), the notal stripes are separate (not fused), a posteromedial stripe is usually also present on the scutum, male tergites 1–3 are more extensively brown with the remaining tergites brown anteromedially

(often yellow in *L. bella*) and the female abdomen is brown dorsally (not almost entirely yellow excluding the dark oviscape). This species is much more widespread in western North America than previously known and additional new state and county records likely await discovery.



FIGURES 19–25. Figs 19–23: *Liriomyza admiranda* Spencer, male genitalia; 19: holotype phallus, right lateral; 20: ejaculatory apodeme; 21: external components, ventral; 22: phallus, ventral; 23: phallus, left lateral. Figs 24–25: *Liriomyza arnaudi* Spencer, male holotype genitalia; 24: ventral, with phallus broken off and shown to right (right lateral view with most of basiphallus missing); 25: phallus, ventral, from original figure in Spencer (1981).

Liriomyza arnaudi Spencer

Figs 24–25

Liriomyza arnaudi Spencer 1981: 212. Spencer & Steyskal 1986: 121.

Wing length 1.7mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 4.6. Eye height divided by gena height: 5.0. Scutum shining. First flagellomere relatively large and spherical.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head yellow with back of head, ocellar tubercle, clypeus and stripe from posterolateral margin of frons to base of inner vertical bristle (but not touching bristle) dark brown; first flagellomere infuscated along dorsal margin with stripe becoming darker to arista base. Postsutural scutum only yellow along transverse suture laterally; katatergite brown ventrally; anatergite dark below scutellum, and with lateral section paler with posterodorsal corner yellowish. Anepisternum brown on ventral half; anepimeron brown with yellow mottling; meron brown with dorsal margin yellow; ventral $\frac{3}{4}$ of katepisternum brown (bristle surrounded by yellow). Mid and fore tibiae and tarsus brown; hind legs missing; remainder of legs yellow. Abdomen colour unknown.

Genitalia: Figs 24, 25. Surstylus relatively short, with single subapical spine; tapering and lightly setose apically. Paraphallus more heavily sclerotized along anterior margin and upcurved apically. Mesophallus thin and weakly-pigmented ventrally, confluent with distiphallus dorsally. Distiphallus not much longer than mesophallus, pale, cup-shaped, slightly tapered apically and compressed to a point. Ejaculatory apodeme broad, paler apically and with sharp corners on blade.

Host. Unknown.

Range. USA. California [Riverside].

Type material. Holotype, USA. California: Riverside Co., Agua Caliente Indian Reserve, Palm Canyon, 23.ii.1970, P.H. Arnaud, Jr., Type No. 13932 (1♂, CASC).

Comments. The phallus is relatively nondescript in this species, but the mesophallus is directed dorsally and the paraphallus is strongly curved and pointed apically. Externally, the first flagellomere is unusual in being infuscated dorsally (not anteriorly). A similar antenna is seen in *Liriomyza trixivora* and *L. tubula*, but in *L. trixivora* the first flagellomere is usually subquadrate and more extensively infuscated, the pleuron is weakly pigmented, the length of the ultimate section of vein CuA₁ divided by the penultimate section is 2.6–3.6, the paraphallus is not bent, the distiphallus is not directed dorsally (although it is similarly sized) and the surstylus has two spines. In *L. tubula* the first flagellomere is also subquadrate, there are no more than two rows of acrostichal setulae, the parafacial and orbital plate are projecting, the femora are brown basally, the length of the ultimate section of vein CuA₁ divided by the penultimate section is 2.2–2.3 and the distiphallus has one long pair of apical tubules.

Liriomyza artemisiae Spencer

Figs 26–32

Liriomyza artemisiae Spencer 1981: 213. Spencer & Steyskal 1986: 117.

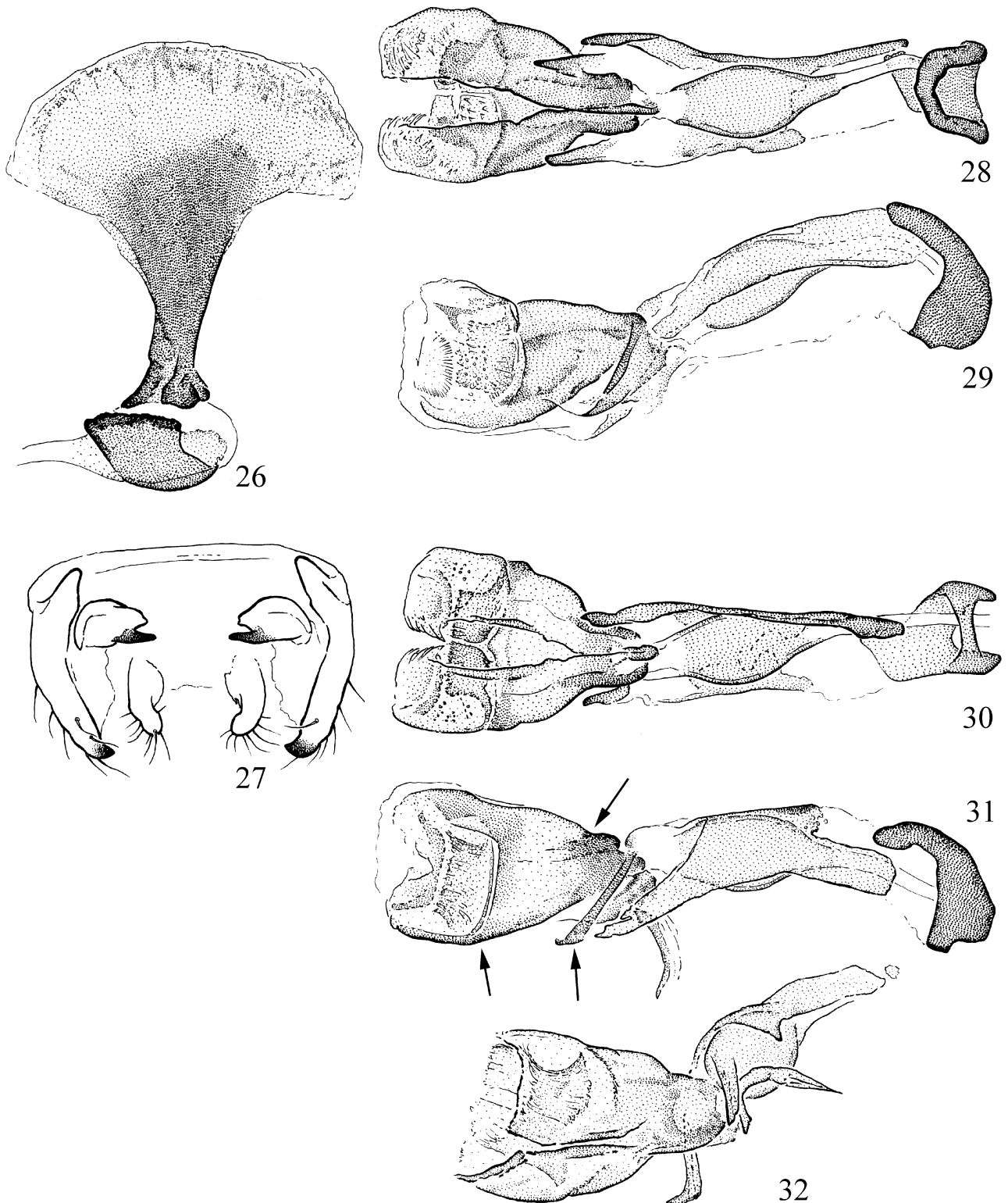
Liriomyza similis Spencer 1981: 272. Spencer & Steyskal 1986: 120. **SYN. NOV.**

Wing length 1.4–1.5mm (♂), 1.3–1.6mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.7–3.7—Spencer (1981) notes that several specimens from Riverside and Los Angeles Counties have vein dm-cu partially to completely atrophied. Eye height divided by gena height: 3.1–5.0. Scutum subshining.

Chaetotaxy: Two ori (anterior ori sometimes slightly reduced), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. First flagellomere infuscated with basal margin yellow; lateral margin of frons yellow, sometimes with very faint stripe that may reach base of ors, or less commonly, base of ori; ocellar triangle, back of head and clypeus dark brown; ventral margin of gena with thin brownish line. Scutum with complete yellow lateral stripe; katatergite yellow; anatergite brown, darker below scutellum and becoming yellow dorsally lateral to scutellum. Anepisternum brown on ventral $\frac{2}{3}$ (dorsal margin irregular) or with posterior margin and broad oblique stripe brown; anepimeron brown with yellow mottling; meron brown with dorsum yellow; katepisternum brown on ventral $\frac{3}{4}$ (not including base of bristle). Legs yellow with base of coxae brown, femora

brown basally, fore femur with strong dorsal striations, mid and hind femora with weak dorsal mottling, and tibiae and tarsi dark brown. Abdomen dark brown.



FIGURES 26–32. Figs 26–29: *Liriomyza artemisiae*, pale-type male genitalia; 26: ejaculatory apodeme; 27: external components, ventral; 28: phallus, ventral; 29: phallus, left lateral. Figs 30–31: dark-type male phallus: 30: ventral; 31: left lateral. Fig. 32: *L. similis* Spencer [=*L. artemisiae*], male holotype phallus.

Genitalia: Figs 26–29. Surstylus with one subapical spine. Paraphallus thin and dark. Hypophallus thin, ill-defined and weakly haired apically. Mesophallus short, dark, narrow and fused to distiphallus. Distiphallus pale and bell-shaped with open suture that unites in front of, and extends past mesophallus; distal half with inwardly-directed hairs on inner-distal margin, and with one pair of short, fringed inner processes. Ejaculatory apodeme with *pileus ejaculatorius* broad, truncated and darker along lateral margin; blade paler to margin and with weak subapical striations.

Variation: Darker specimens (see comments) differ as follows: pigment on antenna and frons darker, orbital plate always partially dark; anepisternum and katepisternum brown with dorsal margin yellow; legs brown with fore coxa yellowish apically, fore femur yellow apically (and sometimes anteroventrally), and mid and hind femora sometimes yellow apically; distiphallus slightly broader and paler (Figs 30, 31).

Host. Asteraceae—*Artemisia* sp., *A. douglasiana*. Adults[?] collected on *Lupinus* (Fabaceae), *Swertia* (Gentianaceae) and *Salix* (Salicaceae).

Range. USA. California [Alameda*, Alpine, El Dorado*, Humboldt*, Los Angeles, Marin*, San Luis Obispo*, Orange, Riverside, San Bernardino*, San Diego, Shasta, Solano, Sonoma*, Stanislaus, Ventura, Yolo*], Colorado*, Montana*, Wyoming*. Since *Artemisia douglasiana* is only known from California, Oregon, Washington, Nevada and Idaho (USDA, 2009), the Wyoming record suggests that *L. artemisiae* may occur on other species of *Artemisia*.

Type material. *Liriomyza artemisiae* [pale type]: Holotype, **USA. California: Ventura Co.**, Point Mugu S.P., caught on *Artemisia douglasiana*, 1.iv.1977, K.A. Spencer (1♂, USNM). ***Liriomyza similis*** [dark type]: Holotype, **USA. California: Alpine Co.**, Hope Valley, 8.viii.1948, sweeping, Lot 91-30, K.E. Frick, Type No. 13941 (1♂, CASC). ***Liriomyza artemisiae*** [dark type]: Paratypes, **USA. California: Shasta Co.**, Old Station, 22.vi.1955, J.W. MacSwain (1♂, EMEC), **Solano Co.**, Vacaville, 3mi SE, 2.viii.1968, J. Powell, No. 68HI, reared from (miner) *Artemisia douglasii*, emgd. 21.viii.1968 (4♀, EMEC), 27.viii.1968 (2♀, EMEC). ***Liriomyza similis*** [one dark type and one non-conspicuous]: Paratypes, **USA. California: Alpine Co.**, Hope Valley, 8.viii.1948, sweeping, Lot 91-30, K.E. Frick (2♀, CASC).

Additional material examined [pale]. USA. California: San Bernardino Co., Crestline, 13.vii.1944, A.L. Melander (1♂, USNM).

Additional material examined [dark]. USA. California: Alameda Co., Albany, on *Salix*, 27.vi.1958, F.D. Bennett (6♂ 3♀, CNC), **El Dorado Co.**, Echo Lake, 7500', 13.vii.1961, J.G. Chillcott, on aphid infested *Swertia* leaves (1♂, CNC), **Humboldt Co.**, Samoa Dunes, 1.vii.1969, *Lupinus arboreus*, J. Powell (2♀, EMEC), **Los Angeles Co.**, Angeles Crest Highway, Arroyo Seco, Switzer Station, 1000m, 29.vii.1977, P.H. Arnaud, Jr. (4♂ 14♀, CASC), Big Dalton Cn., 23.vii.1952, A.T. McClay (1♂, UCD), Glendale, 30.vii.1955[?], E.I. Schlinger (1♂, UCD), **Marin Co.**, Pt. Reyes, 10.iv.1958, D. Burdick (1♀, EMEC), Pt. Reyes, 26.i.1957, J. Powell (1♀, EMEC), **San Luis Obispo Co.**, Montana de Oro St. Pk., dunes 3mi SW Los Osos, 16–17.viii.1983, Malaise trap 10A-4P, M. Wasbauer & P. Adams (1♀, CSCA), **Orange Co.**[?], “S Fks Sta Ana”, 18.vi.1945, A.L. Melander (1♂, USNM), **Riverside Co.**, Hemet Lake, 500', 3.vi.1961, J.G. Chillcott (1♂, CNC), Palm Desert, 2000', 4.iv.1955, W.R. Richards (1♀, CNC), **San Diego Co.**, Palomar Observatory Cpgd., 26.vi.1968, 1524m, P.H. Arnaud, Jr. (1♂ 1♀, CASC), Anza-Borrego State park, 1.5km SE Scissors Crossing, 18.vi.2003, 33°05'30"N, 116°27'16"W, 2240', S.D. Gaimari & E.M. Fisher (1♂, CSCA), **Sonoma Co.**, Salt Point St. Pk., 22.ix.1990, R.&J. Robertson (1♀, CASC), **Yolo Co.**, 9km N Winters, 15.iv.1990, S.L. Heydon (2♂, UCD), **Colorado:** Doolittle ranch, 9800', Mt. Evans, 25.vii.1961, W.R.M. Mason (1♀, CNC), **Montana:** Lake McDonald, Glacier Park, 14.viii.1916, A.L. Melander (1♂, USNM), **Wyoming:** Teton Co., 9.5km E of Moran on Highways 26 and 287, 16.viii.1981, P.H. Arnaud, Jr. (3♀, CASC).

Comments. While differing significantly in external colouration, the two colour types described above are here treated as the same species due to striking similarities in the male genitalia. While minor differences are also present in the phallus, it is not entirely certain as to whether these differences are indicative of the presence of a separate species. The *Liriomyza artemisiae* holotype belongs to the pale colour type, which is less frequently encountered and only known from southern California. This species likely occurs throughout the mountainous western regions of the United States, with specimens recovered from southern California to Yolo, Sonoma and Shasta Counties, as well as Montana and Wyoming.

Liriomyza similis is here included as a junior synonym of *L. artemisiae* because the genitalia and external morphology of the holotypes are highly similar and the external morphology of the holotype (Fig. 32) and one of the

paratypes exactly match those of the “dark type” material described above. The remaining paratype female of *L. similis* is clearly not conspecific with *L. artemisiae* or any other examined material. While somewhat resembling “dark type” *L. artemisiae*, the first flagellomere is entirely dark (not brown with a yellow base), larger, more elongate and highest before the midpoint, the base of the vertical bristles are surrounded by yellow, the orbital plate is yellow, the wing is longer (1.8mm), the length of the ultimate section of vein CuA₁ divided by the penultimate section is 2.1, the eye height divided by the gena height is 3.3, the anterior ori is slightly reduced, the tibiae are paler, and the femora are yellow with a brown base and extensive dorsal streaking. This unusual specimen strangely appears to be the basis for Spencer’s external diagnosis for *L. similis*.

Liriomyza baccharidis Spencer

Figs 33–36

Liriomyza baccharidis Spencer 1963b: 354. Spencer 1981: 216, 1984: 15; Spencer & Steyskal 1986: 124.

Wing length mm 1.8–2.2(♂), 2.2–2.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.5–2.7. Eye height divided by gena height: 4.0–5.3. Scutum shining. Epistoma relatively broad.

Chaetotaxy: Two ori (sometimes three on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head yellow with back of head, ocellar tubercle, stripe on ventral margin of gena, clypeus and posterolateral frons to base of inner vertical bristle dark brown; first flagellomere dark yellow; face brown; lateral margin of frons with thin brown line. Scutum with lateral yellow stripe sometimes brownish or mottled behind wing base; laterotergites dark with posterodorsal corner of anatergite yellowish lateral to scutellum. Pleuron dark with dorsomedial margin of katepisternum yellow, and anterodorsal to entire dorsal margin of anepisternum yellow. Coxae brown with yellow mottling; basal ¼ or less of femora brown with dorsobasal half sometimes mottled; tibiae and tarsi dark brown. Abdomen dark brown.

Genitalia: Figs 33–36. Surstylus C-shaped with short dark spine at each end. Paraphallus dark, thick and curved. Hypophallus relatively small with short subapical hairs. Mesophallus not evident. Distiphallus dark and cylindrical with slight subbasal constriction; with complete ventral suture and thickly enclosed apical chamber containing one pair of very short fringed structures. Stem of ejaculatory apodeme thin; duct pigmented basally; blade broad with medial annulations and dark margin.

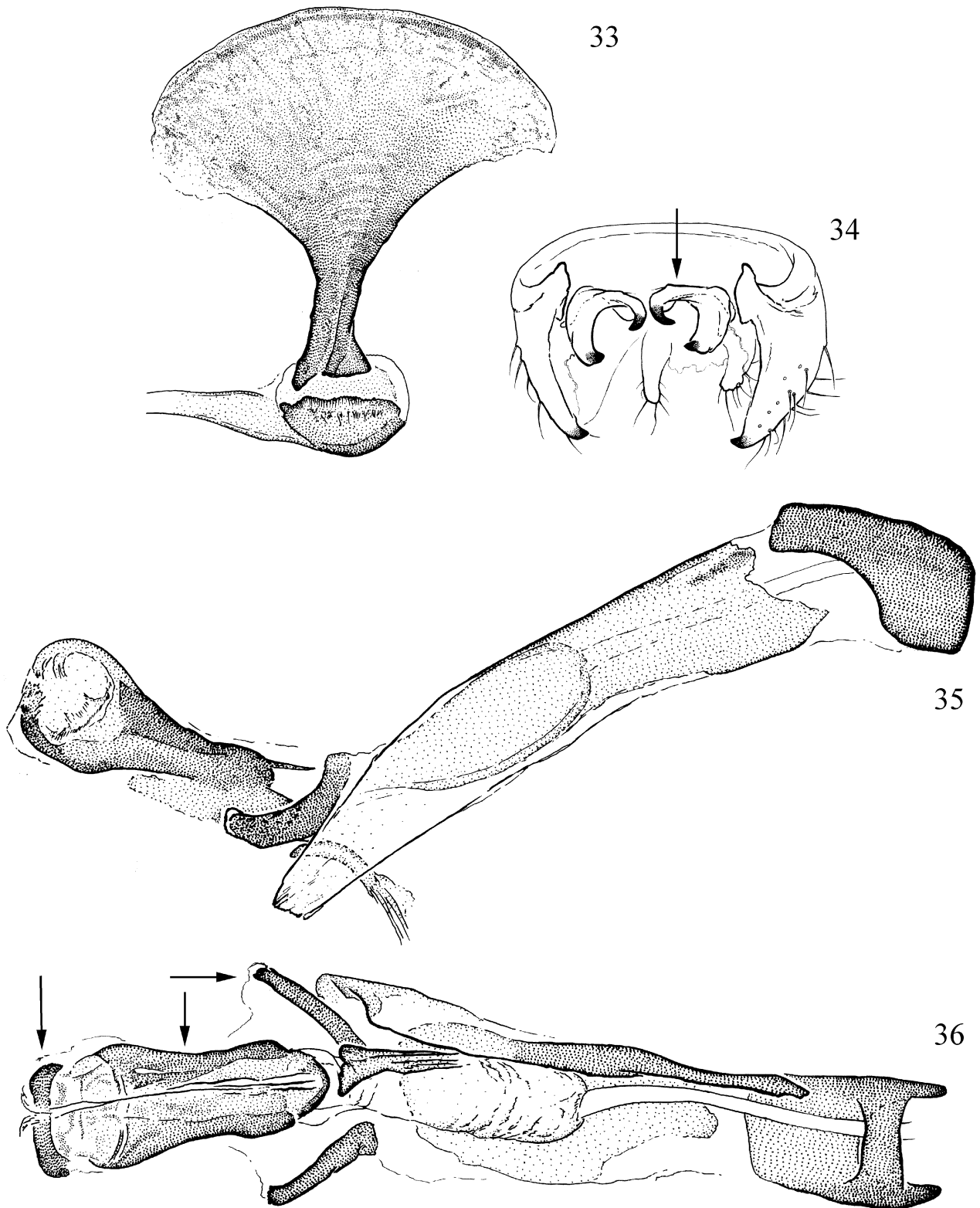
Variation: Darker males differ as follows: scape and surrounding lunule brownish; dark lateral stripe on frons sometimes extending to surround base of ors, or base of all fronto-orbitals surrounded by thin brown spot; mid and hind femora with light dorsal mottling; anepisternum and coxae entirely dark.

Hosts. Asteraceae—*Artemisia douglasiana*, *Baccharis douglasii*, *B. floribunda*, *B. pilularis*, *Baccharis* sp., *Conyza bonariensis*, *C. canadensis*, *Conyza* sp.[?]. Adult[?] on *Cornus californica* (Spencer, 1981, 1984, 1990).

Range. USA. Arizona*, California [Alameda, Contra Costa, Del Norte*, Fresno*, Humboldt*, Los Angeles*, Marin, Modoc*, Monterey, Placer*, Riverside, Sacramento*, San Bernardino*, San Diego*, San Francisco*, San Luis Obispo*, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma*, Tuolumne, Ventura], Idaho*, Washington. Colombia. Venezuela. Likely present throughout Central America (Spencer, 1981).

Type material. Holotype, COLOMBIA. Tequendama Falls, nr. Bogotá, bred ex. leaf mine on *Baccharis floribunda* H.B.&K., 26.xii.1958, K.A. Spencer (1♂, BMNH). [Not examined]

Additional material examined. USA. Arizona: Superior, 13.iv.1935, A.L. Melander (1♂, USNM), **California: Alameda Co.**, Berkeley, 7.x.1948, on leaf of *Cornus californica* Mey., Lot No. 10-2, K.E. Frick (1♂, CASC), Albany, 13.viii.1948, ex. larva *Baccharis douglasii* DC., Lot No. 41-1 (1♂ 1♀ [on slide], CASC), Strawberry Cyn., Berkeley Hills, 14.x.1962, C.A. Toschi (1♀, EMEC), Berkeley, *Baccharis*-like plant, emerged “5-15±25”, W.W. Jones (1♂, EMEC), Berkeley, “*Baccharis*?”, “12-29-24” (1♀, EMEC), “3-25-28” (1♀, EMEC), **Contra Costa Co.**, El Cerrito, 880’, 10.ix.1967, collected in house, D.D. Linsdale (1♀, CASC), Orinda, E. Schlinger, 29.vi.1970 (1♂, EMEC), 18.vi.1970 (1♀, EMEC), 19.vi.1970 (1♀, EMEC), 2mi SE Lafayette, 756’, 10.iv.1968, dry ice Malaise trap, W.J. Turner (1♀, EMEC), **Del Norte**, Six Rivers NF For Route 16N02, nr. Bear Basin Outlk, 41.8016°N, 123.7369°W, 1500m, 3.vi–24.vii.2009, P. Kerr & O. Lonsdale (5♂ 5♀, CSCA), **Fresno Co.**, Sequoia Lake, 7.vi.1935, A.L. Melander (1♂, USNM), **Humboldt Co.**, McKinleyville bog area nr. Azalea Avenue, 9.vii.1980, T.W. Davies (1♂ 1♀, CASC), Grizzly Creek State park, 11.viii.1953, P.H. Arnaud, Jr. (1♀, CASC), Dry Lagoon



FIGURES 33–36. *Liriomyza baccharidis* Spencer, male genitalia; 33: ejaculatory apodeme; 34: external components, ventral; 35: phallus, left lateral; 36: phallus, ventral.

Beach State Park, 10.viii.1953, P.H. Arnaud, Jr. (1♂, CASC), Big Lagoon, 3.vii.1969, J. Powell (1♀, EMEC), **Los Angeles Co.**, Big Dalton Dam, 13.vii.1950, W.C. Bentinck (1♀ 1?, EMEC), Tanbark Flat, 27.vi.1956, W.C. Bentinck (1♀, EMEC), **Marin Co.**, Point Reyes Peninsula, 8mi. NW of Inverness, 12.ix.1967, T.W. Davies (1♀,

CASC), **Modoc Co.**, Cedar Pass campground, 11.viii.1967, 1800m, P.H. Arnaud, Jr. (1♂, CASC), **Monterey Co.**, Castroville, 23.vi.1965, E.L. Smith (3♂ 1♀, UCD), **Placer Co.**, Bear Vy., 1mi N of Emigrant Gap, 5.vi.1970, J. Powell (1♂, EMEC), **Riverside Co.**, Riverside, A.L. Melander, 5.v.1935 (2♂, CSCA), 24.ii.1935 (1♂, CSCA), 10.iii.1946 (1♂, USNM), Palm Springs, 17.i.1953, P.H. Arnaud (1♂, USNM), **Sacramento Co.**, Sacramento, 21.iii.1977, Malaise trap, M. Wasbauer (1♂, CSCA), **San Bernardino Co.**, S fork Santa Ana River, vic. Melander cabin, 2.vii.1968, 1950m, P.H. Arnaud, Jr. (1♀, CASC), Wrightwood, 24.vii.1945, Collection of Grace H. & John L. Sperry (1♂ [pinned with two *L. septentrionalis*], USNM), **San Diego Co.**, Buena Vista Lagoon, 19.vi.1996, M. Gates, LM96-451 (1♂, USNM), **San Francisco**, Lake Merced, 21.vi.1964, P.H. Arnaud, Jr. (3♀, CASC), **San Luis Obispo Co.**, Montana de Oro St. Pk., dunes, 3mi SW Los Osos, M. Wasbauer & P. Adams, Malaise trap 9A-5P, 13-15.viii.1983 (1♀, CSCA), Malaise trap 10A-4P, 16-17.viii.1983 (1♀, CSCA), Oso Flaco Lk., 14.vii.1965, M.L. Gardner (2♀, UCD), **San Mateo Co.**, San Bruno Mountains, Guadalupe Canyon Parkway, 25.viii.1979, P.H. Arnaud, Jr. (1♂, CASC), Mt. San Bruno, 28.iii.1969, P.A. Opler (1♂, EMEC), San Mateo Memorial Park, 31.vii.1971, S.E. Tatro (1♂, CASC), Skyline Blvd., LaHonda Rd., 16.viii.1952, P.H. Arnaud, Jr. (1♂, USNM), **Santa Barbara Co.**, U.C. Goleta, 26.vi.1965, M.R. Gardner (1♂, UCD), UC Coal Oil Pt. Reserve, 34.4105'N, 119.8798'W, Malaise, M. Caterino & A. Borrell, 17-29.iii.2003 (2♂, SBMN), 8-22.iv.2003 (1♂ 2♀, SBMN), 2mi E Solvang, 28.vi.1955, J. Powell (6♂ 2♀, EMEC), Los Prietos, 25.vi.1965, J. Powell (2♀, EMEC), **Santa Clara Co.**, Stanford U., P.H. Arnaud, Jr., 2.vii.1957 (1♂, CASC), Santa Cruz, Aptos, 11.ix.1948, ex. larva *Erigeron canadensis* L. [= *Conyza canadensis*], Lot No. 150-2, K.E. Frick (1♀, CASC), Stanford, em. 24.iv.1947 (1♂, USNM), **Santa Cruz Co.**, along Hwy. 17 nr. Glenwood, 22.iv.1977, D. Wilder (1♂, CASC), **Sonoma Co.**, Atlas-cadera Creek, NW Graton, Williams property, ca. 30m, 21.viii.1966, P.H. Arnaud, Jr. (1♀, CASC), Soquel, ex. larva *Baccharis douglasii* D.C., Lot No., 151-2, K.E. Frick (1♂, CASC), Soquel 14.viii.1948, ex. larva *Baccharis douglasii* DC., Lot No. 151-2 (1♂ [on slide], CASC), Santa Cruz, 21.x.1948, ex. larva cultivated *Aster* sp., Lot No. 181-2 (1♂ 1♀ [on slide], CASC), **Tuolumne Co.**, Sonora Pass, el. 9000, 22.vii.1951, W.C. Bentinck (1♂, EMEC), **Ventura Co.**, Santa Cruz Island, Prisoner's Harbor Cr., 1.v.1966, J. Powell (1♀, EMEC), **Idaho**: Priest Lake, 1.viii.1916, A.L. Melander (1♂, USNM), **Washington**: Mt. Rainier, Ohanapecosh, 11.viii.1940, A.L. Melander (1♂, USNM).

Comments. *Liriomyza baccharidis* is a relatively widespread and commonly-encountered species in California that can be diagnosed externally by a dark brown stripe on the venter of the gena, a similarly dark face and a contrasting yellow antenna. This dark colouration distinguishes it from *L. brassicae*, another frequently encountered species that has a similar dark, cylindrical and medially constricted distiphallus. The surstylus of *L. baccharidis* is also unique among agromyzids in being broad and C-shaped.

Liriomyza baptisiae (Frost)

Figs 37-40

Agromyza baptisiae Frost 1931: 275.

Liriomyza baptisiae. Frick 1952a: 402, 1959: 402; Spencer 1969: 169, 1981: 218; Spencer & Steyskal 1986: 115.

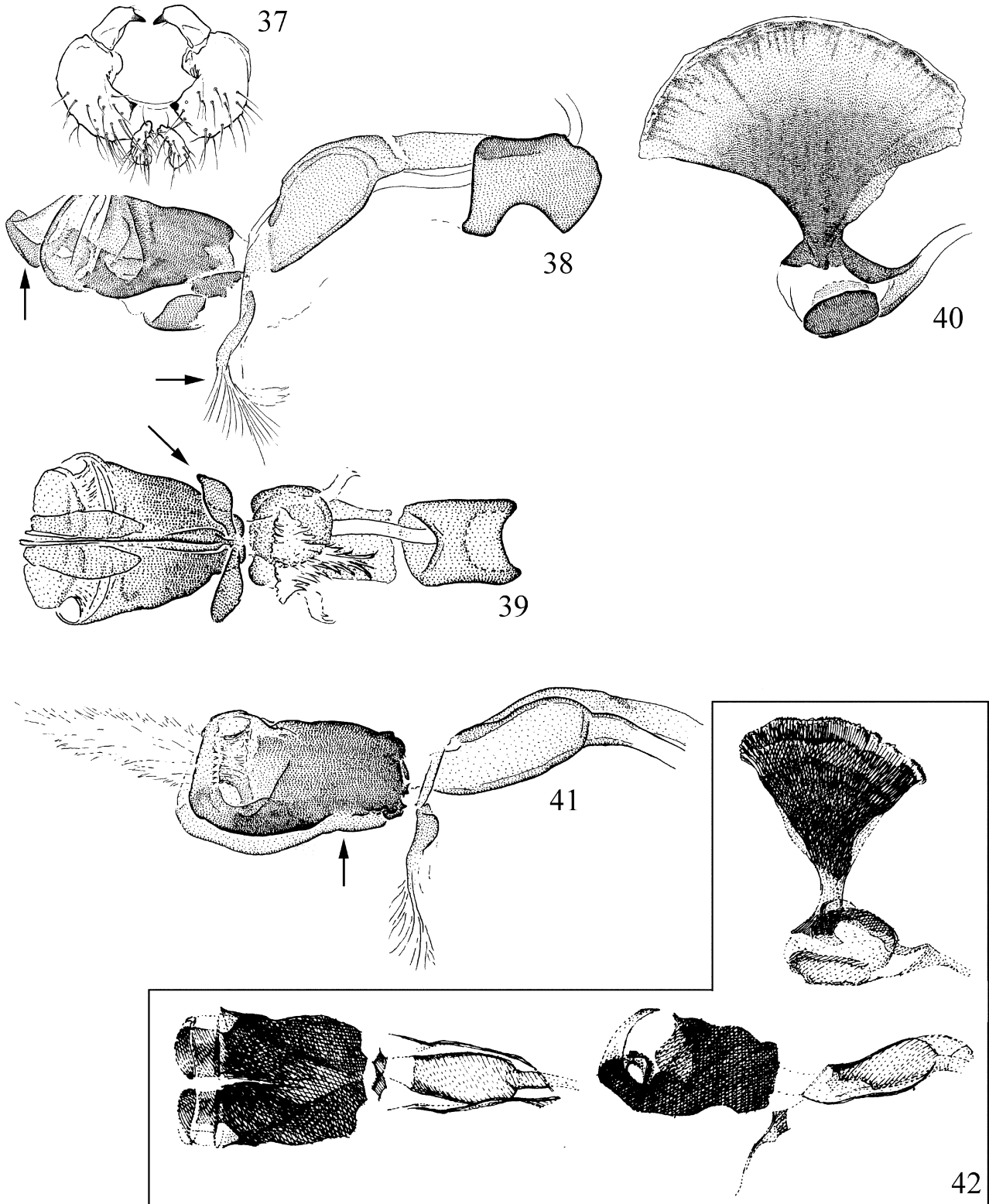
Wing length 1.6-1.9mm (♂), 2.2mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7-2.5. Eye height divided by gena height: 3.2-5.5. Scutum shining. Parafacial and orbital plate slightly projecting.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Base colour of head varies from light yellow to light brown; back of head, ocellar tubercle, posterolateral corner of frons (encompassing base of both vertical bristles), clypeus, palpus and entire antenna dark brown; lateral margin of frons brown with stripe extending onto parafacial and sometimes encompassing base of fronto-orbitals; face brown; gena dirty to light yellow. Scutum dark with lateral margin yellow presuturally (brown spot on postpronotum relatively large) and region above wing base yellowish; laterotergites dark. Pleuron dark with posterodorsal margin of katapisternum yellowish. Legs dark brown with apex of fore femur sometimes yellowish and if so, then apex of mid and hind femora also sometimes yellowish. Abdomen dark brown.

Genitalia: Figs 37-40. Surstylus with single subapical spine. Paraphallus possibly homologous with one pair of transverse petal-shaped lobes that are fused medially to each other and distiphallus. Hypophallus prominent with

long hairs along medial and apical margins. Mesophallus not evident. Distiphallus large, slightly tapering basally (seen ventrally), with one pair of thin elongate-oval apicoventral plates and one pair of small fringed structures in distal chamber. Ejaculatory apodeme with *pileus ejaculatorius* dark; stem nearly absent; base very broad and asymmetrical; blade large and dark, becoming paler apically excluding dark marginal stripe; base of duct dark.



FIGURES 37–42. Figs 37–40: *Liriomyza baptisiae* (Frost), male genitalia; 37: external components, ventral; 38: phallus, left lateral; 39: phallus, ventral; 40: ejaculatory apodeme. Figs 41–42: *L. bellissima* (Spencer), male holotype genitalia; 41: phallus, left lateral; 42: phallus, ventral and left lateral, and ejaculatory apodeme, from original figures in Spencer (1981).

Hosts. Fabaceae—*Baptisia tinctoria*, *Lupinus pratensis*, *L. latifolius*, *L. laxiflorus*, *Lupinus* sp.

Range. **Canada.** Alberta, British Columbia, Saskatchewan. **USA.** California [Alpine, Del Norte*, El Dorado, Humboldt*, Mono*, Monterey*, Santa Cruz, Siskiyou*, Ventura*], Colorado, Montana, Pennsylvania, Washington*.

Type material. Holotype, **USA. Pennsylvania:** Arendtsville, 1.viii.1927, S.W. Frost, *Baptisa tinctoria*. Type No. 62962 (1♂, USNM).

Additional material examined. **USA. California: Del Norte Co.,** Darlingtonia Trail, Six Rivers Natl. For., 41°51'00"N, 123°54'27", 192m, S.D. Gaimari, 2.vi.2009, ex. trail by *Darlingtonia* bog (1♂, CSCA), Six Rivers NF Route 16N02, nr. Bear Basin Outlk, 41.8016°N, 123.7369°W, 1500m, 3.vi–24.vii.2009, P. Kerr & O. Lonsdale (1♂, CSCA), **El Dorado Co.,** Pollock Pines, 14.vii.1948, ex. larva *Lupinus latifolius* Agardh., Lot No. 79-4, K.E. Frick (1♂, CASC), **Humboldt Co.,** Shivley, 4.ii.1968, B.P. Bliven (1♀, CASC), **Mono Co.,** Toms Place, Rock Creek Campground, 2195m, 4–5.vii.1967, P.H. Arnaud, Jr. (1♂, CASC), **Monterey Co.,** Los Padres Nat. For., Antonio R. below Escondido, 22.v.1977, D.D. Wilder (1♀, CASC), **Siskiyou Co.,** Bear Basin, 8000', 9.viii.1967, L. Eighme (1♀, CASC), **Ventura Co.,** Wagon Road No. 2 Campground, spring, 18 air mi WSW Gorman ca. 1585m, 5.vii.1968, P.H. Arnaud, Jr. (1♂, CASC), **Washington:** 15mi W of Kettle Falls, 14.vii.1960, W.F. Rapp (1♂, CSCA), Mt. Rainier, Ararat Mt., 7.viii.1922, A.L. Melander (1♂, USNM), Mt. Rainier, A.L. Melander, 14.viii.1940 (1♂, USNM), 7.viii.192[?](1♂, USNM), viii.1917 (1♀, USNM).

Comments. The EMEC female from Marin Co. mentioned by Spencer (1981) has been tentatively identified as *Liriomyza paumensis*.

Liriomyza bella Spencer

Figs 43–46

Liriomyza bella Spencer 1981: 219. Spencer & Steyskal 1986: 112.

Wing length 1.5–1.8mm (♂), 1.9–2.0mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.9–2.0. Eye height divided by gena height: 2.9–3.0. Scutum with grey pruinosity visible on dark regions. Parafacial and orbital plate projecting.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in two rows.

Colouration: Calypter margin and hairs grey. Head entirely light yellow with ocellar tubercle brown centrally and face whitish. Scutum yellow with dark anteromedial stripe (exceeding midpoint of scutum) fused to lateromedial stripes (sometimes only partially), and with one pair of thin posterolateral stripes; scutellum yellow with lateral corner brown; katatergite yellow; anatergite dark below scutellum and paler lateral to scutellum with dorsum yellow. Pleuron yellow with thin anteromedial spot on anepimeron, faded anteroventral spot on anepisternum (absent in holotype), ventral half of meron brown, and ventral half of katepisternum brown with posterior margin and region around bristle pale. Legs light yellow with tarsi sometimes brownish, becoming darker apically. Abdomen predominantly pale yellow; male with one pair of small medial spots on tergite 1, one pair of wider anterior spots on tergites 2–5 (sometimes connected or only separated by thin yellow line), a single anteromedial spot on tergite 6, and epandrium brown with dorsum and perianal region yellow; female abdomen only with oviscape dark brown, but non-type females with one pair of thin posterolateral spots on tergite 1 and one pair of small spots on tergite 6.

Genitalia: Figs 43–46. Surstylus narrow, setose and truncated apically, with small posterobasal lobe and one subapical spine. Paraphallus relatively long and thin. Hypophallus ill-defined and with several apical hairs. Mesophallus short, barely longer than wide and fused to distiphallus. Distiphallus elongate, with clear apical tubules approximately twice length of remainder of phallus, not much wider than mesophallus at base, and with thin ventrobasal “collar”. Ejaculatory apodeme dark with *pileus ejaculatorius* darker laterally, stem short and blade becoming lighter apically excluding dark marginal striations.

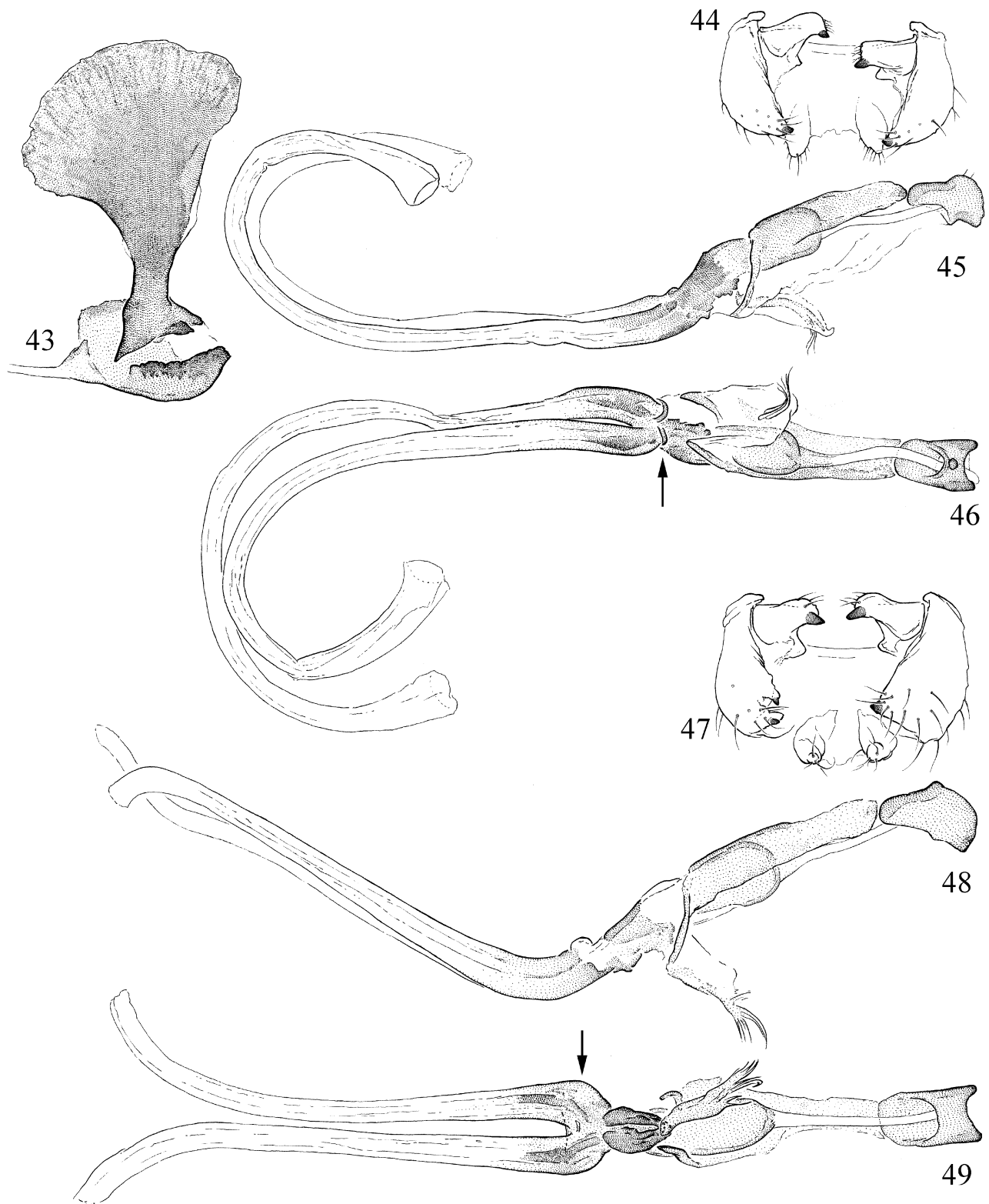
Host. Unknown.

Range. **USA.** California [Del Norte*, El Dorado, Mendocino, Mono, Stanislaus], Colorado.

Type material. Holotype, **USA. California: Mono Co.,** 7mi E of Tioga Pass, 15.vii.1961, G.I. Stage (1♂, CASC). Paratypes examined, **USA. California: El Dorado Co.,** Summit Luther Pass, 6.viii.1948, sweeping, Lot

No. 102-3, K.E. Frick (2♀, CASC), Echo Lake, 23.vii.1955, E.I. Schlinger (3♀ 5♂, UCD), Mono Co., 7mi E Tioga Pass, 15.vii.1961, G.I. Stage (4♂ 3♀, EMEC).

Additional material examined. USA. California: Del Norte Co., Darlingtonia Trail, Six Rivers Natl. For., 41°51'00"N, 123°54'27", 192m, S.D. Gaimari, 2.vi.2009, ex. trail by *Darlingtonia* bog (13♂ 11♀, CSCA).



FIGURES 43–49. Figs 43–46: *Liriomyza bella* Spencer, male genitalia; 43: ejaculatory apodeme; 44: external components, ventral; 45: phallus, left lateral; 46: phallus, ventral. Figs 47–49: *L. parabella spec. nov.*, male holotype genitalia; 47: external components, ventral; 48: phallus, left lateral; 49: phallus, ventral.

Comments. The CSCA paratype of this species is here treated as *Liriomyza admiranda*, which can be distinguished from *L. bella* by the characters listed in the above key. The brown spots on the otherwise pale abdomen further differentiate most material of this species from the otherwise similar *Phytoliriomyza melampyga*, but some specimens (including the type series) have an entirely yellow abdomen, necessitating male dissections for confident identification.

Liriomyza bellissima (Spencer)

Figs 41, 42

Metopomyza bellissima Spencer 1969: 196.

Liriomyza bellissima. Spencer 1981: 221; Spencer & Steyskal 1986: 115.

Wing length 2.0mm (♂), 2.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7–2.0. Eye height divided by gena height: 2.6–3.9. Scutum subshining. Parafacial and orbital plate projecting.

Chaetotaxy: Two or three ori (sometimes also with one or two well developed orbital setulae), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. Head yellow with ocellar tubercle, antenna, clypeus, ventral margin of gena, palpus, face and posterolateral and lateral regions of frons (enclosing base of fronto-orbitals) dark brown. Scutum dark with lateral margin yellow presuturally and brown above wing base; katatergite and posterodorsal margin of anepisternum lateral to scutellum yellowish. Pleuron, legs and abdomen dark brown.

Genitalia: Figs 41, 42. Surstylus with single subapical spine. Epandrium without spine. Paraphallus absent. Hypophallus with bulbous base and numerous long medial and apical hairs. Mesophallus not evident. Distiphallus dark, large, thick (length nearly twice width), and with shallow apical chamber enclosing one pair of short fringed structures; apex with very faint membranous, haired extension. Ejaculatory apodeme large and dark, with stem paler and blade with several annulations.

Host. Unknown.

Range. **USA.** California [Fresno*, Nevada, San Francisco], Washington*. **Canada.** British Columbia.

Type material. Holotype, **CANADA. British Columbia:** Atlin, 2200', 23.vi.1955, H. Huckel (1♂, CNC).

Additional material examined. **CANADA. British Columbia:** 3mi NE of Telegraph Creek, 1.vii.1960, R.J. Pilfrey, "Lir. lupini, K.A. Spencer det. 1967", paratype [1♂, CNC], Robson, "11.v.194", H.R. Foxlee, "Lir. lupini, K.A. Spencer det. 1967", paratype [1♀, CNC], 3.viii.1947 [1♀, CNC], 13.vi.1948 [1♀, CNC]. **USA. California:** **Fresno:** Shaver Lake, 23.vii.1968, J.B. Hoy (1♀, EMEC), **Nevada Co.,** Sagehen Crk., 7.vii.1976, P.F. Smith (1♀, UCD), **San Francisco,** 21.v.1952, C.E. Kaufeldt, in cop. (1♂ 1♀ [same pin], CASC), **Washington:** Glacier Park, S Marys Lake, 21.vii.1935, A.L. Melander (1♀, USNM).

Comments. *Liriomyza bellissima* is a large, distinct species with dark legs and a predominantly dark head. The thorax is also entirely dark excluding the yellow notopleuron and the mostly yellow scutellum and postpronotum. The shape and dimensions of the phallus, in addition to the dark somatic colouration, reveal a close relationship with *L. baptisiae*.

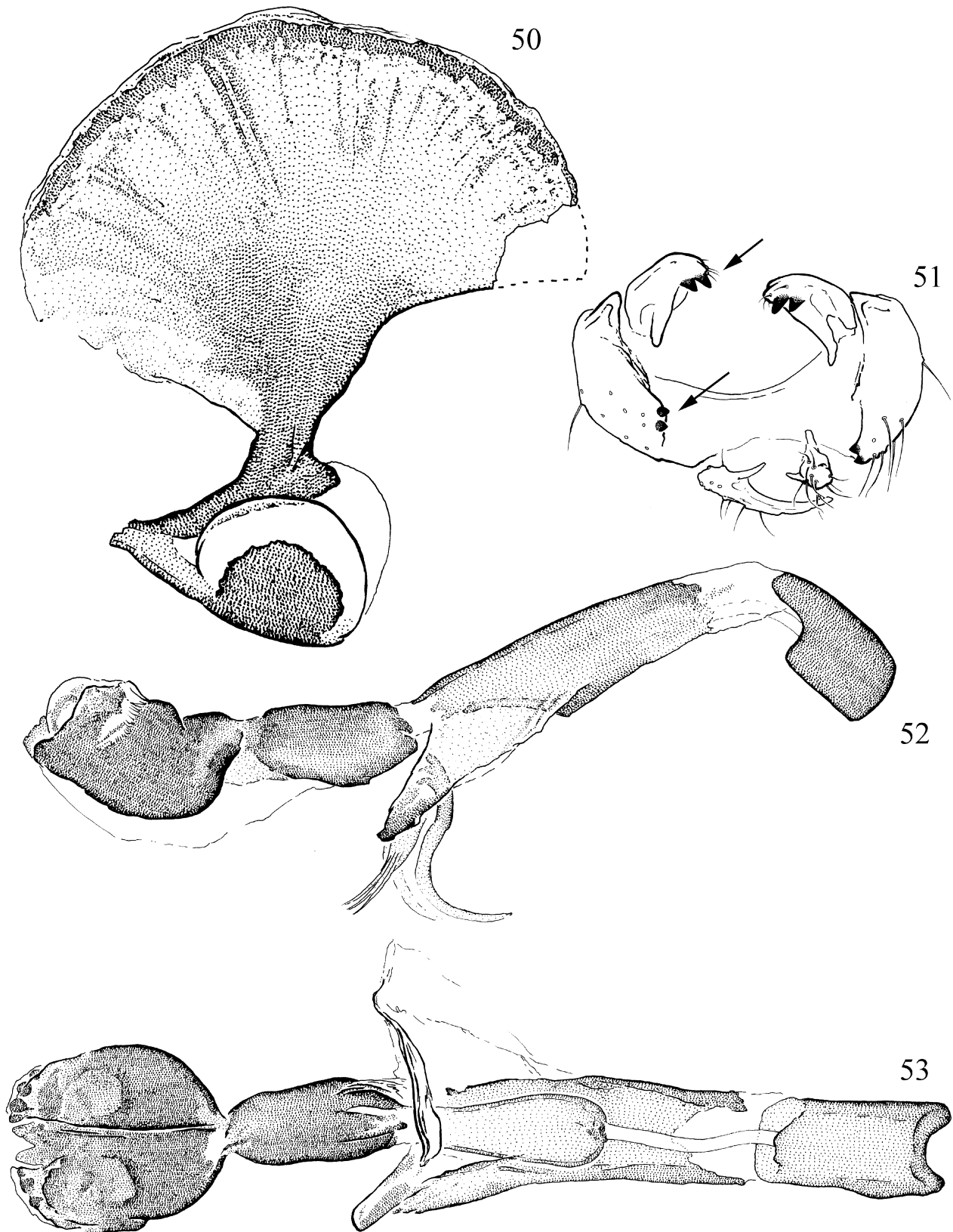
Liriomyza bispinula spec. nov.

Figs 50–53

Wing length 1.5mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.7. Eye height divided by gena height: 2.6. Scutum subshining. Orbital plate, parafacial and cheek slightly pronounced. Vein M₁ not reaching wing margin.

Chaetotaxy: Two ori, one ors (possibly two—head damaged). Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. Head dark brown with gena (excluding dark ventral stripe) yellowish-white, orbital plate with thin light yellow line along inner margin, and centre of frons yellowish on posterior half. Thorax dark brown with scutellum yellow medially and notopleuron yellowish. Legs and abdomen dark brown.



FIGURES 50–53. *Liriomyza bispinula* **spec. nov.**, male holotype genitalia; 50: ejaculatory apodeme; 51: external components, ventral; 52: phallus, left lateral; 53: phallus, ventral.

Genitalia: Figs 50–53. Surstylus with two subapical spines. Epandrium with two small spines. Basiphallus with apical margin produced as membranous lobe on each side that is apically dark. Paraphallus absent. Hypophal-

lus with broad membranous base and several apical hairs. Mesophallus dark, cylindrical and partially fused to distiphallus, with length twice width and ends narrowed. Distiphallus with broadly rounded base, slight dorsoventral compression, several marginal sclerotized spots ventrally, a broad, deep apical depression and one pair of internal fringed structures. Ejaculatory apodeme with *pileus ejaculatorius* dark and rounded at ends; base of duct dark; stem short and blade very large, relatively pale and asymmetric with margin dark and distal half with longitudinal striations.

Etymology. The specific epithet is derived from the Latin for “two small spines”, referring to the two spines on the surstylus and epandrium, which is unusual for this genus.

Host. Unknown.

Range. USA. California [Del Norte].

Type material. Holotype, **USA. California: Del Norte Co.**, 1.6km up Knopki-Creek Rd. off US Rte 199, Six Rivers Natl. For., 41°55'26"N, 123°44'48"W, 430m, 3.vi.2009, S.D. Gaimari (1♂, CSCA).

Comments. This species is easily characterized by a dark head, legs and thorax. The male terminalia are also diagnostic in that the surstylus and epandrium both have two pairs of spines, the paraphalli are absent, both lateral margins of the basiphallus are produced as apically pigmented lobes, the mesophallus is dark and cylindrical, the distiphallus is dark and subovate in ventral view, and the ejaculatory apodeme has a very short stem and a broad blade that is only dark marginally. *Liriomyza bispinula* is morphologically similar to the dark *L. solanita* Spencer, which was reared from *Solanum*, *Physalis*, *Brugmansia* and *Datura* (Solanaceae) in Venezuela and Colombia (Spencer 1963b, 1984), but this tropical species is much larger (wing length 2.2–2.5mm), the thorax has more yellow patches, the surstylus has a single spine and the distiphallus is longer and more extensively fused to the mesophallus.

Liriomyza brassicae (Riley)

Figs 54–68

Phytomyza diminuta. *Nomen dubium*. Walker 1858: 233. Syn. Frick (1952b).

