

Leaf Mining Agromyzidae (Diptera) in Costa Rica

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Abstract: During a 3 weeks' visit to Costa Rica in January/February, 1982, 9 new species of Agromyzidae were discovered and are described in the genera *Melanagromyza*, *Ophiomyia*, *Japanagromyza*, *Liriomyza* and *Phytoliriomyza*. Eighteen species new to Costa Rica were also found, including the three important pests, *Liriomyza huidobrensis*, *L. sativae* and *L. trifolii*. In addition, leaf mines were collected on 10 plants, 2 certainly and 6 probably representing further undescribed species. Keys to the 13 genera and 53 species now known in Costa Rica are provided. *Phytomyza centralis* Frost is synonymised with *Phytomyza loewii* Hendel.

No specialised collecting of Agromyzidae has hitherto been undertaken in Costa Rica and this interesting and important fauna has been poorly known. Only 27 species have been recorded (Spencer, 1973a) out of a total of approximately 220 species known in the Neotropical Region (Spencer, 1963; 1965; 1966; 1973a; 1973b; 1982; Valladares, 1982). A catalogue of 141 species was provided by Spencer (1967) and a review of species in the Caribbean area was given by Spencer and Stegmaier (1973).

During the last few years damage caused by leaf miners to a wide range of cultivated plants, including trees, vegetables and ornamentals, has greatly increased. In nature leaf miners are normally effectively controlled by a large complex of hymenopterous parasites, mainly in the families Braconidae and Eulophidae. However, this natural balance has now been seriously disrupted with the widespread use of modern pesticides resulting in the destruction of beneficial parasites. The economic importance of the Agromyzidae was reviewed by Spencer (1973c).

My visit to Costa Rica was funded by the German Agency for Technical Cooperation (GTZ), with local support from Sanidad Vegetal, Ministerio de Agricultura y Ganadería (MAG) and the American Flower Corporation, primarily to identify and assess the importance

of leaf mining pests. The opportunity was also taken for general collecting on wild plants between visits to nurseries of ornamentals and vegetable growing areas, in order to obtain a better knowledge of the Agromyzidae as a whole in Costa Rica.

Throughout my stay I was based at San José, apart from one night spent at Limón. Visits were made to the main chrysanthemum nurseries at Fraijanes, below Volcán Poás and at San José de la Montaña, above Heredia, and also to the carnation nursery at Llano Grande (Cartago). The large nursery of ornamental shrubs, "Matas de Costa Rica", was inspected at Siquirres. Several visits were made to the important vegetable growing areas north of Cartago and at Santa Ana and San Rafael de Ojo de Agua, west of Alajuela. General collecting was undertaken, normally near the roadside, between these visits, and also on waste ground near the Hotel Irazú, San José.

I established that the serious pest, *Liriomyza trifolii*, was present at both chrysanthemum nurseries and also on onions, beans and tomatoes. *L. sativae* was found on tomatoes, beans, cucumbers and pepper (chili). The third most important *Liriomyza* pest, *L. huidobrensis*, was found at Fraijanes and Llano Grande but only on wild hosts and the garden ornamental, *Tropaeolum*. *Amauromyza maculosa*, a species which can damage lettuce,

was common in the San José area on weeds. No pests were found on carnations.

The nine new species described below were all obtained by sweeping but leaf mines were also found on a number of plants clearly representing further undescribed species. Detailed records are given below of the 18 species discovered as new to Costa Rica. Populations of both pests and other species were low, as was to be expected at the beginning of the dry season but it is now established that the Agromyzidae are well represented in Costa Rica and many new species certainly await discovery.

In order to assist in future identification, keys are provided to the 13 genera and 53 species now known in Costa Rica. These are simplified to cover the Costa Rican fauna but more comprehensive keys are available in other works which may need to be consulted during any thorough study of the Agromyzidae. References are given to all relevant papers on the Agromyzidae of the Neotropical Region. In the interests of economy the number of illustrations has been restricted but it is hoped that sufficient have been included to show the essential characters of the Agromyzidae.