Oscinis brassicae Riley 1885: 322.

Agromyza pascuum Meigen 1830. Misidentification. Melander 1913: 258; Frick 1952a: 402.

Liriomyza cruciferarum Hering 1927: 461. Syn. Frick (1952b).

Liriomyza brassicae. Frick 1952a: 402, 1957: 68, 1959: 402; Spencer 1959: 309, 1963a: 332, 1963b: 356, 1969: 170; Spencer & Steyskal 1986: 127; Deeming 2006: 409; Gil-Ortiz *et al.* 2008: 573, Palacios *et al.* 2008: 12.

Agromyza diminuta Walker. Misidentification, in part. Coquillett 1898: 78.

Phytomyza mitis Curran 1931: 97. Frick 1952a: 427, 1959: 402. Syn. Spencer (1967[?]) [not explicit].

Liriomyza hawaiiensis Frick 1952b: 513. Syn. Spencer (1963b).

Liriomyza bulnesiae Spencer 1963b: 360. Syn. Spencer & Stegmaier (1973).

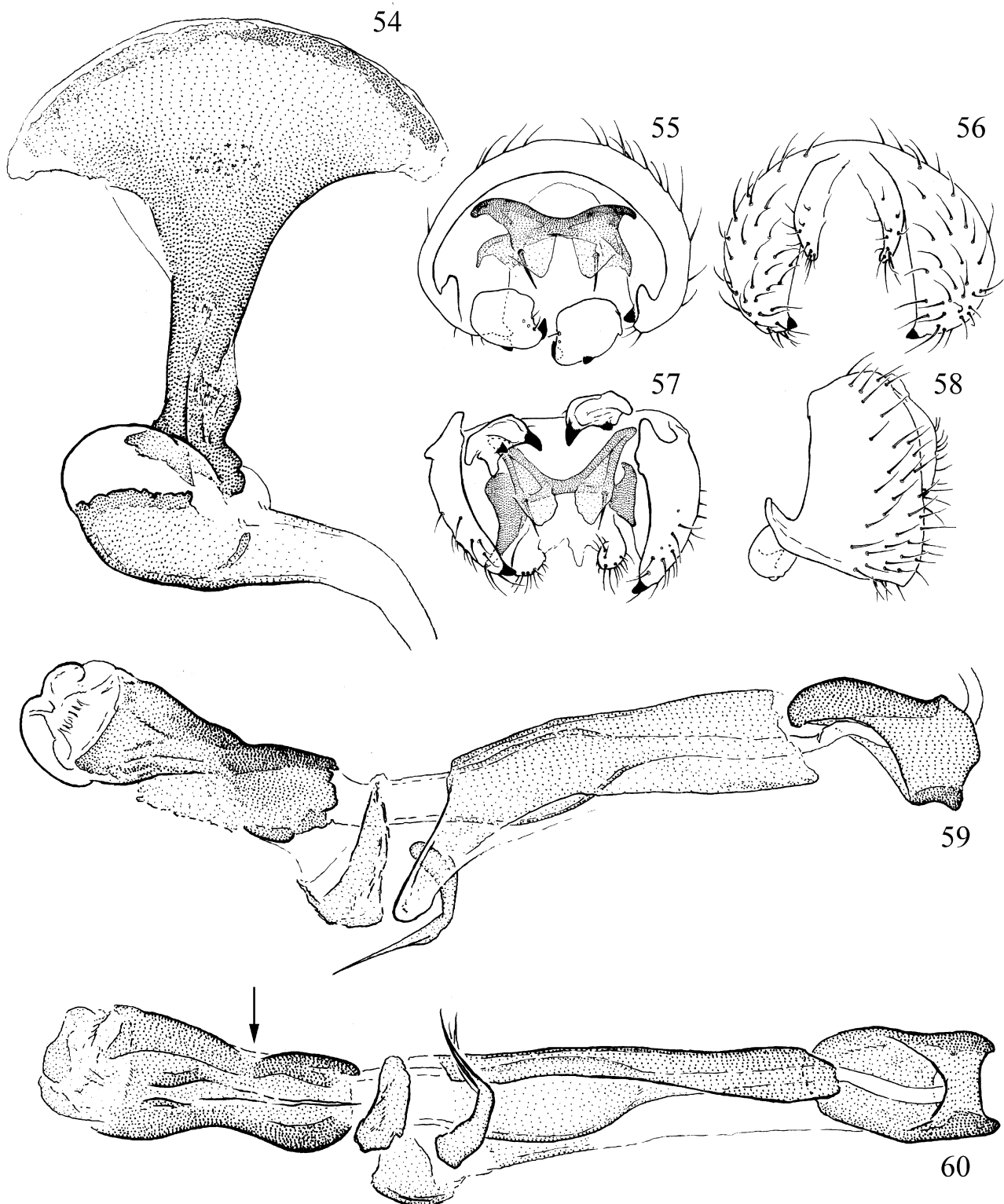
Liriomyza ornephila Garg 1971: 241. Syn. Sasakawa (1977).

Description. Wing length 1.2–1.6mm (♂), 1.7–1.8mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.5–3.5. Eye height divided by gena height: 2.9–5.0. Scutum shining.

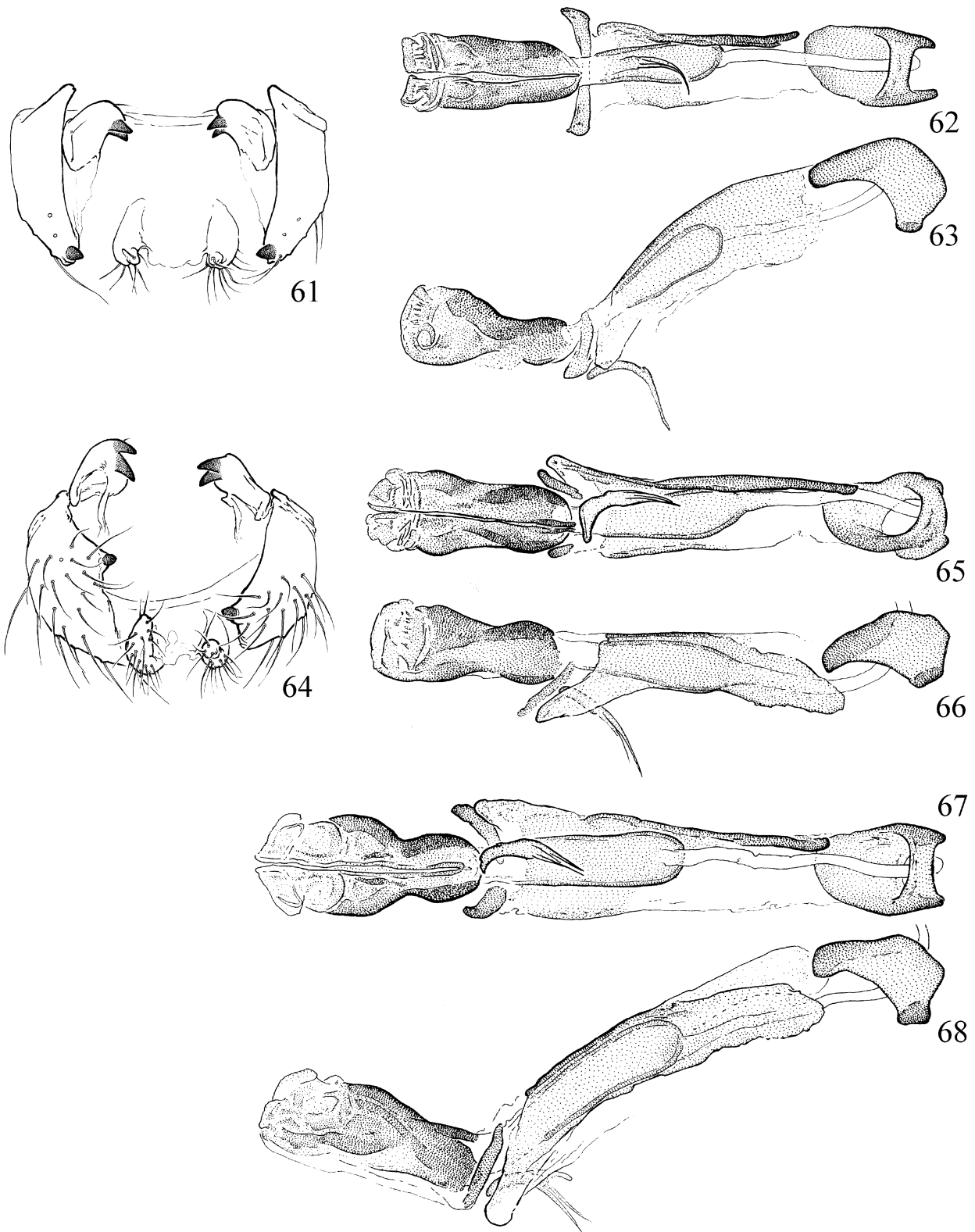
Chaetotaxy: Two or three (rare) ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Lateral margin of frons sometimes with thin brown margin, varying in strength from indistinct (common) to reaching base of fronto-orbitals (rare); posterolateral corner of frons brown to base of inner or outer vertical bristles, sometimes light brown between base of bristles; remainder of head light yellow with back of head and ocellar triangle brown. Scutum with complete lateral yellow stripe; katatergite yellow with posteroventral margin brown; anatergite light brown lateral to scutellum with dorsum yellow and dark below scutellum. Anepisternum usually with most of ventral margin brown, although sometimes also with posterior margin broadly pigmented or only with small anteroventral spot; anepimeron mottled; meron brown with dorsal 1/3 yellow; katepisternum with large brown triangular spot (not enclosing bristle). Legs yellow with tibiae, tarsi and base of fore coxa brown (lighter on fore and mid legs, particularly towards apex); sometimes base of femora (often only dorsally) and scraper on hind femur brown; uncommonly with brown streaking on fore femur, but if present, then lateral margin of frons thinly brown, dark line present between base of vertical bristles, and hind coxa brown. Abdomen brown with lateral and sometimes posterior margin of tergites yellow; tergite 2 sometimes with yellowish mottling, tergites 2–4 sometimes with thin medial dividing yellow line, and tergite 4 often nearly divided

medially into two pairs of connected spots; tergite 5 yellow with large brown medial spot; epandrium with yellow dorsal mottling; some California males with abdomen only faintly brownish dorsally.



FIGURES 54–60. *Liriomyza brassicae* (Riley), genitalia of “typical” male; 54: ejaculatory apodeme; 55: external components, anterior; 56: external components, posterior; 57: external components, ventral; 58: external components, left lateral; 59: phallus, left lateral; 60: phallus, ventral.



FIGURES 61–68. Figs 61–63: *Liriomyza brassicae* (Riley), genitalia of “brassicae 2” male collected on *Foeniculum*; 61: external components, ventral; 62: phallus, ventral; 63: phallus, left lateral. Figs 64–66: *L. brassicae*, genitalia of “brassicae 3” male; 64: external components, ventral; 65: phallus, ventral; 66: phallus, left lateral. Figs 67–68: *L. brassicae*, genitalia of male reared from *Lantana*; 67: phallus, ventral; 68: phallus, left lateral.

Genitalia: Figs 54–60. Surstylus with prominent apical spine and smaller ventromedial spine; less commonly with spines closer and subequal in length. Hypophallus small, thin, curved anteriorly and with few apical hairs.

Paraphallus thin or slightly expanded distally. Distiphallus thin, cylindrical, slightly constricted before midpoint (ie. at point of fusion between distiphallus and mesophallus) and dark with pale apical chamber; distal half sometimes wider, appearing as *Lantana*-reared material discussed below. Ejaculatory apodeme dark and broad, with corners pronounced.

Variation: “Brassicae 2” (Figs 61–63) collected on *Foeniculum vulgare* (Umbelliferae) as adult: wing length 1.5mm (♂); length of ultimate section of vein CuA₁ divided by penultimate section 3.3–3.4; eye height divided by gena height 3.8–4.8; first flagellomere dark yellow with basal margin pale; lateral margin of frons very thinly brownish; posterolateral corner of frons to base of outer vertical bristle and thin line in front of inner vertical brown, and space between vertical bristles light brown; katatergite brown; anepisternum with oblique clavate stripe; base of femora and streaking on fore femur brown; scraper brownish; tibiae and tarsi brown; ejaculatory apodeme slightly thinner; surstylus with two closely-spaced subequal subapical spines; distiphallus nearly parallel-sided in ventral view (slightly wider subapically) and strongly compressed dorsoventrally on basal half.

“Brassicae 3” (Figs 64–66), host unknown: wing length approximately 1.5mm (♂); length of ultimate section of vein CuA₁ divided by penultimate section indeterminate; eye height divided by gena height 4.5; first flagellomere dark yellow with basal and inner-ventral margins paler; face brown; lateral margin of frons to base of fronto-orbitals with faint brownish stripe; posterolateral corner of frons dark to base of outer vertical bristle and brownish to base of inner vertical; dorsal 1/3 of anepisternum yellow with yellowish posterior emargination; katatergite brownish ventrally; coxae brown with apex of fore coxa yellow; base of femora and dorsal mottling brown; tibiae and tarsi brown; surstylus with two subequal subapical spines; paraphallus thin and relatively dark; distiphallus barely constricted medially.

Specimens reared from *Lantana* (Verbenaceae) (Figs 67, 68) and allied material of unknown hosts, differ as follows: wing length 1.5–1.9mm (♂), 1.9mm (♀); length of ultimate section of vein CuA₁ divided by penultimate section 2.6–3.7; eye height divided by gena height 4.2–4.8; dm-cu sometimes incomplete; lateral margin of frons usually yellow, sometimes faintly brownish laterally; posterolateral corner of frons usually only brown to base of outer vertical bristle but sometimes light brown to base of inner vertical; anepisternum sometimes with ventral 2/3 brown; mid and hind femora sometimes brownish dorsoapically and hind femur always at least thinly brown dorso-basally; tibiae sometimes paler on anterior legs, and sometimes with base and apex of fore tibia yellow; abdomen thinly to broadly yellow laterally; epandrium sometimes entirely brown; paraphallus slightly thinner and darker; distiphallus more strongly constricted medially and distal half wider with apical chamber slightly larger.

Hosts. See table 1. Adult collected on *Foeniculum vulgare* (Umbelliferae).

Range. Widespread in Nearctic, Neotropical, Oriental, Afrotropical and Australasian Regions. Europe. Arabian Peninsula. Japan.

Type material. *Oscinis brassicae*: Holotype, **USA. Montana**: St. Louis, 30.iv.1876 (1♀, USNM). *Phytomyza mitis*: Holotype, **CANADA. Manitoba**: Aweme, 20.vii.1929, R.H. Handford (1♀, CNC); Paratypes examined, **Manitoba**: Aweme, 3.ix.1929, R.H. Handford (2♂, CNC). *Liriomyza hawaiiensis*: Holotype, **USA. Hawaii**: Oahu, Honolulu, 1.i.1947, E.C. Zimmerman, ex. leaf of *Cleome* (1♀, BPBM) [Not examined]. *Liriomyza bulnesiae*: Holotype, **VENEZUELA**. Caracas, Botanical Gardens, caught on *Bulnesia arborea* Engl. (Zygophyllaceae), 5.xii.1958, K.A. Spencer (1♂, BMNH) [Not examined]. *Liriomyza ornephila*: Holotype, **INDIA**. Uttar Pradesh, Pithoragarh (1♀, depository not given) [Not examined]. *Liriomyza cruciferarum*: Syntypes, **CANARY ISLANDS**. La Palma: Santa Cruz (2?, ZMHU) [Not examined].

Additional material examined. **USA. California: Alameda Co.**, Berkeley, “Aug. 23/17” (1♂ 1♀, EMEC), Berkeley, “57”, on *Brassica nigra*, W.W. Jones (2♀, EMEC), Berkeley, 17.iii.1954, E. Oatman, Columbine, coll. 3.iii.1954 (1♂, EMEC), **Contra Costa Co.**, Moraga, 21.v.1977, D.G. Denning (1♂, UCD), **El Dorado Co.**, River-ton, 19.viii.1953, E.I. Schlinger (1♂, UCD), Snowline Camp, 2.viii.1943, ex. larva *Brassica arvensis* L., lot No. 70-1, K.E. Frick (1♂ 1♀, EMEC), 2mi N Kelsey, 23.vi.1967, W.J. Turner (1♂, EMEC), **Imperial Co.**, S End Chocolate Mts., Ogilby Rd., 3mi S Jct. Hwy 78, malaise trap, 7AM-5PM, 20–22.iii.1978, Wasbauer, Slansky & Adams (1♂, CSCA), Algodones Dunes, Niland-Glamis Rd., 2.6km n. Hwy 78, 33°00’N, 115°06’W, 7–9.ii.2008, S.L. Heydon & T.J. Zavortink, 80m (1♂, UCD), 85m, on sand dunes (1♂, UCD), 85m, wash below dunes, Malaise (3♂, UCD), Algodones Dunes, Wash Road, 10.4km SE Glamis, 32°55.4’N, 114°59’W, 29.iv–2.v.2008, S.L. Heydon & K. Lorenzen, microphyll forest, Malaise (1♂, UCD), Algodones Dunes, Buttercup Region, 1.6km ESE Gordon’s Well exit & Hwy. 8, 32°45.5’N, 114°57.5’W, 24–28.iii.2008, Bohart Museum Survey Team, MT in Creosote (1♂, UCD), **Inyo Co.**, Mt. Whit. F. Hatchery, 5mi NW Independence, 28–29.viii.1979, M. Wasbauer & P. Adams,

Malaise trap, 8AM–6PM (1♂ 2♀, CSCA), **Los Angeles Co.**, Baldwin Park, 20.viii.1945, J.C. Elmore, “TC639cauliflower” (4♂ 23♀, USNM), Gardena, 7.vi.1948, ex. Cauliflower (1?, UCD), Glendale, 30.vii.1955, E.I. Schlinger (1♂, UCD), **Marin Co.**, Bolinas, 2mi, 5.x.1968, P.A. Rude (1♂, EMEC), **Mendocino Co.**, Ukiah, 8.x.1964, sweeping ground cherry (2♂, UCD), **Modoc Co.**, Willow Rch., 3mi E, 6.vi.1970, *Isatis tinctoria*, P. Opler (1♂, EMEC), **Orange Co.**, Long Beach, 26.v.1951, W.W. Jones (1♂, USNM), El Toro, E.R. Oatman, collected on cabbage, 1.xii.1964 (1♂, UCR), 13.iv.1963 (1♂, UCR), **Riverside Co.**, Riverside, A.L. Melander, 22.ii.1935 (1♂, USNM), Univ. Cal. River campus, 18.x.1978, E.M. Fisher (2♂, CASC), Fullerton, 13.ii.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♂, UCR), Yorba Linda, 30.xii.1968, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♀, UCR), India, 25.iii.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♀, UCR), Riverside, malaise, 20.vi.1971, M.E. Irwin (1♂, UCR), **San Bernardino Co.**, New York Mts., 5400', Keystone Cyn., 4.5mi S Ivanpah, 12.iv.1978, Malaise trap, 8AM–5PM, M. Wasbauer & T. Eichlin (1♂, CSCA), **San Diego Co.**, Borrego-Clark L. N. End, 23.iii.1978, Wasbauer, Slansky & Adams, Malaise trap, 8AM–5PM (2♂, CSCA), Escondido, E.R. Oatman, 9.vii.1964 (1♂, UCR), 20.viii.1964 (1♂, UCR), Jamul, 5.vi.1969, insectary reared on *Ambrosia psilostachys* Decandolle (1♂, UCR), Alpine, 28.ii.1970, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♀, UCR), San Onofre Bluff, 33°21'38"N, 117°32'22"W, 4.ix.1999, Yanega & Gates (1♂, UCR), **Santa Barbara Co.**, Sta. Cruz. Isl., Water Cyn., 400', 17.vi.1967, R.O. Schuster (1♂, UCD), Sta. Cruz Isl., Christi Beach, 29.iv.1969, D.S. Horning, Jr. (1♀, UCD), UC Coal Oil Pt. Reserve, 34.4105°N, 119.8798°W, Malaise, M. Caterino & A. Borrell, 8–22.iv.2003 (3♂, SBMN), Los Prietos, 23.vi.1965, J. Powell (1♂, EMEC), Santa Barbara, 22.iv.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♀, UCR), **Santa Clara Co.**, Stanford U., P.H. Arnaud, Jr., 1.v.1961 (1♂, CASC), Stanford Univ., 9.x.1950, P.H. Arnaud, Jr. (1♂, USNM), San Jose, 15.x.1948, P.H. Arnaud, Jr. (1♂, USNM), Vacaville, 8.vi.1953, E. Mexger (1♂, UCD), **Sonoma Co.**, Healdsburg, 8.x.1964, sweeping Dandelion (1♂ 1♀, UCD), **Ventura Co.**, beach nr. Punta Gorda, 27.viii.1976, P. Rude, on *Franseria* (1♂, EMEC), Fillmore, 3.ii.1970, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♂, UCR), Ventura, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle, 16.iv.1969 (1♀, UCR), 30.vi.1969 (1♀, UCR), Port Hueneme, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle, 5.ii.1970 (1♀, UCR), 15.iv.1969 (1♀, UCR), **Yolo Co.**, Woodland, 28.viii.1953, A.T. McClay (2♀, UCD), Davis, 4.viii.1955, E.I. Schlinger (1♂, UCD), Davis, 23.iv.1966, R.O. Schuster (1♂, UCD), **Montana**: Mineral Co., St. Regis, 770m, 28.viii.1981, P.H. Arnaud, Jr. (1♂, CASC), Columbia, Malaise trap, 7AM–7AM, 18.v.1970, F.D. Parker (1♂, UCD).

Additional material examined, “brassicae 2” [on *Foeniculum*]: USA. California: Solano Co., Cordelia, 24.vii.1959, P.H. Arnaud, Jr., coll. at flowers *Foeniculum vulgare* (L.) Gaertn. (1♂, USNM).

Additional material examined, “brassicae 3”: USA. California: **San Bernardino Co.**, Crestline, 4.vi.1947, A.L. Melander (1♂, USNM).

Additional material examined, *Lantana*-reared material: USA. California: HuntngtnBon[?], “4/6/45”, A.L. Melander (1♂, USNM), **San Luis Obispo Co.**, San Luis Obispo City, on *Lantana* sp., 20.iii.1997 (6♂ 4♀, CSCA), **Riverside**, Riverside, A.L. Melander, 25.v.1942 (1♂, USNM), Riverside, CR Picnic Hill, 30.iv.1997, M. Gates, ex. surface blotch mine on *Lantana camara* (1♂, USNM), Riverside, UCR campus, M. Gates, ex. upper surface blotch mine on *Lantana camara*, 29.iv.1998 (5♀, USNM), 8.v.1998 (1♂ 1♀, USNM).

Comments. The material here recovered from *Lantana* is the second instance of *Liriomyza brassicae* reared from the family Verbenaceae, with Palacios *et al.* (2008) also finding it on *Lantana camera* L. in Mexico. The adult collected on *Foeniculum* is the first instance of this species on Umbelliferae, although rearing should confirm any potential host association. Morphologically, the *Lantana*-reared specimens are most obviously characterized by a slightly larger body size, a very narrow yellow line along the posterior margin of the scutum, a distiphallus that is more strongly constricted medially and wider distally (base only half width of distal section) and vein dm-cu is sometimes incomplete. The *Foeniculum*-collected male is darker overall, there are two closely spaced spines on the surstylus, and the distiphallus is dorsoventrally compressed basally and nearly parallel-sided in ventral view. Although *L. brassicae* is known to be quite polyphagous, these unusual plant associations (at least the confirmed *Lantana* records) in combination with the variant morphology suggest that this species may represent a species complex and/or collection of host races. This possibility is consistent with results from Tavormina (1982) who documented host-associated behavioural differences and strong host-associated selection in *L. brassicae* feeding on three sympatric host plant species.

The only other Agromyzidae known from *Foeniculum* are *Melanagromyza foeniculi* Spencer, *Phytomyza ferulae* Stackelberg and *Ptochomyza czernyi* (Strobl), and the only Agromyzidae known from *Lantana* are *Calycomyza bahamarum* Spencer, *C. lantanae* Frick, *L. trifolii*, *Ophiomyia camarae* Spencer, *O. lantanae* (Froggatt) and *O. legitima* Spencer (Perkins & Swezey 1924, Spencer 1990, Benavent-Corai *et al.* 2005).

In addition to this material, there is one male (“*brassicae* 3”) that also has two subapical spines on the surstylus and a distiphallus that is nearly parallel-sided in ventral view. It is more distinct externally, however, in that the face is brown and the body is slightly darker. The host is unknown. Although there is potentially enough evidence to provide separate specific status to these three atypical groups, it seems preferable to gather additional biological data and material appropriate for molecular analysis before any taxonomic decisions are made, particularly considering the agricultural significance of this species.

In the United States, a similar phallus is found in *Liriomyza baccharidis* and *L. conclavis*, both of which have a predominantly dark pleuron, but the former (also found on Asteraceae) has a dark face and a C-shaped surstylus. The latter has a relatively large first flagellomere, two long, subapical spines on the surstylus and a large, dorsally-directed apical chamber on the distiphallus. In Canada, a similar phallus is found in the *Asclepias* (Asclepiadaceae) feeders *L. asclepiadis* Spencer and *L. peleensis* Spencer, but the former is slightly larger (wing length 1.8–2.2mm), the distiphallus is broader past a strong medial constriction, and the apical chamber is truncated apically and dorsally and is more strongly angled. The latter is much darker with a narrower distiphallus.

***Liriomyza californiensis* Spencer**

Figs 69–71

Liriomyza californiensis Spencer 1981: 225. Spencer & Steyskal 1986: 120.

Wing length 1.3mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.3. Eye height divided by gena height: 4.8. Scutum shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head mostly light yellow with ocellar tubercle, back of head and clypeus dark brown; posterolateral margin of frons to base of outer vertical bristle dark brown, sometimes lighter to base of inner vertical; lateral margin of frons with thin stripe reaching level of anterior ors, sometimes with pigment extending to base of ors; first flagellomere, excluding basal margin, lightly infuscated; ventral margin of gena with brownish stripe. Scutum dark with lateral stripe yellow in front of transverse suture and brown to light brown behind; laterotergites dark with katatergite yellowish medially. Pleuron dark brown with dorsal margin of anepisternum and meron, and dorsomedial margin of katepisternum yellow; dorsal 1/3 of anepisternum, anepimeron, katepisternum and meron yellow in holotype. Legs brown with distoventral surface of femora yellow; mid and hind femora with additional yellow mottling in holotype, and fore femur yellow with base and distal half, excluding apex, brown. Abdomen dark brown.

Genitalia: Figs 69–71. Surstylus lobate with single short subapical spine. Basiphallus extensively sclerotized dorsally with apical membrane truncated and lightly pigmented. Paraphallus subrectangular, wider apically. Hypophallus well developed with darker base and short apical hairs. Mesophallus fused to distiphallus. Length of distiphallus slightly more than three times width at base, strongly narrowed and darkened basally, with complete ventral suture and clear apical chamber (inner surface minutely spinulose in holotype) surrounding paired fringed structures. Ejaculatory apodeme with *pileus ejaculatorius* darker along lateral margins; blade abruptly broader and paler apically, and with dark marginal band.

Hosts. Unknown; adult collected on *Artemisia douglasiana* (Asteraceae).

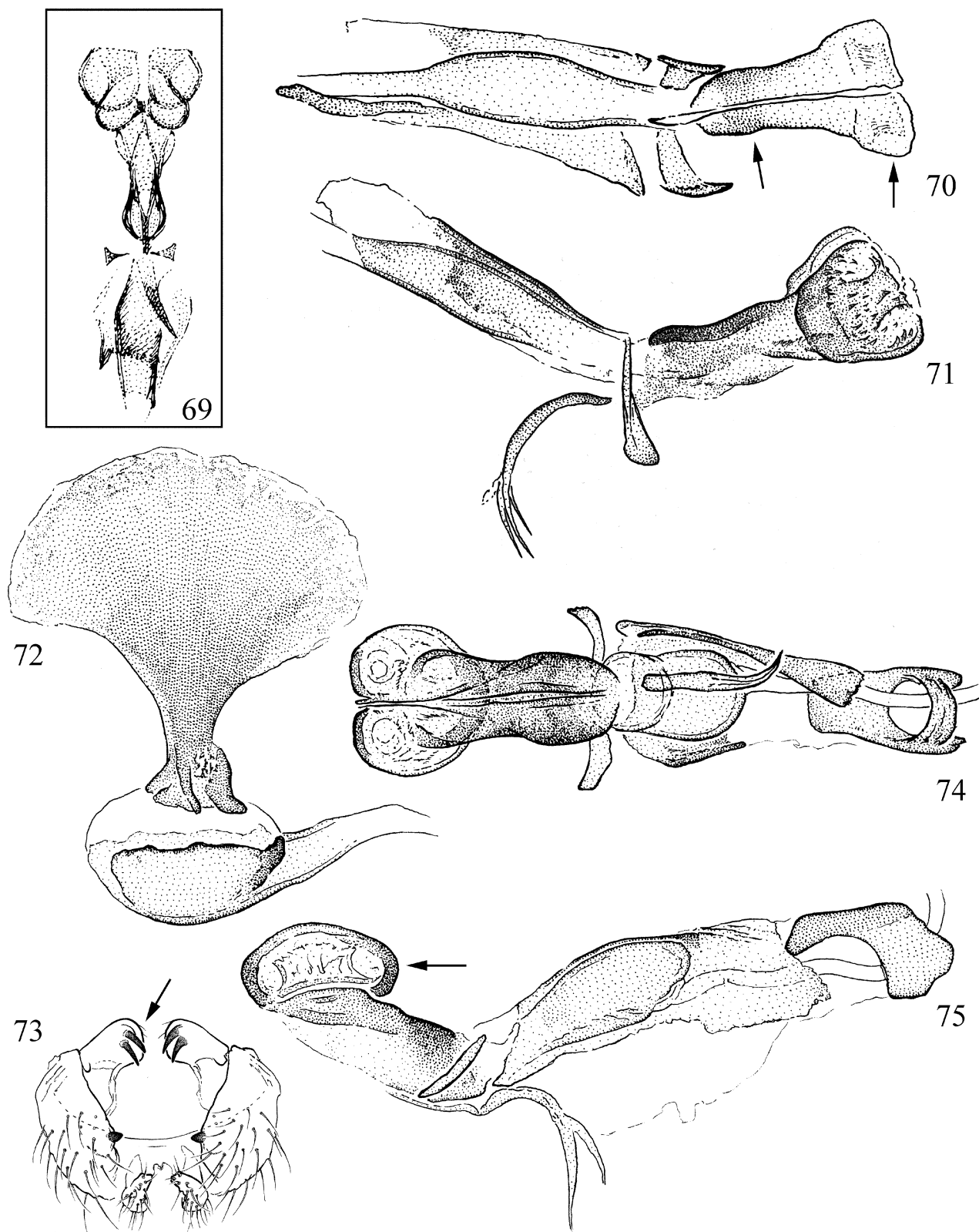
Range. USA. California [Alpine*, Los Angeles, Riverside, San Francisco*].

Type material. Holotype, USA. California: Los Angeles Co., Corral Canyon Rd., near main coastal highway, 27.iii.1977, on *Artemisia douglasiana*, K.A. Spencer (1♂, USNM).

Additional material examined. USA. California: Alpine Co., Hope Valley, 8.viii.1948, sweeping, Lot No. 91–30, K.E. Frick (1♂, CASC), San Francisco Co., San Francisco, 4.iii.1964, P.H. Arnaud, Jr. (1♂, CASC).

Comments. Similar to the more abundant *Liriomyza artemisiae*, *L. californiensis* is relatively dark species with an infuscated orbit (not yellow, as stated in the original description) and first flagellomere, with the base of the flagellomere yellow. The phallus is more similar to that of *L. helianthi*, however, in that the paraphallus is broad

distally, and the distiphallus is narrow basally and expanded apically. The phallus is also nearly identical to that of *L. freidbergi* Spencer, although this species has an entirely black antenna and is known only from Israel (Spencer 1974).

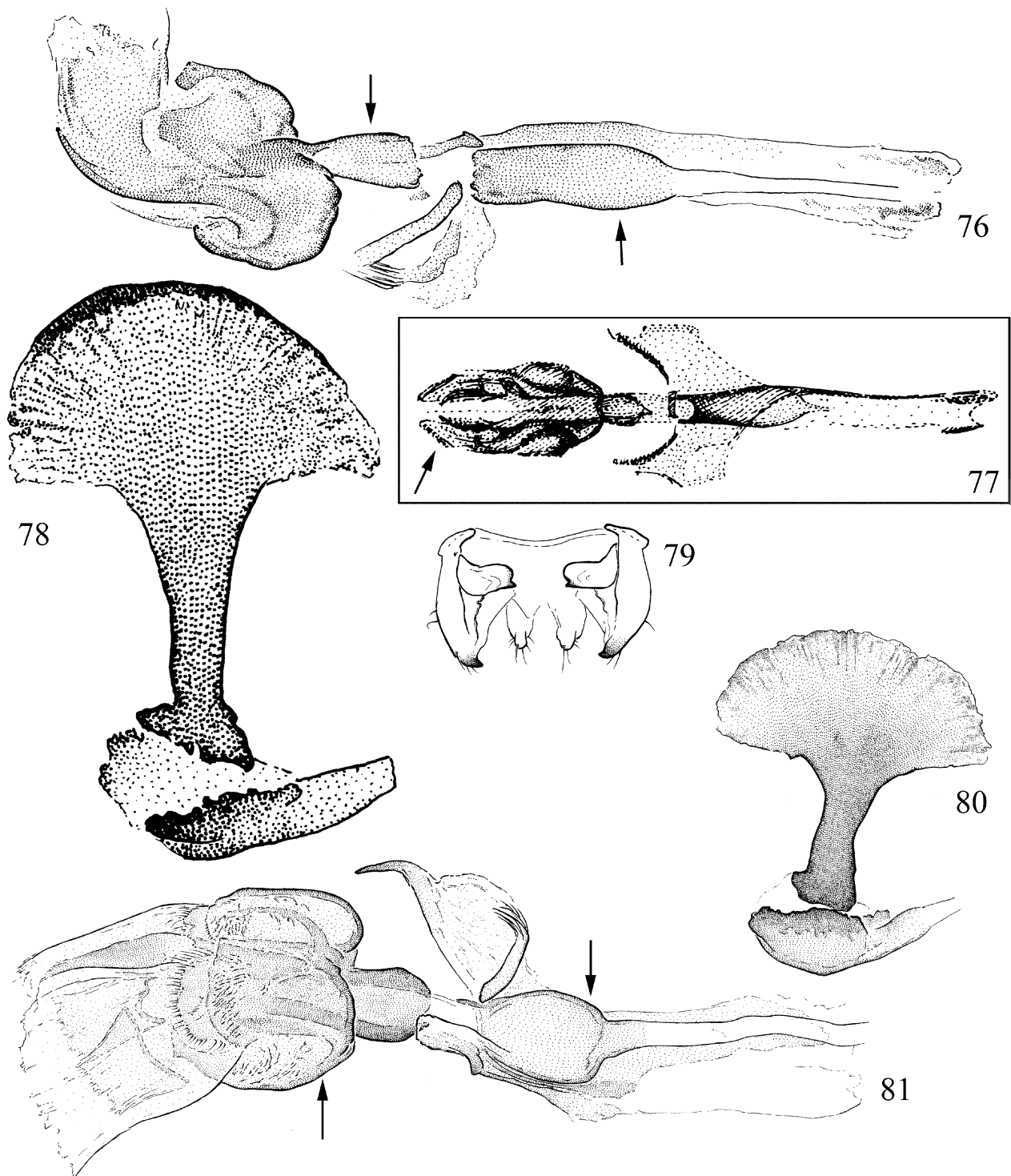


FIGURES 69–75. Figs 69–71: *Liriomyza californiensis* Spencer, male holotype phallus; 69: phallus, ventral, from original figure in Spencer (1981); 70: phallus, ventral, non-type, ventral; 71: phallus, right lateral, holotype. Figs 72–75: *L. conclavis* **spec. nov.**, male holotype genitalia; 72: ejaculatory apodeme; 73: external components, ventral; 74: phallus, ventral; 75: phallus, left lateral.

Liriomyza chemsaki Spencer

Figs 76–79

Liriomyza chemsaki Spencer 1981: 226. Spencer & Steyskal 1986: 133.



FIGURES 76–81. Figs 76–79: *Liriomyza chemsaki* Spencer, male holotype genitalia; 76: phallus, left lateral; 77: phallus, ventral, from original figure in Spencer (1981); 78: ejaculatory apodeme; 79: external components, ventral. Figs 80–81: *L. smilacinae* Spencer (half size relative to *L. chemsaki* illustration); 80: ejaculatory apodeme; 81: phallus, lateroventral.

Wing length 2.1mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1. Eye height divided by gena height: 1.8. Scutum dusted/matt. Parafacial and orbital plate projecting with cheek distinct. Epistoma large.

Chaetotaxy: Three ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with ocellar tubercle, back of head and clypeus dark brown; posterolateral region of frons dark brown to base of outer vertical bristle and light brown to base of inner vertical, and posterodorsal margin of eye dark brown with stripe extending to base of inner vertical. Scutum dark with complete lateral yellow stripe; katatergite yellow and anatergite brown, with section below scutellum darker and section lateral to scutellum yellowish posterodorsally. Pleuron mostly yellow with meron extensively mottled, anepisternum with thick diagonal stripe (tapered posteriorly), ventral 2/3 of meron brown and ventral ¼ of katepisternum (excluding base of bristle) brown. Legs dark brown with distal 1/3 of coxae yellow, tarsi paler to base, and apex, distoventral surface and lateral streaking on femora yellow. Abdomen colour unknown.

Genitalia: Figs 76–79. Surstylus with small subapical spine. Paraphallus long and thin. Hypophallus with short apical hairs. Mesophallus thinner than end of ejaculatory duct, narrowing apically and fused to distiphallus. Distiphallus with broad bowl-like base and with one pair of weakly-sclerotized, elongate, posteriorly-curved apical projections. Ejaculatory apodeme with relatively long, narrow stem and semi-circular blade; *pileus ejaculatorius* heavily-sclerotized and irregular laterally; base of duct sclerotized.

Host. Unknown.

Range. USA. California [Trinity].

Type material. Holotype, USA. California: Trinity Co., Buttercreek Meadow, 21.v.1973, flight trap, J.A. Chemsak, Type No. 14060 (1♂, CASC).

Comments. *Liriomyza chemsaki* is diagnosed by predominantly dark legs, a matt scutum, a mostly pale anepisternum, and an unusual head with a relatively high gena, a large epistoma, a projecting parafacial and orbital plate, and five pairs of fronto-orbitals. The phallus is unusual, similar to that of the cloudy-winged *L. nebulosa*, but much shorter.

***Liriomyza conclavis* spec. nov.**

Figs 72–75

Wing length 1.7mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 3.2. Eye height divided by gena height: 5.6. Scutum subshining. First flagellomere relatively large and quadrate, highest subapically.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Back of head, posterolateral corner of frons (broadly enclosing vertical bristles), ocellar triangle and lateral margin of frons (encompassing ors) dark brown; centre of face faintly brown; venter of gena with light brown stripe; first flagellomere infuscated with basal margin yellow on outer face and basal 1/3 yellow on inner face. Lateral yellow stripe on scutum with brown postsutural mottling. Laterotergites brown with katatergite and dorsal region lateral to scutellum paler. Dorsal ¼ of anepisternum with irregular yellow stripe; anepimeron dark brown with limited yellowish mottling; meron brown with dorsal margin yellow; katepisternum dark brown with posterodorsal margin (excluding corner) yellow. Basal half of fore coxa brown, basal half of mid coxa brown with ventral half mottled, and mid coxa brown; femora mostly yellow with base, broad outer stripe on fore femur (fading distally) and scraper brown; tibiae and tarsi brown with base of fore tibia yellow. Abdomen brown with lateral margin yellow (broadly yellow on tergite 5).

Genitalia: Figs 72–75. Surstylus with two long subapical spines. Swollen apical section ejaculatory duct with subbasal attachment thinner section. Paraphallus thin. Hypophallus long and thin. Distiphallus dark, barrel-shaped in ventral view for most of length, with complete ventral suture and slight medial constriction; venter weakly sclerotized; apical chamber broad, dorsally angled, thick-walled and enclosing paired fringed structures. Ejaculatory apodeme with *pileus ejaculatorius* broad and truncated at ends with apical and basal margins darker; stem short and blade pale and broadly rounded.

Etymology. The specific name is derived from the Latin for “conclave / closed room”, referring to the thick-walled chamber at the apex of the phallus.

Host. Unknown.

Range. USA. California [San Bernardino].

Type material. Holotype, **USA. California: San Bernardino Co.**, Providence Mts., Gilroy Cyn., 4500', 30.iii.1984, J.D. Pinto, UCRC ENT 235245 (1♂, UCR).

Comments. The phallus of *Liriomyza subasclepiadis* Spencer (host: *Asclepias speciosa*) from Washington state is similar to that of *L. conclavis*, although the paraphallus is longer and curved apically, the apical chamber of the distiphallus is longer and the blade of the ejaculatory apodeme is small. The eye is also three times the height of the gena, the length of the ultimate section of vein CuA₁ divided by the penultimate section is 2.0–2.5, and most importantly, the orbital plate is entirely yellow and the first flagellomere is small, ovate and entirely yellow. The phallus of the Canadian *L. asclepiadis* Spencer (host: *Asclepias* spp.) is also similar in that the distiphallus is dark and barrel-shaped with a large apical chamber, but the distiphallus is broader past a stronger medial constriction, and the apical chamber is more angulate in outline and more strongly angled dorsally. Furthermore, the first flagellomere of this species is small, pale and rounded, the inner vertical bristle is on the border of the brown posterolateral region of the frons (not broadly enclosed), the femora are entirely yellow and the tibiae and tarsi are paler. The terminalia of *L. venegasiae* are also similar, but the distiphallus of this species is larger and directed distally (not apically), the mesophallus is distinct, and the antenna, orbital plate and thorax are paler.

The new species is also similar to the European taxa *L. approximata* (Hendel), which differs as follows: palpus dark; centre of frons darker; “jowls” brown; first flagellomere small and round; mesonotum matt; scutellum entirely dark with centre yellowish; pleuron and legs entirely dark; distiphallus longer. *Liriomyza valerianae* is also similar, but differs in having no paraphallus, a basal attachment to the swollen apical section of the ejaculatory duct, and a broader, darker distiphallus that is directed apically (not angled dorsally). The host of *L. approximata* is *Daphne mezereum* (Thymelaeaceae), and those of *L. valerianae* are *Valeriana*, *Centhranthus* and *Valerianella* (Valerianaceae) (Benavent-Corai *et al.*, 2005).

***Liriomyza cunicularia* spec. nov.**

Figs 148–151

Wing length 1.5mm (♂), 1.6–1.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.6–3.2. Eye height divided by gena height: 3.3–3.4. Scutum dusted with light pruinosity.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brownish-grey. Head light yellow with first flagellomere yellow, clypeus yellow to light brown, pale spot present on posterior margin of frons lateral to outer vertical bristle, and ocellar tubercle and back of head brown. Scutum dark with complete lateral yellow stripe broadly overlapping yellow stripe on scutellum; katatergite yellow; anatergite dark below scutellum and yellow lateral to scutellum with venter brownish. Anepisternum with small brown anteroventral spot; anepimeron with small anteromedial stripe; meron with posteroventral spot; katepisternum with large triangular spot on ventral half. Legs light yellow with coxae thinly brown basally, femora faintly brown dorsobasally (and sometimes brownish dorsoapically), and tibiae and tarsi light brown to brown with tarsi becoming paler to base. Abdomen brown dorsally (stripe narrowing posteriorly) with posterior margin of tergites yellow; dorsal stripe interrupted bedially by thin yellow line on tergites 2–4 (5 in females); dorsal surface of epandrium and perianal region yellow.

Genitalia: Figs 148–151. Surstylus with one subapical spine. Paraphallus thin and basally fused to basiphallus. Hypophallus with broad membranous base and long apical hairs. Mesophallus short, fused to distiphallus and with wide ventral suture. Distiphallus damaged with most of paired distal tubules missing; large, stout and bifid with basal section broad and heavily-sclerotized. Ejaculatory apodeme with *pileus ejaculatorius* broad and with ends truncated and dark; stem short, blending into broad blade with dark margin.

Etymology. The specific epithet is derived from the Latin for “miner”, referring to the life history of this species.

Host. Solanaceae—*Capsicum* sp.[?] (“Pepper”).

Range. USA. California [Orange].

Type material. Holotype, **USA. California: Orange Co.**, Talbert, “9/6/28”, A.C.[?] Davis, mining in pepper leaves, no. 6 (1♂, USNM). Paratypes, **USA. California: Orange Co.**, same collection as holotype (3♀, USNM; 1♀, CSCA).

Comments. *Liriomyza cunicularia* is a small pale species similar in appearance to *L. trifolii*, having a lightly dusted scutum and no pigment around the base of the vertical bristles. Although the terminalia of the only known male is partially destroyed, the phallus is clearly unique—the mesophallus is small, dark and thin with a wide ventral suture, and the distiphallus is very large, dark and strongly bifid with no surrounding basal bowl. The basal bowl of the distiphallus is also missing in *L. bella* and *L. parabella*, but the phallus is much less robust and the calypter is entirely pale. *Liriomyza flavonigra* (Coquillett) (from description in Spencer & Steyskal (1986)) from Utah and New Mexico also lacks a basal collar on the distiphallus, but the gena of this species is approximately half the height of the eye, the scutum is narrowly yellow in front of the scutellum, the calypter is entirely white, the wing length varies from 2.3–2.8 or 3.0mm and there are three ori. Of these three species, host data is known only for *L. cunicularia*, which was collected “mining in pepper leaves”. *Liriomyza trifolii* is most commonly encountered mining in pepper.

Liriomyza denudata Spencer

Figs 82–84

Liriomyza denudata Spencer 1981: 226. Spencer & Steyskal 1986: 120.

Wing length 1.5mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 3.0. Eye height divided by gena height: 3.0. Scutum dusted with pruinosity, with shiny stripe along dorsocentral row in holotype.

Chaetotaxy: One ori, two ors. Acrostichal setulae entirely absent.

Colouration: Calypter margin and hairs grey. Head light yellow with clypeus and ocellar tubercle dark brown, first flagellomere yellow (paratype) or brownish (holotype) with basal margin paler, and ventral margin of gena with faint brownish stripe (becoming darker posteriorly); posterolateral corner of frons brownish to base of outer vertical bristle (sometimes also with thin brownish extensions from eye margin to base of inner vertical and ors). Scutum yellow laterally, with region behind wing base brownish/mottled; katatergite yellow, but slightly brownish on anterior margin; anatergite dark below scutellum and paler lateral to scutellum with posterodorsal corner yellow. Anepimeron largely brown, anepisternum with extensive brown mottling (mostly yellow in posterodorsal corner), ventral 2/3 of meron dark, and ventral 3/4 of katepisternum brown (bristle bordering pigment). Legs yellow with tibiae, tarsi, and base of coxae and femora brown; femora also with dorsal mottling at 2/3 length, but pigment only distinct on fore femur, which also has additional dorsal streaking. Abdomen colour unknown.

Genitalia: Figs 82–84. Surstylus and with single subapical spine. Basiphallus with thick lateromedial ridge. Paraphallus absent. Hypophallus membranous and atrophied. Mesophallus pale, slightly longer than wide and only fused to distiphallus dorsally. Distiphallus approximately as long as mesophallus plus swollen section of ejaculatory duct; bifid with tubules membranous distally and lightly sclerotized basally; basal section with toothed dorsal plate and one pair of small, pale, basally-directed ventral tubules.

Host. Unknown.

Range. USA. California [Alpine].

Type material. Holotype, **USA. California: Alpine Co.**, Hope Valley, 7.viii.1948, sweeping, Lot 19-21, K.E. Frick (1♂, CASC). Paratype, **USA. California: Alpine Co.**, same collection as holotype (1♂, CASC).

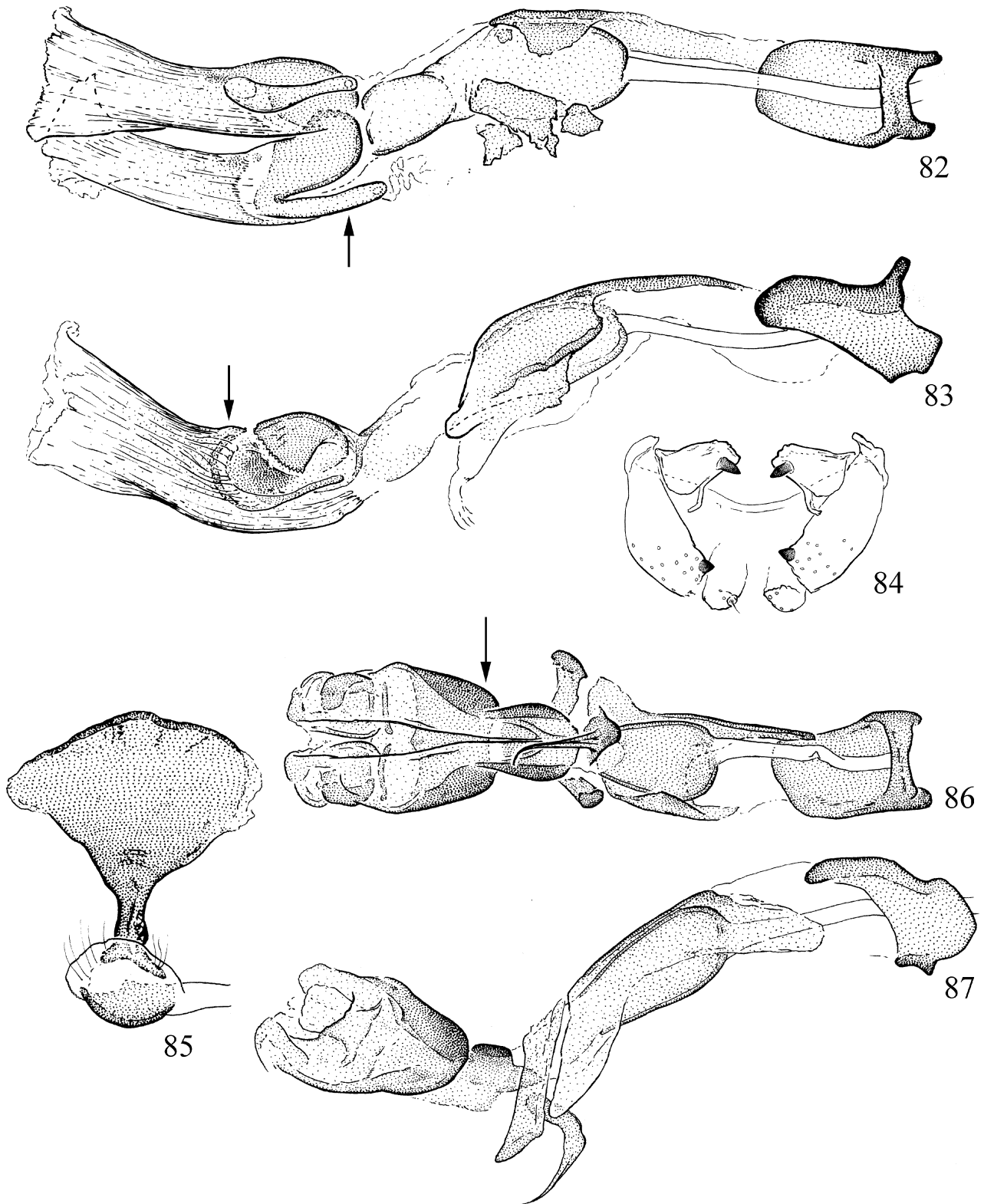
Comments. *Liriomyza denudata* is a relatively pale, species without any acrostichal setulae and an unusual phallus—the mesophallus is very pale and the distiphallus is divided between one pair of stout tubules, each with a toothed dorsobasal sclerite and a single thin ventral process.

Liriomyza equiseti de Meijere

Figs 88–91

Liriomyza equiseti de Meijere 1924: 124. Spencer 1972: 58, 1976: 249, 1990: 6.

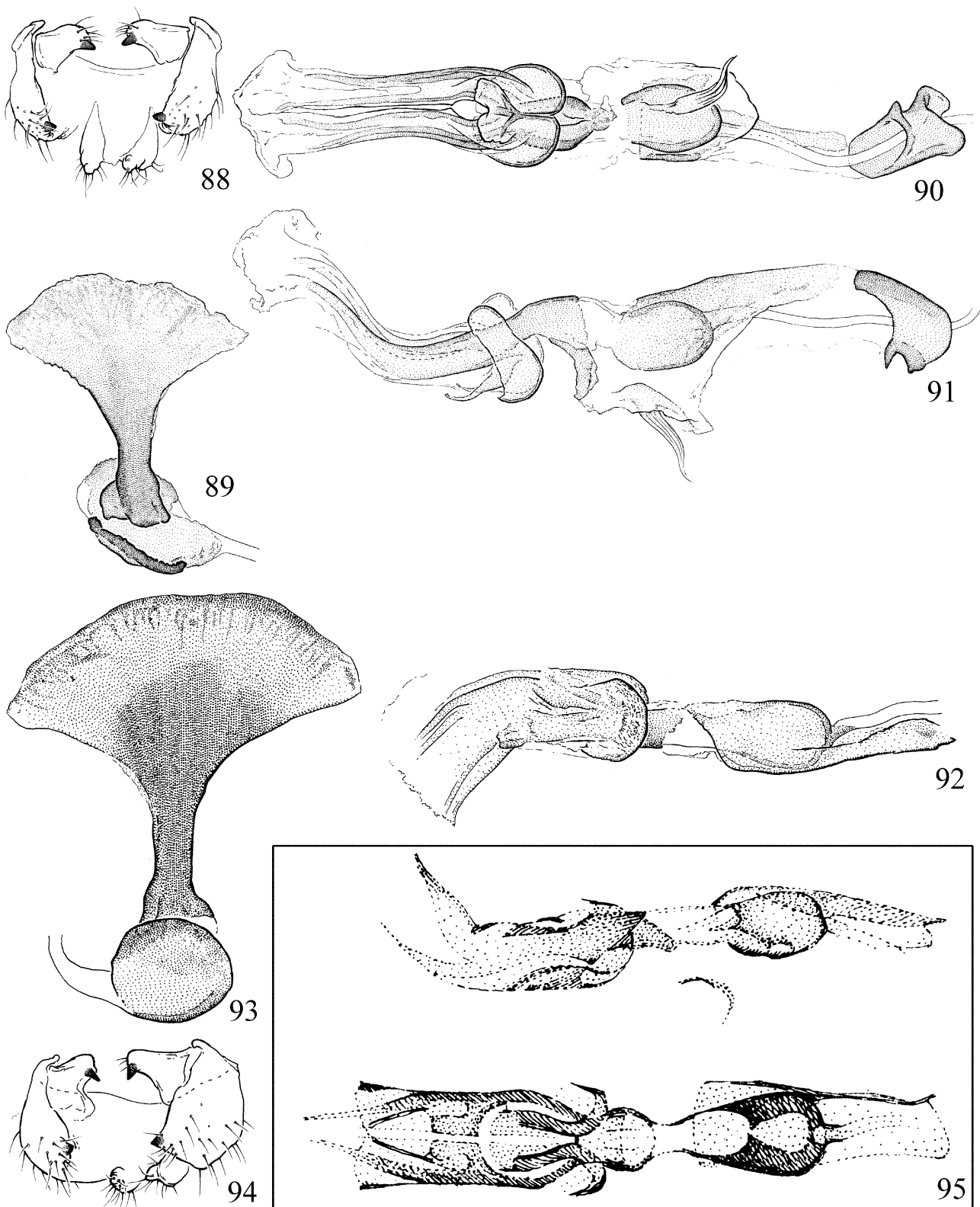
Liriomyza kenti Spencer 1969: 176. Syn. Spencer (1990).



FIGURES 82–87. Figs 82–84: *Liriomyza denudata* Spencer, male genitalia; 82: phallus, lateroventral; 83: left lateral; 84: external components, ventral. Figs 85–87: *L. eupatorii* (Kaltenbach), male genitalia; 85: ejaculatory apodeme; 86: phallus, ventral; 87: phallus, left lateral.

Wing length 1.6–1.8mm (♂). Females not examined. Length of ultimate section of vein CuA₁ divided by penultimate section: 1.9–2.3. Eye height divided by gena height: 3.2–3.7. Scutum heavily dusted but not grey. Parafacial

and orbital plate distinctly projecting but narrow. Spencer (1969) notes that the first flagellomere of this species (as *L. kenti*) is somewhat quadrate in Canadian specimens, but this is not the case in the Californian material examined.



FIGURES 88–95. Figs 88–91: *Liriomyza equiseti* Meijere, male genitalia; 88: external components, ventral; 89: ejaculatory apodeme; 90: phallus, ventral; 91: phallus, left lateral. Figs 92–95: *L. flavicola* Spencer, male holotype genitalia; 92: phallus, right lateral; 93: ejaculatory apodeme; 94: external components, ventral; 95: phallus, left lateral and ventral, from original figure in Spencer (1981).

Chaetotaxy: Two ori, two ors. Acrostichal setulae in three sparse irregular rows; two rows in Canadian and European material (Spencer, 1969, 1972).

Colouration: Calypter margin and hairs grey. Head (including clypeus) light yellow with back of head and ocellar triangle dark brown, and posterolateral corner of frons dark brown to base of outer vertical bristle and light brown to base of inner vertical bristle. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite dark below scutellum, and brown lateral to scutellum with posterodorsal corner yellow. Anepisternum with small brown anteroventral stripe; anepimeron yellow with brown mottling; meron brown with dorsum yellow; katepisternum brown on ventral 2/3 (not including base of bristle). Legs yellow with tibiae, tarsi, and base of coxae brown. Epandrium and dorsum of pregenitalic abdomen brown.

Genitalia: Figs. 88–91. Surstylus with apical setae and one subapical spine. Swollen apical section of ejaculatory duct broad and short. Paraphallus absent. Hypophallus with broad membranous base and long hairs. Mesophallus tapering apically, fused to distiphallus and with anteroventral margin thin and strongly produced, forming carina. Distiphallus with broad, pale, bowl-like base and long, clear distal tubules that are darker basally; tubules bent dorsally at midpoint, abruptly separated at base and shielded ventrally by short bilobed plate. Ejaculatory apodeme with *pileus ejaculatorius* broad laterally with margins thickly sclerotized; blade pale with and short with corners pointed and margin with faint striations.

Host. Equisetaceae—*Equisetum arvense*.

Range. USA. California [Modoc*]. Canada. Alberta, British Columbia. Britain. Netherlands.

Type material. *Liriomyza equiseti*: Syntypes, NETHERLANDS. Haarlem, “Stengelmijn an *Equisetum arvense*” (type information unknown) [Not examined]. *Liriomyza kenti*: Holotype, CANADA. British Columbia: Prince George, 18.vi.1966, K.A. Spencer, Type No. 16128 (1♂, CNC); Paratype examined, CANADA. Alberta: Jasper, 19.vi.1966, [illegible], K.A. Spencer (1♂, CNC).

Additional material examined. USA. California: Modoc Co., 1mi E Pine CR., 13.vi.1970, P.A. Rude (1♂, EMEC).

Comments. Four *Liriomyza* species are known to mine horsetails: the European *L. occipitalis* Hendel and *L. virgula* Frey (Tschirnhaus, pers. comm.), the European and Canadian *L. virgo* (Zetterstedt), and the Nearctic and European *L. equiseti*, found here for the first time in the United States.

Liriomyza eupatorii (Kaltenbach)

Figs 85–87

Agromyza eupatorii Kaltenbach 1873: 320.

Liriomyza eupatorii. Hendel 1920: 143, 1931: 217; Frick 1959: 404; Spencer 1969: 174, 1976: 245 [designation of *orbitella* lectotype], 1981: 230; Spencer & Steyskal 1986: 129.

Liriomyza orbitella Hendel 1931: 236. Syn. Spencer (1976).

Description. Wing length 1.7–2.2mm (♂), 1.9–2.0mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.0–2.7. Eye height divided by gena height: 3.0–4.4.

Chaetotaxy: Two ori (sometimes three on one side), two ors. Acrostichal setulae in four irregular rows.

Colouration: As described for typical *L. sativae* specimens except as follows: lateral margin of frons brown (not encosing fronto-orbitals) if first flagellomere brownish on distal margin; only base of hind femur sometimes brown dorsally, or in western North America, femora brown basally and with light dorsoapical mottling (rarely with more extensive pigmentation), but less commonly with only basal markings or sometimes entirely yellow; yellow posterolateral spots on scutum sometimes large and distinct; anepisternum dark along anteroventral and ventral margins, sometimes with spot reaching base of anepisternal bristle.

Genitalia: Figs 85–87. Epandrium and surstylus as in *L. sativae*. Paraphallus well enveloped, subrectangular. Hypophallus thin and strongly curved. Mesophallus half width of distiphallus; mesophallus and distiphallus with complete ventral suture. Distiphallus broadly cup-shaped with sides slightly converging apically and basal margin thick and truncated (sometimes as narrow as in figure, often much broader). Ejaculatory apodeme with stalk thin and blade broad with dark distal margin.

Variation: Specimens “ex. *Callistephus*” differ as follows: wing length 1.6mm; femora and first flagellomere entirely yellow; surstylus distinctly darker than epandrium; distiphallus subrectangular, not narrowing apically.

Hosts. Asteraceae—*Aster chilensis*, *Eupatorium*, *Galeopsis*, *Lapsana*, *Solidago* (Benavent-Corai *et al.*, 2005), *Xanthium strumarium**. Possibly *Callistephus* (Asteraceae).

Range. USA: California [Alameda, Los Angeles*, Orange*, Riverside*, San Bernardino*, San Mateo*], Georgia, Mississippi, Montana, North Carolina, South Carolina, Tennessee, Virginia, Washington. **Canada:** Alberta, Ontario, Quebec. Europe.

Type material. *Agromyza eupatorii*, Syntypes, **AUSTRIA** [not given]. (location of all types unknown) [Not examined]. *Liriomyza orbitella*: Lectotype, **FINLAND**. Esbo (1♂, NMW) [Not examined].

Additional material examined. USA. California: Los Angeles Co., Yuddingstone, 11.vii.1974, J.H. Hilgendorf, reared serpentine mine, *Xanthium strumarium* (1♀, UCR), Hawthorne, ix.1940, *Callistephus* (1♂ 2♀, UCR), **Orange Co.,** O.F.F. 174, 18.v.1950, citronella bait trap (1♂, CSCA), **Riverside Co.,** Riverside, A.L. Melander, 5.v.1935 (2♂, USNM), 22.ii.1935 (1♂, USNM), 24.ii.1935 (1♂, USNM), 25.v.1942 (1♂, USNM), **San Bernardino Co.,** Chino, 23.vii.1974, J.H. Hilgendorf, reared from leaf *Xanthium strumarium* L. (1♂, UCR), **San Mateo Co.,** La Honda, 10.viii.1963, P.H. Arnaud, Jr. (1♀, CASC), **Montana:** Glacier Park, Lake McDonald, 14.viii.1916, A.L. Melander (1♂, USNM).

Comments. When viewed ventrally, the broad, truncated base of the distiphallus is diagnostic of this widespread and sometimes locally abundant species, distinguishing it from similar taxa such as *Liriomyza sativae*, and one of the main reasons why the tentatively-identified *Callistephus* material has been included. The phallus is very similar to that of the Palaearctic *L. pusilla* (Meigen), but the distiphallus of that species is more globular and with one pair of rounded distal sclerotizations, the paraphalli are more splayed, the hypophallus is haired and the mesophallus is very slightly separated from the distiphallus.

Liriomyza flavicola Spencer

Figs 92–95

Liriomyza flavicola Spencer 1981: 231. Spencer & Steyskal 1986: 110.

Wing length 2.0mm (♂), 2.1mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7. Eye height divided by gena height: 2.2. Pruinosity on scutum not visible. Frons relatively wide with eyes small.

Chaetotaxy: One or two ori, two ors. Acrostichal setulae in two sparse irregular rows.

Colouration: Calypter margin and hairs white. Body entirely light yellow with bristles black, ventral half of katepisternum and meron yellow, ocellar tubercle brownish and fore distal tarsomere brownish.

Genitalia: Figs 92–95. Surstylus with one subapical spine. Paraphallus absent. Hypophallus small. Mesophallus short, thin, cylindrical and fused to distiphallus. Distiphallus with basal bowl and one pair of thick apical tubulus with basal sclerotizations. Ejaculatory apodeme with *pileus ejaculatorius* broadly rounded and upcurved laterally; stalk long and thin; blade wide with base and margin darker.

Host. Unknown.

Range. USA. California [Mono, Nevada].

Type material. Holotype, **USA. California: Mono Co.,** 7mi E of Tioga Pass, 15.vii.1961, G.I. Stage, Type No. 14061 (1♂, CASC); Paratypes examined, **USA. California: Mono Co.,** same collection as holotype (1♂ 1♀, EMEC), **Nevada Co.,** Sagehen Crk., 22.vii.1970, R.M. Bohart (1♀, UCD).

Comments. The only entirely pale *Liriomyza* in California is *L. flavicola*, which is only known from the central-eastern counties of Mono and Nevada.

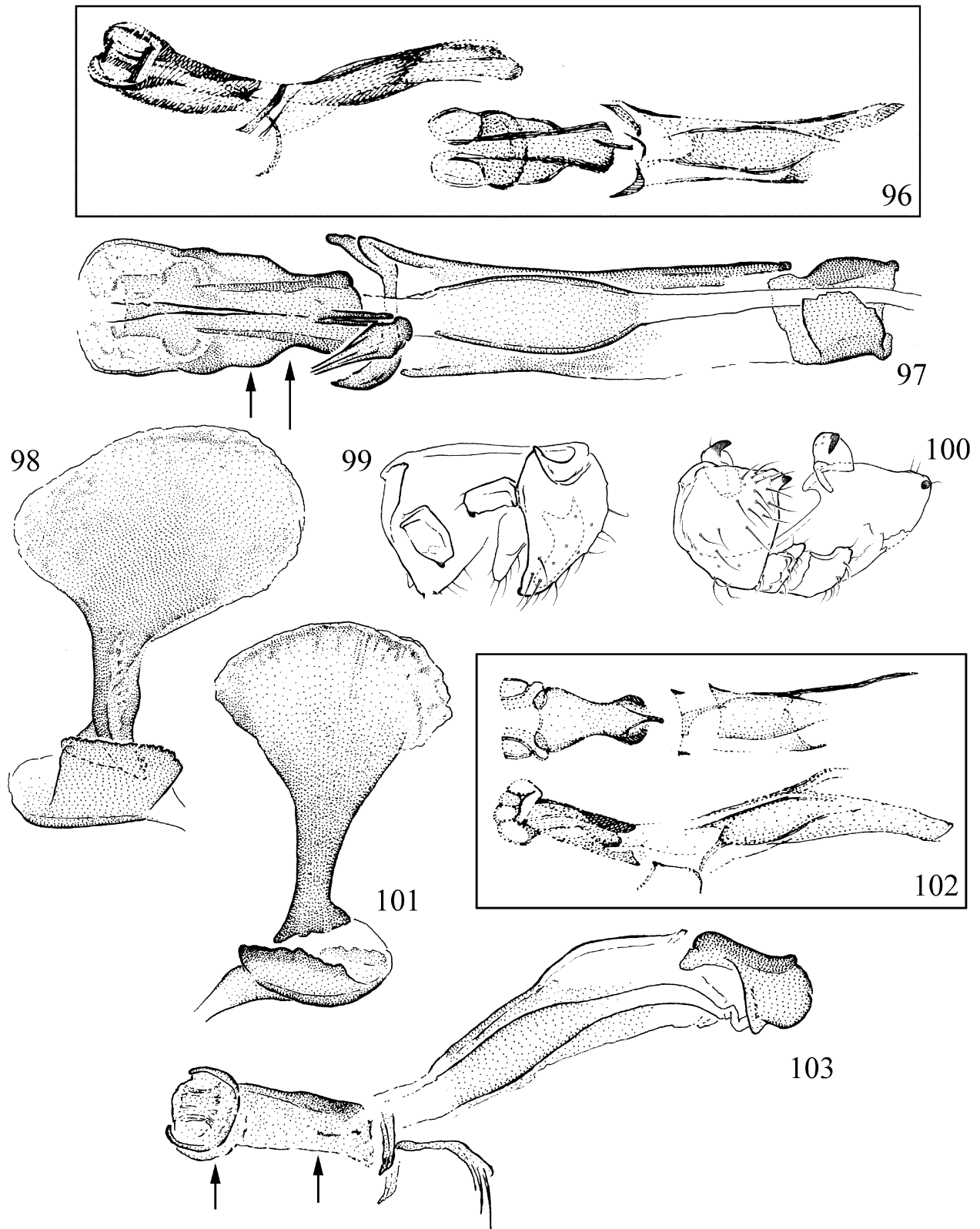
Liriomyza frickella Spencer

Figs 96–99

Liriomyza frickella Spencer 1981: 231. Spencer & Steyskal 1986: 119.

Wing length 1.5mm (♂), 1.5mm (♀). Vein dm-cu absent. Eye height divided by gena height: 3.8. Scutum shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.



FIGURES 96–103. Figs 96–99: *Liriomyza frickella* Spencer, male holotype genitalia; 96: phallus, left lateral and ventral, from original figure in Spencer (1981); 97: phallus, ventral; 98: ejaculatory apodeme; 99: external components, ventral. Figs 100–103: *L. frigida* Spencer, male holotype genitalia; 100: external components, ventral; 101: ejaculatory apodeme; 102: phallus, left lateral and ventral, from original figures in Spencer (1981); 103: phallus, left lateral.

Colouration: Calypter margin and hairs grey. Head light yellow with ocellar tubercle, clypeus and posterolateral region of frons to base of outer vertical bristle dark brown; region between vertical bristles and lateral margin

of frons to base of fronto-orbitals light brown; first flagellomere brownish, becoming yellow basally. Scutum dark with lateral margin yellow presuturally and yellowish above wing base; laterotergites dark. Pleuron dark brown with dorsal margin of anepisternum, meron and katepisternum yellow. Coxae brown on basal half (more extensive on hind coxa); femora brown basally and with extensive dorsal mottling; tibiae dark brown with fore tibia yellowish basally; tarsi dark brown, becoming lighter to base. Abdomen dark brown.

Genitalia: Figs 96–99. Surstylus subquadrate with one subapical spine. Paraphallus slightly expanded apically, and narrowed and contiguous dorsally. Hypophallus well developed. Mesophallus fused to distiphallus; mesophallus and distiphallus with complete ventral suture forming shallow carina. Distiphallus narrow with distal half thin-walled, enclosing medial fringed process (possibly two separate structures). Ejaculatory apodeme with *pileus ejaculatorius* produced and truncated laterally; stem with medial texturing and blade rounded and thin with margin pale.

Variation: WN male with lateral pigment on orbital plate mostly absent, lateral margin of scutum with thin, but complete stripe postsuturally, tibiae and tarsi entirely dark brown, and mid and hind coxae brown with yellow mottling on distal 1/3. See comments.

Host. Unknown.

Range. USA. California [Los Angeles, Tuolumne], Washington*.

Type material. Holotype, **USA. California: Tuolumne Co.**, summit of Sonora Pass, sweeping, Lot 115-2, 10.viii.1948, K.E. Frick (1♂, CASC); Paratype, **USA. California: Tuolumne Co.**, Same collection as holotype (1♀, CASC).

Additional material examined. USA. California: Los Angeles Co., 6mi SW Pomona, 20.xii.1960, C.A. Toschi (1♀, EMEC), **Washington: Kennewick**, 7.vi.1916, A.L. Melander (1♂, USNM).

Comments. *Liriomyza frickella* and *L. paumensis* are highly similar in colour and genitalic morphology, and while the dissected WN male shows more genitalic similarity to the latter species, the missing vein dm-cu identifies this male as *L. frickella*. Further investigation of the species boundaries of these, and putatively related species such as *L. californiensis* and *L. frigida* is warranted when more material is available.

Liriomyza fricki Spencer

Figs 104–107

Liriomyza fricki Spencer 1965: 35. Spencer 1969: 175; Spencer & Steyskal 1986: 136.

Description. Wing length 1.3–2.0mm (♂), 1.4–1.6mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7–3.5. Eye height divided by gena height: 3.0–4.2. Scutum lightly dusted with pruinosity.

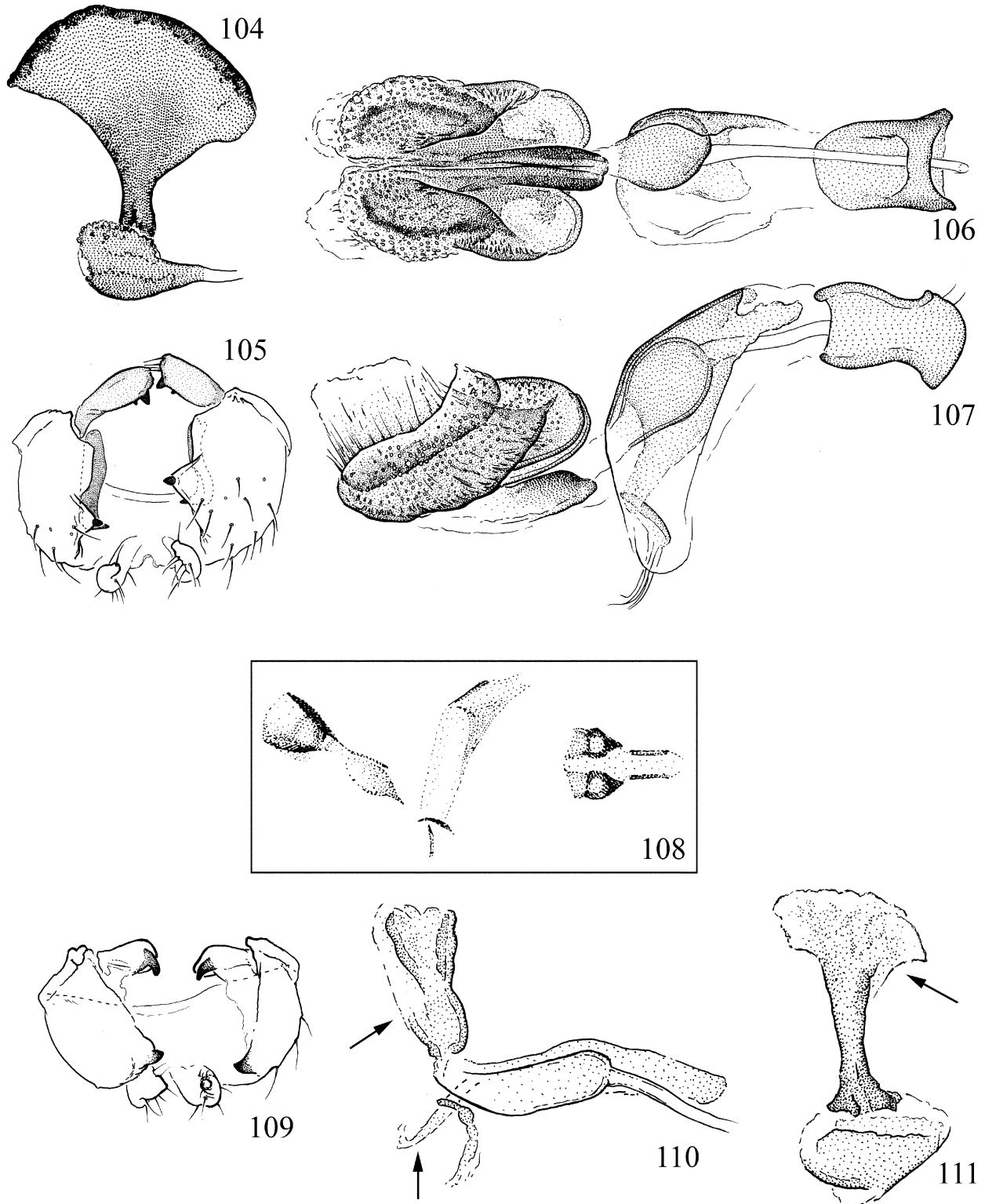
Chaetotaxy: Two ori (anterior bristle small to absent), two ors. Acrostichal setulae in two rows (sometimes three anteriorly).

Colouration: Calypter margin and hairs brownish. Head yellow with posterolateral margin of frons lateral to vertical bristles yellow to brown, back of head brown dorsally, and ocellar tubercle and clypeus brown. Scutum with complete lateral yellow stripe broadly overlapping scutellum; katatergite yellow; anatergite brown ventral to scutellum and sometimes ventrally brownish lateral to scutellum. Pleuron yellow with large spot on katepisternum and meron, and with small (sometimes very faint to indistinct) anteroventral spot on anepisternum and anepimeron. Legs yellow with fore tibia and tarsus brownish, mid and hind tarsus brown, and mid and hind tibiae brown at base, tip and on dorsal surface; material from western United States with tibiae yellow with dorsum thinly brown (paler or entirely yellow on anterior legs) and tarsi only brownish on distal three segments, becoming darker apically. Abdomen yellow with dorsum and epandrium brown.

Genitalia: Figs 104–107. Inner surface of epandrium flanked by one pair of dark, thin sclerites with terminal spine. Surstylus with single subapical spine and smaller accessory process. Hypophallus well developed. Swollen portion of ejaculatory duct strongly tapering to apex. Mesophallus thin, dark and fused to distiphallus. Distiphallus with large, bilobed and dorsally-swollen basal bowl with minutely-tuberculate inner surface, and with one pair of wide and very short apical tubules; membrane ventral to distiphallus thick and with skin-like texture. Ejaculatory apodeme with stalk thin and blade broad and dark with heavily sclerotized margin.

Hosts. Fabaceae—*Caragana pubescens* (uncertain record), *Lathyrus*, *Medicago*, *Melilotus*, *Trifolium* sp., *T. hybridum*, *T. repens*, *Vicia*, *Vigna* (Spencer, 1969; Sehgal, 1971).

Range. USA: California [Glenn*, Nevada], Washington. **Canada:** Alberta, Ontario, Quebec.



FIGURES 104–111. Figs 104–107: *Liriomyza fricki* Spencer, male genitalia; 104: ejaculatory apodeme; 105: external components, ventral; 106: phallus, ventral; 107: phallus, left lateral. Figs 108–111: *L. frommeri* Spencer, male holotype genitalia; 108: phallus, left lateral, from original figure in Spencer (1981); 109: external components, ventral; 110: phallus, left lateral; 111: ejaculatory apodeme.

Type material. Holotype, **USA. Washington:** Benton Co., Prosser (1♂, location unknown); Paratypes examined, **USA. Washington:** Yakima Co., Buena, ex. larva *Trifolium hybridum*, lot No., 207-1, K.E. Frick, 19.vii.1950 (1♂, USNM), 10.vi.1950 (2♂, CASC), Benton Co., Prosser, ex. larva *Vicia rosa*, 18.vii.1950, Lot. No. 227-1, K.E. Frick (1♂, USNM).

Additional material examined. **USA. California: Glenn Co.,** Maxwell, 1.viii.1953, R.F. Smith, Ladino clover (2♂ 3♀, EMEC).

Comments. *Liriomyza fricki* is a pale, widespread species similar in appearance to *L. trifolii*, but the gena is smaller and posterolateral region of the frons is sometimes entirely yellow, not brown lateral to vertical bristles. The male genitalia are also distinct in that the distiphallus is large, minutely tuberculate and globose (reminiscent of *L. lupini*), the membrane ventral to the distiphallus is textured and the ejaculatory apodeme is large and dark.

Liriomyza frigida Spencer

Figs 100–103

Liriomyza frigida Spencer 1981: 234. Spencer & Steyskal 1986: 116.

Wing length 1.3mm (♂), 1.2–1.3mm (♀). Vein dm-cu absent. Eye height divided by gena height: 3.8. Scutum subshining (holotype) to shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head mostly light yellow with ocellar tubercle, clypeus, back of head and posterolateral region of frons to base of inner vertical bristle (slightly fading medially) dark brown; space behind tubercle yellow; lateral margin of frons brown with pigment extending to base of fronto-orbitals; first flagellomere, excluding basal margin, light brown, with basal half of inner surface yellow; venter of gena with light brown stripe. Scutum dark with complete lateral yellow stripe becoming lightly mottled with brown posteriorly; katatergite with light mottling; anatergite dark below scutellum, and paler lateral to scutellum with posterodorsal margin yellowish. Pleuron mostly dark with dorsal margin of anatergite yellow (margin irregular in female), anepimeron with yellow mottling, and dorsal margin of meron and katapisternum (excluding posterior corner) yellow. Base of coxae brown in females; coxae brown in male with distal half of fore coxa and apex of mid coxa yellow; femora with brown spot at base, dorsally at 2/3 length, and with and thin dorsal striations; tibiae and tarsi dark brown with base of fore and mid tibiae yellowish. Abdomen brown.

Genitalia: Figs 100–103. Surstylus with one long subapical spine. Ejaculatory duct only slightly swollen apically. Paraphallus short and weakly sclerotized. Hypophallus well developed. Mesophallus slightly darker than, and fused to distiphallus, with point of attachment narrow. Distiphallus thin and with swollen apical chamber enclosing one pair of fringed structures. Ejaculatory apodeme relatively small with *pileus ejaculatorius* wide, truncated and thickened at ends; blade relatively narrow with dark submarginal band and striations.

Host. Unknown.

Range. **USA.** California [Alpine].

Type material. Holotype, **USA. California: Alpine Co.,** Hope Valley, 7.viii.1948, sweeping, Lot 91-20, K.E. Frick (1♂ [head missing], CASC); Paratypes examined, **USA. California: Alpine Co.,** Hope Valley, sweeping, 8.viii.1948, Lot No. 91-30, K.E. Frick (1♀, CASC), 8.viii.1948, Lot No. 91-30 (1♀, CASC).

Comments. *Liriomyza frigida* is a distinct species with no vein dm-cu and a small wing (1.2–1.3mm). The holotype is in poor condition, missing its head and all legs excluding the right fore leg and the left hind leg.

Liriomyza frommeri Spencer

Figs 108–111

Liriomyza frommeri Spencer 1981: 235. Spencer & Steyskal 1986: 127.

Wing length 1.2mm (♂), “up to 1.5mm” (♀) (Spencer, 1981). Length of ultimate section of vein CuA₁ divided by penultimate section: 5.0. Eye height divided by gena height: 6.0. Scutum glossy. Frons relatively narrow.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with ocellar tubercle and posterolateral region of frons to base of inner vertical bristle dark brown; clypeus brownish; first flagellomere yellow with basal margin slightly paler. Scutum dark with yellow lateral stripe, with stripe brownish behind wing base; katatergite yellow and anatergite brown (darker below scutellum). Pleuron yellow with brown mottling on anepimeron, small posterior spot and clavate anteroventral spot on anepisternum, and ventral $\frac{3}{4}$ of meron and katepisternum brown, with area around katepisternal bristle yellow. Legs yellow with tibiae and tarsi brown, with tarsi paler to base. Colour of abdomen unknown.

Genitalia: Figs 108–111. Surstylus with single subapical spine. Basiphallus without process on left distal margin. Swollen portion of ejaculatory duct only slightly constricted apically. Paraphallus thin and pale. Hypophallus dark basally with medial swelling and apex without distinct hairs. Mesophallus contiguous with distiphallus dorsally, and approximately as long as wide with sides narrow and pointed. Distiphallus not much longer than mesophallus, but broader and cup-shaped. Ejaculatory apodeme with evenly sclerotized *pileus ejaculatorius* and blade strongly atrophied with distal margin clear.

Hosts. Unknown; adults collected on *Chilopsis linearis* (Bignoniaceae) and *Melilotus indica* (Fabaceae).

Range. USA. California [Riverside].

Type material. Holotype, **USA. California: Riverside Co.**, P.L. Boyd Desert Research Center, 3.5mi S of Palm Desert, 24–26.vi.1969, Malaise Marker #57, S. Frommer & B. Worley, Type No. 16033 (1♂, CASC).

Comments. *Liriomyza frommeri* is a small (wing length 1.2mm) pale species with a yellow clypeus and antenna, as well as a very small blade on the ejaculatory apodeme and a reduced phallus with a narrow, parallel-sided mesophallus that is distinctly upturned.

***Liriomyza graminaceae* Spencer**

Figs 112–115

Liriomyza graminaceae Spencer 1981: 237. Spencer & Steyskal 1986: 132.

Wing length 2.2–2.4mm (♂), 2.5–2.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.4–2.1. Eye height divided by gena height: 4.1–6.2. Scutum subshining. Orbital plate projecting anteriorly.

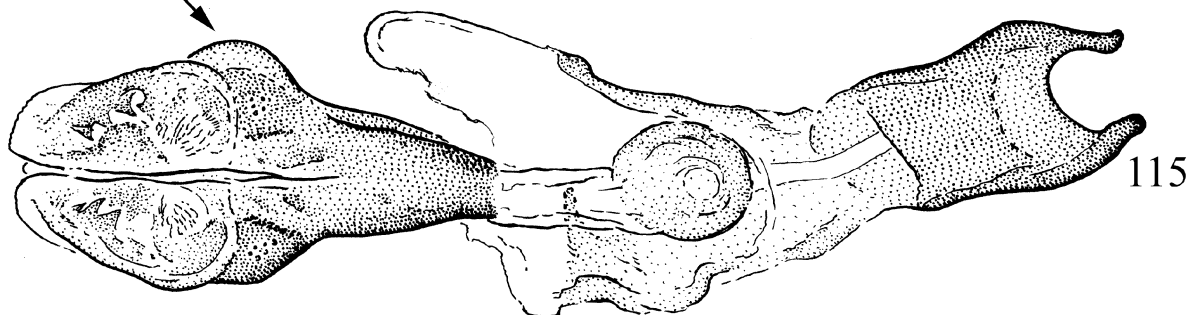
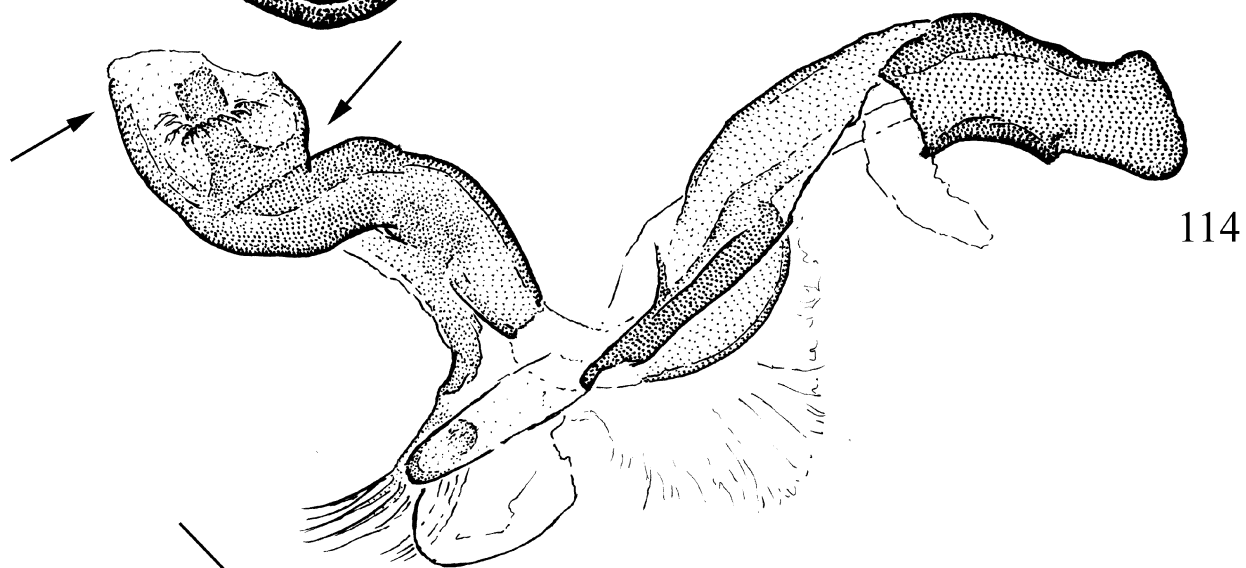
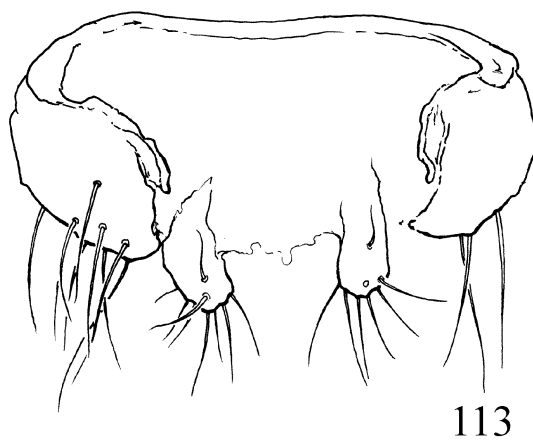
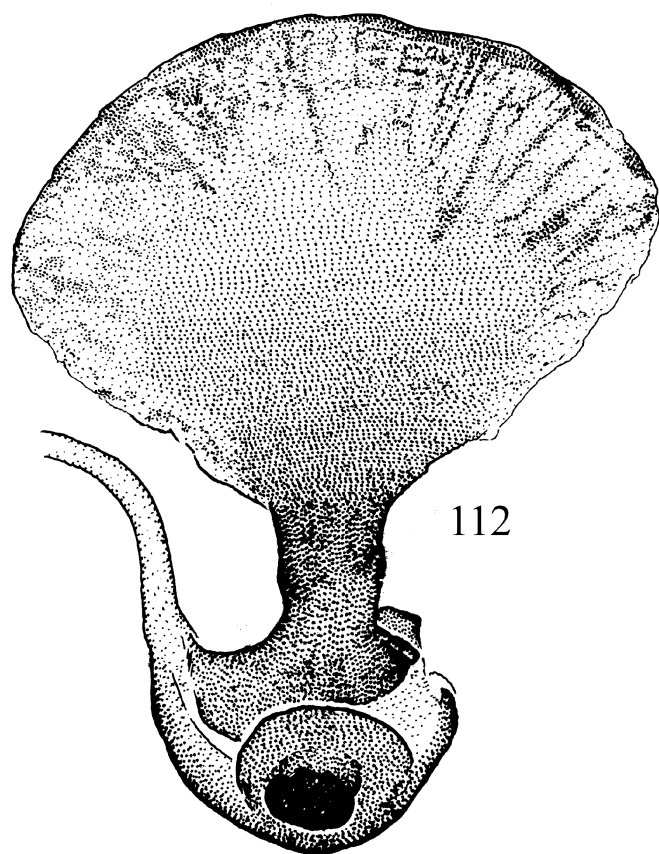
Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head yellow with brownish stripe along ventral margin of gena, and ocellar tubercle, clypeus, back of head and posterolateral region of frons to base of inner vertical bristle (excluding yellowish spot at base of outer vertical) dark brown. Scutum dark with complete yellow lateral stripe; katatergite brown; anatergite brown with posterodorsal corner lateral to scutellum yellow and region below scutellum darker. Pleuron dark with dorsal $\frac{2}{5}$ of anepisternum yellow (with deep triangular emargination at midpoint), dorsal margin of meron yellow, and dorsal margin of katepisternum yellow to base of bristle. Base of fore coxa, basal half of mid coxa and all of hind coxa dark brown; femora with brown base, fore femur brown basally on outer half and on dorsal $\frac{2}{3}$, mid femur brown basally on outer $\frac{1}{3}$ and dorsal half (reduced to thin stripes in holotype), and hind femur dark with distal $\frac{1}{3}$ yellow; fore tarsus brown, fore tibia brown with base yellow, but sometimes yellow with brown mottling; mid and hind tibiae and tarsus dark brown with base of tibiae sometimes yellow. Abdominal tergites brown with posterior margin thinly yellow and lateral margin broadly yellow, particularly on anterior tergites, as in *L. septentrionalis*.

Genitalia: Figs 112–115. Surstylus vestigial, and surstylus and epandrium without spines. Basiphallus sclerotized dorsally, with one pair of anterolateral processes and single membranous lobe on left distal margin. Swollen region of ejaculatory duct dorsally flat. Paraphallus absent. Hypophallus long-haired and narrowly joined to base of distiphallus. Mesophallus indistinct. Distiphallus pipe-shaped, with narrow, curved basal section that expands to apex, and small cup-like distal section enclosing long, thin, dark inner processes and inner-marginal spines. Ejaculatory apodeme with heavily-sclerotized *pileus ejaculatorius*, with dark process extending from each end; stem short, dark and stout; blade broad and subovate, becoming paler apically with dark marginal band and longitudinal striations.

Hosts. Unknown; likely Poaceae.

Range. USA. California [Alameda, Contra Costa*, El Dorado, Fresno, Inyo, Mono, Nevada, Placer, San Diego, San Luis Obispo*, San Mateo, Santa Clara*, Santa Cruz, Tulare], Colorado.



FIGURES 112–115. *Liriomyza graminaceae* Spencer, male genitalia; 112: ejaculatory apodeme; 113: external components, ventral; 114: phallus, left lateral; 115: phallus, ventral.

Type material. Holotype, **USA. California: San Diego Co.**, La Mesa, 15.x.1958, P. Rude (1♂, CASC); Paratypes examined, **USA. California: Alameda Co.**, Albany, 21.vi.1971, C.A. Belmont (1♀, EMEC), **Fresno Co.**, Hooper Cr. at road to gauging station on S Pk., San Joaquin River, 7200', 30.viii.1971, H. Leech (1♂, CASC), **Mono Co.**, Alt. 7200', Leavitt Meadow, 13.viii.1963, flight trap, H.B. Leech (1♀, CASC), **Nevada Co.**, Sagehen Cr., R. Villegas, 24.vi.1970 (1♀, UCD), 23.vi.1976 (1♀, UCD), Sagehen Cr., nr. Hobart Mills, 15.vii.1964, M.E. Irwin, Malaise in meadow (1♀ ??, UCR), **Placer Co.**, E end Bear Val., 2.vi.1964, P.H. Arnaud, Jr. (1♀, CASC), **San Mateo Co.**, Daly City, 21.xi.1960, K. Leavey, **Santa Cruz Co.**, Santa Cruz, 29.iii.1961, R. Brown (1♀, CASC), **Tulare Co.**, Johnsondale, 27.iv.1964, J. Doyen (1♂, EMEC).

Additional material examined. **USA. California: Contra Costa Co.**, Walnut Cr., foot Shell Ridge, 15.iv.1964, J. Powell (1♂, EMEC), **Nevada Co.**, Sagehen Cr., 28.vi.1978, L.R. Bronson (1♂, UCD), **San Diego Co.**, San Diego, 8.iii.1953, P.H. Arnaud (1♂ 1♀, CASC), **San Luis Obispo Co.**, 10.ix.1941, R.M. Bohart, ex. lawn grasses (1♂, UCD), **San Mateo Co.**, San Bruno Mts., 24.iii.1963, P.H. Arnaud, Jr. (1♂, USNM), **Santa Clara Co.**, Stanford U., 25.iv.1961, P.H. Arnaud, Jr. (1♀, CASC). **Colorado:** Boulder Co., Corona Pass, 10,600', 11.viii.1961, J.G. Chillcott (1♂, CNC).

Comments. Although the host for *Liriomyza graminaceae* is unknown, it is likely that the name given by Spencer will prove appropriate, as this species belongs to a distinct group of species including the European *L. flavveola* (Fallén) and the Nearctic *L. septentrionalis*, which has been reared exclusively from Poaceae. This assumption was also made by Spencer (1969, 1981) in his (re)descriptions of *L. abnormis*, *L. cordillerana* Sehgal and *L. montana*. Like most of its Nearctic relatives, *L. graminaceae* is relatively large with contrasting colouration, there is a yellow halo around the outer vertical bristle (absent in *L. abnormis*), the surstylus is reduced, the epandrial and surstylar spines are absent, there is more extensive dorsal sclerotization on the basiphallus, which is produced anterolaterally as dark distolateral rods, the distiphallus is long, thin, medially curved, dorsally-angled and with an apical bowl (ie. pipe-shaped), the hypophallus is fused to the base of the distiphallus, and the large, heavily sclerotized ejaculatory apodeme has dark lateral processes on the *pileus ejaculatorius*.

Liriomyza helenii Spencer

Figs 116–119

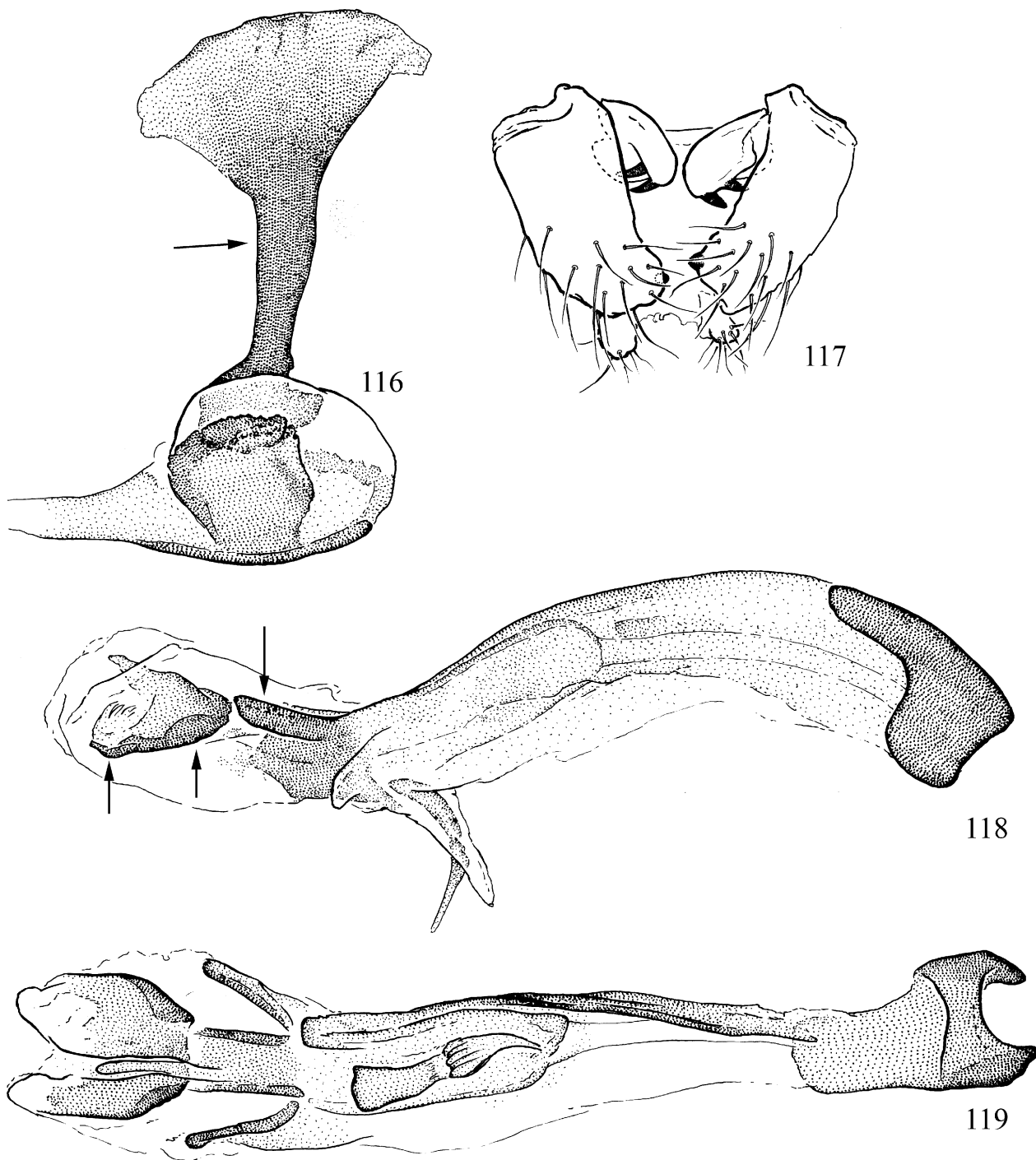
Liriomyza helenii Spencer 1981: 239. Spencer & Steyskal 1986: 122.

Wing length 1.8–2.0mm (♂), 2.0mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.0–3.8. Eye height divided by gena height: 2.8–4.0. Scutum lightly dusted. First flagellomere relatively large with dorsal margin nearly straight. Parafacial and orbital plate slightly pronounced laterally and cheek evident.

Chaetotaxy: Two ori, two ors; holotype with three ori (reduced right side). Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brownish grey. Head yellow with first flagellomere darker, ocellar tubercle, back of head, clypeus and posterolateral region of frons to inner vertical bristle (paler between verticals) dark brown; ventral margin of gena with faint stripe (sometimes darker anteriorly). Scutum with complete lateral yellow stripe; katatergite yellow and anatergite brown with posterodorsal corner lateral to scutellum yellow and region below scutellum darker. Anepimeron with extensive anterior and posterior streaking; anepisternum with large anteroventral spot or with ventral 2/3 brown; meron brown with dorsal margin yellow; katapisternum brown on ventral 3/5 to level of bristle. Base of fore and mid coxae brown and basal half of hind coxa brown; base of femora narrowly brown and fore femur sometimes with light dorsal mottling; holotype with fore and hind femora distinctly streaked dorsally; tibiae and tarsi dark brown; paler male with distinct dorsal subapical spots on mid and hind femora.

Genitalia: Figs 116–119. Surstylus with two subapical spines. Basiphallus elongate and slightly curved. Paraphallus short, dark and directed apically (not ventrally). Hypophallus well developed and with hairs possibly fused. Mesophallus short, with slight lateral compression. Distiphallus not much longer than mesophallus, more heavily sclerotized on ventral and basal walls, with complete ventral suture interspaced by thin plate, narrowed at base (more pronounced when seen laterally), and with pale, haired inner-ventral processes. Ejaculatory apodeme with *pileus ejaculatorius* broadly rounded and darker at ends; venter of bulb and basal section of duct lightly pigmented; stem long and dark, and blade small and subtriangular with distomedial margin dark.



FIGURES 116–119. *Liriomyza helenii* Spencer, male genitalia; 116: ejaculatory apodeme; 117: external components, ventral; 118: phallus, left lateral; 119: phallus, ventral.

Hosts. Asteraceae—*Hymenoxys hoopesii* [formerly considered *Helenium*].

Range. USA. California [Mono].

Type material. Holotype, **USA. California: Mono Co.**, Summit Sonora Pass, 28.viii.1948, ex. mines on *Helenium hoopesii*, Lot 113-1, K.E. Frick (1♂, CASC); Paratypes examined, **USA. California: Mono Co.**, Summit Sonora Pass, 28.viii.1948, ex. larva *Helianum hoopesii* Gray, Lot No. 113-1, K.E. Frick (3♂ 1♀, CASC).

Comments. *Liriomyza helenii* is relatively variable in external colouration and should only be considered reliably identified after the male terminalia have been examined—the surstylus has two subapical spines, the ejacula-

tory apodeme has a long, narrow stalk and a reduced triangular blade, a small cup-like distiphallus basally compressed in lateral view and an apically (not ventrally) directed paraphallus.

***Liriomyza helianthi* Spencer**

Figs 120–124

Liriomyza helianthi Spencer 1981: 240. Spencer & Steyskal 1986: 289.

Liriomyza virginica Spencer In Spencer & Steyskal 1986: 297. **SYN. NOV.**

Wing length 1.3–1.5mm (♂), 1.5–1.6mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–3.7. Eye height divided by gena height: 4.0–5.3. Scutum lightly dusted to subshining.

Chaetotaxy: Two ori, two ors (three in one male from Riverside). Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with ocellar tubercle, back of head, clypeus and posterolateral region of frons to inner vertical bristle (paler between verticals) dark brown. Scutum with complete lateral yellow stripe; katatergite yellow and anatergite brown with posterodorsal corner lateral to scutellum yellow and region below scutellum darker. Anepimeron mostly brown, anepisternum with variable brown striping on ventral half, meron brown with dorsal margin yellow and katepisternum brown on ventral $\frac{3}{4}$ (yellow around base of bristle). Base of coxae, tibiae and tarsi brown, with tarsi (and sometimes tibiae) becoming paler to base; femora sometimes with very small, weak basal spot. Abdomen brown with tergites thinly yellow posteriorly and broadly yellow laterally.

Genitalia: Figs 120–124. Surstylus with single subapical spine. Paraphallus large and well-defined, becoming broader distally and sometimes strongly clavate. Hypophallus well developed. Distiphallus with complete ventral suture widening apically; darker on basal half, thin, but gradually widening apically, and with wide chamber on distal $\frac{1}{4}$ enclosing paired fringed structures; distiphallus straight to slightly sinuate in profile, and with relative dimensions (width or height at base relative to apex) and amount of pigment variable between specimens. Ejaculatory apodeme with *pileus ejaculatorius* broad, truncated and heavily sclerotized laterally; stem narrow at base; blade broad, and rounded to diamond-shaped. Male from Forest Home with hairs on hypophallus long and base of distiphallus slightly curved with apex broader.

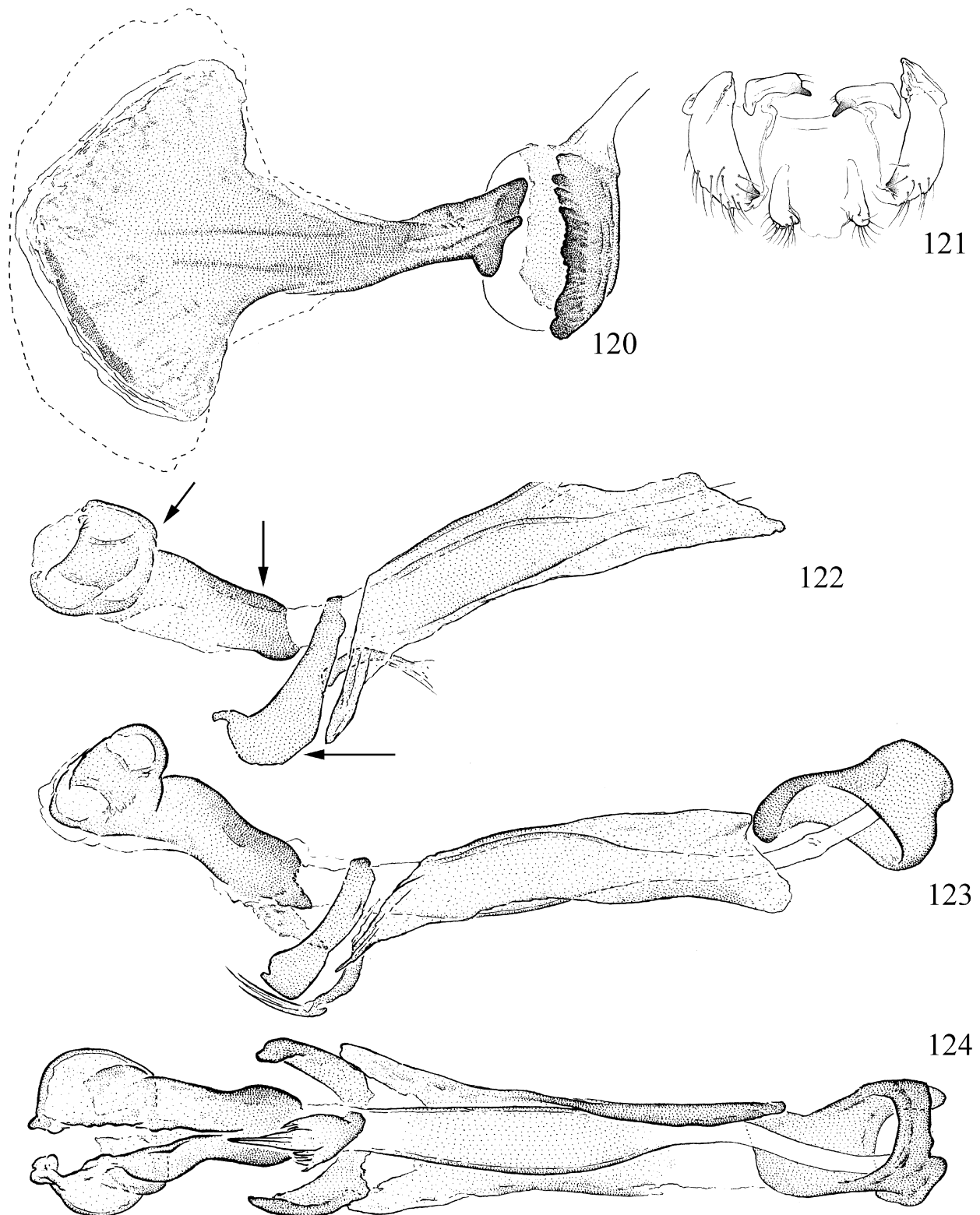
Variation: Some material from Riverside and Orange Counties with yellow lateral stripe on scutum brownish or extensively mottled or thinned postsuturally. If lateral margin of frons brown (sometimes enclosing base of ors, or base of bristle surrounded by spot), then tibiae darker, femora striated or darker apically (at least on fore femur), and pleuron darker with only dorsal $\frac{1}{3}$ – $\frac{1}{2}$ of anepisternum yellow and base of katepisternal bristle sometimes surrounded by brown (material from New Mexico, and Riverside and Orange Counties). Washington male differs as follows: dorsoapical region of first flagellomere possibly with very light infuscation; lateral margin of frons brown, enclosing base of ors; postsutural scutum brown; pleuron dark brown with dorsal margin of anepisternum, katepisternum and katatergite yellow; base of femora yellow and fore femur with light, thin outer striations; abdomen entirely brown; apex of paraphallus narrower, base of distiphallus darker and slightly broader, and distiphallus slightly shorter and broader.