Key to genera of Costa Rican Agromyzidae

- | | | |
|---------|---|---|
| 1. | Subcosta developed throughout its length, coalescing with vein R1 before reaching costa (Subfamily Agromyzinae) | 2 |
| — | Subcosta becoming a fold distally and ending at costa separately and basad of R1 (Subfamily Phytomyzinae). | 5 |
| 2(1). | Pre-scutellars lacking | 3 |
| — | Pre-scutellars present | 4 |
| 3(2). | Mesonotum or abdomen normally with some metallic coloration, greenish or coppery, more rarely entirely black; antennae not normally separated by raised facial keel, male never with vibrissal fasciculus; male genitalia: aedeagus symmetrical (Figs. 2,9) | <i>Melanagromyza</i> Hendel |
| — | Uniformly black species; antennae frequently divided by conspicuous facial keel, male with vibrissal fasciculus (Fig. 11); male genitalia: aedeagus asymmetrical (Figs. 13,15) | <i>Ophiomyia</i> Brashnikov |
| 4(2). | Two pairs of dorso-centrals | <i>Japanagromyza</i> Sasakawa |
| — | At least 3 pairs of dc | <i>Agromyza</i> Fallén |
| 5(1). | Orbital setulae erect, reclinate or absent | 6 |
| — | Orbital setulae distinctly proclinate | 12 |
| 6(5). | Vein R4+5 ending nearest wing tip | <i>Phytobia</i> Lioy |
| — | Vein M1+2 ending nearest wing tip | 7 |
| 7(6). | Male genitalia: sperm pump with enlarged, bowl-shaped base (Fig.29). <i>Amauromyza</i> Hendel | |
| — | Male genitalia: sperm pump without such enlarged base | 8 |
| 8(7). | Third antennal segment with a spine, scutellum with only one pair of bristles (Subgenus <i>Cerodontha</i>); or lunule conspicuously higher than a semicircle (subgenus <i>Poemiza</i>) | <i>Cerodontha</i> Rondani |
| — | Third antennal segment without spine, lunule broader, lower | 9 |
| 9(8). | Fore-tibia with lateral bristle; abdomen in male yellow | <i>Nemorimyza</i> Frey |
| — | Only mid-tibia sometimes with bristle, fore-tibia never | 10 |
| 10(9). | No pre-sutural dc; epandrium with conspicuous patch of spines at hind-corner (Fig. 45). | <i>Calycomyza</i> Hendel |
| — | Pre-sutural dc present; epandrium without such spines | 11 |
| 11(10). | Frons and scutellum characteristically bright yellow | <i>Liriomyza</i> Mik |
| — | Frons and scutellum variable, darker | <i>Phytoliriomyza</i> Hendel
in part |
| 12(5). | Costa extending to vein M1+2 | <i>Phytoliriomyza</i> Hendel
in part |
| — | Costa extending only to vein R4+5 | 13 |
| 13(12) | Male genitalia: distal section of aedeagus simple (not bifid), lying below a lobe with supporting sclerites on dorsal side of aedeagus; pupation in mine . <i>Chromatomyia</i> Hardy | |
| — | Male genitalia: distal section of aedeagus bifid, without such lobe above; pupation on ground | <i>Phytomyza</i> Fallén |

Sub-family Agromyzinae

Genus *Melanagromyza* Hendel

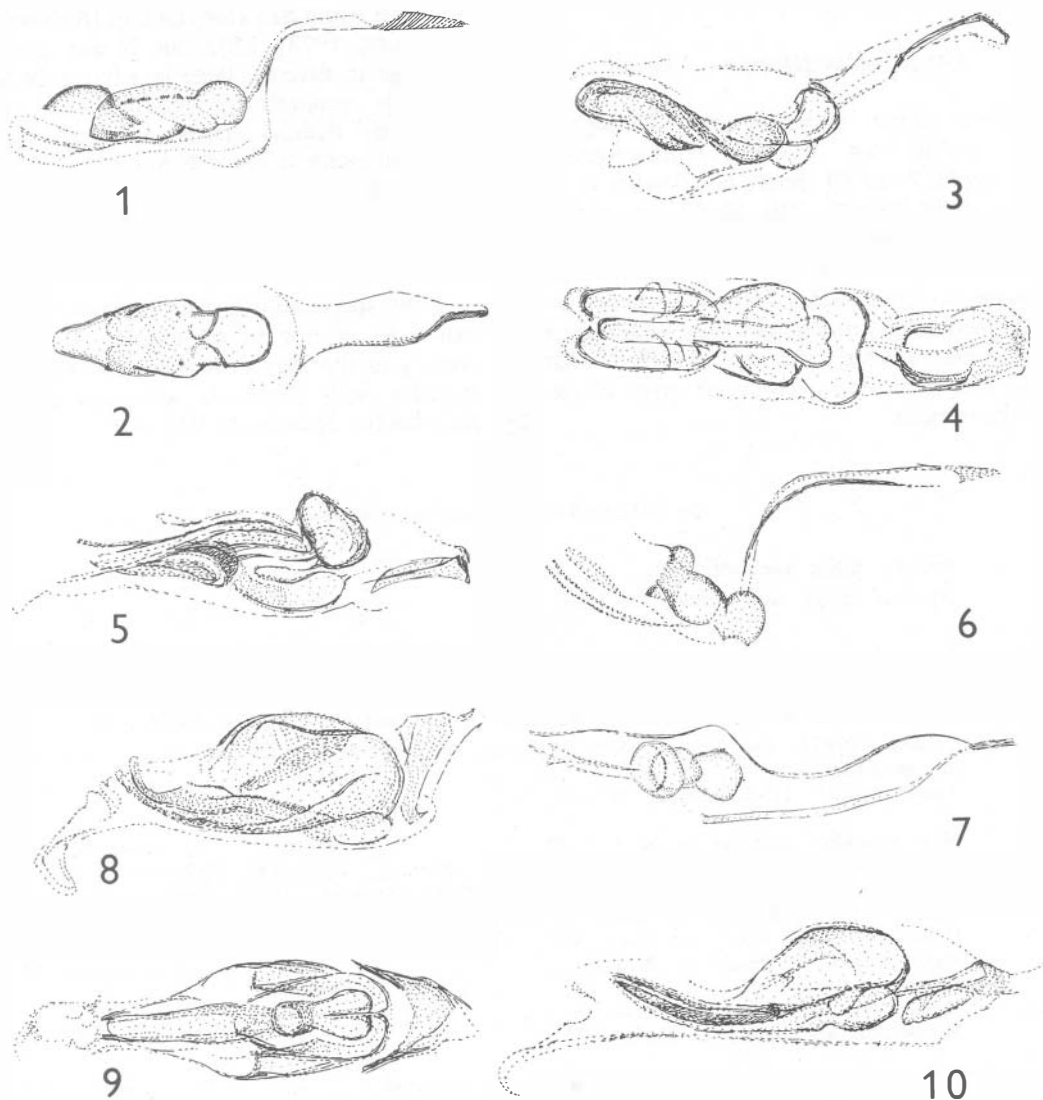
This large genus occurs throughout the world but is best represented in the tropics, with 80 species now known in the Neotropical Region. The larvae are internal feeders, mainly in stems but also in flower-heads. Five species have hitherto been known in Costa Rica. Two new species are described below, one species only known from California has been tentatively identified at San José and additional records are given of two further species.

Ten apparently undescribed species have been seen from San José, La Caja (Spencer and Stegmaier, 1973: 150) but it was not felt desirable to describe these largely on the basis of male genitalia of specimens in poor condition. Rearing specimens from puparia found in stems is not difficult and after such collecting, with the host identified and larval or puparial characters known, many further species can certainly be discovered in Costa Rica.

Many species in this genus damage cultivated plants by boring in stems and two species feeding in this way on tomatoes in Colombia, Ecuador and Venezuela were described by Steyskal (cf. Spencer, 1973b: 24).

Key to Costa Rican *Melanagromyza* species

1. Squamal fringe pale, whitish 2
- Squamal fringe dark, brown or black 4
- 2(1). Jowls narrow, 1/8 height of eye; small species, wing length 1.75-2.0 mm . . . *floris* Spencer
Note: Described by Spencer, 1963: 313 from Mexico, Puerto Rico and one female from Higuito, Costa Rica. Subsequently recorded from Venezuela (Spencer, 1973b: 18 and Chile, Spencer, 1982); also known from Argentina (Valladares). Host *Bidens pilosa*, larvae feeding in seed-heads.
- Jowls broader, 1/5-1/4 height of eye 3
- 3(2). Male genitalia: aedeagus as in Fig. 10 *neotropica* Spencer
Note: Described from Mexico and Brazil (Spencer, 1963:319). Subsequently found in Venezuela (Spencer, 1973b: 22) and in Chile (Spencer, 1982) where specimens were reared from seed-heads of *Bidens pilosa* at Arica; also present at Córdoba, Argentina (Valladares). One male seen from San José, La Caja, 1930 (H. Schmidt).
- Male genitalia: aedeagus as in Fig. 5 *circsiophila* Spencer
- 4(1). Mesonotum and abdomen greenish 5
- Mesonotum and abdomen black 6
- 5(4). Eye bare in male; female ovipositor greatly elongated *minima* (Malloch)
- Eye with patch of conspicuous hairs at level of ors; ovipositor normal . . . *mayi* sp.n.
Note: Discussed by Spencer and Stegmaier (1973:44); larva feeding and pupating in seed-heads of Asteraceae, confirmed on *Wedelia* and probably on *Eupatorium*; known from Florida, Trinidad, Jamaica. One male, one female previously reared from San José, La Caja. One female caught at San José, waste ground near Hotel Irazú, 21-I-82 and one at Santa Ana, 3-II-82.
- 6(4). Arista conspicuously pubescent; wing length in male 2.1 mm *chitariensis* sp.n.
- Arista virtually bare; smaller species, wing length 1.7-2.0 mm 7
- 7(6). Male genitalia: aedeagus as in Figs. 6, 7 *eleutherensis* Spencer
Note: Described from Eleuthera Is. (Bahamas) and two males from San José, La Caja (Spencer and Stegmaier, 1973: 155). One male, one female caught at San José, waste ground near Hotel Irazú, 25 and 31-I-82. This minute black species is only reliably distinguishable from *M. caribbea* by the male genitalia, which are of the same general form, but significantly different in detail.
- Male genitalia: aedeagus as in Figs. 1, 2 *caribbea* Spencer
Note: Described from Florida, Dominica and one male from Higuito, near San Mateo, Costa Rica (Spencer and Stegmaier, 1973: 34).