Hosts. Asteraceae—*Helianthus annuus*, *Xanthium strumarium* (Spencer & Steyskal, 1986), *Ambrosia psilostachya**

Range. USA. California [Alameda*, Modoc*, Orange*, Riverside*, Sacramento*, San Bernardino[?]*, San Diego*, Stanislaus, Ventura*], New Mexico*, Oregon*, Virginia, Washington.

Type material. *Liriomyza helianthi*: Holotype, **USA. California: Stanislaus Co.**, Patterson, 27.ix.1948, swept on *Helianthus annuus*, Lot 162-1, K.E. Frick (1♂, CASC); Paratypes examined, **USA. California: Stanislaus Co.**, Patterson, sweeping *Helianthus annuus* L., Lot No. 162-1, K.E. Frick, 24.ix.1948 (2♀, CASC), 6.ix.1948 (1♀, CASC), 20.ix.1948 (1♀, CASC). *Liriomyza virginica*: Holotype, **USA. Virginia:** Patrick Co., Vesta, 2800ft, 30.v.1962, J.R. Vockeroth (1♂, CNC).

Additional material examined. USA. California: Alameda Co., UC Berkeley, Oxford Tract, 10.vii.1997, C. Gratton, from lab colony on *Helianthus annuus* (2♂ 3♀, EMEC), **Modoc Co.**, Cedar Pass Campground, 10.viii.1967, 1800m, P.H. Arnaud, Jr. (1♂, CASC), **Orange Co.**, “Up Sta Ana Riv”, 28.v.1950, A.L. Melander (1♂, USNM), San Juan Hot Springs, 18.vii.1945, A.L. Melander (1♂, USNM), Fullerton, 13.ii.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (2♂ 2♀, UCR), **Riverside Co.**, Riverside,



FIGURES 120–124. *Liriomyza helianthi* Spencer, male genitalia; 120: ejaculatory apodeme, showing variation in blade shape; 121: external components, ventral; 122: holotype phallus, left lateral; 123: phallus, non-type, left lateral; 124: phallus, same male, ventral.

22.ii.1930, A.L. Melander (1♂, USNM) , Riverside, 5.v.1925, A.L. Melander (1♂, USNM), India, 25.iii.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♂, UCR), **Sacramento Co.**,

Stone Lake Wildlife Refuge, 3km E Hood, C. Gratton, 2.viii.1993, serpentine mine on *Xanthium strumarium* (1?, EMEC), 19.vii.1996, serpentine mine on *Helianthus annuus* (1♂, EMEC), 27.vi.1996, serpentine mine on *Helianthus annuus* (1♂, EMEC), HW160/HW12 jct., C. Gratton, serpentine mine on *Helianthus annuus*, 8.iv.1993 (2♀ 1?, EMEC), 12.ix.1992 (1 puparium, EMEC), **San Bernardino Co.**[?], Forest Home, 25.v.1935, A.L. Melander (1♂, USNM), **San Diego Co.**, Oceanside, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle, 3.vi.1969 (1♂, UCR), 1.iv.1969 (1♂, UCR), Valley Centre, 28.v.1969, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♂, UCR), **Ventura Co.**, Fillmore, 3.ii.1970, R.D. Goeden & D.W. Ricker, insectary reared on *Ambrosia psilostachys* Decandolle (1♀, UCR), **New Mexico:** Cimarron, 26.v.1969, W.W. Wirth, river margin (1♂ [head missing], USNM), **Oregon:** Lake Co., 3.vii.1971, 10mi NE Christmas Valley, G. Steyskal (1♂ [head missing], USNM), **Washington:** Kamiac Butte, 25.vii.1914, A.L. Melander (1♂, USNM).

Comments. With the examination of additional material, *Liriomyza helianthi* now appears to be much more variable in colouration than previously assumed, with the type series representing the palest material examined. The terminalia are also relatively plastic with regards to the height of the paraphallus and distiphallus, the latter of which may be slightly stouter and/or darker basally, less broad or high apically, or straight to sinuate in profile. Furthermore, the eastern material differs in that the eye is 3.8 times higher than the gena and the femora and the base of the tibiae are yellow.

Liriomyza virginica is here included as a junior synonym of *L. helianthi* because the male genitalia and colouration of the two are nearly identical. Spencer (Spencer & Steyskal, 1986) described *L. virginica* in comparison to *L. schlingeri* from California, but apparently did not examine his own California material of *L. helianthi*, which he described at the same time as *L. schlingeri*.

One of the paratypes with a strong distal spot on hind femur and stronger mottling on fore femur has been dissected and found to be *Liriomyza sativae*.

***Liriomyza huidobrensis* (Blanchard)**

Figs 125–128

Agromyza huidobrensis Blanchard 1926: 10.

Liriomyza cucumifoliae Blanchard 1938: 352. Syn. Spencer (1973a).

Liriomyza decora Blanchard 1954: 31. Spencer 1963b: 359 (as syn. *bryoniae* (Kalt.)). Syn. Spencer (1973a).

Liriomyza langei Frick. Misidentification. Frick 1951: 81; Rautz & Trumble 2002: 101.

Liriomyza bryoniae (Kaltenbach). Misidentification. Spencer 1963b: 359.

Liriomyza dianthi Frick. Misidentification. Frick 1958: 1.

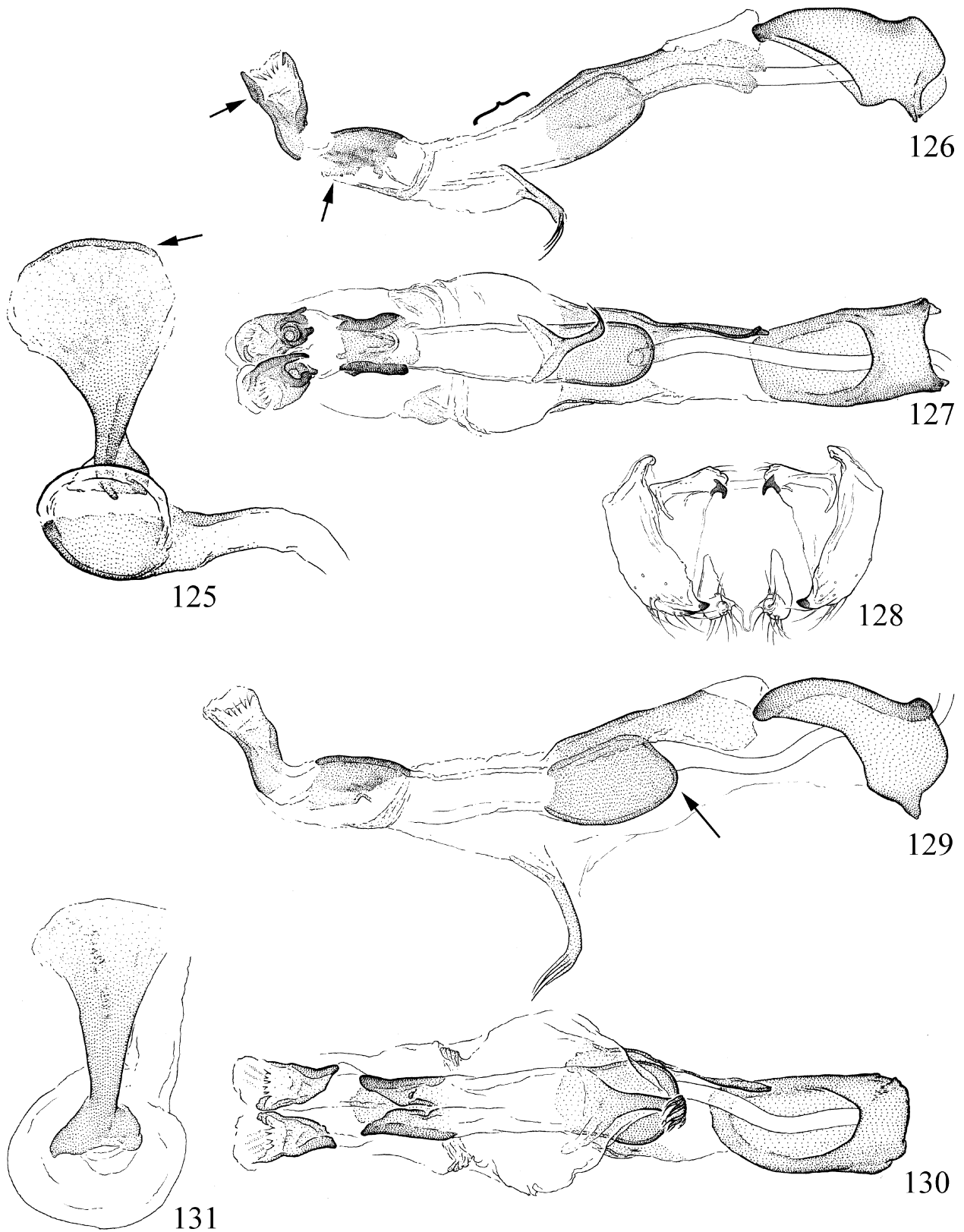
Liriomyza huidobrensis. Blanchard 1938: 356; Porter 1939: 139; Frick 1952a: 403; Spencer 1973a: 215, 1981: 241, 1982: 24, 1983: 55, 1984: 18; Spencer & Steyskal 1986: 119 (in part); Anonymous 1996: Map 568, 2002: Map 568; Steck 1996: 1 (in part); Aukema *et al.* 1998: 17; Shepard *et al.* 1998: 43; Rauf *et al.* 2000: 257; Shiao & Wu 2000: 250; Scheffer & Lewis 2001: 648; Salvo & Valladares 2002: 874; Martin *et al.* 2005: 1170; Takano *et al.* 2005: 43; Deeming 2006: 410; Takano *et al.* 2008: 397; USDA 2008: 1.

Wing length 1.9–2.6mm (♂) [usually 2.3–2.6 in darker males and 1.9–2.2 in paler males], 2.1–2.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.5–2.5. Eye height divided by gena height: 2.5–4.3. Scutum shining to subshining. Vein dm-cu rarely broken.

Chaetotaxy: Two ori (anterior bristle rarely reduced), two ors. Acrostichal setulae usually in two to three sparse rows, but less commonly more closely spaced and with up to four rows; darker specimens more frequently with additional setulae.

Colouration: Calypter margin and hairs brown. Head yellow with back of head, ocellar triangle, clypeus and posterolateral corner of frons to base of outer vertical bristle dark brown; region from base of outer vertical to inner vertical brown to yellow; venter of gena with light brown line; distal half to distal 2/3 of first flagellomere orange to infuscated with margin darker. Posterolateral corner of scutum with small spot; katepisternum brownish posteroventrally; anatergite dark brown below scutellum and brown lateral to scutellum with dorsum yellow. Pleuron yellow with broad brown anteroventral stripe on anepisternum that sometimes includes much of ventral 2/3; anepimeron yellow with light to extensive mottling; most of meron brown; katepisternum brown below base of bristle (sometimes touching bristle) and sometimes behind bristle base. Legs yellow with base of fore and mid

coxae mottled brown, hind coxa brown on basal half or entirely brown, femora brown at base, fore and mid femora with light dorsal mottling, hind femur with heavier streaking, tibiae brown with posterior legs darker and tarsus brown. Abdomen dark brown, sometimes yellowish medially on second tergite.



FIGURES 125–131. Figs 125–127: *Liriomyza huidobrensis* (Blanchard), male genitalia; 125: ejaculatory apodeme; 126: phallus, left lateral; 127: phallus, ventral; 128: external components, ventral. *L. langei* Frick, male genitalia; 129: phallus, left lateral; 130: phallus, ventral; 131: ejaculatory apodeme.

Variation: Paler specimens described above are typical of most males and a minority of females outside of Chile and populations introduced into western North America. Darker specimens differ as follows: pigment more black instead of brown; basal 2/3 to basal margin of first flagellomere yellow; posterolateral corner of frons dark brown to base of inner vertical; orbital plate brown to base of posterior ors or level of posterior ori; dorsal 1/6–1/4 of anepisternum yellow; anepimeron and laterotergites darker; katepisternum yellow to level of bristle base or above, with only dorsomedial suture pale; mottling on femora wider and contiguous with basal spot; coxae more extensively brown with mid coxa entirely dark; legs rarely as dark as seen in *L. langei*, with only knees and distoventral surface of femora yellow. Intermediates between pale and dark colour “types” uncommon for females.

Genitalia: Figs 125–128. As described for *L. langei* except as follows: gap present between base of hypophallus and sclerotized section of ejaculatory duct; swollen portion of ejaculatory duct usually parallel-sided and not bulging ventrobasally; distiphallus and mesophallus relatively dark with thick walls, and distal half of distiphallus and basal half of mesophallus bulging; ejaculatory apodeme with relatively broad, rounded blade that is weakly to very strongly sclerotized and with margin dark.

Hosts. See Table 1 for host genera.

Range. USA. California [unknown if populations established]. **Canada.** Alberta, British Columbia, Ontario, Nova Scotia [unknown if populations established]. Afrotropics: Mauritius, Réunion, Seychelles. Neotropics: Argentina, Brazil, Belize, Chile (inc. Juan Fernandez Isl.), Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guadeloupe (not established), Guatemala, Honduras, Mexico (Mexico State), Nicaragua, Panama, Peru, Venezuela. Palaeartic: Arabian Peninsula, Austria, Belgium, Crete, Cyprus, Czech Republic, France, Ireland, Israel, Italy, Lebanon, Malta, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, Syria, Turkey, United Kingdom; eradicated from Denmark, Finland and Sweden. Asia/Pacific: Australia, China, Easter Island, Guam, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Sri Lanka, Taiwan.

Type material. *Agromyza huidobrensis*: Syntypes, **ARGENTINA**. Buenos Aires [not given], ex. *Cineraria* (?♀, MLPA) [Not examined]. *Liriomyza cucumifoliae*: Syntypes, **ARGENTINA**. Buenos Aires, ex. melon (?♀, MLPA) [Not examined]. *Liriomyza decora*: Syntypes, **ARGENTINA**. Buenos Aires, ex. Fava bean (2 ♀, MLPA) [Not examined].

Additional material examined. BRAZIL. Campinas, vii.1960, on potato (A.S. Costa) (1♂ 1♀, CNC), Faz. Sta. Elisa campinas, S.P., x.1962, C.J. Rossetto (1♀, CNC), Mindano melanica (1♂, CNC). **CANADA. Alberta:** Elkwater, 11.vi.1956, O. Peck (1♂, CNC), **British Columbia:** Surrey, 16.ix.1994, host: celery, R. Costello (3♂ 1♀, CNC), **Nova Scotia:** CBHnt Pk., Pleasant Bay, PG682873, 6.vi.1984, mixed forest, B.E. Cooper (1♂, CNC), **Ontario:** Essex Co., Point Pelee N.P., Visitor Centre, malaise & pans, O. Lonsdale, 5–26.ix.2000 (1♀, DEBU), 18.x–19.xi.2000 (1♀, DEBU), Wellington Co., Guelph, U of Guelph colony, 27.x.2001, S. Goodfellow (1♂, DEBU), Guelph, colony, 1.xi.2000, C. Mackinnon (1♂ 1♀, DEBU), R. Bannister (1♂, DEBU), University of Guelph, Env. Biol., raised in colony, 17.iii.2005, S. Campbell (1♂ 1♀, DEBU), Simcoe Co., Bradford, greenhouse, ii.2000, M.R. McDonald (4♂ 1♀, DEBU), Ontario, ix.1999, ex. celery leaf mines, M. Ruth (3♂ 9♀, CNC), Hamilton-Wentworth Reg., Flamborough, 5th Conc., Lawson Farm, 43°18'58"N, 80°02'26"W, alvar, yellow pans, 1.vi.2003, M. Buck (1♂, DEBU). **CHILE.** La Cruz, iii.1966, leaf mine in Aster, leg. Rojas (1♂ 1♀ [same pin], CNC), Ovalle, Coquimbo, 1.viii.1960, L. Pena (2♂, CNC), Piscicultura, Aconcagua, 1600m, 11.xi.1963, L. Pena (2♂ 14♀, CNC), Talca, Vegas del Flaco, 29.xi.1957, L.E. Pena (3♀, CNC), Camarones, xi.1955 (1♀, CNC), Coquimbo, Port tres Cruces, 1900m, L.E. Pena, 21.x.1957 (1♀, CNC), Coquimbo, Port tres Cruces, 30.x.1957, L.E. Pena (1♂ 1♀, CNC), 31.x.1957 (1♂ 1♀, CNC), Coquimbo, Hda Illapel, 20.xi.1954, 18–2200m, L.E. Pena (2♀, CNC), Apoquindo, Santiago, ix.1953, L.E. Pena (1♂, CNC), Coquimbo, Ovalle, 1.viii.1960, L.E. Pena (1♂, CNC), Coquimbo, Huaquén, 26.vii.1960, L.E. Pena (1♂, CNC). Tarapaca, Azapa, L.E. Pena, 8–10.xi.1955 (1♀, CNC). **PERU.** Lima, leaves of Gypsophila, L-84-1007 (1♂, CNC). **USA. California: Alameda Co.,** Albany, U.C. Gill Tract, 13.ii.1968, G.L. Jensen (2♂ 2♀ 1?, CNC), **Ventura Co.,** West Flower Growers, Oxnard, import from Burnaby, BC, 3.xi.2008, ex. *Dianthus* (reared) (1♂, CNC).

Comments. *Liriomyza huidobrensis* is so morphologically similar to *L. langei*, its putative sister species, that they were considered conspecific until only recently, with molecular data (Scheffer 2000; Scheffer & Lewis 2001) and rearing experiments (Takano *et al.* 2008) convincingly supporting their separate specific status. One possible synonym of *L. huidobrensis* may be the Argentinean *L. pagana* (Malloch), as suggested by Spencer (1982), but this problem is outside of the scope of the present study.

While the diagnostic morphological characters newly presented in this study can differentiate most specimens

of *Liriomyza huidobrensis* and *L. langei*, the characters are subtle and sometimes overlapping, and molecular data should still be used to support identifications whenever possible. The molecular procedures recommended for the diagnosis of these two species are outlined in Scheffer *et al.* (2001, and in prep.). The Old World *L. bryoniae* (Kaltenbach) and *L. strigata* (Meigen) are also clearly allied to *L. huidobrensis* on the basis of the structure of the male phallus (see Spencer (1973a)), but they do not appear to be as closely related, as suggested by external colouration, chaetotaxy and overall genitalic morphology. The widespread North American *L. trifoliarum* also belongs to this group, but this species is paler and has one pair of distinct “wings” emerging from the anterolateral margins of the basiphallus that are likely homologous to the paraphalli. A thorough summary of host preference, life history, environmental tolerance, sexual selection and pesticide efficacy in *L. huidobrensis* and *L. langei* (as the “Californian population” of *L. huidobrensis*) is provided in USDA (2008).

Externally, most *Liriomyza huidobrensis* can be diagnosed in part by two rows of sparse, scattered acrostichal setulae, but three sparse to four dense rows may sometimes be present in darker specimens. These darker specimens are frequently females, but all individuals of both sexes are darkly pigmented in the Chilean and western North American populations examined. This contrasts *L. langei*, which commonly has four to (less commonly) three dense rows of setulae between the presutural dorsocentrals, never two. With regards to the head, while virtually all specimens of both species have two well-developed ori, *L. huidobrensis* occasionally has the anterior bristle reduced and *L. langei* infrequently has three. With regards to colour, the pleuron and femora are paler in most *L. huidobrensis*, but darker specimens can be similar in appearance to paler *L. langei*, and several of the Californian and Chilean females have the predominantly dark brown femora typical of darker *L. langei*. Furthermore, while generally paler than *L. langei*, darker *L. huidobrensis* have a more extensively pigmented first flagellomere, which is occasionally only yellow along the basal margin. Lastly, the male genitalia of *L. huidobrensis* are often distinct from those of *L. langei* as described above.

Liriomyza langei is most commonly encountered in California, where it is particularly abundant around agricultural crops, but it has also been collected in Oregon and Washington. The latter two state records are possibly the result of human-facilitated introductions, as has been suggested for the disjunct Hawaiian populations (Scheffer 2000) and the unestablished Florida, Utah and Virginia populations (Steck 1996). *Liriomyza huidobrensis*, conversely, is endemic to the cooler highland areas of the Neotropical Region (Steck 1996), but it has been introduced with apparent ease via human activities throughout much of the World, including the United States, Canada, Europe, South Africa and Asia (Scheffer, 2000; Scheffer *et al.*, 2001; USDA 2008). It is likely that *L. huidobrensis* is endemic to South America because it was not known from Central America until 1983 (Spencer 1983; Scheffer 2005), although the possibility that this represents a collecting artifact cannot be entirely eliminated. Only *L. huidobrensis* has been confirmed as present in Mexico (Hernández Regalado *et al.* 2009), although Takano *et al.* (2005) state that specimens of *L. langei* (as the “Californian clade”) were intercepted in Japan from a package originating from somewhere in that country. Anonymous (1996) reported *L. huidobrensis* from Mexico, French Guiana and the Canary Islands in their distributional map for that species, but removed these records in a subsequent revision (Anonymous, 2002), stating that they could not be confirmed. Specimens of “*Liriomyza* sp.”, which could be representatives of either species, were collected in Tabasco and Mexico states on *Cucumis* and *Dendranthema* (Marín Turriza *et al.* 1995, Huerta P. *et al.* 2003).

***Liriomyza langei* Frick**

Figs 4, 129–131

Agromyza scutellata var. *orbona* Meigen. Misidentification, in part. Melander 1913: 258; Frost 1943: 259.

Liriomyza langei Frick 1951: 81, 1952a: 403, 1958: 1, 1959: 405; Scheffer & Lewis 2001: 648 [stat. reinst.]; Scheffer *et al.* 2001: 1177.

Liriomyza huidobrensis (Blanchard). Misidentification. Spencer 1973a: 215 [as syn. of *L. huidobrensis*], 1981: 241; Spencer & Steyskal 1986: 119; Steck 1996: 1 (in part); Takano *et al.* 2008: 397.

Liriomyza dianthi Frick 1958: 1. Syn. Frick (1964). Spencer 1973a: 215 [as syn. *huidobrensis*].

Fig. 4. Wing length 1.6–2.2mm (♂), 1.9–2.3mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.8–2.7. Eye height divided by gena height: 3.5–4.2. Scutum shining.

Chaetotaxy: Two ori (sometimes three in larger specimens), two ors. Acrostichal setulae in four rows, rarely three.

Colouration: Calypter margin and hairs brown. Head light yellow with ocellar tubercle, back of head, clypeus and posterolateral region of frons to base of inner or outer vertical bristle (sometimes excluding space behind verticals) dark brown; lateral margin of frons brown to brownish, sometimes with small oblique extensions or entire margin of stripe reaching base of posterior three fronto-orbitals, but more commonly frons only brown to level of posterior ors; first flagellomere rarely entirely yellow (see below), often with orange tint on distal half or more, and usually variably infuscated on distal half, often only on distal or dorsoapical margin; face sometimes light brown to brown, at least medially; ventral margin of gena with thin brown stripe, sometimes paler medially and posteriorly, rarely anteriorly. Scutum dark with yellow lateral stripe becoming brownish to brown past wing base, rarely entirely yellow (see below); katatergite variable, but always brown in part; anatergite brown. Anepisternum yellow on dorsal 1/3 or less, but never entirely dark; anepimeron with limited yellow mottling; dorsal margin of meron yellow; katepisternum never yellow below level of bristle, sometimes only with dorsomedial margin yellow. Legs mostly dark brown; femora yellow apically, and fore and sometimes mid and hind femora also yellow distoventrally; femora uncommonly only brown at base and with dorsal streaking; fore coxa sometimes yellow on distal half, but always yellow apically (if paler, then fore femur with distinct yellow striations and knees more extensively yellow); base of tibiae sometimes yellowish. Abdomen brown.

Genitalia: Figs 129–131. Surstylus with single subapical spine. Paraphallus atrophied. Hypophallus long, thin, pale and with few, strongly curved apical hairs; emerging from base of elongate, upcurved membranous section between basiphallus from mesophallus. Mesophallus slightly longer than wide, separate from distiphallus. Distiphallus short and bifid (appearing entirely divided from a distance), enclosing paired inner-distal fringed structure. Ejaculatory apodeme with *pileus ejaculatorius* narrow; blade short and narrow, margin clear, and base smoothly blending into stem.

Variation: Specimens with lateral margin of frons entirely yellow (uncommon) usually with lateral margin of scutum entirely yellow and first flagellomere entirely yellow. Larger (2.4–2.5mm), darker females rarely with yellow striations on mid and hind femora, brown pigment only reaching posterior ors, and eye 2.8 times higher than gena. One male with dm-cu absent medially. Females reared from “peas” sometimes with posterior margin of tergite 6 yellowish.

Hosts. See Table 1 for host genera. Examined Californian material reared from: alfalfa; artichoke; celery; chrysanthemum; lettuce; lima bean; onion; peas (including “alderman peas”, “green peas” and “pole peas”); *Ambrosia chamissonis* (Less.); spinach; sugar beet; *Aster* spp. (including “rainbow aster”); *Calendula*; *Chenopodium murale*; *Dianthus* sp.; *Dianthus caryophyllus*; *Gypsophila*; *Iva axillaris*; *Pisum sativum*; *Primula* sp.; *Senecio vulgaris*; *Sonchus oleraceus*. Adults have been also collected on: “wild mustard”; Nasturtium; radish; *Ambrosia chamissonis*; *Bellis*; *Callistephus*; *Centranthus*; *Cineraria*; *Convolvulus macrostegius*; *Petunia*.

Range. USA. Identified from California, Hawaii, Oregon, Utah & Washington (Scheffer *et al.*, 2001). Possibly present in Mexico (Takano *et al.*, 2005).

Type material. *Liriomyza langei*: Holotype, **USA. California: Santa Clara Co.**, Sunnyvale, 15.x.1948, K.E. Frick, ex. leaf mine on garden pea (1♂, CASC); Paratypes examined, **USA. California: Santa Clara Co.**, Sunnyvale, 30.ix.1948, ex. larva *Pisum sativum*, Lot No. 170-1, K.E. Frick (1♂ 1♀, USNM; 3♂ 5♀, CSCA; 1♂ 1♀, UCD), San Jose, 23.x.1928 (5♂ 5♀, EMEC). *Liriomyza dianthi*: Holotype, **USA. California: San Mateo Co.**, Redwood City, 3.xii.1956, H. Sciaroni, ex. leaf of carnation, *Dianthus caryophyllus*, L. (1♂, CASC); Paratypes examined, **USA. California: Santa Clara Co.**, Redwood City, xii.1956, R.H. Sciaroni, carnations (1♀ 1?, EMEC).

Additional material examined. USA. California: 436♂ 656♀ 23? [CASC, CSCA, CNC, EMEC, SBMN, UCD, UCR, USDA, USNM].

Comments. See comments for *Liriomyza huidobrensis*.

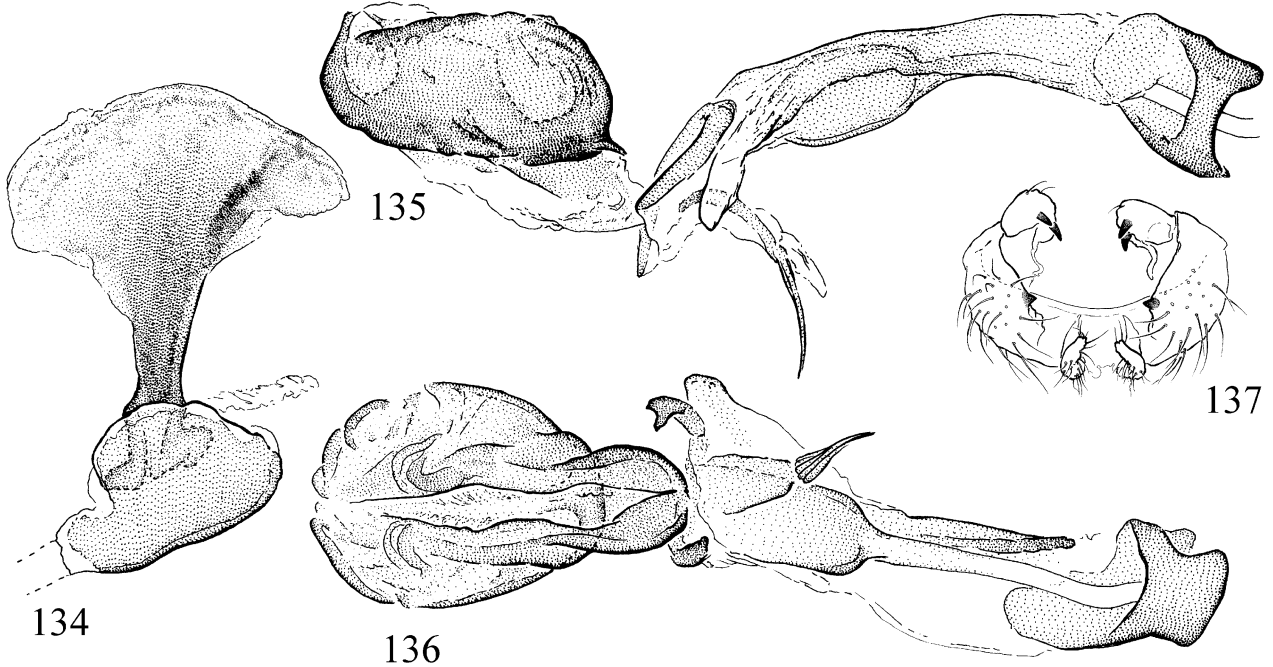
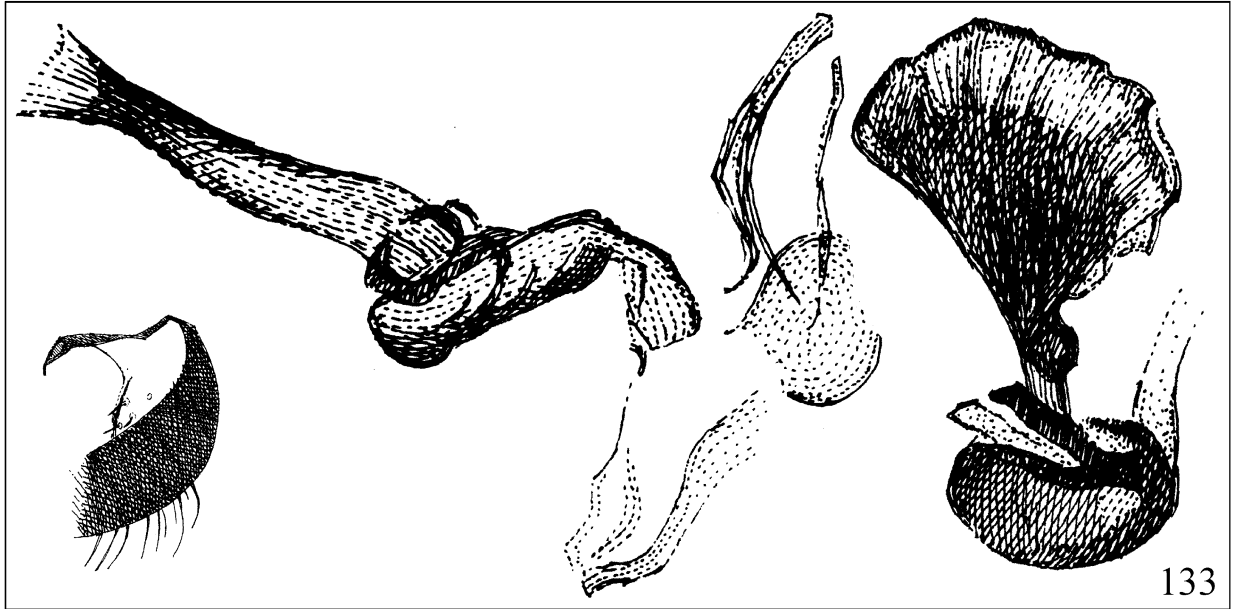
Liriomyza lathyroides (Spencer)

Figs 132, 133

Amauromyza (*Annimyzella*) *lathyroides* Spencer 1981: 145. Spencer & Steyskal 1986: 83.

Amauromyza lathyroides. Spencer 1990: 131.

Liriomyza lathyroides. Zlobin 1996: 277.



FIGURES 132–137. Figs 132–135: *Liriomyza lathyroides* (Spencer), male genitalia; 132: CASC paratype, phallus, ventral; 133: USNM holotype, from original figure in Spencer (1981), left half of epandrium (ventral), phallus and ejaculatory apodeme. Figs 134–137: *L. lupinella* Spencer, male genitalia; 134: ejaculatory apodeme; 135: external components, ventral; 136: phallus, left lateral; 137: phallus, ventral.

Wing length 2.2mm (♂) (recorded as 2.0mm in Spencer (1981)), 2.3mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.0. Eye height divided by gena height: 4.2. Scutum subshining. Epistoma large. Parafacial and orbital plate strongly projecting.

Chaetotaxy: Three ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. Head yellow with back of head, posterior margin of frons, ocellar triangle, orbital plate, antenna, face, clypeus and lower margin of gena dark brown; oblique region encompassing vertical bristles brown. Remainder of body dark brown with postpronotum (excluding large dark anteromedial spot), notopleuron and apices of femora yellow, with apex of hind femur more narrowly and faintly yellow.

Genitalia: Figs 132, 133. Epandrium without spine. Surstylus relatively narrow, broadly rounded apically and with one subapical spine. Basiphallus comprised of one pair of slightly diverging bars. Apical swollen section of ejaculatory duct wide, broadly ovate. Hypophallus weakly sclerotized medially, enclosing base of well developed tuft of hairs; right lateral surface of membranous region lightly sclerotized, left lateral surface with small, irregularly sclerotized patches. Distiphallus with long basal stem (possibly homologous with mesophallus) strongly bent at midpoint and widening to broad medial recurved region with ventral suture enclosing dark thin bar; apically with one pair of long, dark tubules formed from hairs. Ejaculatory apodeme large, dark and well developed with distal half of blade paler, excluding lightly striated apical margin; base of duct and *pileus ejaculatorius* dark and well sclerotized, nearly encompassing stem.

Hosts. Fabaceae—*Lathyrus vestitus*; likely other *Lathyrus* spp. (Spencer, 1981).

Range. USA. California (Alameda, Amador, Contra Costa, Marin), Oregon.

Type material. Holotype, USA. California: Alameda Co., east end of Caldecott Tunnel, 18.v.1977, on *Lathyrus vestitus*, K.A. Spencer (1♂, USNM) [Not examined]; Paratype examined, USA. California: Marin Co., Mill Valley, 360', FT, 1–6.viii.1966, P.H. Arnaud, Jr. (1♂, CASC).

Comments. *Liriomyza lathyroides* is an unusually dark species, with the face, antenna, orbital plate, pleuron and the entirety of the scutellum dark brown. This, combined with three pairs of ori, a large pronounced epistoma, a projecting orbital plate and parafacial, and an elongate dark, bifid distiphallus readily characterize the species. Similar taxa belong to the genus *Amauromyza* Hendel (the genus in which it was originally described), particularly *A. remus* Spencer, but these species have differing notal and cephalic chaetotaxy, an entirely dark notum and do not have the apically swollen ejaculatory duct typical of *Liriomyza*.

Liriomyza lupinella Spencer

Figs 134–137

Liriomyza lupinella Spencer 1981: 244. Spencer & Steyskal 1986: 118.

Wing length 1.4–2.0mm (♂), 1.8–2.0mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.2. Eye height divided by gena height: 3.8–4.0. Scutum shining. Epistoma relatively broad. Parafacial and orbital plate very slightly projecting.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. First flagellomere brown with base faded to yellow or orange along basal margin, rarely entirely yellow (see variation); pedicel and scape brownish when first flagellomere darker; posterolateral corner of frons dark brown to base of inner vertical bristle; lateral margin of frons brown with stripe extending to encompass base of fronto-orbitals, with extensions faint or sometimes not reaching ori; back of head, posterior margin of frons, ocellar triangle and ventral stripe on gena dark brown; face brown, sometimes only medially; palpus brownish, becoming darker apically. Scutum with lateral yellow stripe light brown postsuturally and nearly faded posteriorly; scutellum with wide to narrow central yellow stripe; laterotergites brown. Pleuron dark with only dorsal suture of meron and dorsal suture (or just anterodorsal margin) yellow. Legs dark brown with knees narrowly yellow; distal ½–2/3 usually with yellow tint and fore femur sometimes with disventral surface distinctly yellow; infrequently with femora fading to yellow distally or femora predominantly yellow with base and dorsal streaking brown. Abdomen dark brown with thick yellow band on posterior margin of female tergite 6.

Genitalia: Figs 134–137. Surstylus with two subapical spines. Swollen apical section of duct relatively short. Paraphalli rod-like, fused dorsally. Hypophallus with compressed basal section and long apical hairs. Mesophallus flattened, fused to distiphallus. Distiphallus directed dorsally, broad, short, ovate in ventral view and with one pair of short internal processes. Ejaculatory apodeme with *pileus ejaculatorius* broad and evenly sclerotized; blade with sublateral sclerotization, margin irregular and pale, with light submarginal streaking.

Variation: One female paratype (ex. *Lupinus variicolor*) with first flagellomere entirely yellow. Legs with strong yellow streaking (primarily along distoventral surface), abdomen yellow anterolaterally and stripe on venter of gena faint. Material from El Toro differs as follows: femora relatively pale with distoventral surface yellow; first flagellomere dark yellow and pedicel and scape yellow; face yellow; orbital plate only brownish around base of fronto-orbitals; dorsal margin of anepisternum entirely yellow; lateral margin of scutum yellow with brownish tint postsuturally; anatergite sometimes paler lateral to scutellum.

Hosts. Fabaceae—*Lupinus variicolor*, *L. pratensis*, probably *L. arboreus*, *L. latifolius*, *L. variicolor* and likely other *Lupinus* spp.

Range. USA. California [Alameda*, Del Norte*, El Dorado, Humboldt*, Kern*, Marin, Monterey*, Orange*, Riverside*, San Francisco, San Luis Obispo, San Mateo, Santa Barbara*, Santa Cruz, Sonoma*, Ventura], Washington*.

Type material. Holotype, **USA. California: Santa Cruz Co.**, Mt. Hermon, ex. larva on *Lupinus variicolor*, 21.vii.1948, Lot 49-1, K.E. Frick (1♂, CASC); Paratypes examined, **USA. California: Marin Co.**, Pt. Reyes, 26.v.1957, J. Powell, *Lupinus* (1♂, EMEC), **San Francisco**, 28.x.1925, Pres. by E. Walther, leaves *L. arboreus* (1♀, CASC), San Francisco, 28.x.1925, Pres. by E. Walther (1♂, CASC), San Francisco, 31.x.1925, H.H. Keifer, *L. arborius* Leprd. Galls (1♂, CASC), **San Luis Obispo Co.**, Morrow Bay, 30.iv.1962 (1♂, EMEC), **San Mateo Co.**, Halfmoon Bay, 11.vii.1950, E.C. Carlson (2♂, UCD), **Santa Cruz Co.**, Mount Hermon, 29.vi.1948, sweeping *Lupinus latifolius* Agardh., Lot No. 51-1, K.E. Frick (1♀, CASC), Mount Hermon, sweeping *Lupinus variicolor* Steud., Lot No. 49-1, 21.vii.1948, K.E. Frick (1♀, CASC), **Ventura Co.**, Ventura, 1.vii.1959, W.A. Steffan (1♂ 13, EMEC).

Additional material examined. USA. California: Alameda Co., Berkeley, “*Agromyza scutellata*”, 18.iii.1924, Lupine [illegible], W.W. Jones (1♀, EMEC), **Del Norte Co.**, 28.vi.1972, 5mi N Crescent City, G. Steyskal (12♂, USNM), **Humboldt Co.**, Arcata Lanphere-Christensen Dunes Preserve, 6m, 12.viii.1980, T.W. Davies (1♂, CASC), **Kern Co.**, Arvin, 14.iii.1935, A.L. Melander (1♂, USNM), **Marin Co.**, Dillon Beach, 26.x.1969, M. Wasbauer (2♂, CSCA), McClure’s Beach, 8.vii.1961, C.A. Toschi (1♀, EMEC), Pt. Reyes, 19.i.1958, D.J. Burdick (1♀, EMEC), **Monterey Co.**, Asilomar, 2.x.1946, A.L. Melander (1♂ [on pin with *L. langei*], USNM), **Orange Co.**, El Toro, 23.vi.1963, E.R. Oatan (3♂ 4♀, USNM), **Riverside Co.**, R.R. Cyn., 4mi E Elsinore, 17.iv.1965, J. Powell (1♀, EMEC), **San Francisco Co.**, Yerba Buena Id., 2.vi.1980, J. Powell, *Lupinus arboreus* (1♂, EMEC), **San Luis Obispo Co.**, Oso Flaco Lake, 5mi S Oceano, 18.v.1965, R.L. Langston (1♂, EMEC), **San Mateo Co.**, South San Francisco, 3955 Reston Court, 140m, 27.viii.1979, P.H. Arnaud, Jr. (1♂, CASC), **Santa Barbara Co.**, UC Coal Oil Pt. Reserve, 34.4105°N, 119.8798°W, Malaise, M. Caterino & A. Borrell, 10–17.iii.2003 (1♀, SBMN), **Sonoma Co.**, Bodega Bay, 19.x.1947, W.W. Wirth (1♂, USNM), Bodega Head, 25.vi.1971, I.A. Boussy (1♂ 2♀, CASC), **Ventura Co.**, San Nicolas Island, Celery Canyon, 100’, 22–26.vi.1976, A.S. Menke, D.R. Miller & R.W. Rust (1♂, USNM), **Washington:** Seattle, 16.v.1963, Harbor Id., S. Nakahara, Lupine (7♂ 6♀, USNM).

Comments. As seen for other widespread Californian species, *Liriomyza lupinella* exhibits much more external variation than previously assumed, but the males of all populations possess the same genitalic morphology: there are two spines on the surstylus, the mesophallus is fused to the distiphallus, and the distiphallus is quite broad, dark and donut-shaped with a short fringed medial process. Similar terminalia are seen in *L. lupini*, also a specialist on lupine, but the distiphallus is broader, shallower and nearly transparent.

Other Nearctic *Liriomyza* on lupine include the polyphagous *L. langei* and *L. sativae*, and the Fabaceae specialists *L. baptisiae* and *L. lupiniphaga*. *Liriomyza baptisiae* (also bound on *Baptisia*) can be diagnosed by an entirely dark antenna, a yellowish fore knee, a small gena, a very broad ejaculatory apodeme and a dark distiphallus with one pair of small longitudinal distoventral plates and one pair of thin transverse basoventral plates. *Liriomyza lupiniphaga* is an uncommon species with a dark first flagellomere and a paler scape and pedicel, a dark thorax (notopleuron and stripe on scutellum yellow), legs and orbital plate, the length of the mesophallus is twice its width, and the distiphallus is dark, globular and angled dorsally. Label data also has *L. artemisiae* collected on lupine, but it is uncertain as to whether this represents a rearing record or a casual adult association.

Liriomyza lupini Spencer

Figs 138–141

Liriomyza lupini Spencer 1981: 247. Spencer & Steyskal 1986: 121.

Wing length 1.5mm in holotype, 1.8–2.1mm in non-types (♂), 1.9–2.2mm (♀). Length of ultimate section of vein Cu₁ divided by penultimate section: 1.6 (holotype), 2.2–2.4. Eye height divided by gena height: 3.8–4.2. Scutum subshining with light dusting of pruinosity.

Chaetotaxy: Two ori (sometimes only one on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. First flagellomere with distal 1/3–1/2 dark yellow to brownish, palpus brownish, and clypeus, ocellar tubercle and back of head dark brown; posterolateral corner of frons dark brown to base of inner vertical bristle, sometimes paler between base of vertical bristles. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite yellow dorsally lateral to scutellum. Anepisternum yellow with thin posteromedial vertical stripe and broad transverse stripe that becomes narrower posteriorly; anepimeron with brown streaking; dorsal ¼ of meron and katepisternum yellow, with katepisternal bristle surrounded by yellow. Legs yellow with fore coxa brown at base, mid coxa mottled brown or only brown basally and hind coxa brown on dorsal half; femora brown basally, and tibiae and tarsi dark brown; fore femur sometimes with dorsolateral mottling on distal 1/3. Abdomen dark brown with lateral margin of tergites thinly yellow and posterior margin thinly to broadly yellow; tergite two sometimes with central yellow line.

Genitalia: Figs 138–141. Surstylus with two subapical spines. Paraphallus absent. Hypophallus well developed. Mesophallus longer than wide, cylindrical and continuous with medial sclerotized process of distiphallus. Distiphallus directed dorsally; with clear, short and very broad donut-shaped basal section with small inner-distal spines and darker, cylindrical medial process. Ejaculatory apodeme with *pileus ejaculatorius* pale and reduced; blade pale apically and narrowing basally, blending with stem.

Hosts. Fabaceae—*Lupinus albicaulis*, *L. latifolius*, *L. pratensis* and probably other *Lupinus* spp.

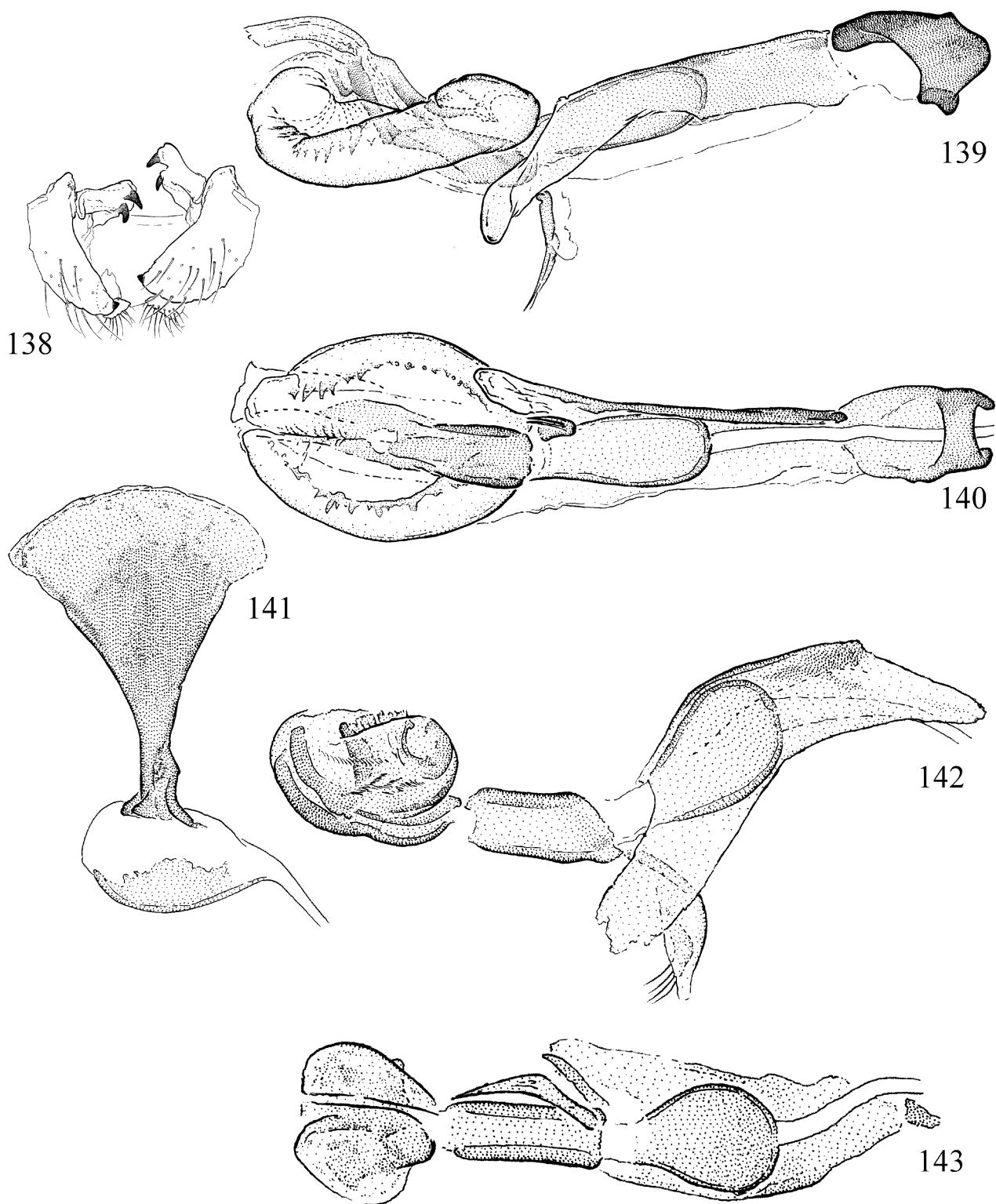
Range. USA. Arizona*, California [Alpine, El Dorado, Fresno, Madera*, Mariposa*[*?], Orange*, Nevada, Santa Cruz, Toulumne*, Trinity].

Type material. Holotype, USA. California: El Dorado Co., Pollock Pines, 14.vii.1948, ex larva on *Lupinus latifolius*, Lot 79-3, K.E. Frick (1♂, CASC); Paratypes examined, USA. California: El Dorado Co., Pollock Pines, 14.vii.1948, ex. larva *Lupinus latifolius* Agardh., Lot No. 79-8, K.E. Frick (2♀ 1♂, CASC), Fresno Co., End, Stump Springs, road to Aspen Mdw., Alt. 6350', W of Huntington Lake, 26.viii.1971, H.B. Leech (1♂, CASC), Summit Luther Pass, 28.viii.1948, ex. larva *Aquilegia truncata* F.&M., Lot No., 97-3, K.E. Frick, "in fact bred from *Lupinus*, labeled in error from *Aquilegia*" (1♂, CASC), Trinity Co., Hayfork Rgr. Sta., 22.v.1973, flight trap, J. Chemsak (1♂, EMEC).

Additional material examined. USA. Arizona: Portal SW Res. Sta., 5–9.vi.1972, W.W. Wirth, Malaise trap (1♂, USNM), Cochise Co., Rustler Park, 9.vi.1972, W.W. Wirth (1♂, USNM), California: El Dorado Co., Pollock Pines, 2.viii.1948, ex. larva *Lupinus latifolius* Agardh., Lot No. 79-3 (1♂ [on slide], CASC), Summit Luther Pass, 28.viii.1948, ex. larva *Lupinus pratensis* Hel., Lot No. 99-1 (3♂ 1♀ [on slide], CASC), Camp Sacramento, 18.vii.1948, sweeping, Lot No. 72-2, K.E. Frick (1♂, CASC), Fresno Co., Bolsillo Creek at Bolsillo Campground, SW of Mono Hot Springs, 8.viii.1975, 2270m, P.H. Arnaud, Jr. (1♂, CASC), Madera Co., upper end Indian Meadow, S slope Green Mt., 7400', 18.viii.1971, Leech (2♂, CASC), Orange Co., "S Fork St Ana R", 28.vii.1942, A.L. Melander (1♂, USNM), Santa Cruz Co., Laurel, 22.viii.1948, sweeping, Lot 136-1, K.E. Frick (1♀, CASC), Toulumne Co., Summit Sonora Pass, 10.viii.1948, sweeping, Lot No. 114-2, K.E. Frick (1♀, CASC), Pinecrest, P.H. Arnaud, Jr., 11.viii.1948 (2♀, USNM), 5.vii.1948 (1♀, USNM), Belle Meadows, 18.viii.1948, P.H. Arnaud, Jr. (2♂ 14♀, USNM).

Tentatively identified females: USA. California: Mariposa Co., Yosemite National Park, Crane Flat, meadow, 1900m, 37°45'22"N, 119°47'50"W, 15.vi.2003, J.&A. Skevington (7♀, CSCA).

Comments. Darker specimens with an entirely brown palpus (one female with palpus yellowish to base), which were likely influential in the construction of Spencer's (1981) original description, have been examined (with one male dissection) and found to be *Liriomyza bellissima*. These CNC specimens from British Columbia, labelled by Spencer as paratypes, were not listed in the original species description.



FIGURES 138–143. Figs 138–141: *Liriomyza lupini* Spencer, male genitalia; 138: external components, ventral; 139: phallus, left lateral; 140: phallus, ventral; 141: ejaculatory apodeme. Figs 142–143: *L. lupiniphaga* Spencer, phallus; 142: left lateral; 143: ventral.

Liriomyza lupiniphaga Spencer

Figs 142, 143

Liriomyza lupiniphaga Spencer 1981: 248. Spencer & Steyskal 1986: 117.

Wing length 1.3–1.4mm (♂), 1.3–1.4mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.5–3.0. Eye height divided by gena height: 3.6–3.8. Scutum subshining.

Chaetotaxy: Two ori, one ors. Acrostichal setulae in three to four rows.

Colouration: Calypter margin and hairs grey. First flagellomere light brown to dark brown; scape and pedicel brownish with ends more yellow; lateral margin of frons dark brown with stripe extending to surround base of ors and sometimes base of posterior ori; posterolateral corner of frons to base of vertical bristles, ocellar triangle, back of head and clypeus dark brown; face brown; ventral margin of gena with light brown stripe. Scutum dark brown with notopleuron yellow and postpronotum brown with darker anteromedial spot; laterotergites dark brown. Pleuron, legs and abdomen dark brown.

Genitalia: Figs 142, 143. Surstylus with single subapical spine. Swollen apical section of ejaculatory duct broad, tapering apically. Left paraphallus sometimes present. Hypophallus well developed. Mesophallus narrow, cylindrical and approximately as long as distiphallus. Distiphallus broad, bowl-like and directed dorsally, enclosing paired, fringed inner structures; with slight anterobasal stem and complete ventral suture. Ejaculatory apodeme large and well-developed with broad blade that becomes paler apically excluding slightly darker marginal band.

Hosts. Fabaceae—*Lupinus albicaulis* and probably other high altitude *Lupinus* spp.

Range. USA. California [El Dorado, Riverside, Trinity], Colorado.

Type material. Holotype, **USA. California: El Dorado Co.**, Snowline Camp, 2.viii.1948, ex. larva on *Lupinus albicaulis*, Lot 79-1, K.E. Frick, Type No. 13939 (1♂, CASC); Paratypes examined, **USA. California: El Dorado Co.**, Camino, 19.vii.1948, sweeping *Lupinus albicaulis* Dougl., Lot No. 74-8, K.E. Frick (2♂ 1♀, CASC), **Riverside Co.**, 4mi SE Keen Camp Summit, 8.vii.1964, E.I. Schlinger (1♂, UCR).