Figs. 1, 2. *Melanagromyza caribbea*: 1. aedeagus, side view; 2. same, ventral view.

Figs. 3, 4. *Melanagromyza chitariensis*: 3. aedeagus, side view; 4. same, ventral view.

Fig. 5. *Melanagromyza cirsiophila*: aedeagus, side view (San José).

Figs. 6, 7. *Melanagromyza eleutherensis*: 6. aedeagus, side view; 7. same, ventral view.

Figs. 8, 9. *Melanagromyza mayi*: 8. aedeagus, side view; 9. same, ventral view.

Fig. 10. *Melanagromyza neotropica*: aedeagus, side view (ex *Bidens*, Argentina).

Melanagromyza chitariensis sp.n.
(Figs. 3,4)

Head: Frons broad, twice width of eye, not significantly projecting above eye in profile; 2 upper orbital bristles (ors), 2 lower orbitals (ori), orbital setulae sparse, reclinate; ocellar triangle extending only to level of lower ors, orbits narrow; jowls deepest in front, narrow, about 1/7 height of eye, this bare; third antennal segment small, round, arista long, little shorter than height of eye, conspicuously pubescent.

Mesonotum: 2 strong dc, acrostichals (acr) numerous, in about 10 rows.

Wing: Length in male 2.1 mm; costa extending strongly to vein M 1+2, last section of M 3+4 shorter than penultimate, in ratio 15:25, inner cross-vein at midpoint of discal cell.

Colour: Black; ocellar triangle and orbits only weakly shining; mesonotum moderately shining from rear, more mat from front; squamae dark grey, margin and fringe black; halteres black.

Male genitalia: Aedeagus as in Figs. 3, 4; sperm pump with blade long and narrow; inner margin of spandrium slightly rounded, with numerous short bristles; end of hypandrium broad, blunt.

Holotype: ♂, Costa Rica, roadside E of Chitaría (Turrialba) 29-I-82, in AC (author's collection).

Remarks: The pubescent arista and larger size distinguish this species from the two other entirely black species known in Costa Rica, *M. caribbea* and *M. eleutherensis*.

Melanagromyza cirsiophila Spencer
New to Costa Rica
(Fig. 5)

Melanagromyza cirsiophila Spencer, 1981:41

This greenish species with the squamal fringe pale was reared from "thistle" in southern California. The type specimens are large, with wing length of 2.5-3.25 mm. The male genitalia are distinctive (cf. Spencer, 1981: Figs. 23, 24). A series of 14 specimens from San José and 3 others from Atenas and Llano Grande are substantially smaller, with wing length of 2-2.5 mm. However, the male genitalia (Fig. 5) agree exactly with the holotype and I hesitate to treat the Costa Rican population as distinct merely on the smaller size. It will be of the utmost interest to find additional material from intermediate areas further north in Central America and in Mexico to ascertain the size of populations there. Further clarification of the Costa Rica species will only be possible when additional material becomes available and in particular when the host can be established.

Some thistles were growing where the main series was caught but the dominant composite was *Bidens pilosa* and this is possibly the host, with the larvae feeding and pupating internally in the stems.

Material seen: San José, waste ground near Hotel Irazú, 5 ♂, 9 ♀, 21-25-I-82; Llano Grande, above Cartago, 2100 m, 2 ♀, 26-I-82; W of Atenas, Nature Reserve, 1 ♀, 1-II-82.

Melanagromyza mayi sp.n.
(Figs. 8,9)

Head: Frons narrow, equal to width of eye, not projecting above eye in profile; 2 ors, 2 ori; orbits broad, with orbital setulae short but numerous, in 2 rows, those nearest eye margin reclinate, the inner row proclinate; apex of ocellar triangle extending to just below level of lower ors; jowls deepest in centre, rather narrow, about 1/7 height of eye, this round, upright, with distinct patch of hairs in male at level of ors; third antennal segment small, round, arista appearing bare.

Mesonotum: 2 strong dc, acr numerous, in about 8 rows.

Wing: Length 1.9-2.0 mm in both sexes; costa extending strongly to vein M 1+2, last section of M3+4 short, little more than 1/2 length of penultimate. (In holotype there is a venational aberration with M1+2 curving up to join R4+5 at the distal third of the discal cell).

Colour: Head black, both ocellar triangle and orbits moderately shining; mesonotum and scutellum distinctly shining green viewed from rear, more mat seen from front, abdomen almost brilliantly shining green; squamae grey, margin and fringe black; halteres black but paler above in holotype.

Male genitalia: Aedeagus as in Figs. 8, 9, basal sclerite closely adjoining distiphallus complex; sperm pump large, with well-defined central vein; inner margin of epandrium rounded, with a row of short bristles; epandrium with greatly elongated apodeme.

Holotype: ♂, Costa Rica, San José, waste ground near Hotel Irazú, 31-I-82; paratypes: 2 ♀, same locality, 25-I-82, all in AC. A male

Key to Costa Rican *Ophiomyia* species

1. Halteres brown below, with circular white area above *punctohalterata* (Frost)
 Note: Described from Guatemala by Frost (1936, Ann. Entomol. Soc. Amer., 29: 311).
 Eight males and 4 females were seen from San José, La Caja (Spencer and Stegmaier,
 1973: 171); also known from Venezuela (Spencer, 1973b: 29).
 — Halteres uniformly dark 2
- 2(1). Squamal fringe white *buscki* (Frost)
 — Squamal fringe brown or black 3
- 3(2). Proboscis elongate (Fig. 16) 4
 — Proboscis short, normal 5
- 4(3). Large species, wing length in female 2.9 mm; vibrissal corner forming angle of 80° . . .
 *magna* sp.n.
 — Smaller species, wing length 2-2.2 mm; vibrissal corner acute, forming angle of less than
 40° *valida* Spencer
 Note: Described from Bahamas; Jamaica and 7 males from San José, La Caja (Spencer
 and Stegmaier, 1973: 173).
- 5(2). Ocellar triangle brilliantly shining; wing with veins pale, whitish *gentilis* Spencer
 Ocellar triangle only moderately shining; veins dark brown *costaricensis* sp. n.

from Santa Ana, 3-II-82 closely resembles the type series but is not included as a paratype. It is larger, with wing length of 2.25 mm, with very slight differences in the male genitalia. It may possibly represent a further species but more material will be required before this can be decided.

Remarks: I have pleasure in naming this species after Ing. Juan José May, Vice-President of the Convenio Costarricense-Alemán, MAG, whose courtesy and assistance throughout my visit was greatly appreciated.

M. mayi generally resembles *M. erechtioidis* Spencer (1966a: p.10) known from Florida, feeding in flower-heads of *Erechtites hieraciifolia*. The aedeagus somewhat resembles that of *M. neotropica* (Fig. 10) but in this species the squamal fringe is pale.

Genus *Ophiomyia* Braschnikov

Species in this genus are entirely black, as opposed to the normally greenish or bluish colour of the mesonotum or abdomen normally found in *Melanagromyza*. Characteristically, males have a pronounced vibrissal fasciculus (Fig. 11) and there is a prominent raised facial keel in both sexes. However, in a few species these characters may be lacking and correct generic assignment may only be possible from the male genitalia.

Over 150 species are known and the genus is well represented in the Neotropical Region, extending to Chile, with 7 species known in Venezuela. Three species have hitherto been known in Costa Rica. Two new species are described below and one, *O. buscki* (Frost), is recorded as new to Costa Rica, originally described from Panamá.