Comments. See comments for *Liriomyza lupinella*.

Liriomyza merga spec. nov.

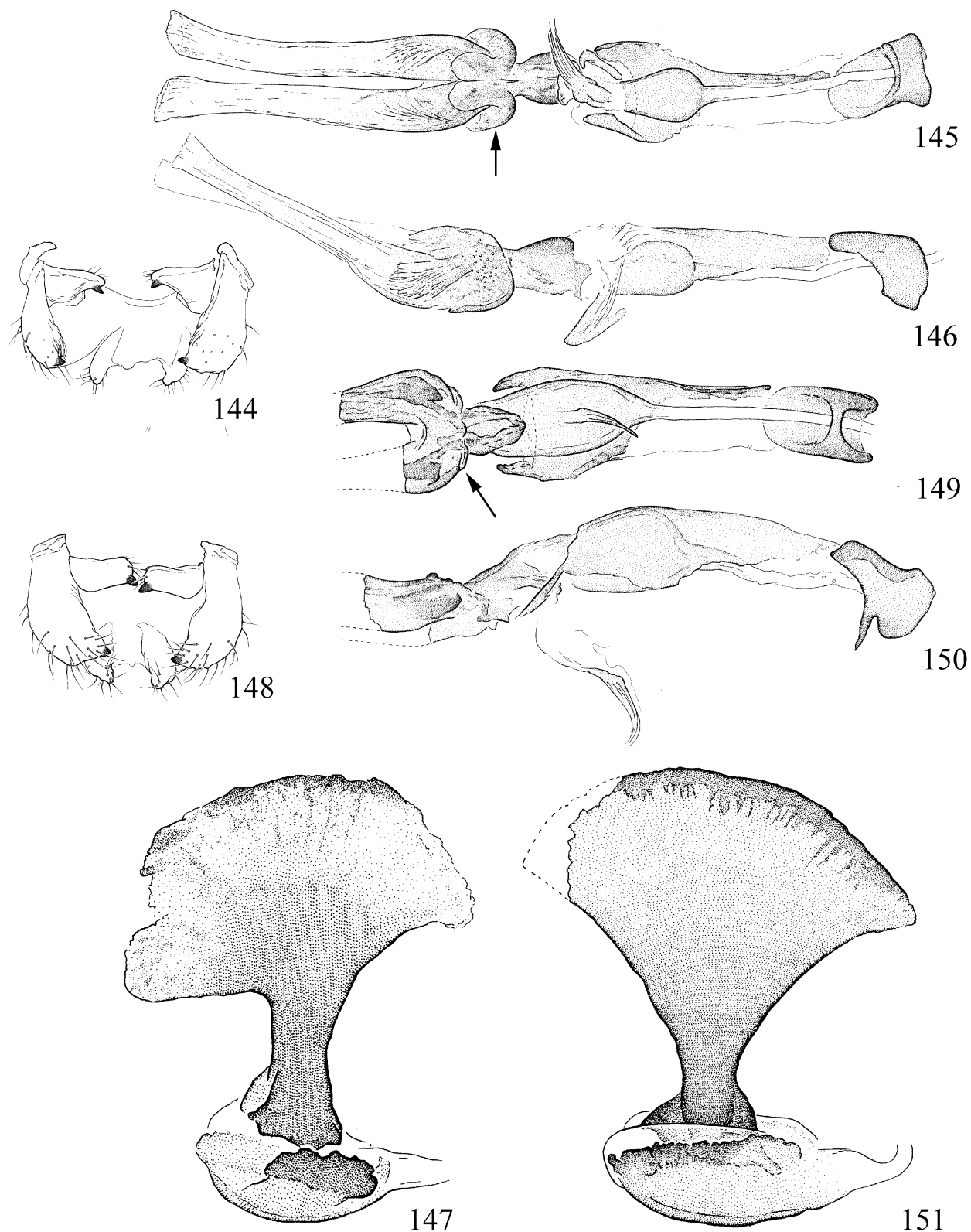
Figs 144–147

Wing length 1.8–1.9mm (♂), 2.3–2.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.3–3.0. Eye height divided by gena height: 2.1–3.4. Scutum lightly dusted with pruinosity. Parafacial, orbital plate and thin cheek pronounced.

Chaetotaxy: Two ori (anterior ori sometimes reduced on one side), one or two ors. Acrostichal setulae in up to four rows, often three or two.

Colouration: Calypter margin and hairs yellow to white. Head light yellow with first flagellomere lemon yellow, clypeus yellow to brown, back of head and ocellar tubercle brown and posterolateral corner of frons with pale spot lateral to outer vertical bristle. Scutum with complete yellow lateral stripe; katatergite brown ventrally; anatergite brown, darker below scutellum and dorsum yellow lateral to scutellum. Anatergite with small oblique stripe in anteroventral corner; anepimeron with mottling and posterior margin brown; meron brown with dorsal margin yellow; ventral ¾ of katapisternum (not including base of bristle) and spot behind bristle brown. Legs yellow with base of coxae brown (widest on hind coxa), base of femora narrowly brown (widest on hind femur and sometimes vestigial on fore femur), hind femur with streaking along scraper, fore tibia sometimes brownish, mid tibia brownish (sometimes paler at base and apex), hind tibia dark brown medially, and tarsi brownish, becoming paler to base. Abdomen brown with posterior margin of tergites narrowly yellow and lateral margin broadly yellow.

Genitalia: Figs 144–147. Surstylus narrowed apically and with one subapical spine. Swollen distal section of duct relatively short with base bulbous. Paraphallus rod-shaped, fused to basiphallus on right side. Hypophallus with base ill-defined and apex with long hairs. Mesophallus narrowed apically, approximately as long as high and partially fused to distiphallus. Distiphallus bifid with base darker and more stout, and with long, clear apical tubules with basolateral striations wrapping around tubule; base of distiphallus surrounded by internally spinulose collar. Ejaculatory apodeme with *pileus ejaculatorius* truncated and dark at ends; stem well-developed and blade broad, sometimes semicircular and with distal margin dark medially.



FIGURES 144–151. Figs 144–147: *Liriomyza merga* **spec. nov.**, male holotype genitalia; 144: external components, ventral; 145: phallus, ventral; 146: phallus, left lateral; 147: ejaculatory apodeme. Figs 148–151: *L. cunicularia* **spec. nov.**, male genitalia; 148: external components, ventral; 149: phallus, ventral; 150: phallus, left lateral; 151: ejaculatory apodeme.

Variation: Male from Glenn Co. with wing length of 1.6mm, eye height divided by gena height 1.8, acrostichal setulae almost entirely absent, pleuron more extensively pigmented and distiphallus approximately $\frac{3}{4}$ as long.

Etymology. The specific epithet is Latin for “two pronged pitchfork”, referring to the shape of the phallus.

Host. Unknown; adult collected on *Veratrum californicum* (Melanthiaceae).

Range. USA. California [Glenn, Mariposa, Placer], Montana, Utah, Washington.

Type material. Holotype, **USA. Washington:** Mt. Rainier, Paradise Park, viii.1917, A.L. Melander (1♂, USNM); Paratypes, **USA. California: Glenn Co.,** Black Butte, 6500-7400', 16.vi.1972, *Veratrum californicum* foliage, S.L. Szerlip (1♂, EMEC), **Mariposa Co.,** Yosemite Park, Glac[ier] P[oin]t R[oa]d, A.L. Melander, 6.vii.1947 (1♀, UCR), 1.vii.1947 (1♀, CSCA), **Placer Co.,** E end Bear Val., 1.vi.1964, P.H. Arnaud Jr. (1♂, CASC), **Montana:** Glacier Park, Grinnell Lake, 24.vii.1935, A.L. Melander (1♀, CSCA), Avalanche Lake, 14.vii.1935 (1♂ 1♀, USNM), A.L. Melander (1♀, USNM), **Utah:** L. Cottonwood Canyon, 8000', 23.vi.1940, A.L. Melander (3♀, USNM, 2♀, CASC), **Washington:** Mt. Rainier, Paradise Park, viii.1917, A.L. Melander (1♂ 1♀, USNM).

Comments. *Liriomyza merga* is a relatively large, pale species with a greyish scutum, almost no pigment on the frons, sometimes only a single ori, and a large, bifid phallus with a basal collar, one pair of ventrobasal plates and laterobasal striations. A number of taxa have a similar phallus and can be confused for this species, including *L. cunicularia*, *L. bella*, *L. parabella*, *L. tubula*, *L. elevata* Spencer and *L. splendens* Spencer. *Liriomyza bella* and the new species *L. parabella* are most easily diagnosed because the scutum is yellow with dark stripes, *L. cunicularia* has a much larger and more robust phallus; all three of these species also lack a basal collar on the distiphallus. *Liriomyza tubula* always has two rows of acrostichal setulae, the outer vertical bristle touches the lateral brown spot, the first flagellomere is subquadrate with the dorsal margin partially brown, the parafacial/orbital plate is most pronounced anterodorsally, the face is sometimes brownish medially, the pleuron and femora are darker and the calypter margin is grey. *Liriomyza elevata* (Colorado) differs in having the first flagellomere orange to brown, the thorax and legs are much darker, the paraphallus is well developed, the basiphallus is flared laterally towards the apex and the distiphallus tubules are strongly bent dorsally at the midpoint. *Liriomyza splendens* (New York) also has an entirely pale calypter, but there are three ori, the outer vertical bristle is surrounded by brown, the femora are entirely light yellow, the ejaculatory apodeme is larger and darker, and the distiphallus is smoother with a basal collar.

Liriomyza minor Spencer

Figs 152–154

Liriomyza minor Spencer 1981: 250. Spencer & Steyskal 1986: 120.

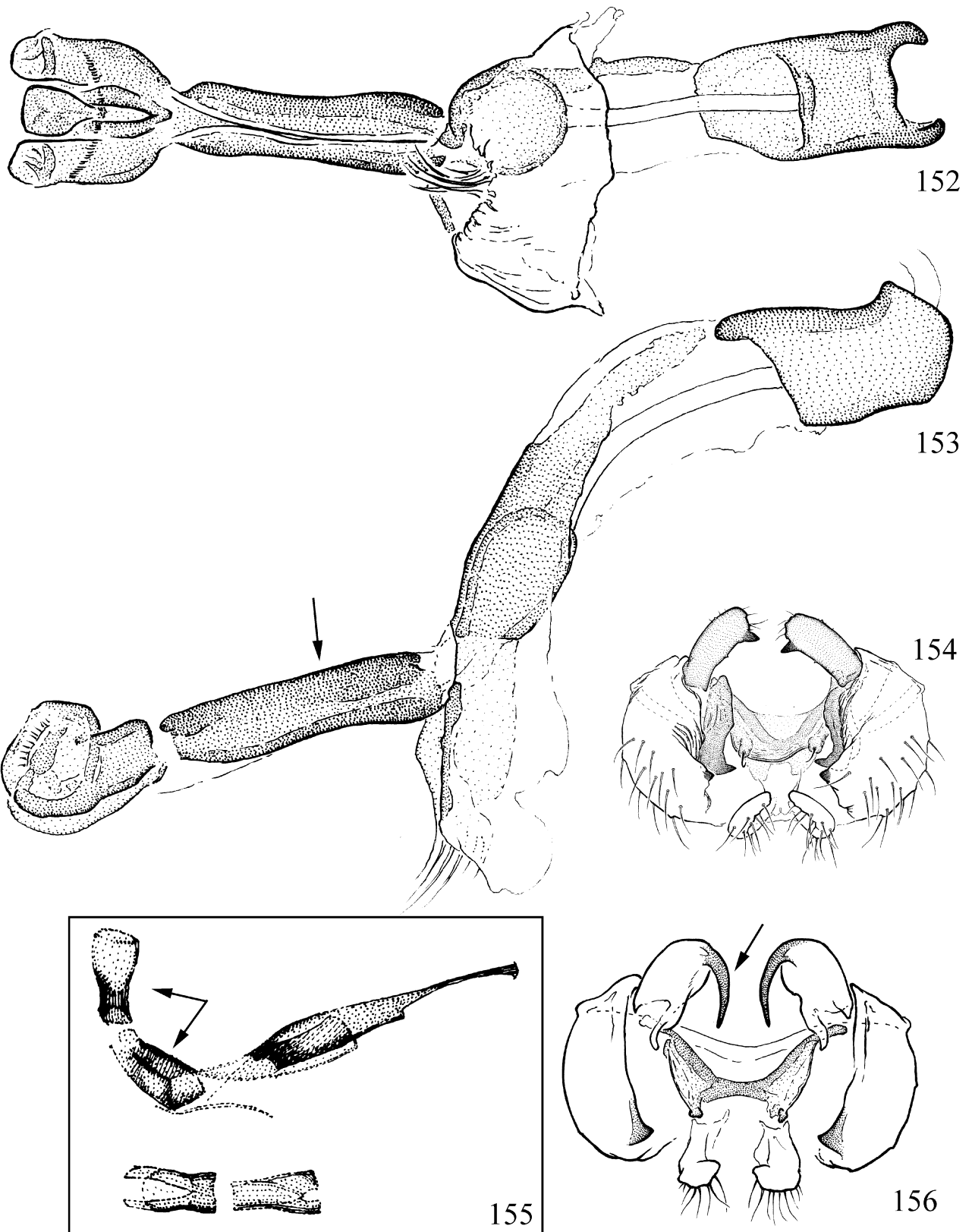
Wing length 1.6–1.7mm (♂), 1.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.3–2.7. Eye height divided by gena height: 2.9–3.7. Scutum lightly pruinose to subshining. First flagellomere relatively large and highest subapically, or only slightly enlarged, ovate and widest near base.

Chaetotaxy: Two ori (sometimes one on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey to brown. First flagellomere brownish-orange, sometimes with basal margin yellow; ocellar triangle, clypeus, back of head and posterolateral corner of frons to base of outer vertical bristle dark brown. Lateral margin of scutum yellow presuturally and slightly yellowish above wing base; katatergite yellowish; anatergite yellowish to light brown dorsally lateral to scutellum (otherwise brown). Pleuron dark brown with dorsal margin of anepisternum, meron and katepisternum yellow; anepisternum sometimes yellowish posteriorly on dorsal 1/3 or with broad oblique brown stripe. Legs dark brown with distal 2/3 of fore coxa, distal 1/2 of mid coxa, base of male fore tibia, apices of femora and sometimes streaking on femora yellow (fore femur mostly yellow in holotype). Abdomen sometimes paler laterally.

Genitalia: Figs 152–154. Surstylus darkly pigmented, thin along length and with one subapical spine. Inner-ventral margin of epandrium (or subapical sclerite?) differentiated into dark ventral plate with terminal spine. Basiphallus slightly elongate and ventrally curved. Swollen apical section of ejaculatory duct short, not much longer than wide. Paraphallus thin and dark, fused to margin of membrane supporting haired hypophallus. Mesophallus dark, cylindrical, narrowed medially, nearly as long as basiphallus and separate from distiphallus. Distiphallus short, enclosing one pair of small fringed processes; bell-shaped in ventral view with shallow longitudinal suture separated by broad apical plate; basal half narrow and stem-like in lateral view. Ejaculatory apodeme with *pileus ejaculatorius* thickly sclerotized and truncated at ends, stem well developed and blade abruptly widened before

midpoint, pointed at corners, with dark apical margin, numerous perpendicular striations, and with several abrupt gradations in pigment near base.



FIGURES 152–156. Figs 152–154: *Liriomyza minor* Spencer, male genitalia; 152: phallus, ventral; 153: phallus left lateral; 154: external components, ventral. Figs 155–156: *L. monoensis* Spencer, male genitalia; 155: holotype phallus, left lateral and ventral, from original figures in Spencer (1981); 156: external components, ventral.

Variation: UCD male differs as follows: first flagellomere ovate and dark yellow with base paler; anepisternum and katapisternum dark with only dorsal margin thinly yellow; femora pale with extensive streaking; tibiae brown (paler on anterior legs) with venter yellow.

Hosts. Unknown.

Range. USA. California [Alpine, Riverside*, Sierra*, Ventura].

Type material. Holotype, USA. California: Alpine Co., Hope Valley, 5.viii.1948, sweeping, Lot 91-12, K.E. Frick, Type No. 13940 (1♂, CASC); Paratypes examined, USA. California: Alpine Co., Hope Valley, sweeping, K.E. Frick, 7.viii.1948, Lot No. 91-20 (2♂, CASC), 8.viii.1948, Lot No. 91-30 (1♀, CASC).

Additional material examined. USA. California: Riverside Co., R.R. Cyn., 4mi E, Elsinore, 13.iv.1965, J. Powell (1♂, EMEC), Sierra Co., Kyburg Flat, 30.vi.1976, J.R. Nixon (1♂, UCD).

Comments. *Liriomyza minor* is a morphologically variable species darker than most other *Liriomyza* (excluding the frons) with an enlarged first flagellomere, and confident identification should only be made following examination of the male genitalia. The surstylus is darker than the epandrium with the sides nearly parallel, there is a dark pronounced plate along the inner-ventral surface of the epandrium, the mesophallus is long, dark and cylindrical, the swollen apical section of the ejaculatory duct is very small, and the distiphallus is small and bell-shaped with a ventral suture separated by a broad plate.

Liriomyza miserabilis spec. nov.

Figs 157–160

Wing length 1.1mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 4.0. Vein dm-cu nearly in line with vein r-m. Eye height divided by gena height: 7.0. Scutum subshining. Holotype in poor condition—most bristles missing and colouration difficult to discern.

Chaetotaxy: Two ors; number of ori indistinguishable. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with back of head, ocellar triangle and posteroventral corner of frons to base of outer vertical bristle brown (lighter between base of verticals). Scutum with complete lateral yellow stripe; posteroventral margin of katatergite brownish; anatergite brown ventral to scutellum and yellow lateral to scutellum with venter brownish. Anepisternum with pale oblique stripe; anepimeron with thin anterior stripe; venter of meron brown; katapisternum with triangular spot on ventral half. Legs yellow with hind tibia brown and fore tarsus becoming brown on apical four segments. Tergites yellow with dorsum brown excluding posterior margin; epandrium brown.

Genitalia: Figs 157–160. Surstylus with strong subapical spine. Paraphallus broad, leaf-like and weakly sclerotized. Hypophallus short and very thin. Distiphallus angled dorsally, with complete ventral suture; base (mesophallus) cylindrical with length twice width and venter weakly sclerotized; distal section darker, slightly wider, enclosing narrow chamber and with inner-distal surface spinulose. Ejaculatory apodeme with ends of *pileus ejaculatorius* pale and broadly rounded; blade relatively small and pale with distal margin slightly darker.

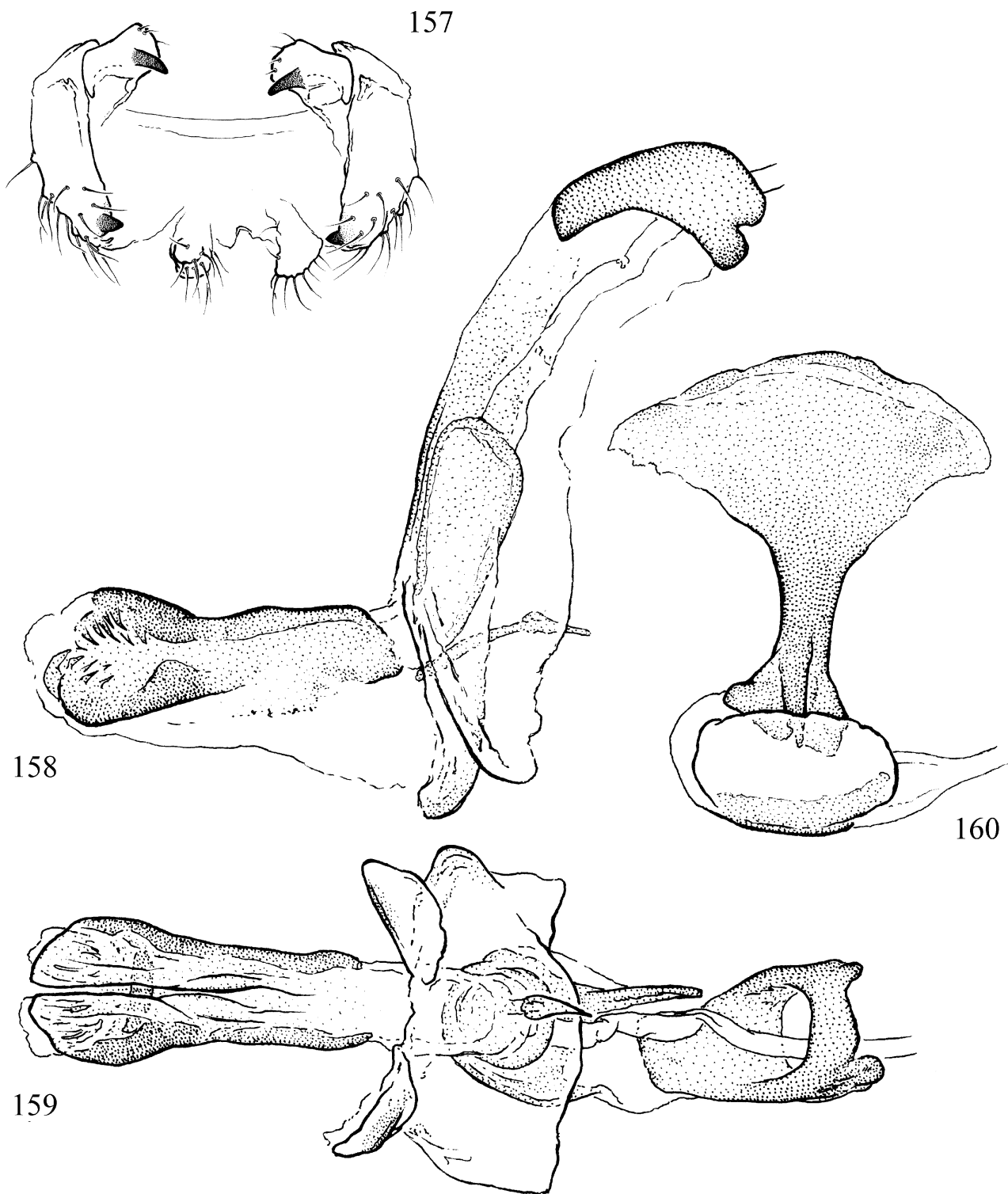
Etymology. The specific epithet, Latin for “pitiable” or “wretched”, refers to the general condition of the holotype.

Host. Unknown.

Range. USA. California [Riverside].

Type material. Holotype, USA. California: Riverside Co., P.L. Boyd Res. Centre 3.5mi S Palm Desert, 6–13.vi.1969, Malaise trap marker -5700, S. Frommer, UCRC ENT 235382 (1♂, UCR).

Comments. The holotype is in poor condition, with most bristles missing and the colour difficult to discern, but the pleuron appears to be almost entirely yellow, and the legs are yellow with the hind tibia brown and the tarsi becoming increasingly brown on the distal four segments. Other distinguishing features of this new species include vein dm-cu being nearly in line with vein r-m, the wing length is only 1.1mm, the *pileus ejaculatorius* is broad but clear, the hypophallus is very thin, the mesophallus is slightly longer than wide and fused to the distiphallus, which has a complete ventral suture, is barely wider than the mesophallus and has numerous inner-distal spines.



FIGURES 157–160. *Liriomyza miserabilis* **spec. nov.**, male holotype genitalia; 157: external components, ventral; 158: phallus, left lateral; 159: phallus, ventral; 160: ejaculatory apodeme.

***Liriomyza monoensis* Spencer**

Figs 155, 156

Liriomyza monoensis Spencer 1981: 251. Spencer & Steyskal 1986: 125.

Wing length 1.5mm (♂), 1.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.6. Eye height divided by gena height: 3.5–4.9. Scutum shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs greyish-brown. First flagellomere dark yellow, pedicel and scape slightly brownish; posterolateral corner of frons dark to base of outer vertical bristle and brown to region surrounding inner vertical; brown stripe from posterior margin of frons to base of posterior ors and faint stripe to base of anterior ors; back of head, clypeus and ocellar triangle dark brown. Scutum with complete yellow lateral band; laterotergites dark. Pleuron dark with dorsal suture of katapisternum and anepisternum yellow. Fore coxa brownish with basal half darker, mid and hind coxae brown and tibiae and tarsi dark brown; femora yellow with base brown, fore femur with dorsal mottling on basal ½–2/3 or with faint dorsal mark at 2/3 length.

Genitalia: Figs 155, 156. Surstylus with single thin, elongate, curved ventroapical spine. From illustration in Spencer (1981): mesophallus and distiphallus separate, cylindrical, subequal in length and width, with combined length approximately that of basiphallus; mesophallus slightly narrowing apically; distiphallus with ventral suture, basal half darker and distal half enclosing narrow, smooth chamber.

Host. Unknown.

Range. USA. California [Mono, Siskiyou*].

Type material. Holotype, USA. California: Mono Co., 7mi E of Tioga Pass, 15.vii.1961, G.I. Stage, Type No. 14063 (1♂, CASC); Paratype, USA. California: Mono Co., same collection as holotype (1♀, EMEC).

Additional material examined. USA. California: Siskiyou Co., Bear Basin, 7000', 9.viii.1967, L. Eighme (1♂, CASC).

Comments. The terminalia are most characteristic for this species—the spine on the surstylus is apical, curved and very elongate, and the mesophallus and distiphallus are thin, cylindrical and subequal in length. The distiphallus of the holotype was largely destroyed during the original dissection, and as such, has not been reillustrated here. The figure provided is from the original publication (Spencer 1981). The only other known male was dissected to find the phallus missing.

Liriomyza montana Sehgal

Figs 161–164

Liriomyza montana Sehgal 1968: 67. Spencer 1969: 179.

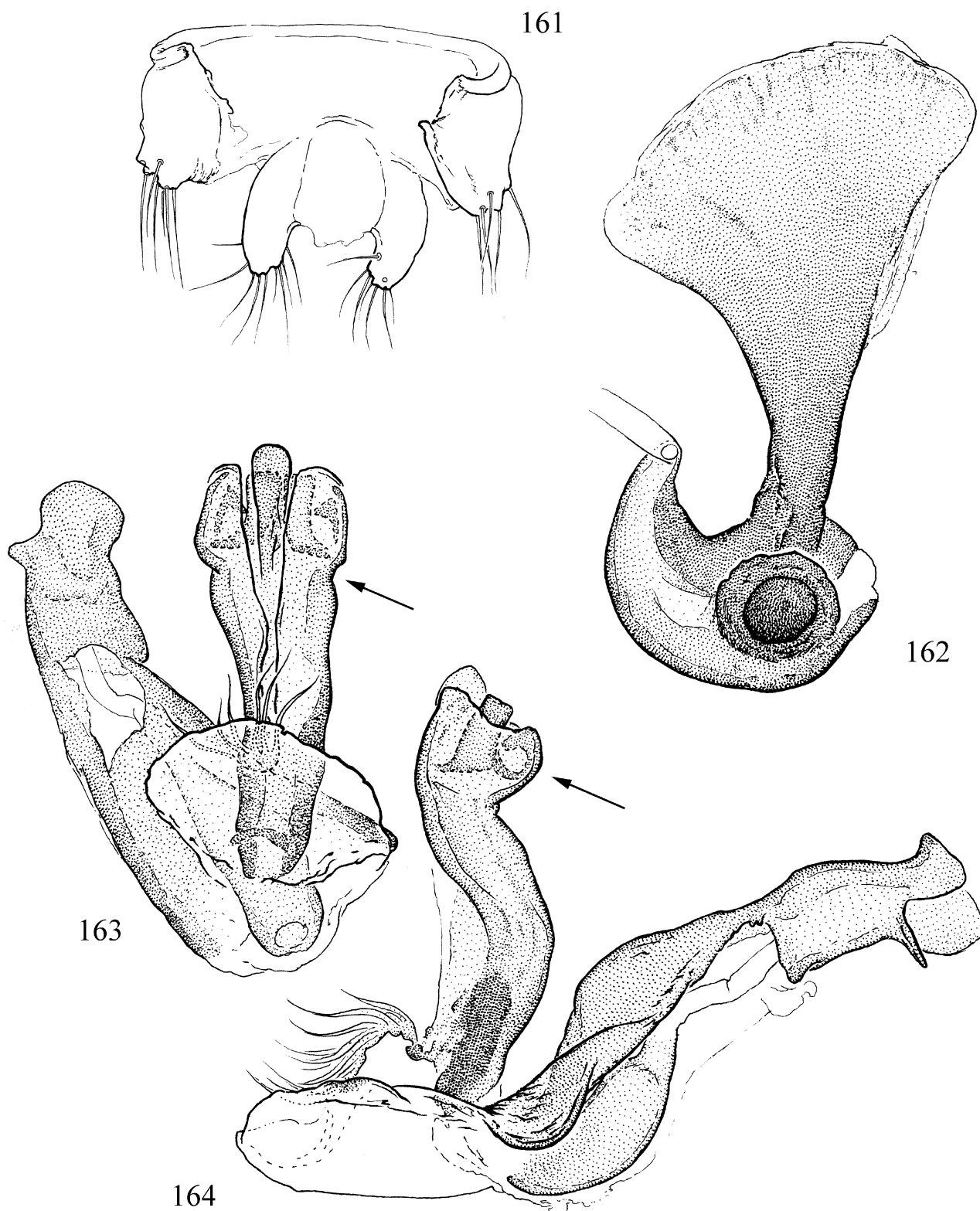
Wing length 2.0–2.7mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 1.8–2.3. Eye height divided by gena height: 4.5–5.8. Scutum shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with first flagellomere yellow, ocellar tubercle and back of head brown, clypeus yellow or slightly brownish, and posterolateral region of frons brown excluding base of vertical bristles (thin brownish stripe sometimes present between verticals, outer base of inner vertical sometimes deep yellow to brownish, or outer vertical encompassed by brown spot excluding yellow spot at base of bristle). Scutum dark brown with complete yellow lateral stripe that sometimes extends partially along posterior margin; katatergite yellow; anatergite brown, becoming yellow lateral to scutellum dorsally and darker beneath scutellum. Anepisternum yellow with faint to broad oblique stripe and sometimes posteroventral margin brown; anepimeron with faint to distinct mottling; meron brown with dorsal and sometimes anterior margins yellow; katapisternum brown on ventral ¾ (not encompassing base of bristle) or with large triangular ventral spot. Legs yellow with base of coxae brown, base of femora sometimes brownish (sometimes only dorsally, and/or with pigment faded on fore and mid legs), scraper on hind femur sometimes brown, fore tibia brownish, becoming paler to base, mid tibia similar but slightly darker, hind tibia brown (sometimes yellow at base and apex), and tarsi brown, becoming paler to base; Canadian material with additional brownish striations on femora. Broad lateral yellow margin on abdominal tergites becoming wider anteriorly, and posterior margin of tergites thinly yellow; epandrium light brown.

Genitalia: Figs 161–164. Spines on surstylus and epandrium absent. Basiphallus fused to phallosorus and with lateral margins and dorsum sclerotized, excluding basomedial fossa. Swollen distal section of ejaculatory duct with ventral curve. Paraphallus absent. Hypophallus surrounded ventrally by broad membranous lobe, with con-

stricted base fused to venter of distiphallus and with long fringe of hairs. Mesophallus indistinct. Distiphallus long, strongly angled dorsally, with ventral suture (broadly separated by thin plate apically), with slight bend at midpoint and with small apical bowl surrounding thin, dark paired medial processes; bowl barely wider than stem. Ejaculatory apodeme with ends of *pileus ejaculatorius* dome-like with long apical process; base of stem broad, gradually widening into blade; base of duct broad and sclerotized; blade with light marginal sclerotizations.



FIGURES 161–164. *Liriomyza montana* Sehgal, male genitalia; 161: external components, ventral; 162: ejaculatory apodeme; 163: phallus, ventral; 164: phallus, left lateral.

Host. Unknown, likely Poaceae.

Range. USA. California [Kern*, Riverside*]. **Canada.** Alberta.

Type material. Holotype, **CANADA. Alberta:** Jasper, 17.vi.1966, V.K. Sehgal (1♂, CNC); Paratype examined, **CANADA. Alberta:** Same collection as holotype (1♂, CNC).

Additional material examined. USA. California: Kern Co., Fort Tejon State Park, 5.iv.1980, P.H. Arnaud, Jr. (1♂, CASC), **Riverside Co.,** Riverside, 5.v.1935, A.L. Melander (1♂, USNM).

Comments. Aside from being considerably paler than its Nearctic relatives, the distiphallus of *Liriomyza montana* is also considerably thinner with the apical bowl barely wider than the stem. Since the vertical bristles are sometimes entirely surrounded by yellow and the “*L. septentrionalis*” type abdominal pattern is difficult to distinguish, this species comes out in multiple places in the key. The holotype collection locality was incorrectly stated in Spencer (1969) (“Banff, 28.vi.1966”). See comments for *L. graminaceae*.

Liriomyza nebulosa spec. nov.

Figs 3, 165–168

Fig. 3. Wing length 2.2mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.0. Eye height divided by gena height: 3.4. Scutum subshining. Cheek distinct.

Chaetotaxy: Three ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. Wing with brownish infuscation that is slightly darker along veins. Head light yellow with back of head, clypeus and ocellar triangle dark brown; posterolateral corner of frons dark brown to level of outer vertical bristle (with small yellow spot extending laterally from base of bristle) and brown to base of inner vertical; lateral margin of frons brownish (darker posteriorly) with broad extensions reaching base of fronto-orbitals; venter of gena with brown stripe that fades posteriorly; face brownish with lateroventral region darker. Scutum with complete lateral yellow stripe; katatergite yellow with posteroventral corner brown; anatergite dark brown below scutellum and brown lateral to scutellum with dorsum yellowish. Pleuron dark brown with dorsal ¼ of anepisternum yellow, anepimeron with light yellow mottling medially, and katepisternum with dorsomedial margin yellow and posterodorsal corner light brown. Legs brown with femora apices yellowish (pronounced on fore femur), fore femur with yellow streaking, mid and hind femora with faint yellowish mottling and tarsus becoming paler to base. Abdomen brown.

Genitalia: Figs 165–168. Surstylus relatively broad with several apical setae and one small subapical spine. Ejaculatory apodeme large, heavily pigmented and with base of duct stout and dark; *pileus ejaculatorius* narrow, heavily sclerotized and strongly projecting; blade relatively undeveloped with limited apical striations. Basiphallus extremely long and thin, flared apically, with anterodorsal surface and distolateral margin weakly sclerotized. Paraphallus thin and angled apically. Hypophallus with long, well developed hairs and weakly pigmented base. Mesophallus cylindrical, fused to distiphallus and with length nearly three times width; mesophallus and distiphallus with complete ventral suture. Distiphallus bowl-shaped, slightly more than twice width of mesophallus and with one pair of short projecting structures (largely pale excluding irregular internal sclerotized structures on basal 2/3).

Etymology. The specific epithet is Latin for “cloudy”, referring to the infuscated wings of this species.

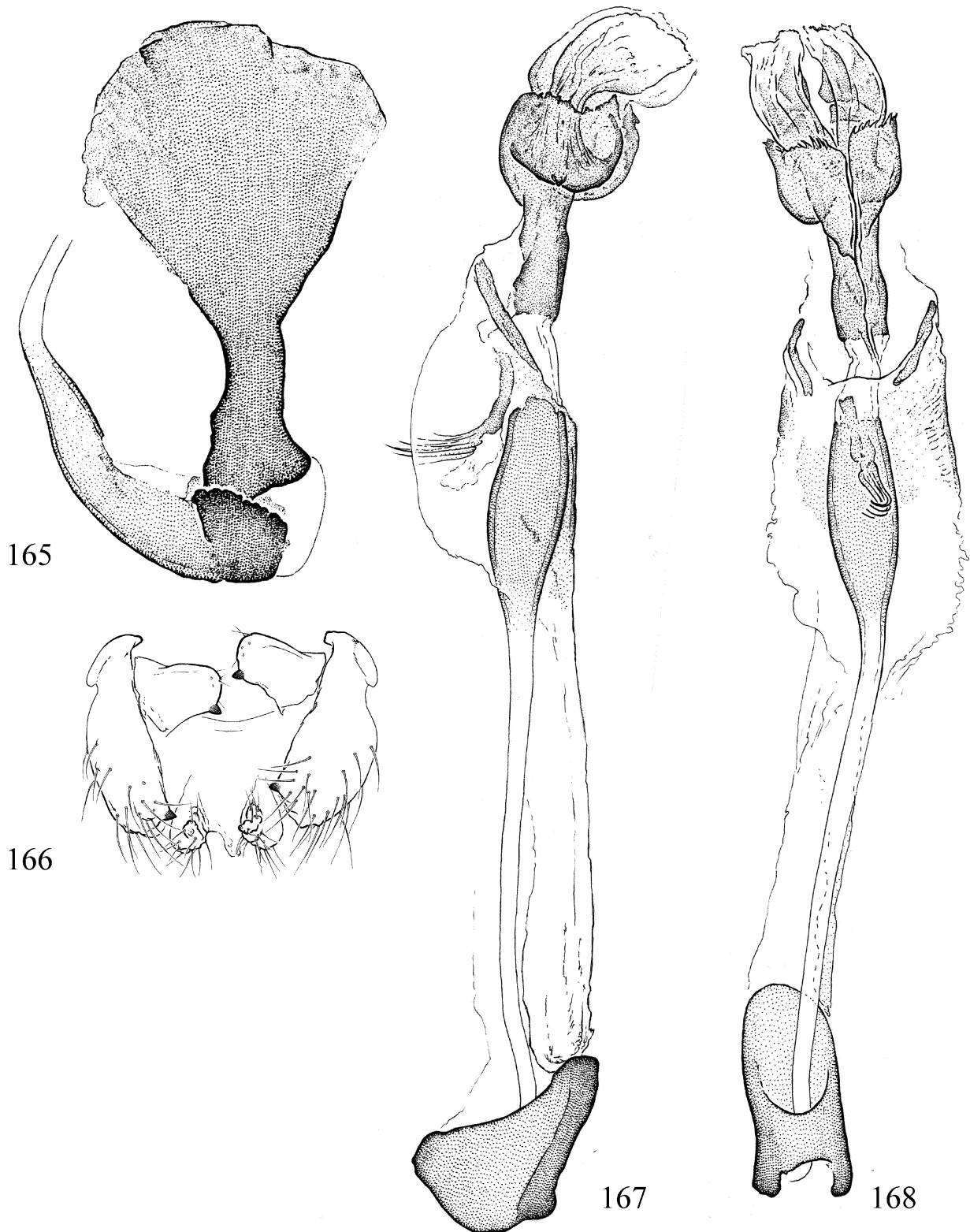
Host. Unknown.

Range. USA. California [Del Norte].

Type material. Holotype, **USA. California: Del Norte Co.,** Six Rivers NF For Route 16N02, nr. Bear Basin Outlk, 41.8016N, 123.7369W, 1500m asl, 3.vi–24.vii.2009, Malaise trap, P. Kerr & O. Lonsdale (1♂, CSCA).

Comments. *Liriomyza nebulosa* is most obviously characterized by lightly infuscated wings (entirely clear in other Californian *Liriomyza*), but it also has a brownish face that is darker laterally, five pronounced fronto-orbitals and a thin, elongate phallus similar to that of *L. chemsaki* (California), *L. smilacinae*, *L. pulloides* Spencer (Colorado) and the entirely yellow *L. flavicola*. *Liriomyza chemsaki* differs in having a much higher gena (eye only 1.8 times higher), paler colouration (distal 1/3 of coxae yellow, slightly paler femora and a much paler head and pleuron), a thinner surstylus and blade on the ejaculatory apodeme, a much shorter basiphallus, a longer and thicker mesophallus, and the basal bowl of the distiphallus is larger. *Liriomyza smilacinae* has reduced acrostichal setulae, both vertical bristles surrounded by yellow, there is an entirely white calypter, a projecting yellow parafacial and orbital plate, and an incredibly large, globose distiphallus. *Liriomyza pulloides* differs in having a predominantly

yellow orbital plate (base of fronto-orbitals with narrow infuscation), two rows of acrostichals, a grey pruinose scutum, a wing length of 1.6mm, three ori and one ors, a higher gena (eye 2.5 times height of gena), a darker pleuron and a yellow face. The elongate phallus of *L. nebulosa* also suggests a relationship with the Colombian *L. chiensis* Spencer, an unusual lightly-pigmented species with approximately eight rows of acrostichal setulae and no spine on the surstylus (Spencer 1984).



FIGURES 165–168. *Liriomyza nebulosa* spec. nov., male holotype genitalia; 165: ejaculatory apodeme; 166: external components, ventral; 167: phallus, left lateral; 168: phallus, ventral.

Liriomyza nigriscutellata Spencer

Figs 169–174

Liriomyza nigriscutellata Spencer 1981: 253. Spencer & Steyskal 1986: 108.

Wing length 1.4mm (♂), 1.6mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.6–3.0; vein dm-cu sometimes absent. Eye height divided by gena height: 4.2–4.8. Epistoma distinct. Scutum subshining. First flagellomere enlarged, truncated apically and sometimes with dorsoapical corner slightly pointed. Orbital plate and parafacial slightly projecting anteriorly.

Chaetotaxy: Two ori, two ors; sometimes appearing as three ori and one ors. Acrostichal setulae in two rows.

Colouration: Calypter margin and hairs light grey to yellow. Distal 2/3 of first flagellomere brownish (paratype), lightly infuscated (holotype) or entirely yellow; posterolateral corner of frons dark brown to base of inner vertical bristle (region between base of vertical bristles paler in holotype), and with thin brown line along posterior margin of eye; lateral margin of frons with thin brown line that extends to base of posterior ors in all specimens, and very faintly to base of anterior ors and posterior ori in all specimens excluding holotype; ocellar triangle and back of head dark brown (with brownish connection); clypeus dark brown; ventral margin of gena with light brownish stripe that fades posteriorly; face brownish in holotype; tip of palpus sometimes slightly infuscated. Thorax dark brown with notopleuron yellowish posterolaterally (palest along transverse suture); types with relatively small light yellow spot on notopleuron, postpronotum brown with margins yellow (venter more broadly yellow in holotype) and holotype with region immediately behind transverse suture light yellow; centre of scutellum yellowish. Legs dark brown with femora yellowish apically (palest on fore femur) and tarsi paler to base. Abdomen dark brown.

Genitalia: Figs 169, 170. Surstylus thin and with single subapical spine. Swollen apical section of duct only slightly narrowed at ends. Paraphallus membranous. Hypophallus curved with long apical hairs. Mesophallus slightly longer than wide, cylindrical, slightly narrowed apically and fused to distiphallus. Distiphallus with dark bulbous base (inner surface with several small spinules) and with clear apical tubules; base of tubules continue ventrally along bulb, becoming darker and thinner. Ejaculatory apodeme with *pileus ejaculatorius* darker laterally, stem relatively long and thin and blade small and pale with slightly darker submarginal band.

Variation: Material from Darwin Falls (Figs 171–174) and Wister differ as follows: eye height divided by gena height 5.0–5.7; calypter margin yellow; orbital plate entirely yellow or only dark to level of anterior ors; epistoma indistinct; base colour of postpronotum and sometimes notopleuron light brown; scutum shining; base of all tibiae yellow; tubules on distiphallus with base more strongly arched to meet apex of dark, heavily spinulose dorsobasal dome.

Host. Unknown; adult[?] collected on *Bebbia juncea* (Asteraceae).

Range. USA. California [Imperial*, Inyo*, Riverside, San Bernardino, San Luis Obispo*, Santa Barbara*].

Type material. Holotype, USA. California: Riverside Co., P.L. Boyd Desert Research Center, Coyote Creek, 3.5mi S of Palm Desert, 27.iv.1974, J.K. Mollett (1♂, CASC); Paratype, USA. California: San Bernardino Co., 3mi S Kramer Jct., 6.iv.1966 (1♀, UCD).

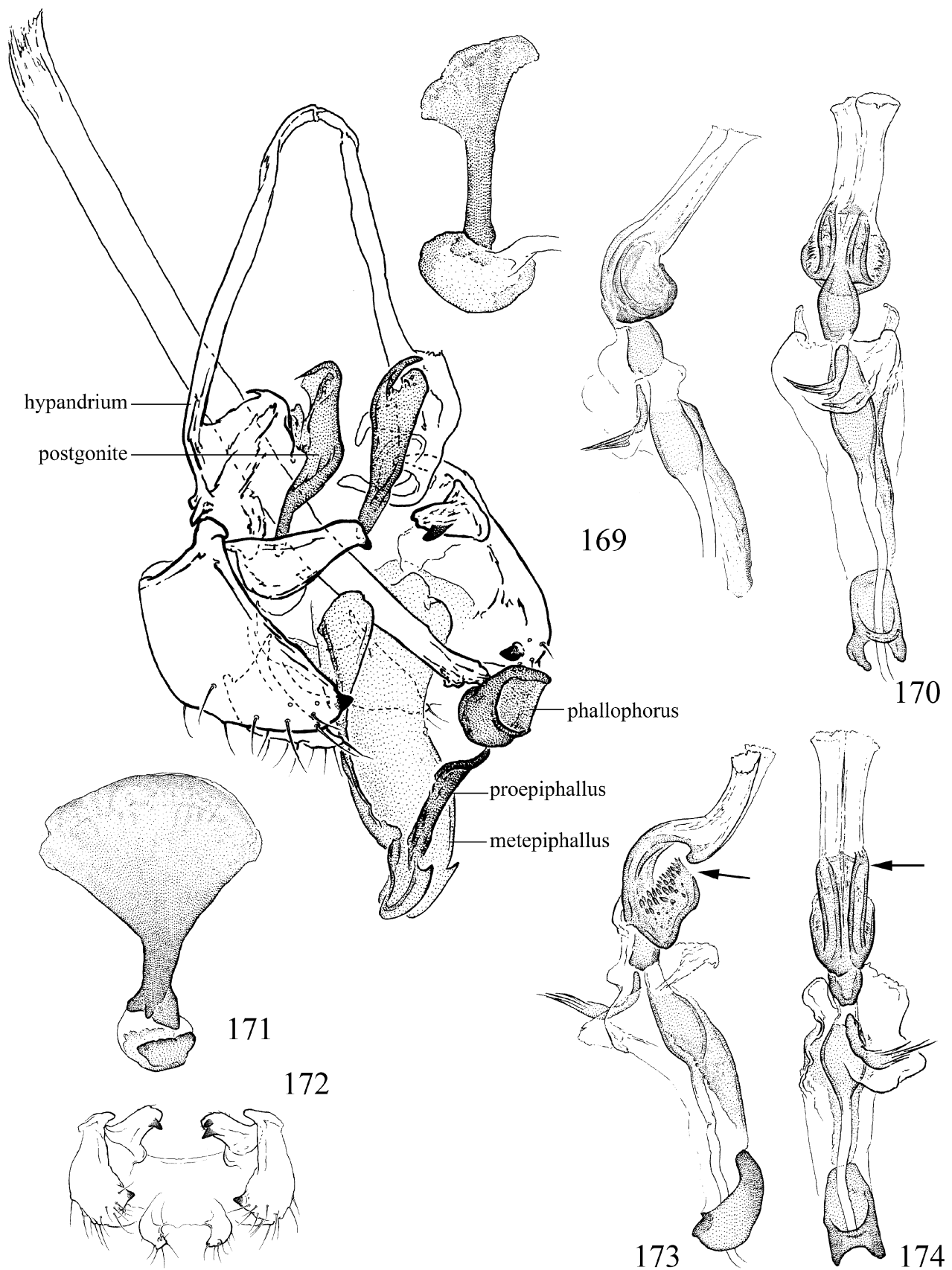
Additional material examined. USA. California: Imperial Co., Wister, 13.iv.1986, T10S, R14E, S5, R.D. Goeden & D.W. Ricker, field collected from *Bebbia juncea* (Benth) Greene, BJ-86-6k (1♂, UCR), Inyo Co., Darwin Falls, 14.v.1969, P.A. Rude (1♂, EMEC), Mazourka Cyn., Independence, 8mi NE, 11.v.1969, J. Powell (1♀, EMEC), San Luis Obispo Co., 10mi SE Creston, 25.iv.1968, J. Powell (1♂, EMEC), Santa Barbara Co., Davey Brown Cpgd., 12mi NE Los Olivos, 10.viii.1983, Malaise trap 9A-5P, M. Wasbauer & P. Adams (1♀, CSCA).

Comments. The distiphallus of the holotype has a relatively short basal section with a minutely-spinulose dorsal chamber and straight apical tubules, but the dissected non-type males differ slightly externally and in the structure of the phallus: the tubules of the distiphallus are strongly curved, the basal section is elongate with the basal section dome-like and heavily spinulose, the mesophallus is smaller and the ejaculatory apodeme is broader.

Liriomyza nigrissima Spencer

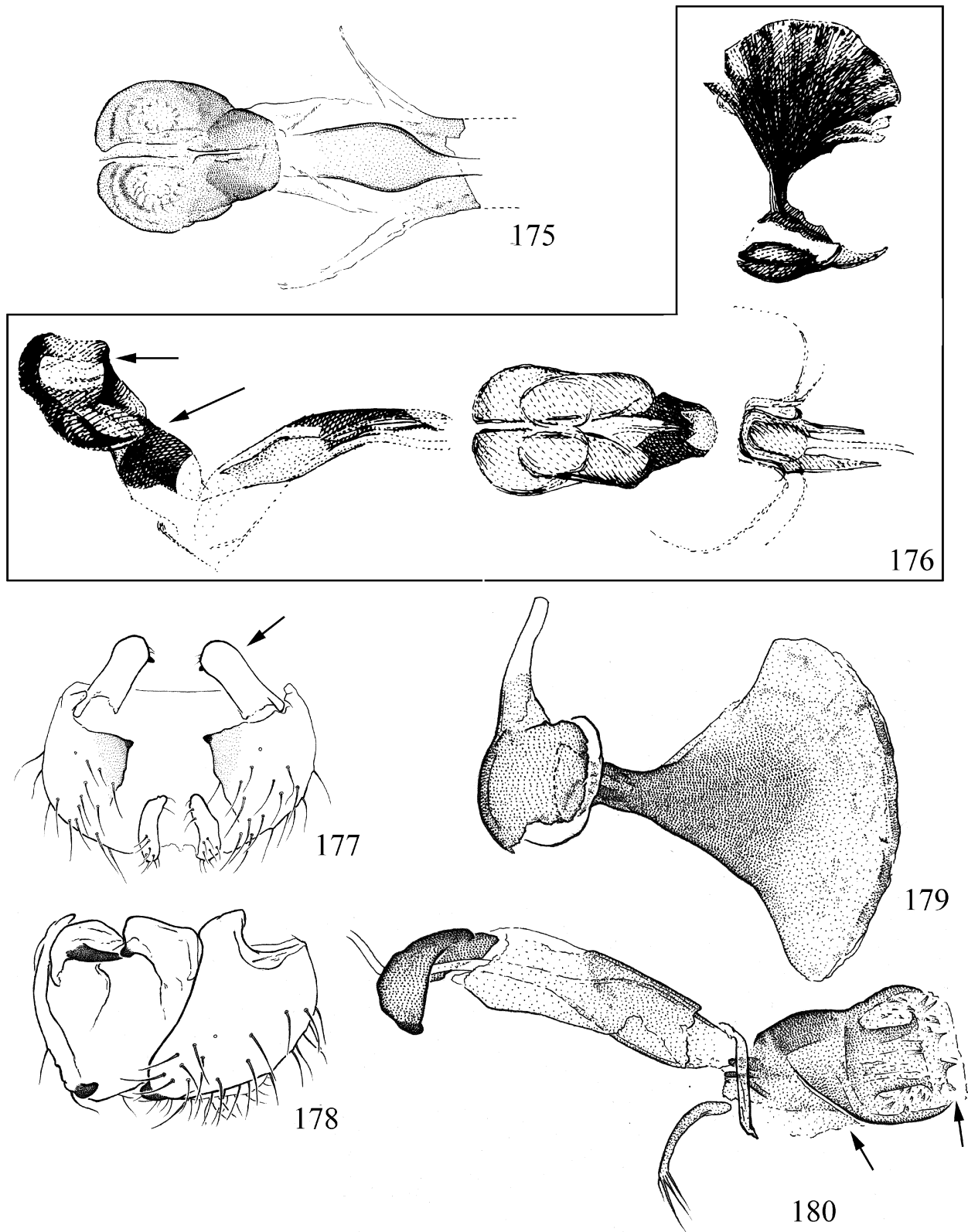
Figs 175–177

Liriomyza nigrissima Spencer 1981: 254. Spencer & Steyskal 1986: 108.



FIGURES 169–174. Figs 169–170: *Liriomyza nigriscutellata* Spencer, male genitalia; 169: male holotype genitalia; 170: phallus, ventral (Creston male). Figs 171–174: *L. nigriscutellata*, male genitalia (Darwin Falls male); 171: ejaculatory apodeme; 172: external components; 173: phallus, left lateral; 174: phallus, ventral.

Wing length mm 1.7mm (♂), 1.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.3. Eye height divided by gena height: 6.5. Scutum subshining. Anterodorsal corner of first flagellomere sometimes slightly pointed.



FIGURES 175–180. Figs 175–177: *Liriomyza nigrissima* Spencer, male holotype genitalia; 175: phallus, ventral; 176: phallus, left lateral and ventral, and ejaculatory apodeme, from original figures in Spencer (1981); 177: external components, ventral. Figs 178–180: *L. paumensis* Spencer, male holotype genitalia; 178: external components, ventrolateral; 179: ejaculatory apodeme; 180: phallus, right lateral.

Chaetotaxy: One ori, two ors; three ori (becoming shorter anteriorly) and one ors in holotype. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head dark brown with frons yellowish medially, and gena and inner-dorsal margin of parafacial paler; parafacial and inner margin of orbital plate sometimes entirely brownish-yellow. Thorax dark brown with notopleuron yellowish along border (primarily posteromedial corner). Legs dark brown with tarsi paler to base. Abdomen dark brown.

Genitalia: Figs 175–177. Surstylus with one small subapical spine (absent in holotype), apex broadly rounded and sides nearly parallel; inner surface of epandrium with dark plate near base of surstylus with three strong spines. Hypophallus absent. Paraphallus long, thin, tapering along length and continuous with anterolateral margin of basiphallus. Mesophallus dark, fused to distiphallus and not longer than wide. Distiphallus enclosing paired fringed structures and angled dorsally. Ejaculatory apodeme large, dark and with broad, asymmetric blade (one side thinner and atrophied to corner) and *pileus ejaculatorius* truncated and slightly thickened at ends.

Host. Unknown.

Range. USA. California [El Dorado*, Riverside, San Diego, Ventura].