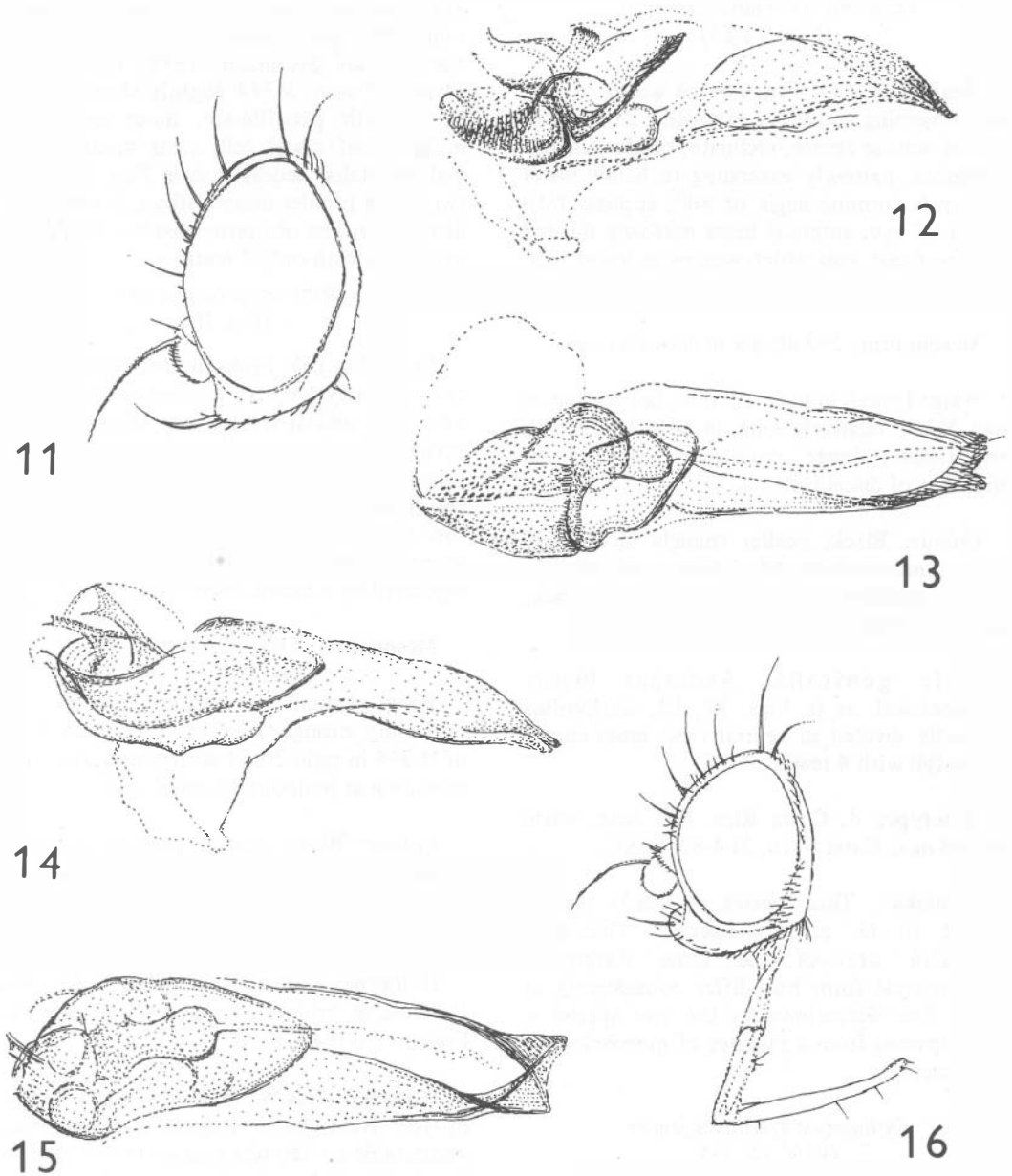
Larvae feed predominantly as external stem-miners, pupating in the stem with the anterior spiracles projecting through the epidermis. Possibly the most serious agromyzid pest in the world, *O. phaseoli* (Tryon), feeds on beans throughout the Old World tropics. This species recently reached Hawaii but is not so far known in mainland America or in the Neotropical Region.

Ophiomyia buscki (Frost)
New to Costa Rica

Agromyza buscki Frost, 1936, Ann. Entomol. Soc. Amer. 29: 315.

Ophiomyia buscki, Frick, 1957, Ann. Entomol. Soc. Amer. 49: 200.

This is a distinctive species with white squamal fringe and elongated proboscis. Spencer (1963: 325) considered specimens bred from stem-mines on *Alternanthera philoxeroides* in Argentina and Brazil to represent *O. buscki* described from Panamá and the male genitalia and puparial spiracles were illustrated. However,



Figs. 11, 13. *Ophiomyia costaricensis*: 11. head; 12. aedeagus, side view; 13. same, ventral view.

Figs. 14, 15. *Ophiomyia gentilis*: 14. aedeagus, side view; 15. same, ventral view (San José).

Fig. 16. *Ophiomyia magna*: head.

later some doubt was expressed as to whether the populations in Argentina and Brazil on the one hand and Panamá on the other were really

identical and a further rather similar species, *O. haydeni*, was described from the Bahamas and southern Florida (Spencer and Stegmaier, 1973: 57).

A single female from Moín, near Limón, 29-I-82, is tentatively identified as *O. buscki*, as this habitat certainly closely resembles that of the type locality, Corozal, Panamá but this group can only be further clarified as additional material becomes available.

Ophiomyia costaricensis sp.n.
(Figs. 11-13)

Head (Fig. 11): Frons twice width of eye, not projecting above eye in profile; 2 ors, 2 ori, orbital setulae sparse, reclinate; ocellar triangle elongated, narrowly extending to below lower ori; jowls forming angle of 80°, approx. 1/10 height of eye; antennal bases narrowly divided by low facial keel which widens in lower half; vibrissal fasciculus finely tapering.

Mesonotum: 2+0 dc, acr in about 6 rows.

Wing: Length in male 1.9 mm; last section of vein M3+4 relatively long, in ratio 16:19 with penultimate; inner cross-vein well beyond midpoint of discal cell.

Colour: Black; ocellar triangle moderately shining; mesonotum and abdomen only slightly shining; squamae grey, margin and fringe black; wing with veins brown, normal.