Type material. Holotype, **USA. California: Ventura Co.**, Point Mugu S.P., 1.iv.1977, K.A. Spencer (1♂, USNM); Paratype examined, **USA. California: Riverside Co.**, Corona, 6mi SE, 12.iv.1965, D. Veirs (1♂ [head missing], EMEC).

Additional material examined. USA. California: El Dorado Co., Blodgett For., 13mi E Georgetown, 16.vii.1967, J. Powell (1♀, EMEC).

Comments. *Liriomyza nigrissima* is an easily identified species with an entirely dark body excluding a pale tint on the notopleuron, gena and parafacial, and a stout, dark bilobed distiphallus that is fused to a short, darker mesophallus. The dark, three-spined plate basal to the surstylus inside the epandrium is also distinct. The type material was collected in southern California, so the El Dorado female presented here significantly expands the known distribution of this species.

Liriomyza parabella spec. nov.

Figs 47–49

Wing length 1.9–2.0mm (♂), 2.2mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.9–2.1. Eye height divided by gena height: 1.8–2.2. Scutum grey pruinose. Parafacial, orbital plate and cheek pronounced.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows, becoming scattered and sparse anteriorly and posteriorly.

Colouration: Calypter margin and hairs brown. Wing veins yellow. Scutum with dark anteromedial stripe reaching midpoint of postsutural scutum, one pair of thick lateral stripes that meet medial stripe presuturally, and one pair of thinner posterolateral stripes; katatergite yellow; anatergite dark below scutellum and yellow lateral to scutellum with venter brownish. Anepisternum with small anteroventral spot; katepisternum with small anteromedial stripe; meron with posteroventral spot; katepisternum with large triangular spot on ventral half. Legs yellow. Abdomen yellow with epandrium brownish (perianal region yellow); female sternite 6 with medial stripe.

Genitalia: Figs 47–49. Surstylus with small posterobasal process and one posterodistal spine. Right posterodistal margin of epandrium apparently with developmental flaw, producing emargination and two small, separate spines. Paraphallus thin, basally fused to basiphallus. Hypophallus with weakly-sclerotized base and short apical hairs. Mesophallus approximately as long as high, with ventral suture, and separate from (and darker than) distiphallus. Distiphallus bifid with narrow sclerotized base and long, thin clear apical tubules. Ejaculatory apodeme very large with stem short, and *pileus ejaculatorius* broad, truncated and thickened at ends; most of blade destroyed during dissection.

Etymology. The specific epithet refers to the close relationship between this species and *L. bella*.

Host. Unknown.

Range. USA. California [Del Norte].

Type material. Holotype, **USA. California: Del Norte Co.**, Smith River, 22.vii.1932, J.M. Aldrich (1♂, USNM); Paratypes, **USA. California: Del Norte Co.**, same collection as holotype (1♂ 1♀ 1?, USNM; 1♂, CSCA).

Comments. The new species *Liriomyza parabella* is most similar in morphology to *L. bella*, also found in California—the phallus of both is highly similar, the orbital plate and parafacial are projecting, the scutum is grey with yellow stripes and the body is predominantly yellow. The phallus of *L. parabella*, however, is shorter and mostly straight, the tubules are darker, and more broadly spaced basally and without any vestiges of a collar, there are four rows of acrostichal setulae (not two), the notal stripes are more broadly separated, the male wing is larger and the eye is 2.9–3.0 times higher than the gena (not 1.8–2.2 times).

Liriomyza parabella also shows a slight resemblance to *L. cunicularia*, but the phallus of that species is much heavier, the notum is less pruinose, there are no stripes on the scutum and there is only one ori. Among the European fauna, *L. parabella* appears to be related to *L. lutea* (Meigen), which is similarly patterned, but cell dm is smaller, and the distiphallus has shorter tubules and a basal collar. *Liriomyza suecica* Rydén also has similar terminalia and a matt notum. The known hosts of these putative relatives are in the Umbelliferae (*L. lutea*—*Angelica*, *Heracleum* and *Pastinaca*) and Solanaceae (*L. cunicularia*—*Capsicum*[?]).

Liriomyza paumensis Spencer

Figs 178–180

Liriomyza paumensis Spencer 1981: 255. Spencer & Steyskal 1986: 117.

Wing length mm 1.3mm (♂), 1.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.8. Eye height divided by gena height: 3.8–4.0. Scutum subshining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Externally as described for darker *L. artemisiae* specimens except as follows: first flagellomere slightly larger with base only slightly paler on outer face and more yellowish on inner face (basal 2/5 of segment yellow in holotype); orbit yellow with brownish stripe approaching, or reaching posterior ori; sometimes only dorsomedial margin of katepisternum yellow; femora always yellow distoventrally.

Genitalia: Figs 178–180. Surstylus with one long subapical spine. Paraphallus very thin and weakly-pigmented. Hypophallus well developed with short apical hairs. Mesophallus fused to distiphallus. Distiphallus slightly longer than wide, dorsum well sclerotized and thick, and internally spinulose apical chamber on distal 2/3 enclosing paired fringed processes. Blade of ejaculatory apodeme with darker margin and faint distal annulations.

Host. Unknown.

Range. USA. California [Los Angeles, San Diego, San Luis Obispo].

Type material. Holotype, **USA. California: San Diego Co.**, Pauma Valley, 17.iv.1977, K.A. Spencer (1♂, USNM); Paratypes, **USA. California: San Luis Obispo Co.**, La Panza Camp, 25.iv.1968, J.A. Chemsak (1♂, EMEC), La Panza Cp., 12mi NE POZO, 29.iv.1962, C.A. Toschi (1♀, EMEC).

Comments. Aside from a number of minor colour differences, these specimens strongly resemble *Liriomyza artemisiae* and may represent the same species. The genitalia of the dissected males are also largely similar to those of darker *L. artemisiae*, although the phallus of one is preserved on an angle that makes it difficult to make a proper comparison.

Liriomyza phyllodes spec. nov.

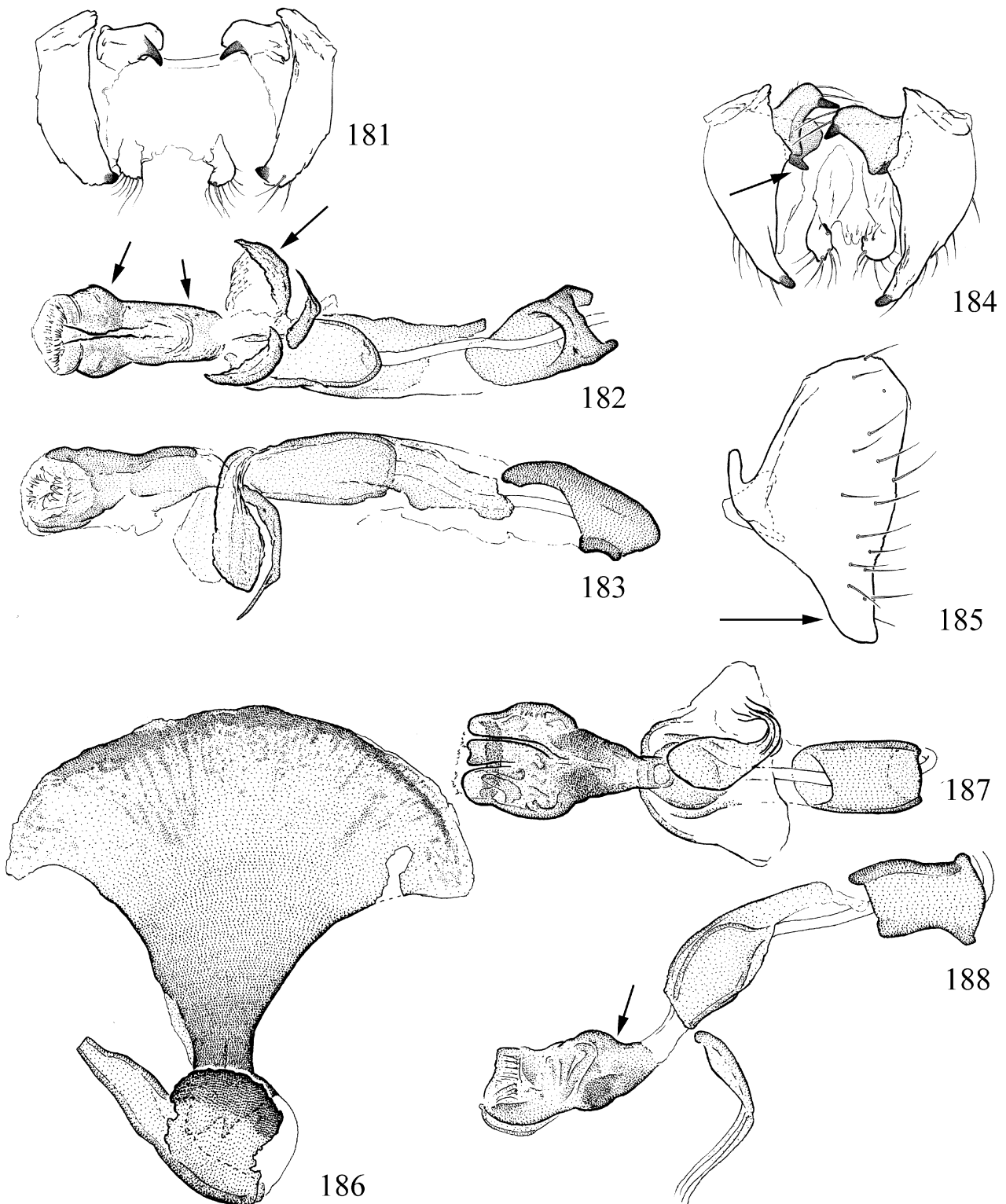
Figs 181–183

Wing length 1.6mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 4.3. Eye height divided by gena height: 4.0. Scutum subshining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head yellow with distal margin of first flagellomere infuscated, and ocellar triangle, back of head, posterolateral corner of frons (encompassing both vertical bristles) and clypeus dark brown. Scutum with yellow lateral stripe that ends above wing base; laterotergites brown (paler anteriorly). Pleuron mostly brown with dorsal 1/3 of anepisternum yellow (margin irregular), anepimeron with yellow mottling, meron yellow on dorsal 1/3 and dorsal 1/4 of katepisternum yellow (including base of bristle) with postero-

dorsal margin brown. Legs yellow with base of coxae, base of femora and dorsal streaking brown, and tibiae and tarsi dark brown. Abdomen dark brown with tergites 1 and 2 yellow medially, tergites 3–5 slightly depigmented medially, and lateral margin of tergites yellow (yellow margin broader posteriorly).



FIGURES 181–188. Figs 181–183: *Liriomyza phyllodes* **spec. nov.**, male holotype genitalia; 181: external components, ventral; 182: phallus, ventral; 183: phallus, left lateral. Figs 184–188: *Liriomyza projecta* **spec. nov.**, male holotype genitalia; 184: external components, ventral; 185: external components, left lateral; 186: ejaculatory apodeme; 187: phallus, ventral; 188: phallus, left lateral.

Genitalia: Figs 181–183. Surstylus bare with one subapical spine. Paraphallus broad, weakly pigmented and leaf-like, with outline broadly ovate. Hypophallus long, with hairs fused and pointed. Mesophallus fused to distiphallus. Distiphallus little longer than wide, with lateral subapical swelling laterally, thickly sclerotized dorsum, spinulose internal distal surface and thin ventral suture.

Etymology. The specific epithet is Greek for “leaflike”, denoting the shape of the paraphallus, which is frequently rod-like in other *Liriomyza*.

Host. Unknown.

Range. USA. California [Riverside].

Type material. Holotype, **USA. California: Riverside Co.**, Palm Desert, P.L. Boyd Deep Canyon Desert Research Center, 33°38'52.3"N, 116°22'36.0"W, 940', 27.i–2.ii.2007, P.H. Arnaud, Jr. & M.M. Arnaud, Arnaud Malaise trap (1♂, USNM).

Comments. *Liriomyza phyllodes* is a relatively dark species most similar in external appearance to *L. langei*, but they can be separated using the above key. The best way to diagnose this species is by examining the phallus, which has a thin, pointed hypophallus with fused hairs, broad leaf-like paraphalli and a thin distiphallus with a lateral subapical swelling.

***Liriomyza pictella* (Thomson)**

Fig. 244

Agromyza pictella Thomson 1869: 609. Malloch 1913: 280 [as synonym of *Agromyza scutellata* Fallén]; Melander 1913: 258 [as synonym of *Agromyza scutellata* var. *puella* Meigen].

Liriomyza pictella. Frick 1957: 66; Spencer 1981: 257; Spencer & Steyskal 1986: 125.

Liriomyza sativae. Misidentification, in part. Frick 1957: 66, 1959: 408.

Wing length 1.6mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section approximately 3.0. Eye height divided by gena height unknown. Scutum shining.

Chaetotaxy: Fronto-orbital number unknown, presumably four. Acrostichal setulae presumably in four rows.

Colouration: Calypter margin and hairs dark. Head yellow with orbital plate greyish-black; posterolateral corner of frons brown to base of inner vertical bristle. Notum as described for *L. sativae*. Anepisternum brown with dorsal 1/3 and posterior margin yellow. Legs yellow with femora predominantly dark with venter yellowish, and tibiae and tarsi brownish-yellow.

Genitalia: Fig. 244. Paraphallus relatively small and thin; hypophallus short, upcurved and poorly developed; mesophallus approximately as wide as long, slightly compressed dorsoventrally and separate from distiphallus; distiphallus pale, slightly darker dorsobasally, relatively large, globose, with width and length subequal, bulging basolaterally, and height slightly less than length; ejaculatory apodeme with thin dark stem, *pileus ejaculatorius* broad, and blade very wide, scalloped on distal margin and with dark subapical band.

Host. Unknown.

Range. USA. California [San Francisco].

Type material. Holotype, **USA. California:** “California” [San Francisco area, possibly Sacramento, 29.vii–9.viii.1852] (1♂, NRS) [Not examined].

Comments. The above description was taken from Spencer (1981). Requests to the NRS for permission to examine the holotype were not answered. Spencer (1981) is followed here in treating *L. pictella* as a valid species known only from the holotype. The terminalia are similar to those of *L. sativae*, although the base of the distiphallus is broad and truncated as in *L. eupatorii*, however, the large ejaculatory apodeme and dark femora would exclude the possibility of these taxa being conspecific. The terminalia are also similar to those of *L. artemisiae*, *L. tricornis* and *L. admiranda*, but colour characters and slight genitalic differences again make these possibilities unlikely.

***Liriomyza projecta* spec. nov.**

Figs 184–188

Wing length 1.3mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate sec-

tion: 2.7. Eye height divided by gena height: 3.0. Scutum subshining. Orbital plate and parafacial very flat (somewhat translucent) and projecting, particularly anterodorsally.

Chaetotaxy: Three ori, one ors. Acrostichal setulae in approximately two sparse rows.

Colouration: Calypter margin and hairs grey. First flagellomere infuscated (not brown) with basal margin yellow; back of head, clypeus and ocellar triangle dark brown; posterolateral corner of frons to base of outer vertical bristle and small spot in front of inner vertical bristle dark brown, and space between verticals light brown; venter of gena with light stripe; face yellow, possibly brownish medially. Scutum with complete lateral yellow stripe with limited mottling next to scutellum; katatergite yellow with posteroventral corner brown; anatergite dark brown ventral to scutellum, and brown lateral to scutellum with dorsum yellow. Dorsal ¼ of anepisternum yellow (excluding dark posterior corner), with deep yellow dorsomedial emargination; anepimeron brown with yellow mottling; meron yellow dorsally; dorsum of katepisternum yellow to level of bristle and with small posterodorsal spot. Legs yellow with basal 2/3 of fore coxa brown, mid and hind coxae brown with tip yellow, femora brown at base, fore and mid femora with light streaking, hind femur with darker streaking, and tibiae and tarsi brown. Abdomen brown.

Genitalia: Figs 184–188. Epanthrium with long posteroventral process with small spine on inner-distal margin. Surstylus slightly darker than epanthrium, tapering apically, with two long apical setae and one relatively long sub-apical spine; inner basal margin flanked by small dark plate with apical setae. Paraphallus absent. Hypophallus with broad base and long apical hairs. Distiphallus dark, strongly tapered to base; distal half much wider with apex slightly tapered, with ventral suture divided by thin plate, paired inner structures and with transverse anterodorsal sclerotization. Ejaculatory apodeme with duct broad and sclerotized at base; *pileus ejaculatorius* narrow with ends projecting and thickly sclerotized; blade very broad with distal margin dark and corners pale and slightly downturned.

Etymology. The specific epithet refers to the projecting parafacial and orbital plate, as well as the produced posterodistal margin of the epanthrium.

Host. Unknown.

Range. USA. California [Modoc].

Type material. Holotype, USA. California: Modoc Co., 3mi NW Alturas, 8.vi.1970, J. Powell (1♂, EMEC).

Comments. *Liriomyza projecta* is a minute species similar in colouration to *L. langei* and *L. trifoliarum*. The male genitalia are distinct, however, and clearly distinguish it from Nearctic congeners: the posterodistal margin of the epanthrium is strongly produced; the ejaculatory apodeme and the base of the ejaculatory duct are large and heavily sclerotized; there is an additional dark internal sclerite near the base of the surstylus; the paraphallus is absent; the hypophallus is broad basally; and the distiphallus is unique.

***Liriomyza ptarmicae* de Meijere**

Figs 189–193

Liriomyza ptarmicae de Meijere 1925: 286–291. Spencer 1976: 263, 1981: 258; Spencer & Steyskal 1986: 121.

Liriomyza millefolii Hering 1927: 185. Syn. Spencer (1976).

Liriomyza aequalon Hering 1936: 74. Syn. Spencer (1971).

Liriomyza chrysanthemi Hering 1956: 116. Syn. Spencer (1976).

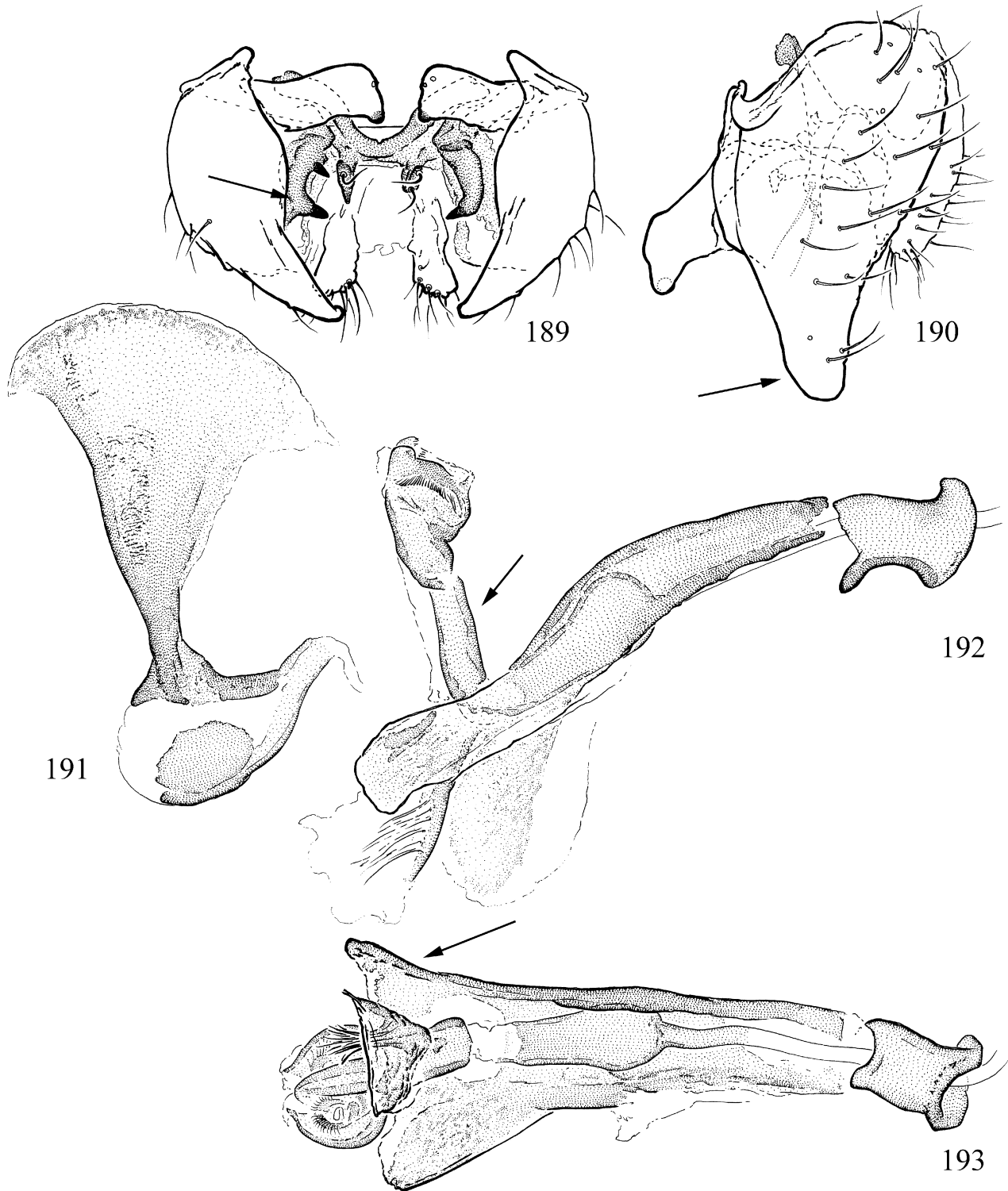
Liriomyza pilosa Spencer 1969: 182. Syn. Spencer (1981).

Wing length 1.7–1.8mm (♂); reportedly as small as 1.5mm (Spencer, 1981). Females not examined. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.9; vein dm-cu absent in WN and OR material. Eye height divided by gena height: 4.4. Scutum shining. First flagellomere sometimes relatively large and ovate with long marginal hairs (some USA and most Canadian specimens)

Chaetotaxy: Two ori with anterior bristle minute to absent, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. First flagellomere sometimes brownish to deep yellow with basal margin yellow, but often entirely yellow (including all Canadian specimens); posterolateral corner of frons narrowly brown, not reaching base of outer vertical bristle; clypeus, back of head and ocellar triangle brown. Scutum with yellow lateral stripe interrupted posteriorly; katatergite yellow; anatergite brown below scutellum with remainder of laterotergites variable. Anepisternum brown with dorsal 1/3 and sometimes posterior half yellow.

low; anepimeron with anterior stripe; katepisternum brown (including base of bristle) with dorsomedial margin and sometimes faded vertical anterior stripe yellow; meron brown with dorsum yellow. Legs yellow with base of coxae and femora brown, dorsal mottling on femora faded to extensive, tibiae brown (paler ventrally) with faded to extensive yellow mottling on mid and hind legs, and tarsi brown, becoming paler to base. Abdomen brown with lateral and posterior margins of tergites yellow.



FIGURES 189–193. *Liriomyza ptarmicae* Meijere, male genitalia; 189: external components, ventral; 190: external components, left lateral; 191: ejaculatory apodeme; 192: phallus, left lateral; 193: phallus, ventral.

Genitalia: Figs 189–193. Epandrium produced ventrally, ending in broadly rounded point; inner margin of epandrium (or subepandrial sclerite?) differentiated into plate with one or two terminal spines. Surstylus thin along length and with short subapical spine. Left and right distal margins of basiphallus with elongate, broad, lightly-sclerotized extensions. Swollen apical section of ejaculatory duct broadly rounded basally and narrow with sides slightly converging distally. Paraphallus small and rod-like. Hypophallus well developed with long dorsal hairs on distal half. Length of mesophallus more than twice width, strongly angled dorsally and partially fused to distiphallus. Distiphallus with short basal neck and broad apical section enclosing paired fringed structures. Ejaculatory apodeme with *pileus ejaculatorius* pale and rounded laterally; stem short with base broad, extending onto duct, which is lightly pigmented basally; blade elongate with distal margin slightly darker.

Hosts. Asteraceae—*Achillea*, *Anthemis*, *Chrysanthemum*, *Leucanthemum* (Benavent-Corai *et al.*, 2005).

Range. **USA.** California [Humboldt, Nevada, Santa Cruz], Colorado, Oregon*, Washington. **Canada.** Alberta. Europe.

Type material. *Liriomyza ptarmicae*: Lectotype, **POLAND or GERMANY.** “Aus Achillea ptarmica, Deutschland, Hering leg.” (1♂, ZMHU) [Not examined]. *Liriomyza millefolii*: Holotype, **GERMANY.** Bredow near Nauen (1♀, ZMHU). [Not examined]. *Liriomyza aesalon*: Holotype, **POLAND.** Krosno-Odrzanskie [=Crosen an der Oder] (1♂, ZMHU) [Not examined]. *Liriomyza chrysanthemi*: Holotype, **GERMANY.** Oberlausitz, Buchholz, between Biehain and Horka (1♂, BMNH) [Not examined]. *Liriomyza pilosa*: Holotype, **CANADA. Alberta:** Edmonton, Univ. campus, 20.vi.1966, K.A. Spencer, Type No. 16129 (1♂, CNC).

Additional material examined. **USA. California: Santa Cruz Co.,** Felton, 12.vi.1952, E.I. Schlinger (1♂, UCD), **Oregon:** Mt. Hood, 3000', 29.vii.1931, A.L. Melander (1♂, USNM), Coos Co., 5mi S Brandon, 29.vi.1972, G. Steyskal (1♂, CSCA), **Washington:** Mt. Rainier, Glacier Stn., 15.viii.1917, A.L. Melander (1♂, USNM).

Comments. Although the terminalia are reminiscent of *Liriomyza projecta* (see comments for *L. projecta*), the phallus is much more similar to that of *L. lima* (Melander), *L. minor* and *L. togata*, in that the mesophallus is strongly angled dorsally and the distolateral margins of the basiphallus are strongly produced, although in the latter three taxa the mesophallus is darker, separate from the distiphallus and sometimes with an additional pair of ventromedial plates.

The male adult of *Liriomyza ptarmicae* in ZMHU is labeled as the “lectotype” (J. Ziegler, pers. comm.), and is treated as such here.

Liriomyza quadrisetosa (Malloch)

Figs 194–199

Agromyza quadrisetosa Malloch 1913: 332.

Liriomyza quadrisetosa. Frick 1952a: 405, 1959: 409; Spencer 1969: 183, 1981: 260; Spencer & Steyskal 1986: 114.

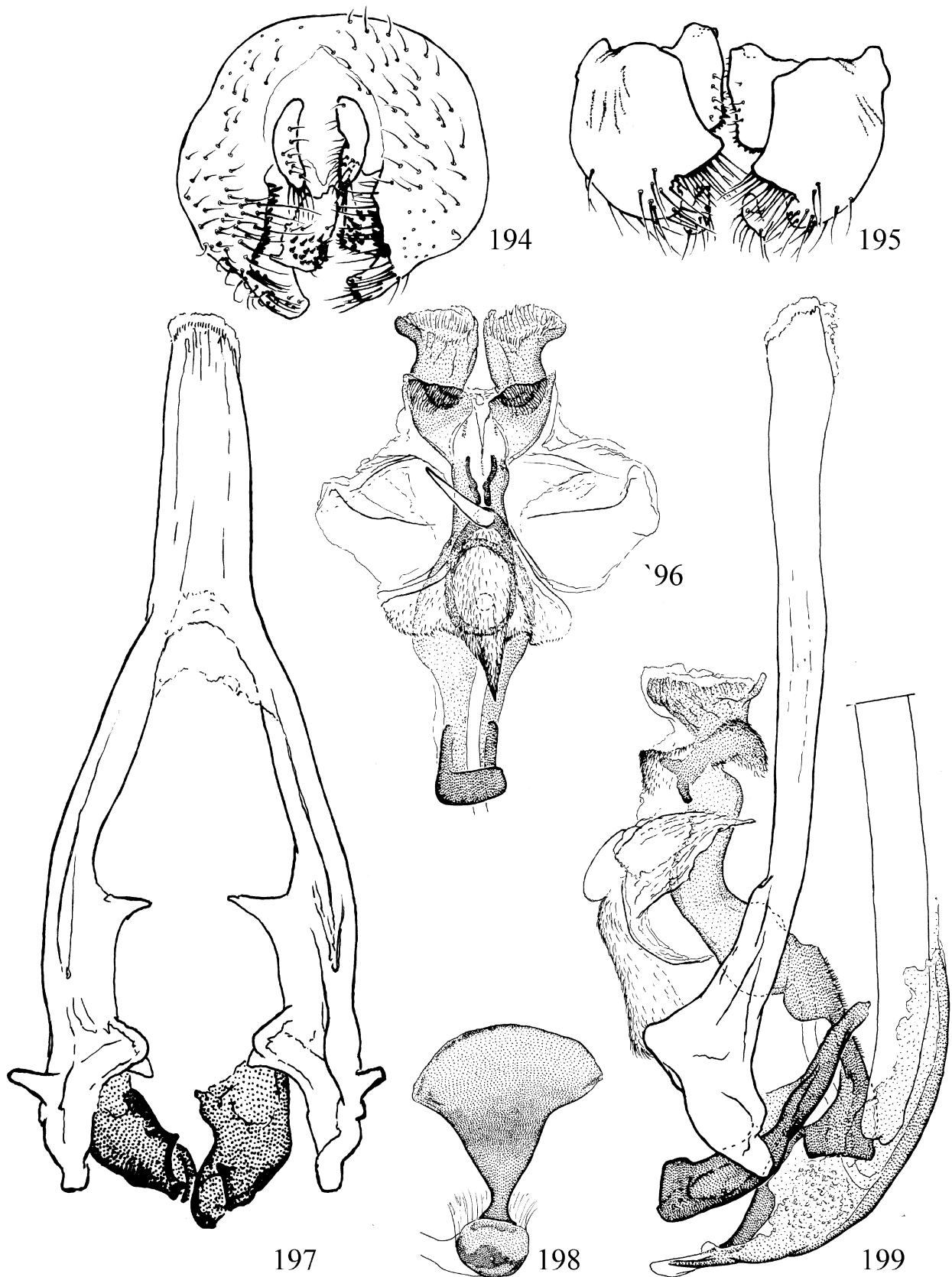
Description. Wing length 2.2–2.5mm (♂), 2.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.8–2.6. Eye height divided by gena height: 2.1–2.7. Epistoma large. Parafacial and orbital plate (anteriorly) prominent and projecting. Scutum shining to subshining.

Chaetotaxy: Five ori; one ors. Acrostichal setulae in two irregular rows. Four dorsocentrals, all long and subequal in length.

Colouration: Calypter margin and hairs dark brown. Orbital plate dark to base of fronto-orbital bristles; face, ocellar tubercle, back of head, first flagellomere, clypeus and palpus dark brown; remainder of head yellow. Thorax dark with postpronotum (excluding anterior spot), notopleuron, supra-alar spot and dorsal margin of anepisternum (dorsal 1/5, with yellow stripe becoming broader posteriorly). Legs entirely dark. Abdomen dark with posterior margin of tergites 2–5 yellow; posterior margin of tergite 6 yellow in female.

Genitalia: Figs 194–199. Epandrium heavily-setose posteriorly and with inner-distal margin lined with small tubercle-like bristles. Surstylus large, truncated and with numerous tubercle-like bristles on inner face. Subepandrial sclerite relatively dark and small with pronounced anteromedial process. Hypandrium elongate with pointed inner-medial process and long, tapered apex. Basiphallus fused to phallopophorus, with posterior surface minutely haired, with shallow outer-distal lobes, and only extending to base of widened, sclerotized portion of ejaculatory duct. Hypophallus densely haired, broad to base and with tapering, posteriorly-directed medial process; side of

phallus with broad membranous “wings”. Distiphallus lightly-sclerotized and composed of two thick tubules that are more narrow and approximated to base; base of tubules surrounded by thick, haired collar.



FIGURES 194–199. *Liriomyza quadrisetosa* (Malloch), male genitalia; 194: external components, posterior; 195: external components, ventral; 196: phallus, ventral; 197: hypandrium, ventral; 198: ejaculatory apodeme; 199: hypandrial complex, left lateral.

Hosts. Unknown, possibly *Clematis* (Ranunculaceae) (Spencer & Steyskal, 1986).

Range. USA: California, Indiana*, New York, Texas, Utah*. **Canada:** Quebec.

Type material. Holotype, **USA. Texas:** San Antonio, 8.iv.1907, F.C. Pratt (1♀, USNM, type No. 15957); Paratype examined, **USA. Texas:** “Brnsville”, Jones & Pratt (1♀, USNM).

Additional material examined. USA. Indiana: Lafayette, 3.vi.1915 (1♀, USNM), **Utah:** Richfield, 15.viii.1930, Beet Coll (1♀, USNM).

Comments. *Liriomyza quadrisetosa* is a large, distinct species that is widespread but uncommon in North America. It can be diagnosed by six fronto-orbitals, a produced parafacial and orbital plate, two irregular rows of acrostichal setulae, multiple minute spines on an enlarged surstylus and epandrium, and a similarly large, robust and distinct hypandrium and phallus.

Liriomyza sabaziae Spencer

Figs 200–203

Liriomyza sabaziae Spencer 1963b: 366. Spencer 1973b: 60, 1981: 262, 1983: 58, 1984: 23; Spencer & Steyskal 1986: 126.

Wing length 1.8–2.1mm (♂), 2.1–2.3 (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.8. Eye height divided by gena height: 4.2–5.4. Scutum subshining.

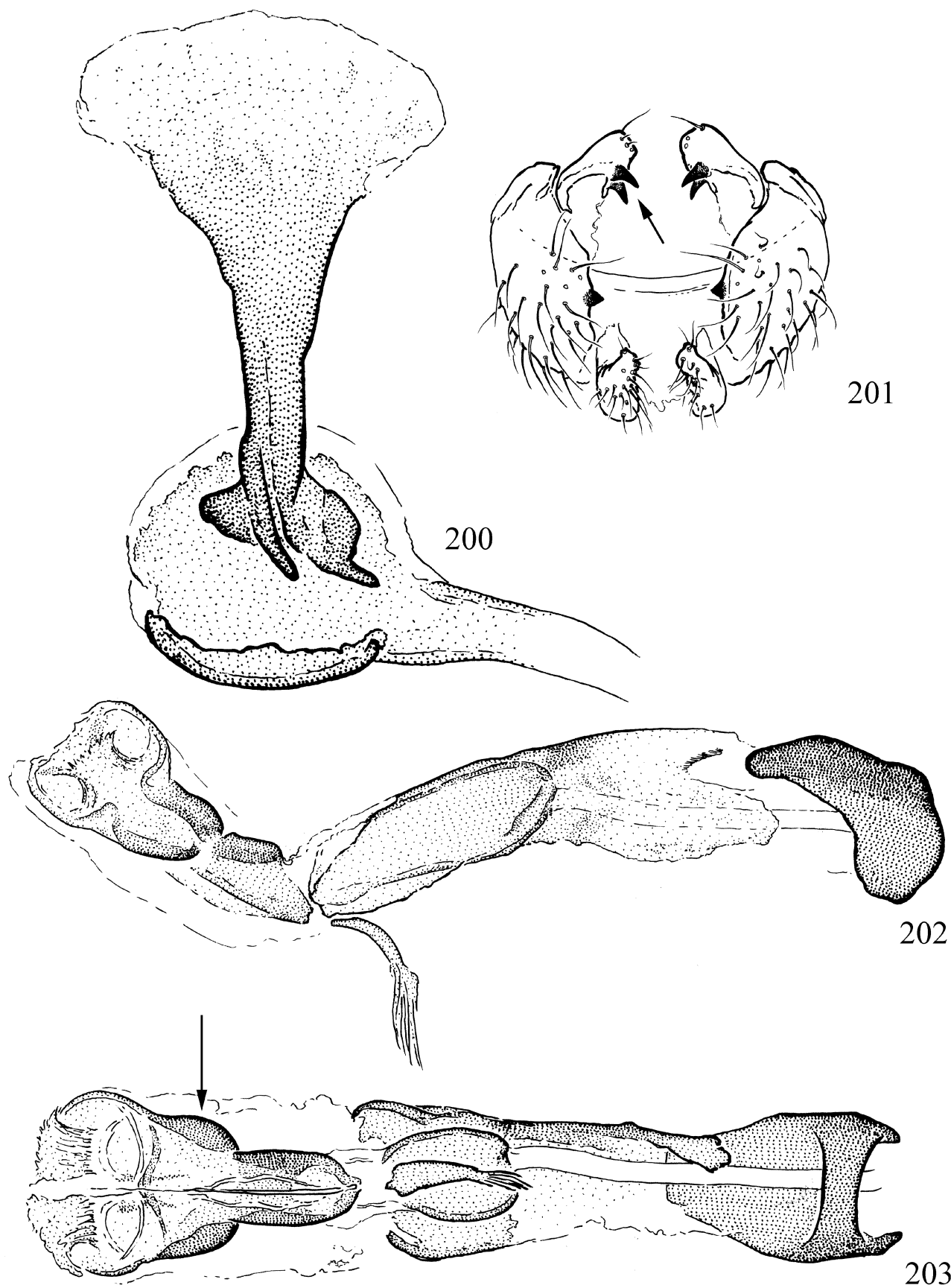
Chaetotaxy: Two ori (rarely with three on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head yellow with first flagellomere yellow, posterolateral margin of frons dark to outer vertical bristle and brown to base of inner vertical, and back of head, ocellar triangle and clypeus dark brown. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite brown, becoming darker below scutellum and yellow dorsally lateral to scutellum. Pleuron usually predominantly yellow with lateral and posteroventral stripes on anepisternum, mottling on anepimeron and meron (meron sometimes entirely brown), and katapisternum brown on ventral 2/3 and behind bristle. Legs yellow with base of fore coxa brown, mid and hind coxae light brown with yellow mottling, base of femora sometimes narrowly brown, apex of hind femur sometimes brown, tarsi brown and tibiae brown with base of fore tibia yellow. Abdomen dark brown with lateral margin of tergites yellow.

Genitalia: Figs 200–203. Surstylus apically setose and with two subapical spines. Paraphallus absent. Mesophallus slightly longer than wide and partially fused to distiphallus; distiphallus and mesophallus with complete ventral suture. Distiphallus slightly longer than wide, base narrow, rounded and dark laterally, and distal half thin-walled and enclosing paired fringed projections. Ejaculatory apodeme with evenly pigmented *pileus ejaculatorius*; base of duct lightly pigmented; blade narrow, gradually blending into stem, and pale with distal margin clear.

Variation: Pale EMEC male with one spine on surstylus and distolateral margins of basiphallus produced. Male from Ash Mountain darker: anepisternum with only anterior margin and dorsal 1/3 yellow, ventral 1/3 of katatergite brown, meron only yellow dorsally, katapisternum brown to level of bristle, femora with additional light streaking, fore tibia entirely brown and mid and hind coxae entirely brown. Male from WA differs as follows: wing length 1.6mm, length of ultimate section of vein CuA₁ divided by penultimate section 3.2, dorsal half of anepisternum yellow, katapisternum slightly darker, femora entirely yellow, distiphallus paler and ejaculatory apodeme with relatively long, thin stem. Males from Santa Barbara Co. (two ex. *Carduus pycnocephalus*) differ as follows: scutum glossy; eye 6.5 times higher than gena; posterolateral corner of frons with faint brown spot not touching base of vertical bristles; thoracic colouration characteristic of paler specimens described above; base of mid coxa brown; femora entirely yellow; base of fore tibia brown; distiphallus slightly shorter and paraphalli present.

Hosts. Asteraceae—*Baccharis*, *Bidens pilosa*, *Carduus pycnocephalus*, *Cirsium arvense*, *C. congdonii**, *C. edule*, *C. tioganum**, *C. vulgare*, *Dahliaimperialis*, *Dahlia* sp., *Galinsoga caracasana*, *Galinsoga quadriradiata* [mines only], *Galinsoga* sp., *Gnaphalium*, *Piqueria trinervia*, *Sabazia urticaefolia*, *Salvia millifera*, *Silybum marianum* (Spencer, 1981, 1983, 1984, 1990). Spencer (1983) also notes mines possibly attributable to *L. sabaziae* on *Melanthera aspera*, *Elvira biflora* and *Alomia microcarpa*. “Marigold” [*Calendula* or *Tagetes*]*, possibly as an adult.



FIGURES 200–203. *L. sabazia* Spencer, male genitalia; 200: ejaculatory apodeme; 201: external components, ventral; 202: phallus, left lateral; 203: phallus, ventral.

Range. USA. California [Alameda, Del Norte*, Imperial[?], Kern*, Los Angeles*, Mendocino*, Modoc*, Orange*, Riverside*, San Bernardino*, San Diego*, San Luis Obispo*, Santa Barbara*, Santa Clara, Santa Cruz, Tulare*, Ventura, Yolo*], Washington. Colombia. Costa Rica. Venezuela.

Type material. Holotype, **VENEZUELA.** Caracas nr. Humboldt Hotel, em. 22.xii.1958, from leaf-mine on *Sabazia urticaefolia* (H.B.K.) DC, found 3.xii.1958 (1♂, BMNH). [Not examined]

Additional material examined. USA. **California:** **Alameda Co.,** Berkeley, "Aug. '15", A.L. Melander (2♂, USNM), Berkeley, 14.ix.1948, ex. larva *Cirsium edule* Nutt., Lot No. 63-1 (2♂ 1♀ [slide], CASC), Berkeley, 24.ix.1948, ex. larva *Cirsium arvense* Nutt., Lot No. 63-1 (1♂ [slide], CASC), Berkeley, 24.ix.1948, ex. larva *Cirsium edule* Nutt., Lot No. 63-1 (1♀ [slide], CASC), Berkeley, 26.ix.1948, ex. larva *Carduus pycnocephalus* L., Lot No. 22-2 (1♂ 1♀ [slide], CASC), Berkeley, 26.ix.1948, ex. larva *Silybum marianum* Gaertn., Lot No. 64-1 (2♂ 2♀ [slide], CASC), Berkeley, 26.x.1963, P.A. Rude (2♂, EMEC), **Del Norte,** Six Rivers NF For Route 16N02, nr. Bear Basin Outlk, 41.8016°N, 123.7369°W, 1500m, 3.vi-24.vii.2009, P. Kerr & O. Lonsdale (1♂, CSCA), **Kern Co.,** Evans Meadow, 30.viii.1983, R.D. Goeden & D.W. Ricker, insectary reared on *Cirsium vulgare* (Savi) (1♂ 4♀, UCR), **Los Angeles Co.,** Sta. Monica Mts., Beverly Glen Cyn., 19.v.1971, E.M. Fisher (2♂ 2♀, CASC), Westwood Hills, vi.1941, ex. *Bidens pilosa*, R.M. Bohart (1♂, UCR), Westwood Hills, 10.x.1940, ex. *Dahlia*, R.M. Bohart (1♂ 2♀, UCR), Westwood Hills, 20.x.1940, ex. *Marigold*, R.M. Bohart (2♂ 1♀, UCR), Westwood Hills, 9.x.1940, ex. *Marigold*, R.M. Bohart (2♀, UCR), Los Angeles, xii.1942, R.H. Smith x *Dahlia* leaf (2♂ 1♀, UCR), **Mendocino Co.,** UC Hopland Fld. Sta., nr H.Q., 880', 2.vi.1968, dry ice Malaise trap, W.J. Turner (1♂, EMEC), **Modoc Co.,** Cedar Pass Campground, 11.viii.1967, 1800m, P.H. Arnaud, Jr. (1♂, CASC), **Orange Co.,** Buena Park, 23.xii.1944, A.L. Melander (2♂[same pin], USNM), Laguna Beach, 28.iii.1935, A.L. Melander (1♂, USNM), Yorba Linda, 28.v.1968, R.D. Goeden & D.W. Ricker, insectary reared from *Silybum marianum* L. (1♂, CSCA), **Riverside Co.,** Riverside, A.L. Melander, 19.v.1935 (1♂, USNM), 22.ii.1935 (1♂, USNM), **San Bernardino Co.,** Fish Creek Meadow, R.D. Goeden & D.W. Ricker, insectary reared on *Cirsium congdonii* Moore&Franklin, leaf, 17.vii.1984 (1♂ 1♀, UCR), 3.vii.1984 (1♂ 1♀, UCR), **San Diego Co.,** Gavilan Hills, 16.iv.1997, M. Gates, ex. upper serpentine mines on *Salvia millifera* (1♂, USNM), Lake Cuyamaca, 31.v.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Cirsium tioganum* (Congd.) (2♀, UCR), **San Luis Obispo Co.,** Montana de Oro St. Pk., dunes, 3mi SW Los Osos, M. Wasbauer & P. Adams, 13-15.viii.1983, Malaise trap 9A-5P (1♂, CSCA), Malaise trap 10A-4P, 16-17.viii.1983 (2♂, CSCA), Pozo, 28.iv.1962, R.L. Langston (1♂, EMEC), **Santa Barbara Co.,** Santa Barbara, 6.v.1971, R.D. Goeden & D.W. Ricker, insectary reared on *Carduus pycnocephalus* L. (2♂, USNM), Sta. Cruz Island, Central Vy., 26.ix.1978, J. Powell (1♂, EMEC), **Tulare Co.,** Sequoia National Park, Ash Mtn., 3.x.1947, R. Coleman (1♂, USNM), Fairview, 10mi S, 2.v.1964, C.A. Toschi (1♂, EMEC), **Ventura Co.,** Point Mugu State park, Sycamore Canyon, 26.vi.1996, M. Gates, upper leaf surface serpentine mine on *Cirsium vulgare* (1♂[with puparium], USNM), complete serpentine leaf mine on *Silybum marianum* (2♂ [with puparia], USNM), mouth of Ventura River, 24.iv.1966, J. Powell (1♀, EMEC), Santa Cruz Island, Prisoner's Harbor Cr., 1.v.1966, A.J. Slater (1♀, EMEC), **Yolo Co.,** Woodland, 13.x.1965, E.J. Sherman (1♂, CASC), **Washington:** Union Flat., 9.vii.1916, A.L. Melander (2♂, USNM).

Comments. *Liriomyza sabaziae* is a relatively common species in California found on numerous Asteraceae. The most reliable character by which to identify this species is the distiphallus, which is small, translucent, simple and cup-like, as seen in a number of other *Liriomyza*, but the base (ventral view) is semi-circular and much darker laterally. There are also two subapical spines on the surstylus and the paraphallus is often absent.

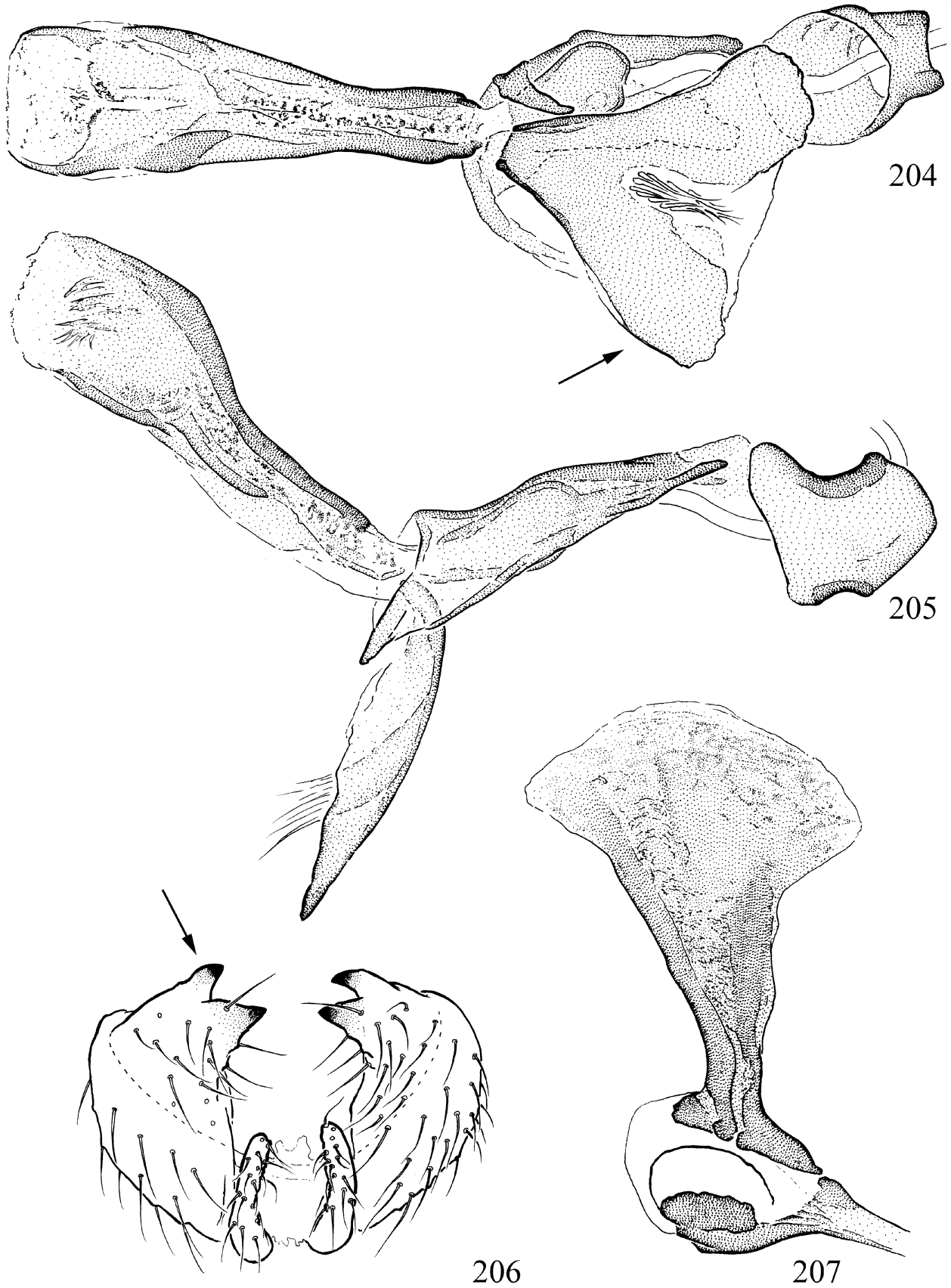
Liriomyza salpingion spec. nov.

Figs 204-207

Wing length 1.6mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.7. Eye height indistinguishable. Scutum glossy.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light brown with first flagellomere yellow and back of head and ocellar tubercle dark brown. Thorax brown with scutum dark brown, scutellum lighter with centre yellowish, and notopleuron and postpronotum (excluding dark medial spot) light brown. Legs and abdomen dark brown.



FIGURES 204–207. *Liriomyza salpingion* spec. nov., male genitalia; 204: phallus, left lateral; 205: phallus, ventral; 206: external components, ventral; 207: ejaculatory apodeme.

Genitalia: Figs 204–207. Surstylus fused to epandrium and with apex split into two pointed, apically darkened lobes. Epandrium without spine. Swollen distal section of duct narrowed to apex. Paraphallus fused to membranous distal margin of basiphallus. Hypophallus forming broad, flattened V-shaped plate with hairs emerging from base of medial desclerotized region. Mesophallus indistinct. Distiphallus long, tapering to base, more thickly sclerotized along dorsal and lateral walls, with slight segmentation on distal half, and apex thin-walled and enclosing one pair of small spinulose pads. Ejaculatory apodeme with *pileus ejaculatorius* relatively thin with ends swollen and dark; base of duct dark; base of stem broad and centre of stem and blade weakly sclerotized with minute transverse striations; blade pale with long, irregular base.

Etymology. The specific epithet, a noun in apposition, is Greek for “small horn”, referring to the shape of the distiphallus.

Host. Unknown.

Range. USA. California [county unknown].

Type material. Holotype, **USA. California:** Yosemite, 10.vi.1935, A.L. Melander (1♂, USNM).

Comments. *Liriomyza salpingion* is a predominantly dark species with a slightly yellowish scutellum, notopleuron and postpronotum, and an entirely yellow antenna. The male terminalia are distinct, with a bifid, pointed surstylus, a large triangular plate-like hypophallus and a long, conical distiphallus.

***Liriomyza sativae* Blanchard**

Figs 1, 5–9

Liriomyza sativae Blanchard 1938: 354. Frick 1959: 405; Spencer 1973a: 219, 1982: 27, 1983: 59, 1984: 23; Spencer & Steyskal 1986: 292; Rauf *et al.* 2000: 257; Scheffer & Lewis 2005: 181; Deeming 2006: 410, Palacios *et al.* 2008: 14 (misidentification, at least in part based on fig. 3).

Liriomyza subpusilla Frost 1943: 255 [preoccupied by Malloch, 1914].

Liriomyza verbenicola Hering 1951: 43. Syn. Spencer & Steyskal (1986).

Liriomyza pullata Frick 1952b: 509. Syn. Spencer (1973a).

Liriomyza canomarginis Frick 1952b: 511. Syn. Spencer (1973a).

Liriomyza minutiseta Frick 1952b: 512. Syn. Spencer (1973a).

Liriomyza propepusilla Frost 1954: 73 [replacement name for *subpusilla*]. Frick 1957: 62. Syn. Steyskal (1973).

Liriomyza munda Frick 1957: 61. Syn. Spencer (1973a).

Liriomyza pictella (Thompson). Misidentification, in part. Frick 1957: 66.

Liriomyza guytana Freeman 1958: 344. Syn. Steyskal (1964) [as syn. *L. munda*].

Fig. 1. Wing length 1.3–1.6mm (rarely 1.1–1.2mm) (♂), 1.4–1.8mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.6–4.0; vein dm-cu sometimes absent if wing length 1.1–1.3mm (Riverside Co., Deep Canyon). Eye height divided by gena height: 4.4–5.8. Scutum shining to subshining.

Chaetotaxy: Two ori (anterior bristle sometimes reduced to absent), sometimes three; two ors. Acrostichal setulae in four irregular rows.

Colouration: Calypter margin and hairs grey. Posterolateral corner of frons brown, usually fading to yellow to base of outer or inner vertical bristle; orbital plate sometimes with thin brown margin tapering to anterior ori (few western specimens); back of head above foramen, ocellar tubercle and clypeus brown; venter of gena with thin brownish stripe that sometimes fades posteriorly; anterior margin of first flagellomere rarely appearing lightly infuscated. Scutum with complete lateral yellow stripe, sometimes with brown posterior mottling; katatergite sometimes with posterior margin to posterior half brown; anatergite dark below scutellum and paler lateral to scutellum, often with posterodorsal corner yellow. Pleuron yellow with ventral 2/3 of katepisternum, meron, variable markings on anepimeron and anteroventral corner of anepisternum brown; anepisternum sometimes predominantly brown along ventral margin; specimens from western North America sometimes darker with only dorsal 1/4 of anepisternum (as well as deep posterodorsal emargination), meron and katepisternum yellow; if only dorsal margin of anepisternum thinly yellow (rare), then lateral margin of frons infuscated, femora more extensively mottled dorsally or only yellow apically and distoventrally, lateral margin of scutum sometimes brownish postsuturally, laterotergites darker and abdomen entirely brown. Legs yellow with tibiae, tarsi and base of coxae light brown; base or dorsal base of hind and (less commonly) mid femora sometimes brown (if so, base of fore femur occasionally also brown); fore femur, and much less commonly mid and hind femora sometimes with outer-dorsal striations.