Male genitalia: Aedeagus highly asymmetrical, as in Figs. 12, 13, distiphallus distinctly divided in ventral view; inner corner of surstyli with 4 teeth.

Holotype: ♂, Costa Rica, San José, waste ground near Hotel Irazú, 31-I-82, in AC.

Remarks: This species is clearly closely related to *O. gentilis* Spencer. The male genitalia are of the same distinctive, asymmetrical form but differ considerably in detail. The distinctness of the two species is also apparent from a number of morphological differences.

Ophiomyia gentilis Spencer
(Figs. 14, 15)

Ophiomyia gentilis Spencer, in Spencer and Stegmaier, 1973: 57.

This species was described from specimens from southern Florida, Dominica and one male from San José, La Caja. A further male was obtained from San José, waste ground near Hotel Irazú, 25-I-82.

O. gentilis closely resembles *O. costaricensis* with the following points of difference: frons narrower, slightly less than 1.5 times width of eye; ocellar triangle brilliantly shining; facial

keel narrower, less raised; vibrissa not curving uniformly, with distinct bend at midpoint (cf. Spencer and Stegmaier 1973: fig. 126); last section of vein M3+4 slightly shorter, in ratio 15:20 with penultimate, inner cross-vein at midpoint of discal cell; veins unusually pale; male genitalia: aedeagus as in Figs. 14, 15. The two distal tubules more distinct, in ventral view distiphallus less obviously divided; inner corner of surstyli with only 2 teeth.

Ophiomyia magna sp.n.
(Fig. 16)

Head (Fig. 16): Frons almost twice width of eye, narrowly projecting above eye in profile; 2 ors, 2 ori; orbital setulae long, sparse, reclinate; ocellar triangle extending to lower ors; jowls broad, 1/3 height of eye, forming angle of about 80°, extending to the lateral margin of the face on which the vibrissa is located; proboscis greatly elongated; antennae widely separated by a broad, raised facial keel.

Mesonotum: 2+0 dc, acr in 10 rows.

Wing: Length in female 2.9 mm; costa extending strongly to vein M 1+2, last section of M 3+4 in ratio 20:34 with penultimate, inner cross-vein at midpoint of discal cell.

Colour: Black; ocellar triangle moderately shining; mesonotum weakly shining, abdomen more so; squamae pale grey, margin and fringe black; halteres black.

Holotype: ♀, Costa Rica, below Volcán Poás, 1950 m, at bridge 5 km above two cafes near Fraijanes, 6-II-82, in AC.

Remarks: This is the largest species known in the Neotropical Region. It is normally undesirable to describe species in this genus on the basis of females; however, the elongate proboscis, large size, broad jowls and broad, high facial keel are distinctive characters and there should be no difficulty in associating males with the female holotype. It can be assumed with certainty, that the male will be typical of the genus in having a developed vibrissal fasciculus.

Genus *Japanagromyza* Sasakawa

As its name implies, this genus was originally described from Japan but it was later found to

occur widely in the Oriental Region and also in southern Florida and the Caribbean area. Two species are now known in Costa Rica, of which one, occurring as a minor pest on *Phaseolus*, is formally described below.

All species hitherto known have been dark, black or greenish. Two species with conspicuous yellow coloration from Jamaica, Grand Cayman and the Bahamas were placed in a new genus *Geratomyza* by Spencer (in

Spencer and Stegmaier, 1973: 140). Dr. von Tschirnhaus has recently informed me that he has seen yellow species of *Japanagromyza* during a visit to Perú in 1981 and it therefore seems probable that *Geratomyza* will prove to be synonymous with *Japanagromyza*. However, this synonymy will not be formally proposed, until the two species of *Geratomyza* can be re-examined.

Key to Costa Rican *Japanagromyza* species

1. Large species, wing 2.5-2.75 mm; male genitalia: hypandrium with short but distinct apodeme (Fig. 19); host *Phaseolus* *phaseoli* sp. n.
Smaller species, wing length 1.9-2.4 mm; male genitalia: hypandrium rounded at end, without apodeme (cf. Spencer and Stegmaier, 1973: Fig. 36B) *perpetua* Spencer
Note: Described from Florida, Bahamas, Puerto Rico and 7 males from San José, La Caja (Spencer and Stegmaier, 1973: 28b). There is no indication of the host.

Japanagromyza phaseoli sp. n. (Figs. 17-22)

Head (Fig. 17): Frons narrow, equal to width of eye, not projecting above eye in profile; 2 equal ors, 2 ori, the upper only slightly weaker than the ors and reclinate, the lower weaker, more incurved; orbital setulae sparse, reclinate; jowls narrow, approx. 1/10 height of eye; third antennal segment large, arista long.

Mesonotum: 2 strong dc, acr in 8 rows in front; pre-scutellars well-developed.

Legs: Fore-tibia with 1 lateral bristle, mid-tibia with 2.