Abdomen brown with lateral and sometimes posterior margins yellow; epandrium dark with dorsum perianal region usually yellowish.

Genitalia: Figs 5–9. Surstylus with single subapical spine. Phallus very short and weakly-sclerotized, with basiphallus faint and cylindrical, paraphallus pale, straight and rod-like, hypophallus well developed, and mesophallus distinct and appearing fused to distiphallus in ventral view; distiphallus with apical, basal and ventral surfaces more well-sclerotized, forming weak C-shape in profile. Ejaculatory apodeme pale and with base of blade and stem relatively dark and narrow, sometimes broader apically with corners more pointed.

Variation: One male and female from San Diego reared ex. *Jacaranda* entirely devoid of pigment. Rarely with lateral yellow stripes on scutum thinly continuing along posterior margin.

Hosts. *L. sativae* is a highly polyphagous species, although crop plants in the Cucurbitaceae, Leguminosae and Solanaceae appear to be favoured (Spencer, 1973a)—see Table 1.

Californian specimens have been reared from the following: beans (including red kidney bean, “k.w. bean” and “beans”); clover; cucumber; squash, including banana squash; pumpkin; “melon”; Crenshaw melon; watermelon; tomato; petunia; “ex. potato tops with tuber moths”; wild mustard; *Ambrosia acanthicarps*; *Ambrosia psilostacha*; “*Cineraria Senecio x hybridus*”; *Coreopsis*; *Cucumis mello*; *Datisca glomerata* (upper surfacer serpentine mine); *Dicoria canescens*; *Jacaranda*; *Medicago sativa*; *Melilotus*. Adults have also been collected on the following: beans (including castor bean, “black eyes”, “lima beans”, “pink beans”, “pole beans” and “beans”); cantaloupe; Crenshaw melon; celery; cockle burr [= *Xanthium strumarium*]; corn; cucumber; ground cherry; lettuce; wild mustard; mustard greens; radish; romaine lettuce squash; watermelon; zucchini; *Baccharis*; *Chenopodium*; *Isomeris*; *Iva axillaris*; *Silybum marianum*; “ex. *Verbena*”. Material, likely adults, have also been collected on “mistletoe on *Pinus sabiniana*”—if reared from mistletoe, this would be the first record of this species on the order Santalales*.

Range. USA: Alabama, California [widespread], Florida, Hawaii, Kansas, Louisiana, Maryland, New Mexico, Ohio [greenhouse], South Carolina, Texas. Neotropics. Introductions: Arabian Peninsula, Cameroon, China, Greece, Guam, India, Japan, Nigeria, Oman, Russia, Tahiti, Thailand, Turkey, Turkmenistan, Zimbabwe (Dempewolf 2004, Deeming 2006, Tschirnhaus, pers. comm.).

Type material. *Liriomyza sativae*: Holotype, **ARGENTINA**. “las larvas producen galerias en las hojas de la alfalfa en General Pico, Pampa ; halladas por mi excelente colaborador Juan Williason, xi.1937”, ex. *Medicago sativa* (1 ♀, Museo de la Plata, Buenos Aires, Argentina) [Not examined]. *Liriomyza canomarginis*: Holotype, **USA. Hawaii**: Oahu, Kaimuki, 12.iv.1921, O.H. Swezey, ex. *Indigofera* sp. (1 ♀, BPBM) [Not examined]. *Liriomyza guytona*: Holotype, **USA. Alabama**: Auburn, 20.iv.1957, ex. beans, C.C. Freeman (1 ♂, USNM); Paratypes examined, **USA. Alabama**: Lee Co., Auburn, 25.iv.1957, *Phaseolus* sp. (2 ♂, EMEC). *Liriomyza minutiseta*: Holotype, **USA. Hawaii**: Oahu, Honolulu, 7.ix.1951, W.C. Mitchell, ex. tomato (1 ♀, BPBM) [Not examined]. *Liriomyza munda*: Holotype, **USA. California**: San Joaquin Co., Tracy, 22.ix.1949, L.L. Lewallen, ex. leaf of tomato (1 ♂, USNM); Paratypes examined, **USA. California: San Joaquin Co.**, Tracy, 28.ix.1948, ex. larva *Lycopersicon esculentum*, Lot No. 175-1, L.L. Lewallen (2 ♂ 2 ♀, EMEC). *Liriomyza subpusilla*: Holotype, **USA. Kansas**: Manhattan, 14.x.1933, C.W. Sabrosky (1 ♂, USNM). *Liriomyza pullata*: Holotype, **USA. Hawaii**: Kanoa, Molokai, 3.iii.1929, O.H. Swezey, ex. *Datura* sp. (1 ♀, BPBM) [Not examined]. *Liriomyza verbenicola*: Holotype, **USA. New Mexico**: Las Cruces, ex. *Verbena* sp. (1 ♀, ZMHU) [Not examined].

Additional material examined. USA. California: 758 ♂ 1021 ♀ 51? [CASC, CSCA, EMEC, SBMN, UCD, UCR, USNM].

Comments. *Liriomyza sativae* is a highly polyphagous species and one of the most commonly encountered *Liriomyza* in agricultural regions in the United States. It is a highly invasive pest and has spread to most regions of the world excluding Australia. The external colouration of this species is incredibly variable and overlaps significantly with other regularly encountered species such as *L. brassicae*, *L. eupatorii*, *L. helianthi*, *L. sabaziae* and even the darker *L. langei*, almost always necessitating male dissections to confirm identifications. Scheffer and Lewis (2005; see also Scheffer (2005)) documented three highly divergent mitochondrial clades within *L. sativae* suggestive of the presence of cryptic species or host races. More recently, samples from South America have shown an additional fourth clade (Scheffer, pers. comm.). To date, globally invasive populations of *L. sativae* have all represented only one of the four mitochondrial clades, suggestive of real interclade biological differences (Scheffer, unpub. data).

Spencer (1981) incorrectly notes that the types of *Liriomyza pullata*, *L. minutiseta* and *L. canomarginis*, designated by Frick, are housed at the CASC. Originally deposited in the collection of the Hawaiian Sugar Planters’

Association, they would have been transferred to the BPBM along with the remainder of that collection (N. Evenhuis, pers. comm.).

Liriomyza schlingeri Spencer

Figs 208, 209

Liriomyza schlingeri Spencer 1981: 269. Spencer & Steyskal 1986: 130.

Wing length 1.4–1.5mm (♂), 1.7mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.6. Eye height divided by gena height: 4.2–5.5. Scutum subshining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Posterolateral margin of head to base of outer vertical bristle, ocellar triangle and back of head brown; clypeus yellow, sometimes brown laterally. Scutum with complete lateral yellow band; katatergite yellow; anatergite dark brown below scutellum and paler laterally. Anepisternum with broad transverse stripe that is highly reduced in non-types; anepimeron sometimes with brown mottling; most of meron brown; katepisternum brown to level of bristle. Legs yellow with base of mid and hind coxae brown (broader on hind coxa), hind femur possibly narrowly brown at base, tibiae brown to light brown and tarsi light brown, becoming paler to base. Abdomen brown with lateral and complete central stripe on all tergites yellow, posterior margin of tergites thinly yellow (incomplete medially on tergite 1) and epandrium yellow dorsally.

Genitalia: Figs 208, 209. External terminalia as described for *L. sativae*. Paraphallus thin and subrectangular. Hypophallus with distal section short-haired and nearly separate. Mesophallus approximately as long as wide, separate from distiphallus; mesophallus and distiphallus with complete ventral suture. Distiphallus darker, tapered at base and with basolateral and dorsal surfaces thick; distal half thin-walled with one pair of dark internal fringed structures.

Hosts. Asteraceae—*Baccharis* sp., *B. glutinosa**.

Range. USA. California [Los Angeles, Riverside].

Type material. Holotype, USA. California: Riverside Co., Deep Canyon, 30.v.1963, reared from *Baccharis* sp., E.I. Schlinger (1♂, CASC); Paratype examined, USA. California: Los Angeles Co., Los Angeles, 3.iv.1915, M.C. VanDuzee (1♂ [head missing], CASC).

Additional material examined. USA. California: Riverside Co., Riverside, 19.viii.1959, *Baccharis glutinosa* (3♂ 1♀ 1?, UCD).

Comments. *Liriomyza schlingeri* is externally similar to other *Liriomyza* with entirely yellow femora, particularly *L. sativae* (also found on *Baccharis*), but subtle characters of the phallus can be used to distinguish them. The examined paratype was not listed in the original description, but bears a circular paratype label typical of Spencer's other species.

Liriomyza septentrionalis Sehgal

Figs 2, 214–217

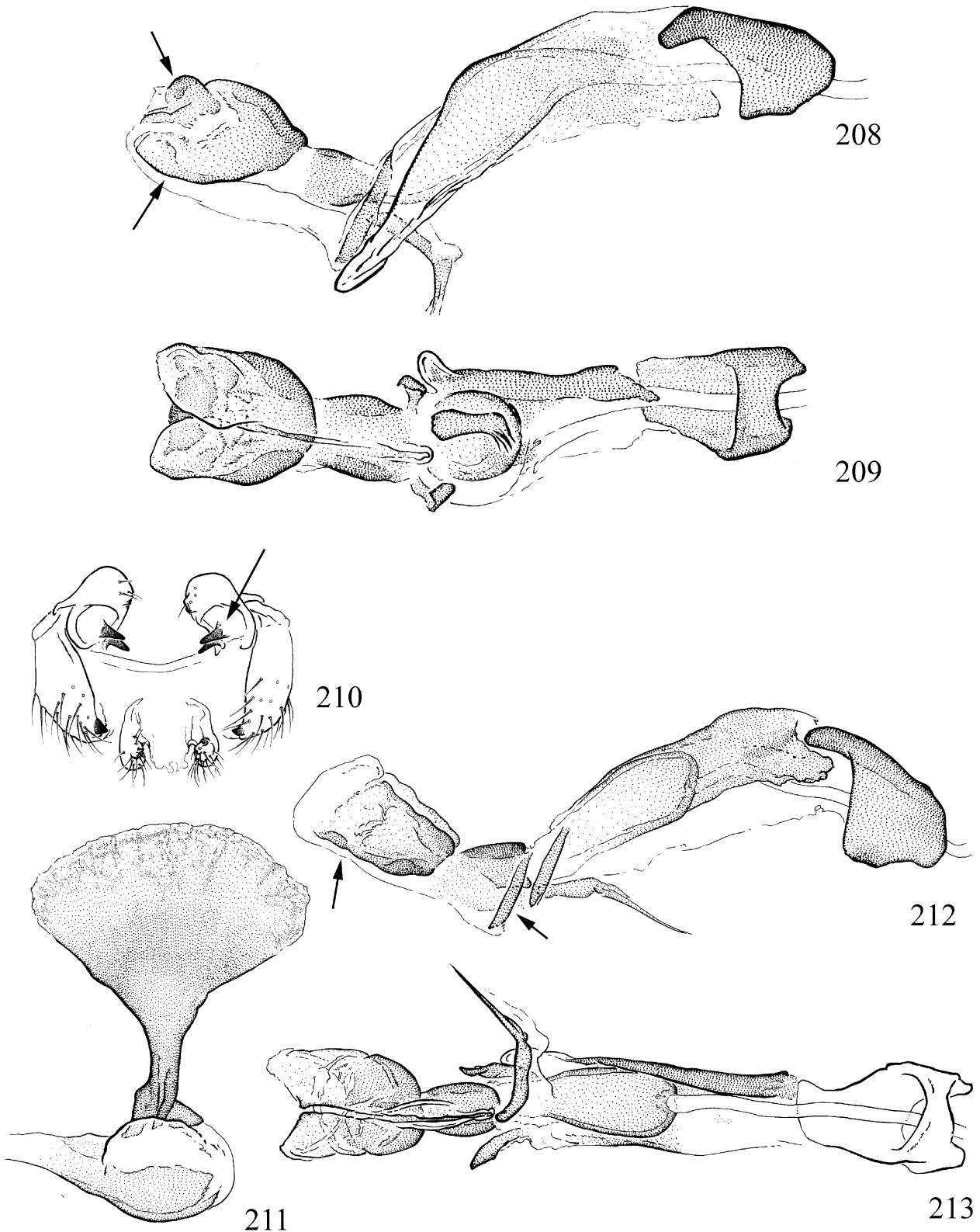
Liriomyza septentrionalis Sehgal 1968: 70. Spencer 1969: 184, 1981: 271; Spencer & Steyskal 1986: 122.

Fig. 2. Wing length mm 1.5–2.7(♂), 2.3–3.5mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7–1.9. Eye height divided by gena height: 4.2. Scutum shining.

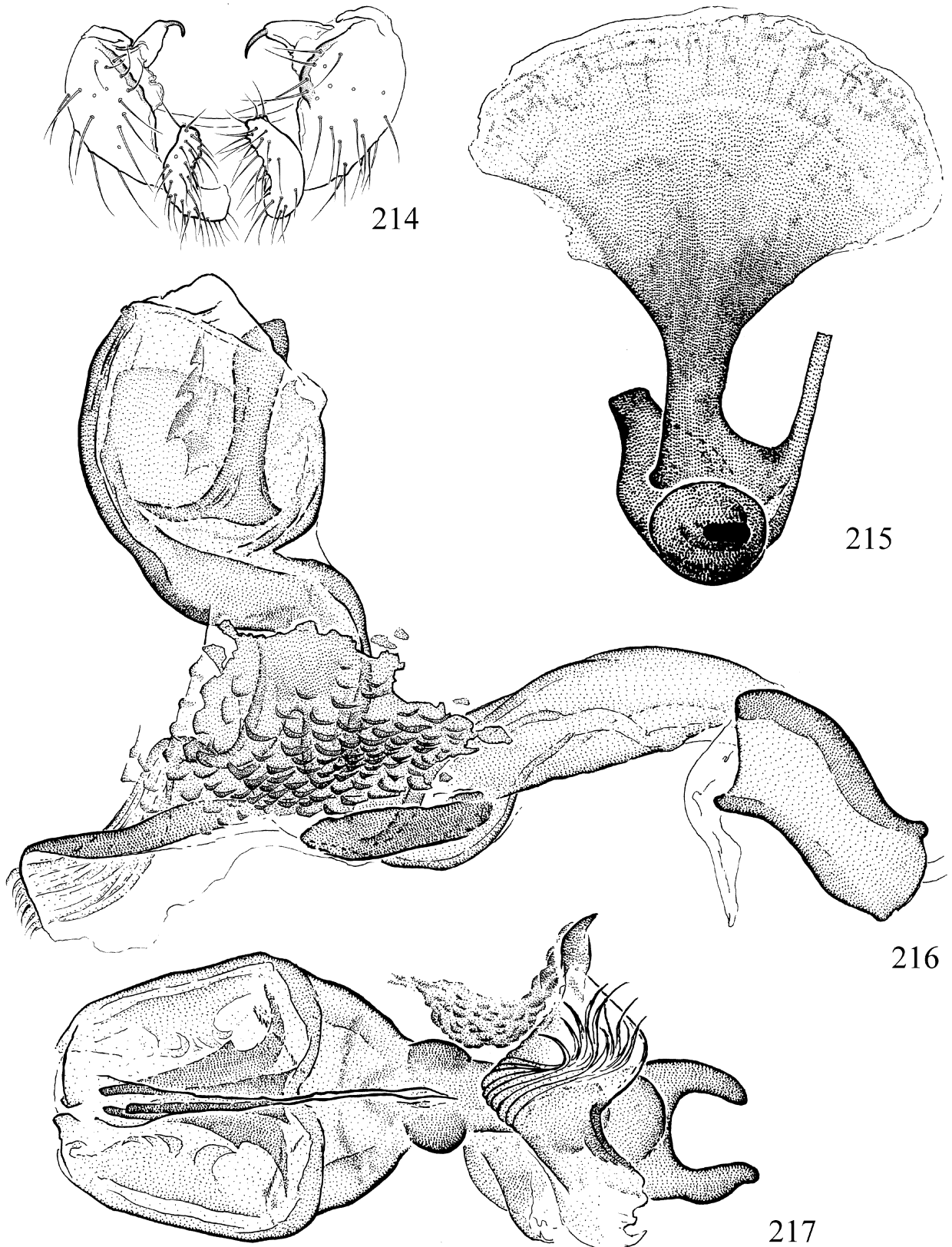
Chaetotaxy: Two ori (sometimes one on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. First flagellomere usually entirely yellow, but sometimes lightly infuscated to slightly darker on anterior margin; posterolateral corner of frons variably dark, with dark region reaching nearly to base of outer vertical bristle or to base of inner vertical (if surrounded by brown, vertical bristles always with narrow yellow spot surrounding base); clypeus, ocellar triangle and back of head dark brown; ventral margin of gena with pale brownish band. Scutum with complete lateral yellow stripe; laterotergites light brown, becoming darker below scutellum. Pleuron dark brown with dorsal 1/5–1/4 of anepisternum and often

katepisternum yellow. Legs dark brown with apex of femora and base of tibiae (narrowly) yellow. Abdomen dark with lateral margin of tergites yellow, with yellow margin broad and easily viewed dorsally on tergites 1–3.



FIGURES 208–213. Figs 208–209: *Liriomyza schlingeri* Spencer, male genitalia; 208: phallus, left lateral; 209: phallus, ventral. Figs 210–213: *Liriomyza tricornis* **spec. nov.**, male genitalia; 210: external components, ventral; 211: ejaculatory apodeme; 212: phallus, left lateral; 213: phallus, ventral.



FIGURES 214–217. *Liriomyza septentrionalis* Sehgal, male genitalia; 214: external components, ventral; 215: ejaculatory apodeme; 216: phallus, left lateral; 217: phallus, ventral.

Genitalia: Figs 214–217. Epandrium without spine. Surstylus small and subtriangular with one long, thin, curved apical bristle. Basiphallus with dark bar on left ventroapical surface; base of distiphallus flanked by dark,

scaled membrane that is often broken off or missing on one or both sides. Swollen apical section of duct short and with strong ventral curve. Hypophallus long-haired and fused to base of distiphallus. Mesophallus not distinct. Distiphallus very large and directed dorsally, with stout, curved basal section and large cup-like apical section; distal cup enclosing inner spines and one pair of thin, flat, dark medial process. Ejaculatory apodeme with *pileus ejaculatorius* dark and strongly produced laterally as domes with ends strongly produced; venter of bulb and broad base of stem well-sclerotized, blending into dark, thin duct; blade broad, becoming paler and annulated with minute striations apically.

Variation: Females with wing length of 4.1mm with higher colour contrast and distoventral surface of fore femur yellow. A minority of material slightly to significantly paler than above description, usually with distoventral surface of fore, and sometimes mid and hind femora yellowish to yellow. Some material from San Mateo, Monterey and Sagehen Counties differ as follows: only posterodorsal corner of anepisternum yellow; dorsal 1/3 of katepisternum and meron yellow; katatergite yellow; only base of fore coxa brown; tip of mid coxa yellow; fore femur only brown dorsobasally; apices of mid and hind femora more broadly yellow. Some material from Berkeley differ as follows: dorsal 1/3 of katepisternum yellow; anepisternum with broad yellow posterodorsal and smaller anteroventral spots; only base of fore and hind coxae brown; fore femur brown basally and dorsally mottled on basal 2/3; mid femur more widely yellow apically. Specimen from Sugarloaf Mountain differs as follows: anterior margin of first flagellomere dark yellow; ventral margin of gena yellow; pleuron yellow with ventral 2/3 of katepisternum and meron brown, anterior margin of anepimeron brown and anteroventral corner of anepisternum with oblique stripe; femora yellow with base narrowly brown; tibiae and tarsi light brown; abdomen more widely yellow.

Hosts. Poaceae—*Bromus*, *Hordeum*, *Lolium*.

Range. USA. California [widespread], Colorado. **Canada.** Alberta, British Columbia.

Type material. Holotype, **CANADA. Alberta:** Banff, 28.vi.1966, V.K. Sehgal (1♂, CNC).

Additional material examined. USA. **California:** 663♂ 947♀ 6? [CASC, CSCA, EMEC, SBMN, UCD, UCR, USNM].

Comments. Among the Californian fauna, the characteristic colour of the abdomen and the legs are very useful for separating this species from the remainder of the agromyzid fauna. Specimens with paler femora can be confused for *Liriomyza langei*, but the abdomen of that species is entirely dark and the first flagellomere is almost always darker apically. Outside of agricultural crops where pests such as *L. sativae* and *L. langei* can be abundant, *L. septentrionalis* is by far the commonly encountered species of *Liriomyza* in California. Californian adults have been collected “on week-old human feces”, the flowers of *Daucus carota* (Umbelliferae), *Lolium* and the foliage of *Pinus radiata*.

Liriomyza septentrionalis is almost entirely indistinguishable from the Albertan species *L. cordillerana* Sehgal externally, with the latter only confidently diagnosed internally by a longer distiphallus with a broader, shallower, darker apical “cup” that reveals the dark medial processes, no lateral “scales” on the distiphallus, more extensive distal processes on the basiphallus and a bare surstylus.

***Liriomyza smilacinae* Spencer**

Figs 80–82

Liriomyza smilacinae Spencer 1969: 186. Spencer 1981: 273; Spencer & Steyskal 1986: 135.

Wing length 1.8mm (♂), 1.8–1.9mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.0–2.5. Eye height divided by gena height: 2.3–4.0. Scutum with greyish pruinosity. Parafacial, cheek and orbital plate projecting. Epistoma slightly pronounced.

Chaetotaxy: Two ori (rarely one), two ors; sometimes two or three ori and one ors. Acrostichal setulae in two sparse anterior rows.

Colouration: Calypter margin and hairs white. Head light yellow with anterior margin of first flagellomere yellow, ocellar triangle and back of head brown, and clypeus light brown to brown; posterolateral margin of frons brownish behind vertical bristles. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite brown lateral to scutellum with dorsum yellow and dark brown below scutellum. Anepisternum yellow with anteroventral

spot; anepimeron with brown mottling; meron largely brown with yellow mottling; katapisternum brown along posterior margin and on ventral 2/3. Legs yellow with base of coxae brown, fore femur sometimes brown dorsobasally, base of mid and hind femora brown dorsally, scraper on hind leg sometimes brown, fore tibia yellow to brown with centre sometimes darker, basal 3/4 of mid tibia brownish excluding base (sometimes only subapically) to entirely brown, hind tibia brown to dark brown on basal 3/4 excluding base (sometimes only medially) to entirely brown, and tarsi entirely brown to yellow with fourth segment light brown and fifth segment brown.

Genitalia: Figs 80–82. Surstylus tapering apically and with one subapical spine. Distal swollen section of duct not much longer than wide. Paraphallus subrectangular to pointed and upcurved apically; broadly fused to membranous distal margin of basiphallus. Hypophallus thin and pale with short apical hairs. Mesophallus cylindrical and projecting into base of distiphallus. Distiphallus with broad, bulbous textured basal bowl and short, broad, distal tubules, each enclosing a small, pale, fringed structure. Ejaculatory apodeme with *pileus ejaculatorius* broad, dark and truncated; base of duct lightly pigmented; blade broad, semicircular and with irregular distal margin.

Variation: New Hampshire males differ as follows: anterior ori absent; legs yellow with tibiae brown medially (becoming much fainter on anterior legs).

Hosts. Convallariaceae—*Maianthemum stellatum* (formerly treated as *Smilacina*), “*Smilacina* sp.”

Range. **USA.** California [El Dorado, Glenn, Modoc(?)*, San Bernardino*, Sierra, Siskiyou*], New Hampshire*. **Canada.** Alberta, Manitoba, Ontario.

Type material. Holotype, **Canada. Alberta:** Edmonton, White Mud Park, mine *Smilacina*, 15.vii.1966, K.A. Spencer (1♂, CNC).

Additional material examined. **USA. California:** **El Dorado Co.,** Echo Lake, 19.vii.1955, W.W. Middlekauff (1♀, EMEC), **Glenn Co.,** Plaskett Meadow, 18.vii.1948, sweeping, lot No. 83-2, U.N. Lanham (1♂, CASC), Black Butte, 6500-7400', 16.vi.1972, S.L. Szerlip (1♀, EMEC), **San Bernardino Co.,** Victorville, 2.v.1953, G.A. Marsh (1♀, EMEC), **Sierra Co.,** Webber Lake, 3.vii.1964, M.E. Irwin (1♂, UCR), **Siskiyou Co.,** Copper Cr., 28.vii.1971, 5000', J. Kraemer (2♀, CASC), **New Hampshire:** Mt. Washington, Bigelow lawn, 5400', Mason, 31.vii.1954 (1♂, CNC), Mt. Washington, Lakes of the Clouds, 5000', Becker, Munroe & Mason, 31.viii.1954 (1♂, CNC).

Questionably-included material: **California. Modoc Co.,** Cold Cr., 5mi S Buck Cr. Rgr. Sta., 6300', 11.vi.1970 (1♀, EMEC).

Comments. The widespread *Liriomyza smilacinae* cannot be distinguished using external characters from the western U.S. *L. merga*, which also has a greyish pruinosity on the notum, a projecting parafacial and orbital plate, an almost entirely yellow frons, an entirely white calypter and no more than two rows of acrostichal setulae. The male terminalia of these species are entirely different, however, with the phallus of *L. smilacinae* being more similar to that of the darker *L. nebulosa* (see comments for *L. nebulosa*).

Liriomyza specifica Spencer

Figs 218–220

Liriomyza specifica Spencer 1981: 275. Spencer & Steyskal 1986: 127.

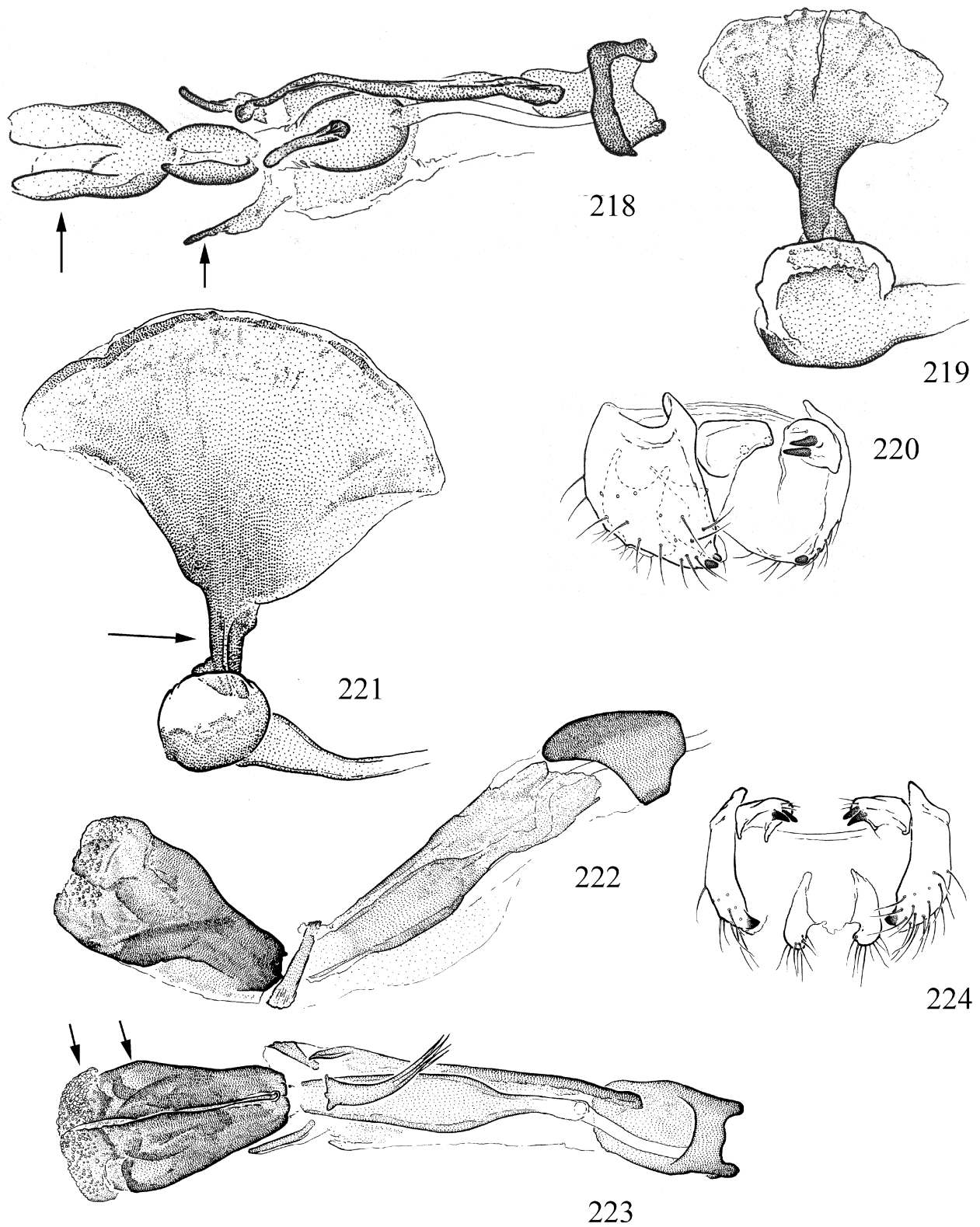
Wing length approximately 1.7mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section, and eye height divided by gena height not discernable. Scutum shining.

Chaetotaxy: Three ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head yellow with back of head, ocellar triangle and clypeus dark brown; distal half of first flagellomere orange; posterolateral corner of frons dark brown to base of outer vertical bristle and paler to base of inner vertical. Scutum with complete lateral yellow stripe. Anepisternum with broad, oblique anteroventral stripe and dark posteroventral margin; anepimeron with brown mottling on anterior half; meron mostly brown; katapisternum brown ventral to base of bristle (not including bristle base). Legs yellow with base of fore coxa, basal half of mid coxa and all of hind coxa brown; fore femur possibly with faint dorsobasal spot, hind femur lightly pigmented on file and possibly with faint dorsal mottling; tibiae brown (paler on anterior legs) and tarsi brown (becoming paler to base). Abdomen brown with sides of tergites yellow.

Genitalia: Figs 218–220. Surstylus with two subapical spines. Dorsal surface of phalophorus narrowed and subrectangular distally. Paraphallus flat, thin and narrowed apically. Hypophallus narrow with few short apical

hairs. Mesophallus slightly longer than wide, tapered at ends and with ventral sulcus. Distiphallus cup-shaped with wide ventral suture and thick-walled base. Ejaculatory apodeme with short dark stalk and short, but well-sclerotized blade.



FIGURES 218–224. Figs 218–220: *Liriomyza specifica*, male holotype genitalia; 218: phallus, ventral; 219: ejaculatory apodeme; 220: external components, ventral. Figs 221–224: *L. stachyos* Spencer, male genitalia; 221: ejaculatory apodeme; 222: phallus, left lateral; 223: phallus, ventral; 224: external components, ventral.

Host. Unknown, possibly *Sambucus mexicana* (Caprifoliaceae).

Range. USA. California [Riverside, Ventura].

Type material. Holotype, **USA. California: Riverside Co.**, Elsinore, 16.iv.1977, on *Sambucus*, K.A. Spencer (1♂, USNM).

Comments. The two spines on the surstylus will most easily distinguish this species from the common *Liriomyza sativae*, and the additional ori on both sides, the narrowed paraphalli and characteristic distiphallus will separate it from *L. sabaziae* and other similar taxa.

Liriomyza stachyos Spencer

Figs 221–224

Liriomyza stachyos Spencer 1981: 276. Spencer & Steyskal 1986: 115.

Wing length 1.4–1.9mm (♂), 1.6–2.2mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.2–2.4. Eye height divided by gena height: 2.9–4.0. Scutum shining.

Chaetotaxy: Two ori (sometimes three on one side), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs greyish-brown. Antenna entirely dark brown; lateral margin of frons dark brown with small spot at base of ori and with extensions from margin surrounding base of ors; ocellar triangle, back of head, ventral margin of gena, face, clypeus, palpus and posterolateral corner of frons (enclosing vertical bristles) dark brown. Scutum with wide lateral yellow stripe presuturally and very narrow yellow stripe above wing base and along posterolateral corner; laterotergites dark brown. Pleuron dark brown with dorsal margin of anepisternum, posterodorsal margin of katapisternum and vertical stripe on katatergite yellow. Legs dark brown with apices of femora narrowly yellow. Abdomen dark brown.

Genitalia: Figs 221–224. Surstylus small with two subapical spines. Swollen apical section of duct only slightly constricted apically. Paraphallus thin, becoming slightly wider apically. Hypophallus with long apical hairs. Mesophallus indistinct. Distiphallus relatively large, dark, and clavate with complete ventral sulcus and minute apical texturing. Basal bulb on ejaculatory apodeme small with venter pigmented; base of duct lightly pigmented; stem short and thin; blade broad, paler apically excluding dark distal margin.

Hosts. Lamiaceae—*Stachys* spp., including *S. albens*, *S. bullata*, *S. californica* and *S. rigida*. Scrophulariaceae—*Castilleja latifolia**.

Range. USA. California [Alameda, Contra Costa, Glenn, Marin, Mendocino*, Monterey*, Napa, Orange*, San Bernardino*, San Francisco, Santa Clara*, Santa Cruz].

Type material. Holotype, **USA. California: Santa Cruz Co.**, Aptos, 14.ix.1948, ex. *Stachys californica*, Lot 145-1, K.E. Frick, Type No. 13942 (1♂, CASC); Paratypes examined, **USA. California: Alameda Co.**, Berkeley, 20.vi.1948, ex. larva *Stachys bullata* Benth. Lot No. 11-1, K.E. Frick (1♀, CASC), **Alpine Co.**, Iceberg Meadow, 24.viii.1976, 6400', H.K. Court (1♂, CASC), **Glenn Co.**, Plaskett Meadow, 18.vii.1948, sweeping, Lot No. 83-1, Pres. By K.E. Frick, U.N. Lanham (2♂, CASC), **Marin Co.**, Hwy. 1, 1.7mi NE Muir Beach, 25.iv.1964, P.H. Arnaud, Jr. (1♂, CASC), **San Francisco**, 14.vi.1951, E.I. Schlinger (1♂, UCD), **San Mateo Co.**, Corte Madera Creek, Alpine Road, SE of Portola, 230m, 19.ix.1976, P.H. Arnaud, Jr. (1♂, CASC), **Santa Cruz Co.**, Aptos, 14.ix.1948, ex. larva *Stachys californica* Benth., Lot No. 145-1, K.E. Frick (1♀, CASC), Soquel, 26.viii.1948, sweeping, Lot No. 153-5, K.E. Frick (2♂, CASC).

Additional material examined. USA. California: Yosemite, 27.vi.1947, A.L. Melander (1♂, CSCA), **Alameda Co.**, Berkeley, on *Stachys*, W.W. Jones (1♀, EMEC), **Mendocino Co.**, UC Hopland Fld. Stn., nr. H.Q., 880', 5.v.1968, dry ice Malaise traps, W.J. Turner (1♂, EMEC), **Monterey Co.**, Ft. Ord: Coast Dunes, 18.v.1977, J. Powell, No 77E117, emerged 8.vi.1977, reared from *Castilleja latifolia* (1♂, EMEC), **Orange Co.**, San Clemente, 23.v.1944, A.L. Melander (1♂, USNM), **San Bernardino Co.**, Barton Flat, 3.viii.1942, A.L. Melander (1♂, USNM; 1♂, CSCA), Sugarloaf, 15.vii.1946, A.L. Melander (1♀, USNM), **Santa Clara Co.**, Alum Rock Park, 26.i.1974, J. Powell (1♀, EMEC).

Comments. Two closely spaced subapical spines on the surstylus, an unusually proportioned ejaculatory apodeme and a heavy, dark, clavate distiphallus with minute apical texturing is diagnostic of *Liriomyza stachyos*. Externally, it has an entirely dark face, palpus, antenna and legs, with the fore knee yellow.

Liriomyza togata (Melander)

Figs 225–228

Antineura togata Melander 1913: 250.

Haplomyza togata. Hendel 1914: 73; Frick 1952a: 410, 1957: 204 [lectotype designation], 1959: 413.

Liriomyza togata. Steyskal 1980: 141; Spencer & Steyskal 1986: 134.

Liriomyza douglasii Spencer 1981: 228. Syn. Spencer & Steyskal (1986).

Wing length 1.6mm (♂), 1.7mm (♀). Vein dm-cu usually absent in U.S. specimens. Eye height divided by gena height: 2.9–5.3. Scutum dusted with pruinosity, not grey. Orbital plate slightly, and parafacial and cheek strongly produced.

Chaetotaxy: Two ori (sometimes three), one ors. Acrostichal setulae in two rows.

Colouration: Calypter margin and hairs grey. Head light yellow with ocellar triangle brown and clypeus and back of head dark brown. Scutum with complete yellow lateral stripe; katatergite with small brown posteroventral spot; anatergite brown, becoming darker below scutellum and yellow dorsally lateral to scutellum. Anepisternum yellow with small posteroventral and anteroventral stripes; anepimeron yellow with anterior mottling and posterior margin brown; katepisternum brown below (and not touching) bristle and with small spot behind bristle; meron brown with dorsal margin yellow. Legs yellow with base of fore coxa, basal half of mid coxa and basal $\frac{3}{4}$ of hind coxa brown, base of femora infrequently brown, fore tibia light brown with base fading to yellow, mid tibia brown dorsally with venter slightly paler, hind tibia dark brown with venter paler, and tarsus brown, becoming paler to base. Abdomen brown with thin medial stripe on tergite 2, and posterior and broad lateral margin on tergites yellow.

Genitalia: Figs 225–228. Surstylus slightly darker than epandrium and with one subapical spine. Basiphallus curved ventrally and mesophallus directed dorsally; left and right margins projecting anteriorly as long, dark bar. Paraphallus flat, lobate and directed laterally from base of mesophallus. Hypophallus with broad membranous base and short subapical hairs. Mesophallus narrowing apically, with ventral suture, and length approximately twice width. Distiphallus globular with rounded, narrower base; distal half relatively dark and enclosing one pair of fringed structures. Ejaculatory apodeme small but well developed, *pileus ejaculatorius* with truncated, heavily sclerotized ends, and blade dark and semicircular with distal margin thickly-sclerotized.

Variation: One dissected male and one female from Modoc Co. with vein dm-cu present (length of ultimate section of vein CuA₁ divided by penultimate section 2.9); three ori (female with only two on one side); tarsi pale on basal 2–3 segments and dark on apical segments; mid tibia brownish with dorsum darker; hind tibia dark brown, becoming paler apically; only posterior margin of tergites yellow in female.

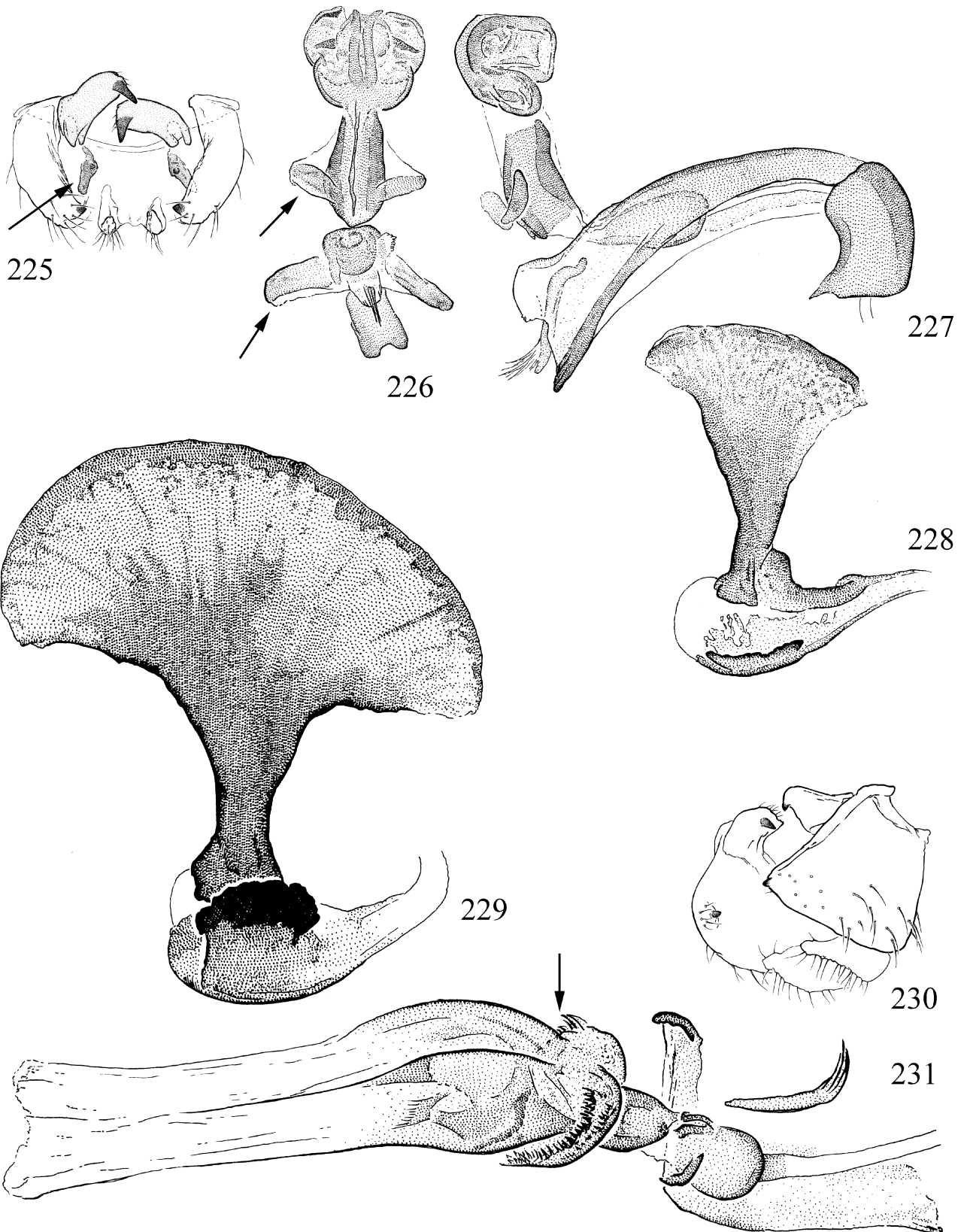
Hosts. Asteraceae—*Baccharis douglasii* (Spencer, 1981), *Artemisia douglasiana* (Spencer & Steyskal, 1986).

Range. USA. California [Alpine, Alameda, Modoc*, Nevada, Siskiyou*, Tuolumne], Washington. Kansas, North Dakota, New Mexico and Texas records (Frick, 1959) are yet to be confirmed.

Type material. *Antineura togata*: Lectotype, **USA. Washington:** Pullman, 12.v.1912, A.L. Melander, “Lectotype *Antineura togata* Mel., Frick 1957” [red label] (1♂, USNM). *Liriomyza douglasii*: Holotype, **USA. California: Nevada Co.,** Sagehen Creek, near Hobart Mills, 15.vii.1964, sweeping, M. Irwin (1♂, CASC).

Additional material examined. USA. California: Modoc Co., 5mi S Alturas, 8.vi.1970, J. Powell (1♂ 1♀, EMEC), **Siskiyou Co.,** Young’s Valley, 31.vii.1971, 4600’, J. Kraemer (1♂, CASC).

Comments. *Liriomyza togata* differs from most Nearctic congeners in lacking vein dm-cu, although the male and female from Modoc County have shown that this vein can sometimes be present. When dm-cu is absent, it can easily be mistaken for the similar genus *Haplopeodes*, and a number of specimens of the more common species *H. minutus* have been misidentified as *L. togata* in collections. *Haplopeodes minutus* can be distinguished from this species as follows: two ori; frons brownish behind eye at level of vertical bristles; tarsi brown (paler on fore legs); tergite 5 yellow in male and with two minute anterior spots in female; epandrium yellow; distiphallus small and clear; hypandrium relatively long and dark with sides close to each other along distal half; ejaculatory apodeme linear.



FIGURES 225–231. Figs 225–228: *Liriomyza togata* (Melander), male genitalia; 225: external components, ventral; 226: phallus, ventral; 227: phallus, left lateral; 228: ejaculatory apodeme. Figs 229–231: *L. tubula* Spencer, male holotype genitalia; 229: ejaculatory apodeme; 230: external components, ventrolateral; 231: phallus, ventrolateral.

***Liriomyza tricornis* spec. nov.**

Figs 210–213

Wing length 2.1mm (♂). Female unknown. Length of ultimate section of vein CuA₁ divided by penultimate section: 2.5. Eye height divided by gena height: 5.0. Scutum subshining.

Chaetotaxy: Two ori, one ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs dark brown. Head yellow with antenna darker, ventral margin of gena with thin brownish stripe, clypeus, ocellar triangle and back of head dark brown, and posterolateral corner of frons dark brown to base of outer vertical bristle and lighter brown to base of inner vertical bristle. Scutum with complete lateral yellow stripe; laterotergites brown with dorsal 1/3 of katatergite yellow. Pleuron dark brown with dorsal 1/3 of anepisternum and dorsal margin of katapisternum yellow. Coxae dark brown with tip of fore coxa yellow; femora yellow with brown base and dorsal streaking; tibiae and tarsi dark brown. Abdomen dark brown.

Genitalia: Figs 210–213. Surstylus broadly rounded with several apical setulae and two basal spines in desclerotized region. Paraphallus thin and bar-like. Hypophallus thin with few apical hairs fused to a point. Mesophallus rounded at sides and slightly longer than wide; mesophallus and distiphallus with complete ventral sulcus. Distiphallus cup-shaped, slightly compressed dorsoventrally, with darker base (walls thickest on dorsal and ventral surfaces) and pale hollow distal section enclosing weak hairs. Ejaculatory apodeme with base of duct and *pileus ejaculatorius* lightly-sclerotized; stem thin past base and blade broad and subovate with marginal streaking.

Etymology. The specific epithet denotes the three (*L. tri-*) pairs of fronto-orbitals (*L. cornu*) on the frons.

Host. Unknown.

Range. USA. California [San Mateo].

Type material. Holotype, **USA. California: San Mateo Co.**, South San Francisco, 326 Alta Loma Drive, 1–25.i.2007, 30m, 37°39'39.8"N, 122°26'36.0"W, P.H. & M.M. Arnaud, Jr., & M.L. Tarbox, Arnaud Malaise trap (1♂, USNM).

Comments. *Liriomyza tricornis* differs subtly from similar species in having only three pairs of fronto-orbitals on both sides of the frons. The surstylus is also unique in having two spines in a desclerotized basal region (not the sclerotized apical region), the hypophallus is thin and pointed, and the left distolateral lobe on the basiphallus is sclerotized, resembling the paraphallus.

***Liriomyza trifoliarum* Spencer**

Figs 236–239

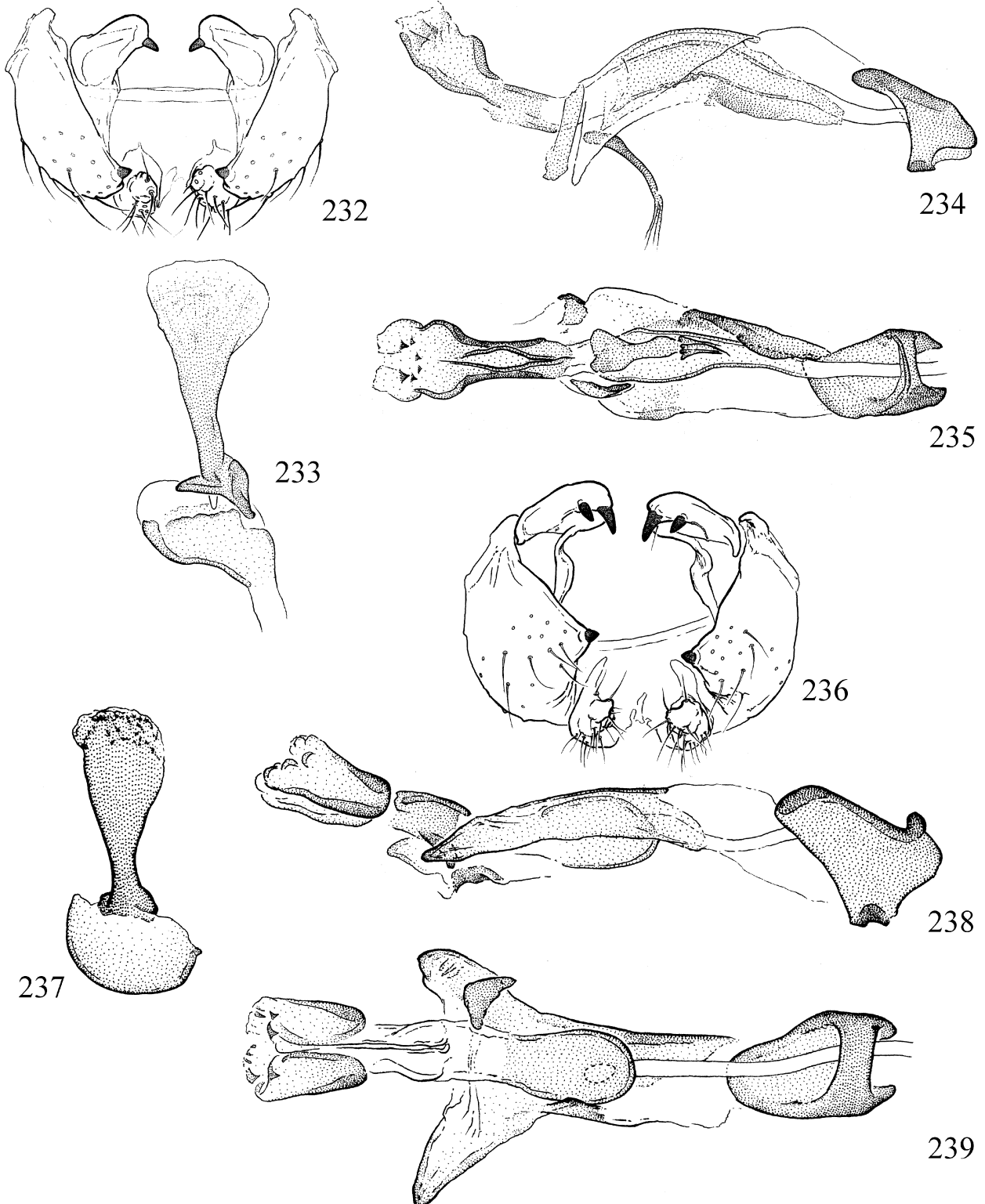
Liriomyza pictella. Misidentification, in part. Frick 1959: 408.

Liriomyza trifoliarum Spencer In Spencer & Stegmaier 1973: 107. Spencer & Steyskal 1986: 296.

Description. Wing length 1.8–2.3mm (♂), 1.8–2.2mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.5–3.3 (up to 4.0 in some CA specimens). Eye height divided by gena height: 2.8–3.2. Scutum subshining.

Chaetotaxy: Two ori (sometimes three on one side), two ors. Acrostichal setulae in four or five irregular rows.

Colouration: Calypter margin and hairs dark. Ocellar triangle, back of head, clypeus and posterolateral margin of frons to base of inner vertical bristle dark brown; orbital plate brown to base of posterior or anterior ors (fading anteriorly), or with light mottling at base of bristles; face light brown to yellow; posteroventral margin of gena with thin brownish stripe; first flagellomere yellow, with distal margin sometimes infuscated. Scutum sometimes brown posterolaterally; laterotergites brown, usually with katatergite partially yellow dorsally. Pleuron brown with dorsal ¼ or less of anepisternum, mottling on anepimeron, dorsal margin of meron, and dorsal or dorsomedial margin of katapisternum yellow; katapisternal bristle usually enclosed by brown, sometimes on yellow border. Coxae (sometimes excluding tip to distal 2/3 of fore coxa), tibiae and tarsi brown; base of femora brown (sometimes only dorsally or mid femur entirely yellow) with remainder variably patterned, but usually paler on fore or mid femora, and infrequently entirely brown with knee and anteroventral surface yellow (that is, similar to *L. lanzei*). Abdomen brown, sometimes with posterior margin of tergites 2–5 yellow, or with lateral margins becoming slightly yellowish along edge.



FIGURES 232–239. Figs 232–235: *Liriomyza trifolii* (Burgess), male genitalia; 232: external components, ventral; 233: ejaculatory apodeme; 234: phallus, left lateral; 235: phallus, ventral. Figs 236–239: *L. trifoliarum* Spencer, male genitalia; 236: external components, ventral; 237: ejaculatory apodeme; 238: hypandrial complex, left lateral; 239: phallus, ventral.

Genitalia: Figs 236–239. Surstylus slightly narrowing distally and with two subapical spines (outer spine slightly smaller). Apical membrane of basiphallus produced into one pair of pointed paraphalli. Hypophallus

absent or present as small offset sclerotized plate. Mesophallus slightly longer than wide, most heavily sclerotized laterally and dorsally; mesophallus and distiphallus with complete ventral suture. Distiphallus almost entirely divided medially with halves narrow, weakly sclerotized apically and with several inner-marginal triangular points. Ejaculatory apodeme narrow and poorly developed with venter of bulb broadly sclerotized.

Hosts. Fabaceae—*Coronilla*, *Medicago sativa*, *Phaseolus vulgaris*, *Pisum*, *Trifolium repens* (Spencer & Steyskal, 1986; Dempewolf, 2004). Solanaceae—*Solanum sarachoides* (Spencer & Steyskal, 1986). Californian adults[?] also found on *Chrysanthemum* (Asteraceae), *Brassica* (Brassicaceae), *Gypsophila* (Caryophyllaceae) and *Adenostoma fasciculatum* (Rosaceae).

Range. **USA:** Arizona*, California [widespread], Florida, Maryland, Massachusetts, New Mexico*, New York, Oregon*, Pennsylvania, Utah*, Washington, Wisconsin. **Canada:** Prince Edward Island.

Type material. Holotype, **USA. Florida:** Gainesville, 24.iv.1964, ex. *Trifolium repens*, D.H. Habeck (1♂, USNM).

Additional material examined. **USA. Arizona:** Tempe, V.L. Wildermuth, “May 24–12” (3♂ 4♀, USNM), **California:** **Alameda Co.,** Live Oak Park, 24.v.1944, A.L. Melander (1♂, USNM), **Del Norte,** Six Rivers NF For Route 16N02, nr. Bear Basin Outlk, 41.8016°N, 123.7369°W, 1500m, 3.vi–24.vii.2009, P. Kerr & O. Lonsdale (1♂ 1♀, CSCA), **El Dorado Co.,** Summit Luther Pass, 6.viii.1948, sweeping, Lot No., 102-2, K.E. Frick (2♀, CASC), Bijou, 10.vi.1952, P.H. Arnaud (1♂, USNM), Echo Lake, 23.vii.1955, E.I. Schlinger (5♂ 5♀, UCD), **Glenn Co.,** Rold Ranch, 1.vii.1953, Ladino clover, R.F. Smith (1♂ 1♀, CASC), **Imperial Co.,** Niland, 17.iv.1979 (1♂, UCR), **Inyo Co.,** Deep Spr., 16.vii.1953, E.I. Schlinger (1♂, EMEC), **Kern Co.,** Havilah, 15mi SW, 15.v.1963, J. Powell (1♂, EMEC), **King Co.,** Corcoran, 18.vii.1967, G.L. Jensen (1♂, CSCA), **Los Angeles Co.,** Llano, Mojave Desert, 13.iii.1935, A.L. Melander (2♂, USNM), **Mendocino Co.,** Ortega Highway nr. Summit, “11/6/44”, A.L. Melander (1♂, USNM), **Monterey Co.,** Chualar, 19.vi.1980, *Chrysanthemum* (2♂ 17♀, EMEC), Chualar, [?].xii.1980 (1♂, EMEC), **Riverside Co.,** Riverside, 21.ii.1935, A.L. Melander (1♂, USNM), P.L. Boyd Des. Res. Centre, 3.5mi S Palm Desert, elev. 2960', 5–13.vi.1973, Malaise trap, A. Tabet (1♀, UCR), **Salinas Co.,** 19.vi.1980, *Brassica* (3♂ 5♀, EMEC), *Solanum* (2♀, EMEC), **San Bernardino Co.,** 9 air mi. S Baker Zzyzx Sprs., 25.iv.1977, Ulrich, Malaise trap (1♂, EMEC), **San Luis Obispo Co.,** Morro Bay, 8mi E, 2.v.1962, *Adenostoma fasciculatum*, C.A. Toschi (2♂, EMEC), **Santa Clara Co.,** Stanford, vi.1915, A.L. Melander (1♂, USNM), Palo Alto, 18.ix.1980, ex. mums (4♂ 3♀, EMEC), ex. tomato (2♂ 2♀, EMEC), **Santa Cruz Co.,** Mount Hermon, 1.viii.1948, sweeping, Lot No., 50-5, K.E. Frick (1♀, CASC), “Santa Cruz Co.”. #5, 10.vi.1917, W.M. Giffard (1♂, CASC), **Siskiyou Co.,** Mt. Shasta City, 24.vi.1958, J. Powell, at light (1♂, EMEC), **Yolo Co.,** Davis, 11.ix.1978, tomato (1♂, UCD), **Florida:** Bradenton, 16.ix.1980, ex. *Gypsophylla* (1♂ 1♀, EMEC), ex. mums (1♂ 2♀, EMEC), ex. *Chrysanthemum* (1♀, EMEC), **New Mexico:** Bandelier Mon., Frijoles Can., 14.vi.1960, Burks & Kinzer (1♂, USNM), **Oregon:** Mt. Hood, Hoods Rapids, 29.vii.1921, A.L. Melander (1♂, USNM), Lake Co., 9mi SE Fort Rock, 3.vii.1971, G. Steyskal (2♂, USNM), **Utah:** Timpanogos Mt., 25.vi.1940, A.L. Melander (1♂, USNM), Salt Lake Laboratory, 22.viii.1913, L.P. Rockwood (1♂ 2♀, USNM), Salt Lake, C.N. Ainslie, 15.vii.1912, reared from *Agromyza* mines (3♂ 3♀, USNM), Salt Lake, C.N. Ainslie, reared from alfalfa leaf mines, “May 11” (1♂, USNM), Salt Lake, C.N. Ainslie, 2.ix.1912, reared from alfalfa mine (1♀, USNM), Salt Lake, T.H. Parks (1♂ 2♀, USNM), **Washington:** Eusum, 28.vi.1917, A.L. Melander (1♂, USNM).

Comments. *Liriomyza trifoliarum* is encountered with relative frequency throughout the United States and has been reared from a number of taxa in the Fabaceae, including several agriculturally significant species. A number of these crops are also attacked by *L. langei*, which is similarly dark and variable in its colouration, and although these two species can be identified externally using the above key, the most reliable means of determination is through examination of the phallus. *Liriomyza trifoliarum* has one pair of pointed, sclerotized “wings” at the base of the mesophallus, which is barely separated from the basiphallus, while *L. langei* is missing these wings and the mesophallus is widely separated from the basiphallus by a long, (usually) curved membranous space from which the elongate, curved hypophallus projects.

Liriomyza trifolii (Burgess)

Figs 232–235

Oscinis trifolii Burgess 1880: 201.

Agromyza trifolii. Coquillett 1898: 78; Malloch 1913: 278.

Liriomyza trifolii. de Meijere 1925: 282; Hendel 1931: 213; Frick 1952a: 405, 1959: 410; Spencer 1965: 37 [neotype designation], 1973a: 226, 1983: 59, 1984: 25; Spencer & Steyskal 1986: 296; Stegmaier 1966: 75; Scheffer & Lewis 2006: 991; Deeming 2006: 412 Gil-Ortiz *et al.* 2008: 573, Palacios *et al.* 2008: 16.
Liriomyza phaseolunata Frost 1943: 256. Frick 1952a: 404, 1959: 408. Syn. Spencer & Steyskal (1986).
Liriomyza alliovora Frick 1955: 88. Frick 1959: 401. Syn. Spencer (1973a).

Description. Wing length 1.2–1.7mm (♂), 1.5–1.9mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 1.7–3.1. Eye height divided by gena height: 2.1–3.0. Scutum with light greyish pruinosity, rarely subshining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in two to four scattered rows.

Colouration: Calypter margin and hairs brownish. Head yellow with back of head above foramen, ocellar tubercle, clypeus, and posterolateral margin of frons lateral to base of outer vertical bristle brown. Scutum with complete lateral yellow stripe; laterotergites brown with sclerites lateral to scutellum lighter, sometimes with katatergite entirely yellow. Pleuron yellow with large ventral spots on katepisternum and meron, and anepisternum and anepimeron with small anteroventral spots. Legs yellow with base of fore coxa sometimes brown, fore femur sometimes with dorsal mottling, base of mid and hind femora sometimes partially brown dorsally, and tibiae and tarsi brown (lighter on fore legs). Abdomen brown with lateral margin broadly yellow and posterior margin of tergites(1)2–4 yellow; tergites 2–5 sometimes with yellow posteromedial emargination (sometimes entirely dividing brown band on tergite 5); epandrium brown, often with dorsum light brown to yellow; tergite 2 sometimes yellow along midline in females.

Genitalia: Figs 232–235. Surstylus with small inner-distal spine. Basiphallus largely recessed distally where swollen section of ejaculatory duct dominates. Paraphallus membranous. Hypophallus small, thin, and slightly curved upwards. Distiphallus small and cup-shaped, fused to mesophallus and inner-distal margin with minute triangular sclerotizations. Ejaculatory apodeme small with base curved and apex relatively narrow and clear.

Range. Widespread in North, Central and South America. Introduced into some European countries, Africa, the Near East, and the Oriental and eastern Palaearctic Regions, most likely the result of dispersal on *Chrysanthemum* cuttings (Dempewolf, 2004). Largely restricted to greenhouses in colder temperate regions, with some evidence of overwintering (Dempewolf, 2004). More detailed distributions are given in Minkenberg and vanLenteren (1986).

Known hosts. *L. trifolii* is a highly polyphagous species, currently known from dozens of families. See Table 1.

Type material. *Liriomyza trifolii*: Neotype [*trifolii*]: **USA. Indiana:** Lafayette, from Alfalfa, 3.ix.1913, J.M. Aldrich (1♂, USNM). *Liriomyza phaseolunata*: Holotype, **USA. New Jersey:** Bridgeton, 24.viii.1942, B.B. Pepper (1♂, Lost). *Liriomyza alliovora*: Holotype, **USA. Indiana:** Ames, 8.vi.1932, H.M. Harris, ex. leaf of onion (1♂, USNM).

Additional material examined. **USA. California: Imperial Co.,** Calexico, 4.x.1979, ex. fruit fly trap, Pineda & Katz (5♂ 61♀, CSCA), Algodones Dunes, 10.4km SE, Glamis, 1.1km W road, 32°55'N, 114°59'W, 24–28.iii.2008, K. Lorenzen & T. Zavortink, YPT in microphyll forest (1♂, UCD), **Kern Co.,** 2km SW Lebec, 12.ix.1992, S.L. Heydon (1♂ 2♀, UCD), **Los Angeles Co.,** Angeles Nat. Forest, Islip Canyon, 12.vi.1974, D.D. Wilder (1♂, CASC), Lakewood, xi.1990, R.W. Miles, host: believed to be bell pepper (1♂, UCR), **Monterey Co.,** Salinas, 14.ix.1977, greenhouse *Chrysanthemum*, W.W. Allen (1♂ 3♀, EMEC), **Orange Co.,** Irvine, 19.x.1961, Bumgardner collector (4♂ 5♀, CSCA), Anaheim, Crawmer collector, ex. bean, em. 1.xi. 1961(1♂ 2♀, CSCA), Anaheim, Crawmer collector, ex. chili pepper, em. 27.xi.1961 (1♂ 2♀, CSCA), **Riverside Co.,** UCR campus, 11.ii.1983, “NP culture” (1♂ 2♀, UCR), UC Riverside, 6.viii.1983, “FL: celery” (3♂, UCR), main celery (1♀, UCR), Riverside, UCR Lab, culture, S. Reitz, 10.x.1998, on pepper, orig. from: CA, San Benito Co., 1996, on *Capsicum anuum* (1♂ 4♀, UCR), 26.xii.1998, on celery, orig. from: CA, Orange Co., 1986–1996, on celery & tomato (1♂ 1♀, UCR), Riverside, UCR Lab, culture, 10.x.1998, S. Reitz, on pepper, orig. from: CA, San Benito Co., 1996, on *Capsicum anuum* (4♂, CSCA), on celery, orig. from: CA, Orange Co., Irvine, 1986–1996, on celery and tomato (3♂ 1♀, CSCA), **San Diego Co.,** Escondido, 13.x.1963, E.R. Oatman (2♂, UCR), **Santa Barbara Co.,** Los Prietos, 23.vi.1965, J. Powell (1♂ 2♀, EMEC), **Santa Cruz Co.,** Watsonville, vi.1980, *Chrysanthemum* (1♂, EMEC), Watsonville, “5-7-80” (1♂, EMEC), **Sonoma Co.,** Atascadero Creek, NW Graton, Williams property ca. 30m, 21.viii.1966, P.H. Arnaud, Jr. (1♀, CASC), **Nevada:** Clark Co., Charleston Peak, Kyle Canyon, ca 2200m, 14.vii.1966, P.H. Arnaud, Jr. (1♀, CASC).

Comments. Of those *Liriomyza* known to be pests on agricultural crops, *L. trifolii* is one of the easiest to identify, having a light grey pruinosity on the scutum, a more extensively yellow abdomen, pleuron and legs, and vertical bristles that are entirely surrounded by yellow basally. *Liriomyza trifolii* is more widely polyphagous than other pest *Liriomyza* and considered one of the most dangerous species of Agromyzidae worldwide, largely because of its increasing resistance to pesticides (Dempewolf 2004) and the apparent ease by which it has been introduced into countries throughout the World. A *Capsicum* (pepper) restricted host race is present within *L. trifolii* in California and other New World locations (Morgan *et al.* 2000; Reitz & Trumble 2002; Scheffer & Lewis 2006); additional mitochondrial clades are present as well (Scheffer & Lewis 2006).

***Liriomyza trixivora* spec. nov.**

Figs 240–243

Liriomyza sp. Goeden & Ricker 1989 : 329.

Wing length 1.6–1.7mm (♂), 1.8mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.6–3.6; vein dm-cu vestigial in one male. Eye height divided by gena height: 5.6–6.5. Scutum shining. First flagellomere relatively large and quadrate.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs grey. Head light yellow with clypeus light brown (yellow medially) and back of head and ocellar triangle dark brown; dorsal margin of first flagellomere infuscated to distinctly brown anterior to base of arista, but in females this pigment often expanded to dorsal half of segment on outer face and to venter on inner face (excluding yellow basal margin); posterolateral corner of frons dark brown to base of outer vertical bristle and light brown to base of inner vertical. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite brown lateral to scutellum with dorsum yellow and dark brown below scutellum. Anepisternum with small faint anteroventral spot that is sometimes enlarged; anepimeron with small brown anterior stripe and sometimes faint brown marginal spot posteriorly; meron brown on ventral 2/3; katepisternum with large brown spot on ventral 2/3. Legs yellow with tarsi and fore and mid tibiae with very light brown tint with distal three tarsomeres slightly darker; hind tibia brown with dorsum darker. Abdomen brown with lateral margin thinly yellow.

Genitalia: Figs 240–243. Surstylus with two or three dark spines. Paraphallus band-like with apex pointed. Hypophallus short with basal stem dark and apical hairs fused to a point. Mesophallus slightly longer than wide and separate from distiphallus; mesophallus and distiphallus with ventral longitudinal suture. Distiphallus pale and bell-shaped with length slightly greater than width and with nearly indistinct inner subapical fringe of hairs. Ejaculatory apodeme weakly-pigmented and gracile, with stem and *pileus ejaculatorius* thin, and with blade small and triangular.

Variation: Male from Palm Desert differs as follows: wing length 2.0mm; length of ultimate section of vein CuA₁ divided by penultimate section 3.1; eye height divided by gena height 6.0; first flagellomere ovate, unenlarged and entirely yellow; pigment on legs not as distinct/contrasting.

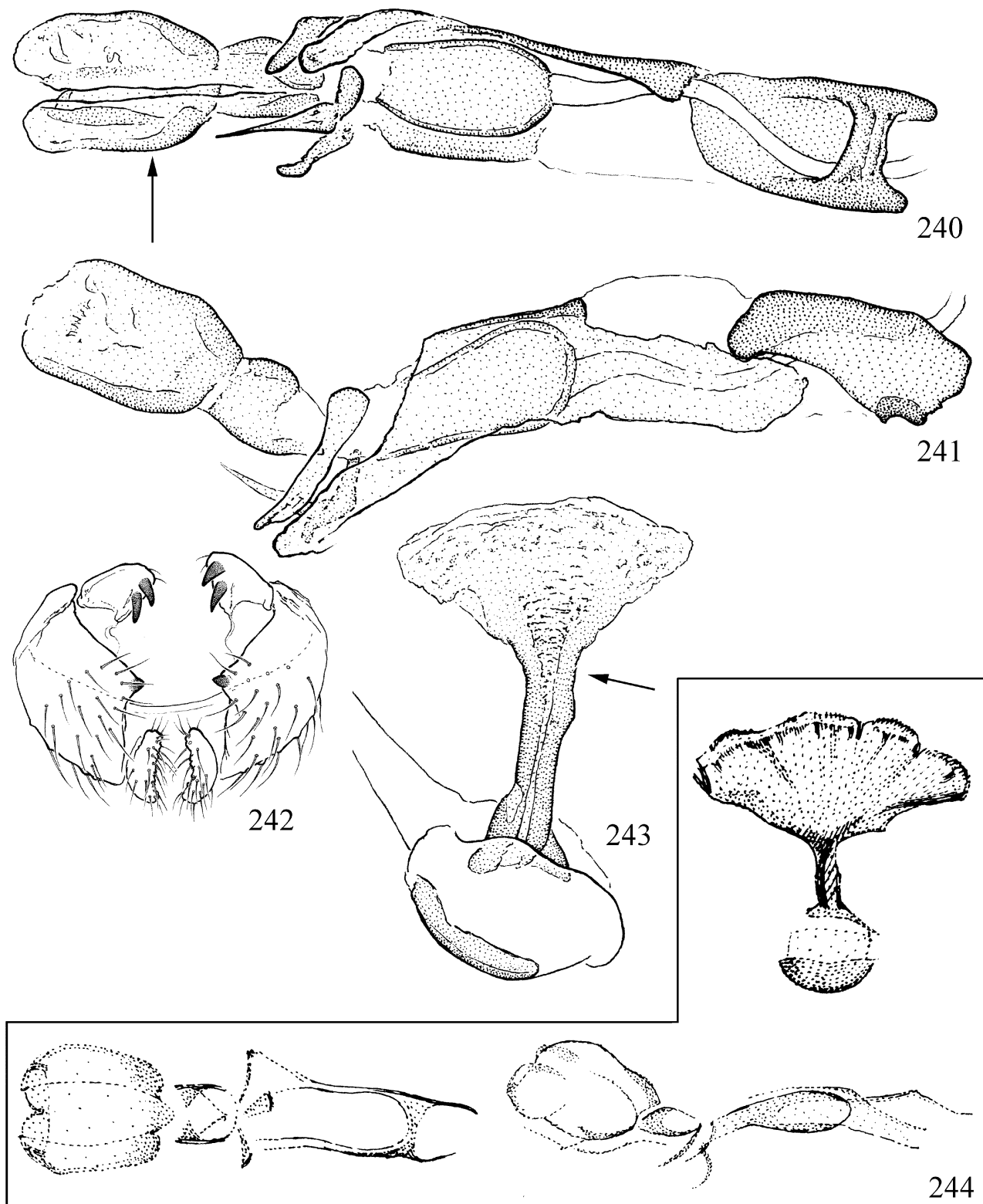
Etymology. The specific name indicates the host plant.

Host. Asteraceae—*Trixis californica*. The last instar larva pupates inside of the leaf.

Range. USA. California [Imperial, Riverside, San Bernardino, San Diego].

Type material. Holotype, USA. California: San Bernardino Co., Sheephole Mtn. [at Sheephole Pass], 14.iii.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., 34°14'49"N, 115°43'03"W, URCR ENT 235263 (1♂ [with puparium], UCR); Paratypes, USA. California: Imperial Co., Indian Well, 8.i.1985, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., URCR ENT 235061 (1♀ [with puparium], UCR), Riverside Co., Desert Center, 14.iii.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., URCR ENT 235274 (1♂ [with puparium], UCR; 1♂ [with puparium], USNM), Graham Pass, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., 21.iii.1984 (1♀, CSCA), 12.iii.1986, URCR ENT 235275 (1♀, UCR), Pines to Palms Hwy., 11.i.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell. (1♀ [with puparium], CASC), Chino Canyon, 29.ii.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., URCR ENT 235276 (1♀ [with puparium], UCR), 3.5mi S Palm Desert (P.L. Boyd Des. Res. Center) Malaise trap, 2–5.vi.1978 (1♂, CSCA), San Diego Co., Yagui Pass,

11.i.1984, R.D. Goeden & D.W. Ricker, insectary reared on *Trixis californica* Kell., URCR ENT 235278 (1♀ [with puparium], UCR).



FIGURES 240–244. Figs 240–243: *Liriomyza trixivora* **spec. nov.**, male genitalia; 240: phallus, ventral; 241: phallus, left lateral; 242: external components, ventral; 243: ejaculatory apodeme. Fig. 244: *L. pictella* (Thompson), ejaculatory apodeme, male phallus ventral and left lateral.

Comments. *Liriomyza trixivora* was discussed as “*Liriomyza* sp.” in Goeden & Ricker (1989), which was commonly collected from the leaves of *Trixis californica* across southern California. Their valuable collected material forms the bulk of the type series. The only agromyzid previously known from *Trixis* is an unknown species from Argentina (Spencer, 1990).

While the phallus of *Liriomyza trixivora* is relatively nondescript, similar taxa (eg. *L. cannabis* Hendel, *L. asterivora* Sasakawa, *L. fasciola* (Meigen), *L. tricornis*, *L. schlingeri*, *L. temperata* Spencer and *L. venturensis*) can be distinguished by a small, ovate and entirely yellow first flagellomere, slightly different dimensions of the distiphallus, a broadly rounded ejaculatory apodeme, and aside from *L. tricornis*, only a single spine on the surstylus. The two spines on the surstylus of *L. tricornis* differ from those of *L. trixivora*, however, in that they emerge from a membranous basal region, not subapically. The phallus of *L. eupatorii* is also relatively similar, but this is a larger species with a broader, basally truncated distiphallus.

Aside from *Liriomyza trixivora*, the remaining North American species with nondescript male terminalia listed above can be quite difficult to tell apart. *Liriomyza temperata* is the only eastern species (North Carolina), and it apparently differs in having a slightly larger wing (2.3–2.5mm), gena (eye approximately three times higher than gena) and cell dm (length of ultimate section of vein CuA₁ slightly more than twice length of penultimate section), although Spencer’s measurements have been known to vary considerably in accuracy and should be verified. *Liriomyza tricornis* is the only one of these species with three pairs of fronto-orbitals (not four), brown streaking on the femora, the inner vertical bristle touching the brown posterolateral region of the frons, and the derived surstylus mentioned above. *Liriomyza schlingeri* differs from *L. venturensis* in having a smaller cell dm (length of ultimate section of vein CuA₁ 2.1–2.6 times length of penultimate section, not 4.1), the eye is only 4.2–5.5 times higher than the gena (not 3.6) and the base of the katapisternal bristle touches the brown ventral marking (not entirely surrounded by yellow).

***Liriomyza tubula* Spencer**

Figs 229–231

Liriomyza tubula Spencer 1981: 282. Spencer & Steyskal 1986: 133.

Wing length 2.0mm (♂), 2.3–2.4mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.2–2.3. Eye height divided by gena height: 2.8–4.8. Scutum lightly dusted with pruinosity. Parafacial and anterior section or orbital plate projecting, particularly along anterodorsal margin of eye. First flagellomere subquadrate and slightly longer than high.

Chaetotaxy: Two ori, two ors (sometimes one on one or both sides). Acrostichal setulae in two irregular rows.

Colouration: Calypter margin and hairs grey. First flagellomere orange with dorsobasal margin lightly infuscated; posterolateral corner of frons dark brown to base of outer vertical bristle; clypeus, back of head and ocellar triangle dark brown; face brownish medially in non-types. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite brown, becoming darker below scutellum and yellow dorsally beside scutellum. Anepisternum yellow with thin oblique brown stripe and thin brown stripe along posteroventral margin; anepimeron with posterior margin and thin anterior mottling brown; ventral 2/3 of meron brown; katepisternum brown with dorsomedial and sometimes (non-types) anterodorsal margin yellow. Outer surface of fore and mid coxae brown on basal half; hind coxa brown; femora broadly brown at base, fore femur brown dorsally (excluding knee) and mid and hind femora with brown dorsal spot at 2/3 length (types with additional dorsal streaking); tibiae and tarsi light brown, with base of fore tibia yellow in non-types and pigment dark brown in holotype.

Genitalia: Figs 229–231. Surstylus tapering apically and with one subapical spine. Paraphallus slightly wider apically. Hypophallus thin with long apical hairs. Mesophallus not much longer than wide, fused to base of distiphallus. Distiphallus long and bifid with wide basal, spinulose collar; tubules mostly narrow and clear with base slightly darker and bulging. Ejaculatory apodeme relatively dark with base of duct pigmented; *pileus ejaculatorius* with thick, dark lateral margins; blade very broad and lighter on distal half with distal margin dark.

Host. Unknown.

Range. USA. California [Trinity, Siskiyou*].

Type material. Holotype, **USA. California: Trinity Co.**, mountain midway between Richhead and Coffee Creek, 5100', 8–10.vii.1969, J.A. Powell (1♂, CASC); Paratype, **USA. California: Trinity Co.**, Mtn. Mdw. Rch., head Coffee Cr., 5100', 8–10.vii.1969, J. Powell (1♀, EMEC).

Additional material examined. **USA. California: Siskiyou Co.**, 12mi W Coffee Ck., Big Flat Camp Gd., 12.viii.1977, S. Kuba (2♀, CASC).

Comments. See comments for *Liriomyza merga*.

Liriomyza venegasiae Spencer

Figs 249–251

Liriomyza venegasiae Spencer 1981: 284. Spencer & Steyskal 1986: 129.

Wing length 1.6mm (♂). Length of ultimate section of vein CuA₁ divided by penultimate section approximately 3.0. Eye height divided by gena height approximately 5.0. Scutum shining.

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head light yellow with first flagellomere yellow (base sometimes lighter), clypeus, ocellar triangle and back of head dark brown, and posterolateral corner of frons dark brown to base of outer vertical bristle and light brown to base of inner vertical bristle. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite dark brown. Pleuron dark brown with dorsal 1/3 of anepisternum yellow with margin irregular (posterodorsal half yellow in *Bidens* reared specimen (Spencer, 1981)), anepimeron with extensive yellow mottling, dorsal 1/3 of meron yellow, dorsal margin of katepisternum yellow, including small emargination behind bristle. Legs yellow with base of fore coxa and basal 1/2 of mid coxa brown, hind coxa light brown with basal 2/3 brown, base of hind femur possibly with very small, almost indistinguishable infuscation (treated as entirely yellow in key), fore tibia light brown, mid and hind tibiae brown, and tarsi brown, becoming paler to base. Colour of abdomen unknown.

Variation: Female non-type differs as follows: length of ultimate section of vein CuA₁ divided by penultimate section: 2.2; eye height divided by gena height: 4.3; one ori on right side; calypter grey; base of first flagellomere paler; venter of katatergite brown; anepisternum with oblique clavate brown stripe; katepisternum yellow on dorsal 1/4, including area around base of bristle; base of femora brown and tibiae brown with base paler; abdominal tergites narrowly yellow laterally.

Genitalia: Figs 249–251. Surstylus with one pair of relatively long subapical spines. Paraphallus dark and elongate-triangular with ill-defined base. Hypophallus long, not haired. Distiphallus and mesophallus with complete ventral suture; mesophallus short, slightly compressed laterally, and darkest along lateral and posterodorsal surfaces. Distiphallus with dark, short basal stem and broad, subspherical apical chamber enclosing one pair of fringed processes. Ejaculatory apodeme well-developed with dark submarginal band.

Hosts. Asteraceae—*Bidens pilosa*, *Venegasia carpesioides*.

Range. **USA.** California [Los Angeles, Riverside, Ventura].

Type material. Holotype, **USA. California: Los Angeles Co.**, Malibu Creek S.P., on *Venegasia carpesioides*, 4.v.1977, K.A. Spencer (1♂, USNM).

Tentatively identified material: **USA. California: Ventura Co.**, mouth of Ventura River, 24.iv.1966, J. Powell (1♀, EMEC).

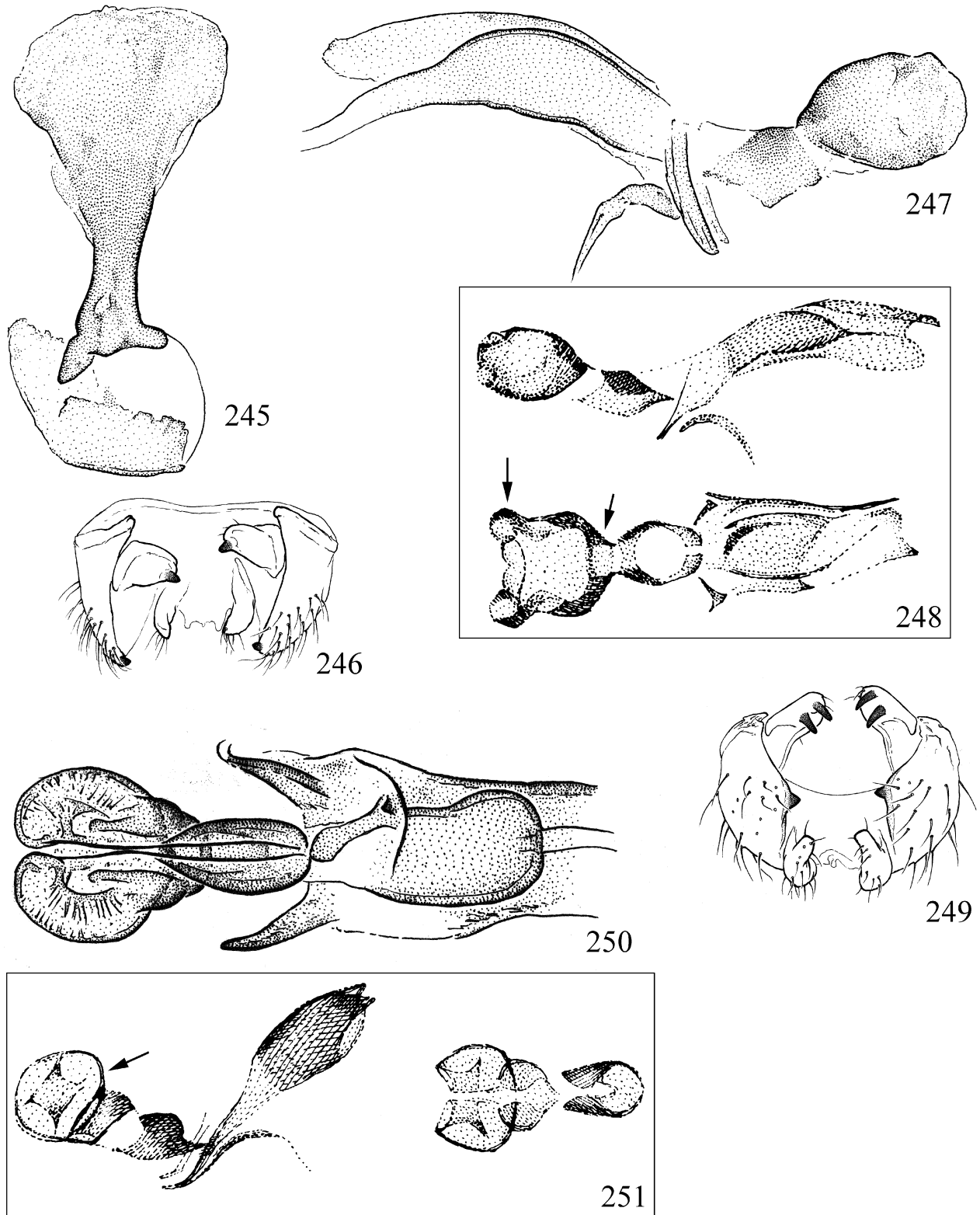
Comments. The non-type female described under the variation section is most similar in appearance to *Liriomyza venegasiae*, but differs enough so as to only be tentatively included in the species, and as such is not used in the above key.

Liriomyza venturensis Spencer

Figs 245–248

Liriomyza venturensis Spencer 1981: 286. Spencer & Steyskal 1986: 132.

Wing length 1.5mm (♂). Female paratypes not examined. Length of ultimate section of vein CuA₁ divided by penultimate section: 4.1. Eye height divided by gena height: 3.6. Scutum subshining.



FIGURES 245–251. Figs 245–248: *Liriomyza venturensis* Spencer, male holotype genitalia; 245: ejaculatory apodeme; 246: external components, ventral; 247: phallus, right lateral; 248: holotype phallus, left lateral and ventral, from original illustrations in Spencer (1981). Figs 249–251: *L. venegasiae* Spencer, male holotype genitalia; 249: external components, ventral; 250: phallus, ventral; 251: phallus, left lateral and ventral, from original illustrations in Spencer (1981).

Chaetotaxy: Two ori, two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head light yellow with antenna yellow, and back of head, ocellar triangle and clypeus dark brown; posterolateral corner of frons dark brown to base of outer vertical bristle and light brown to base of inner vertical. Scutum with complete lateral yellow stripe; katatergite yellow; anatergite dark brown below scutellum and brown lateral to scutellum with dorsum yellow. Anepisternum with broad oblique brown stripe; anepimeron with brown anterior and posterior mottling; meron brown on ventral 1/3; katepisternum brown on ventral 2/3 with small yellow emargination below bristle. Base of fore coxa and basal half of mid and hind coxae brown; base of femora (broadest on hind femur) and scraper on hind femur brown; tibiae brown with mid tibia slightly paler on distal and basal 1/3; tarsi brown, becoming paler to base. Abdominal colour unknown.

Genitalia: Figs 245–248. Surstylus with one posterodistal spine. Paraphallus narrow and pale. Hypophallus short, strongly curved at midpoint. Mesophallus approximately as long as high, venter poorly sclerotized, and separate from distiphallus. Distiphallus cup-shaped, not much longer than mesophallus, and pale with base slightly darker and tapered; ovate in lateral view and with distal margin bulging in lateral view. Ejaculatory apodeme with blade pale, narrow and rounded.

Variation: UCR material as described above except as follows: wing length 1.3mm (♂), 1.6–1.7mm (♂); eye height divided by gena height 4.5; body less robust and pigment faded; distiphallus slightly larger; abdominal tergites becoming yellowish laterally and posteriorly.

Host. Unknown; tentatively-included material reared from *Aster* (Asteraceae).

Range. USA. California [Los Angeles*[*?], Santa Barbara[*?], Ventura].

Type material. Holotype, **USA. California: Ventura Co.**, mouth of Ventura River, 24.iv.1966, R.L. Langston, Type No. 14065 (1♂, CASC).

Tentatively-identified material: USA. California: Los Angeles Co., Altadena, 31.vii.1945, x *Aster*, R.H. Smith (1♂ 2♀, UCR).

Comments. The UCR material is only tentatively included in this species because of the smaller male wing size, faded colouration and slightly larger distiphallus. See comments for *Liriomyza trixivora*.

***Liriomyza zinniae* Spencer**

Figs 252–255

Liriomyza zinniae Spencer 1981: 287. Spencer & Steyskal 1986: 131.

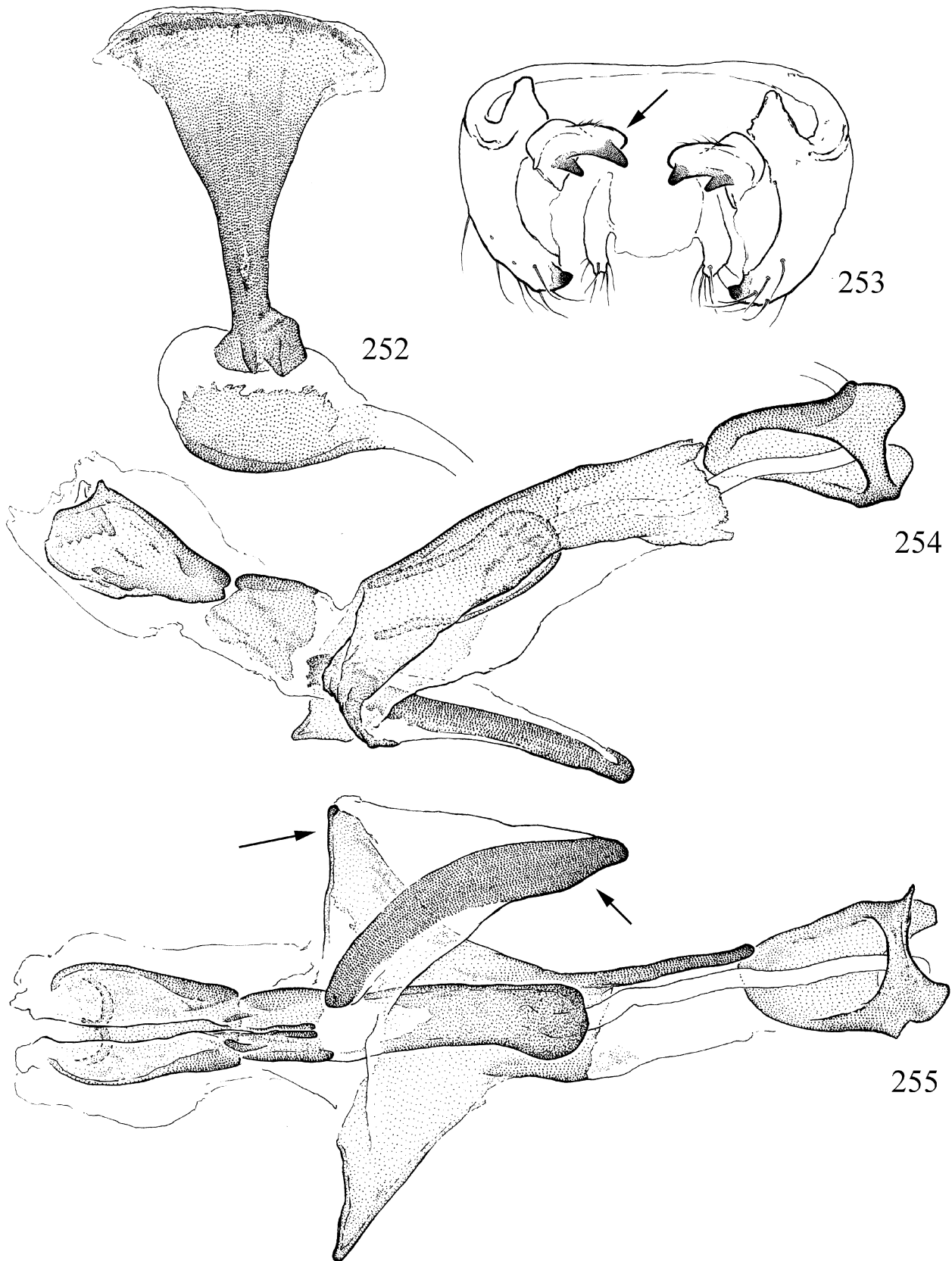
Wing length 1.9–2.1mm (♂), 2.0–2.1mm (♀). Length of ultimate section of vein CuA₁ divided by penultimate section: 2.1–2.7. Eye height divided by gena height: 4.0–5.2. Scutum glossy.

Chaetotaxy: Two ori (anterior bristle sometimes reduced), two ors. Acrostichal setulae in four rows.

Colouration: Calypter margin and hairs brown. Head yellow with first flagellomere becoming darker (but not brown) apically, posterolateral corner of frons dark brown to base, or just past base of outer vertical bristle (sometimes lighter brown to base of inner vertical bristle), and clypeus and ocellar triangle dark brown. Scutum with complete yellow lateral stripe; katatergite yellow with anterior margin brown; anatergite brown, becoming dark below scutellum and yellow dorsally beside scutellum. Anepisternum with thin to broad oblique stripe; anepimeron predominantly brown or with striping on posterior margin and anterior half; meron brown with dorsal and posterior margins yellow; katepisternum brown on ventral ¾ (not including base of bristle). Legs yellow with base of fore and mid coxae brown, and basal half of hind coxa brown, base of femora brown, tibiae light brown, becoming paler to base (entirely dark brown in AZ material), and tarsi light brown (brown in AZ material), becoming paler to base. Abdominal tergites brown with lateral and posterior margins yellow.

Genitalia: Figs 252–255. Surstylus with two widely spaced spines. Basiphallus with one pair of large triangular distolateral processes that may be homologous with paraphalli. Swollen distal section of duct long, thin, and not strongly narrowed apically. Hypophallus long, flat, dark and bare, directed posteroventrally. Mesophallus approximately as long as wide and separate from distiphallus; mesophallus and distiphallus with complete ventral suture. Distiphallus length nearly twice width and strongly narrowed to base (pronounced in lateral view); well-sclerotized basolaterally and thin-walled apically, enclosing one pair of spinulose structures. Ejaculatory apodeme with *pileus ejaculatorius* relatively broad and pale; blade narrow, gradually blending into stem; blade paler apically with dark apical margin.

Hosts. Asteraceae—*Ambrosia psilostacha**, *Encelia californica*, *Heterotheca grandiflora*, *Zinnia elegans*, *Zinnia* sp.



FIGURES 252–255. *Liriomyza zinniae* Spencer, male genitalia; 252: ejaculatory apodeme; 253: external components, ventral; 254: phallus, left lateral; 255: phallus, ventral.

TABLE 1. Host plant genera of the “polyphagous” Californian *Liriomyza* (see literature cited for references).

	<i>L. brassicae</i>	<i>L. huidobrensis</i>	<i>L. langei</i>	<i>L. sativae</i>	<i>L. trifolii</i>
Acanthaceae		<i>Thunbergia</i> ³			<i>Peristrophe, Ruspolia</i>
Amaranthaceae		<i>Amaranthus, Celosia, Deeringia, Spinacia</i>	<i>Spinacia</i>	<i>Amaranthus, Spinacea</i>	<i>Amaranthus, Celosia, Cyathula, Pupalia</i>
Anacardiaceae					<i>Lansea</i>
Asclepiadaceae					<i>Asclepias</i>
		<i>Achillea, Ageratum</i> ¹ , <i>Ambrosia, Anaphalis, Arctium</i> ¹ , <i>Argyranthemum</i> ³ , <i>Bellis, Bidens, Calendula</i> ¹ , <i>Callistephus, Carduus, Carthamus, Chrysanthemum, Cichorium, Cineraria, Cirsium, Conyza</i> ¹ , <i>Crassocephalum, Cynara</i> ³ , <i>Dahlia</i> ¹ , <i>Deltilia</i> (leaf mine only), <i>Dendranthema, Emilia</i> ¹ , <i>Erechtites</i> ¹ , <i>Galinsoga</i> ¹ , <i>Ganzania</i> ¹ , <i>Gerbera</i> ¹ , <i>Helianthus, Kalimeris, Lactuca, Luecanthemum</i> ¹ , <i>Matricaria, Parthenium, Pastinaca, Pericallis, Petasites, Pteris, Pterocaulon, Senecio, Sonchus, Synedrella, Tagetes</i> ¹ , <i>Taraxacum, Tussilago</i> ³ , <i>Zinnia</i>	<i>Ambrosia*, Aster, Calceola*, Chrysanthemum, Cynara* Iva*, Lactuca, Senecio*, Sonchus*</i>	<i>Acanthospermum, Ageratum, Ambrosia, Aster, Baccharis, Bidens, Calendula, Chrysanthemum, Coreopsis*, Dahlia, Dendranthema, Dicoria*, Eclipta, Emilia, Epilobium, Erechtites, Eupatorium, Felicia, Gaillardia, Galinsoga, Gerbera, Gnaphalium, Helianthus, Iva*, Lactuca, Leucanthemum, Lipochaeta, Melanthera, Mikania, Parthenium, Senecio, Silybum, Solidago, Sonchus, Synedrella, Tagetes, Taraxacum, Tridax, Verbesina, Wedelia, Xanthium*, Zinnia.</i> Also “treated from caged leaves of <i>Cineraria*</i> <i>Senecio* x hybridus*</i> ”	<i>Ageratum, Ambrosia, Arctium, Agryranthemum</i> ³ , <i>Artemisia, Aster, Baccharis, Bellis, Bidens, Brachycome, Calendula, Callistephus, Carthamus, Centaurea, Chrysanthemum, Cirsium, Conoclinium, Conyza, Crassocephalum, Dahlia, Dendranthema, Dimorphotheca, Epilobium, Erechtites, Erigeron, Eupatorium, Flaveria, Gaillardia, Galinsoga, Gazania, Gerbera, Gnaphalium, Helianthus, Helichrysum, Hymenopappus, Lactuca, Launaea, Leucanthemum, Melanthera, Raphanus, Senecio, Solidago, Solidaster, Sonchus, Spilanthes, Synedrella, Tagetes, Tanacetum, Taraxacum, Tithonia, Tragopogon, Tridax, Urospermum, Vermonia, Xanthium, Zinnia</i>
Asteraceae	<i>Ambrosia, Dahlia, Raphanus</i>				
Azoiaceae		<i>Tetragonia</i>			
Balsaminaceae		<i>Impatiens</i> ³			<i>Impatiens</i>
Basellaceae		<i>Basella</i>			<i>Basella</i>
Bigoniaceae					<i>Jacaranda*</i>

continued next page

TABLE 1. (continued)

	<i>L. brassicae</i>	<i>L. huidobrensis</i>	<i>L. langei</i>	<i>L. sativae</i>	<i>L. trifolii</i>
Boraginaceae	<i>Arabis, Barbarea, Brassica, Cakile, Cheiranthus, Diplotaxis, Eruca, Hirschfeldia, Isatis, Lepidium, Matthiola, Moricandia, Nasturtium, Raphanus, Rorippa, Sinapis, Sisymbrium</i>	<i>Borago</i>		<i>Cordia</i>	
Brassicaceae		<i>Alyssum³, Barbarea¹, Brassica, Capsella, Cheiranthus³, Eruca³, Matthiola, Nasturtium¹, Raphanus, Rorippa, Sisymbrium</i>	<i>Brassica</i>	<i>Brassica, Lepidium, Raphanus, Rorippa</i> . Also reared from "wild mustard" (<i>Brassica, Sinapis</i> or <i>Sisymbrium</i>)	<i>Brassica, Capsella, Lepidium, Raphanus, Thlaspi</i>
Campanulaceae		<i>Trachelium</i>			<i>Trachelium</i>
Capparaceae	<i>Capparis, Cleome, Gynandropsis</i>			<i>Cleome, Isomeris*</i>	<i>Cleome</i>
Caryophyllaceae	<i>Silene</i>	<i>Dianthus, Gypsophila, Saponaria, Stellaria¹</i>	<i>Dianthus, Gypsophila</i>	<i>Gypsophila</i>	<i>Dianthus, Gypsophila, Stellaria, Vaccaria</i>
Chenopodiaceae		<i>Atriplex, Beta, Chenopodium, Spinacia</i>	<i>Atriplex, Beta, Chenopodium*, Spinacia</i>	<i>Beta, Chenopodium, Spinacia</i>	<i>Beta, Chenopodium, Spinacia</i>
Convulvaceae		<i>Calystegia¹, Ipomoea¹, Bryonia, Citrullus, Cucumis</i>	<i>Convolvulus*</i>		<i>Convolvulaceae, Ipomoea</i>
Cucurbitaceae		<i>Cucurbita, Lagenaria, Luffa, Melothria, Sechium¹</i>	<i>Cucumis⁴, Cucurbita</i>	<i>Cucumis, Cucurbita, Luffa, Marah, Melothria, Momordica</i>	<i>Bryonia, Citrullus, Cucumis, Cucurbita, Momordica</i>
Dioscoreaceae				<i>Datisca glomerata*</i>	
Dipsacaceae				<i>Rajana</i>	
Euphorbiaceae				<i>Succisa</i>	
				<i>Euphorbia, Mercurialis, Phyllanthus, Poinsettia, Ricinus</i>	<i>Ricinus</i>
				<i>Albizia, Arachis, Bauhinia, Cajanus, Canavalia, Cassia, Centrosema, Courseia, Crotalaria, Desmodium, Glycine, Indigofera, Kennedy, Lathyrus, Lupinus, Medicago, Melilotus, Phaseolus, Pisum, Rhynchosia, Trifolium, Vicia, Vigna</i>	<i>Arachis, Cajanus, Canavalia, Cassia, Crotalaria, Glycine, Lathyrus, Medicago, Melilotus, Phaseolus, Pisum, Trifolium, Trigonella, Vicia, Vigna</i>
Fabaceae	<i>Lathyrus, Pisum</i>	<i>Cicer, Galega, Glycine, Lathyrus¹, Lupinus, Medicago, Phaseolus, Pisum, Vicia, Vigna¹</i>	<i>Glycine⁴, Lathyrus, Medicago, Pisum</i>		

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TABLE 1. (continued)

	<i>L. brassicae</i>	<i>L. huidobrensis</i>	<i>L. langei</i>	<i>L. sativae</i>	<i>L. trifolii</i>
Genitaceae		<i>Eustoma, Eriogonum, Vicia</i>			
Geraniaceae		<i>Eustoma¹, Pelargonium</i>			
Goodeniaceae		<i>Scaevola</i>			<i>Scaevola</i>
Iridaceae		<i>Gladiolus¹</i>			<i>Gladiolus</i>
Lamiaceae		<i>Glechoma, Ocimum¹</i>		<i>Hyptis, Melissa, Nepeta, Stachys</i>	<i>Ajuga, Lamium, Moluccella, Nepeta, Ocimum, Sabia</i>
Liliaceae		<i>Allium, Alstroemeria</i> (no adults reared)	<i>Allium</i>	<i>Allium</i>	<i>Allium, Alstroemeria</i>
Linaceae			<i>Linum</i>		
Malvaceae		<i>Althaea, Abelmoschus, Hibiscus, Malva¹, Sida¹</i>		<i>Abelmoschus, Althaea, Anoda, Gossypium, Hibiscus, Malva, Sida, Sidalcea</i>	<i>Abelmoschus, Gossypium, Hibiscus, Malva</i>
Moringaceae				<i>Moringa</i>	
Oleaceae				<i>Jasminum</i>	
Onagraceae				<i>Oenothera</i>	<i>Fuchsia</i>
Oxalidaceae		<i>Oxalis¹</i>			
Papaveraceae		<i>Papaver</i>			
Passifloraceae				<i>Passiflora</i>	<i>Passiflora</i>
Piperaceae					<i>Peperomia, Piper</i>
Plantaginaceae				<i>Plantago</i>	<i>Plantago</i>
Plumbaginaceae		<i>Limonium</i>			
Poaceae		<i>Setaria¹</i>		<i>Agropyron, Chloris, Digitaria, Elymus, Pennisetum, Zea</i>	<i>Avena, Hordeum</i>
Polemoniaceae		<i>Phlox¹, Polemonium³</i>		<i>Phlox</i>	<i>Phlox</i>
Polygonaceae					<i>Polygonum</i> [including “ <i>Fallopia</i> ” in Benavent-Corai et al. (2005)], <i>Rumex</i>
Portulacaceae				<i>Polygonum, Rumex</i>	<i>Portulaca</i>
Primulaceae		<i>Anagallis³, Cyclamen, Lysimachia³, Primula</i>	<i>Primula*</i>		<i>Primula</i>
Ranunculaceae	<i>Aquilegia*</i>	<i>Anemone, Antirrhinum, Delphinium, Ranunculus¹</i>	<i>Aquilegia, Ranunculus</i>	<i>Anemone, Ranunculus</i>	<i>Anemone, Ranunculus</i>

continued next page

TABLE 1. (continued)

	<i>L. brassicae</i>	<i>L. huidobrensis</i>	<i>L. langei</i>	<i>L. sativae</i>	<i>L. trifolii</i>
Resedaceae	<i>Reseda</i>				<i>Agrimonia, Crataegus</i>
Rosaceae					<i>Cardiospermum</i>
Sapindaceae				<i>Cardiospermum, Melicoccus</i>	<i>Antirrhinum, Capraria, Chelone, Linaria</i>
Scrophulariaceae		<i>Antirrhinum</i> ¹ , <i>Bacopa</i> ² , <i>Diascia</i> ³ , <i>Capsicum, Datura</i> ⁴ , <i>Hicandra</i> , <i>Lycopersicon, Nicotiana</i> , <i>Penstemon</i> ³ , <i>Petunia, Physalis</i> ¹ , <i>Solanum</i> ¹ , <i>Torenia</i> ³	<i>Capsicum</i> ⁴ , <i>Datura</i> (Spencer, 1981), <i>Petunia, Solanum</i>	<i>Antirrhinum, Linaria</i> <i>Capsicum, Cestrum, Datura</i> , <i>Lycopersicon, Nicotiana</i> , <i>Petunia</i> ⁴ , <i>Physalis, Ricinus</i> , <i>Solanum</i>	<i>Capsicum, Cestrum, Datura</i> , <i>Lycopersicon, Petunia</i> , <i>Physalis, Solanum, Withania</i>
Solanaceae				<i>Tropaeolum</i>	<i>Tropaeolum</i>
Tropaeolaceae	<i>Tropaeolum</i>				
Turneraceae			<i>Piriqueta</i> ⁴		<i>Piriqueta</i>
Typhaceae					<i>Typha</i>
Umbelliferae		<i>Apium, Bupleurum</i> ³ , <i>Coriandrum, Daucus</i> , <i>Eryngium</i> ³ , <i>Hydrocotyle</i> , <i>Petroselinum</i>		<i>Apium, Daucus, Hydrocotyle</i> , <i>Petroselinum</i>	<i>Anethum, Anthriscus, Apium</i> , <i>Bupleurum</i> ³ , <i>Daucus</i> , <i>Hydrocotyle, Pastinaca</i> , <i>Petroselinum</i>
(Apiaceae)	<i>Foeniculum</i> *		<i>Apium</i>		<i>Centranthus</i>
Valerianaceae		<i>Valerianella</i>	<i>Centranthus</i> *		
Verbenaceae	<i>Lantana</i>	<i>Verbena</i>		<i>Holmskioldia, Verbena</i>	<i>Holmskioldia, Lantana</i> , <i>Verbena</i>
Violaceae		<i>Viola</i> ¹	<i>Melicytus</i> ⁴ , <i>Nicotiana</i>		
Zygophyllaceae	<i>Bulnesia</i>			<i>Kallstroemia</i>	<i>Kallstroemia, Tribulus</i>

1 – From a list of plant species attacked by *Liriomyza huidobrensis* (Blanchard) under natural conditions not known to be hosts of *L. langei* Frick (USDA 2008).

2 – Lab-reared only (Martin *et al.* 2005).

3 – Only known from record on The Natural History Museum (2010).

4 – Record derived from Benavent-Corai *et al.* (2005) - original source not found, but likely represents a rearing record for *Liriomyza huidobrensis*, not *L. langei*.

* - Newly recorded here.

Range. USA. Arizona*, California [Alameda, Contra Costa, Los Angeles*, Orange*, San Diego*, Santa Cruz, Ventura*].

Type material. Holotype, **USA. California: Alameda Co.**, Albany, 14.viii.1948, ex larva on *Zinnia elegans*, Lot 82-1, K.E. Frick, Type No. 13944 (1♂, CASC); Paratypes examined, **USA. California: Alameda Co.**, Berkeley, 2.xi.1948, ex. larva *Zinnia elegans*, Lot No. 82-8, K.E. Frick (1♀, CASC), **Santa Cruz Co.**, Mount Hermon, 12.vii.1948, ex. larva *Heterotheca grandiflora* Nutt. Lot No. 53-4 (1♀, CASC).

Additional material examined. USA. Arizona: Tucson, Saguara Mon, 10.iv.1935, A.L. Melander (2♂, USNM), **California: Los Angeles Co.**, Los Angeles, 23.viii.1940, *Zinnia* serpentine miner, R.M. Bohart (3♂, USNM), Westwood, Westwood Hills, R.M. Bohart, ix.1940, x *Zinnia* serp. mine (3♂, UCR), 5.ix.1940, ex *Zinnia* serpentine (1♀, UCR), ix.1941, x *Encelia californica* (2♂ 2♀, UCR), **Orange Co.**, Laguna Beach, 28.iii.1935, A.L. Melander (1♂, USNM), **San Diego Co.**, San Diego, 28.iii.1947, W.W. Jones (1♂, EMEC), *Encelia californica* (1♂, EMEC), **Ventura Co.**, Ventura, insectary reared on *Ambrosia psilostachys* Decandolle, 16.iv.1969 (2♂, UCR), 30.vi.1969 (3♀, UCR).

Comments. *Liriomyza zinniae*, here recorded for the first time outside of California, is most similar in external morphology to specimens of *L. sabaziae* and *L. sativae*, but the large, flat, dark hypophallus will easily identify it.

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