Wing: Length from 2.5 mm in male to 2.75 mm in female; costa extending strongly to vein M1+2, last section of M3+4 2/3 penultimate.

Colour: Frons slightly variable, dark brownish to black, orbits shining black; mesonotum predominantly mat greyish, sometimes with faint greenish tinge, at most weakly shining; pleura black, with greyish tinge; legs black; abdomen shining greenish; squamae, including margin and fringe, silvery; halteres white.

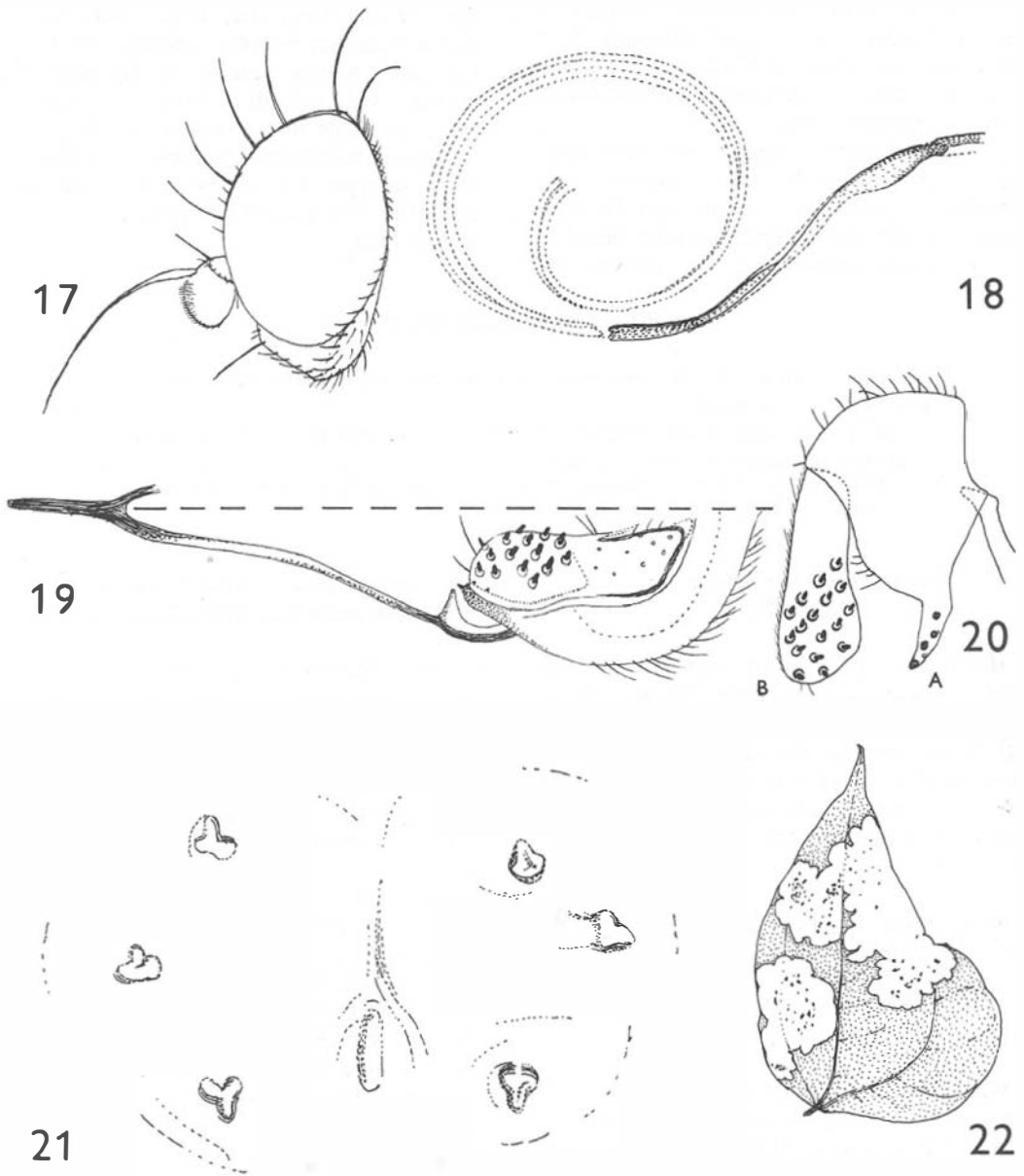
Male genitalia: Aedeagus with 2 pale coiled tubules (Fig. 18); hypandrium with distinct but short apodeme (Fig. 19); surstyli elongate,

with several strong bristles (Fig. 20A), cerci large, with numerous strong bristles (Fig. 20B).

Host: *Phaseolus* spp., also reported in Perú on *Brassica oleracea* larva forming irregular blotch mine, sometimes several in a leaf (Fig. 22), pupating externally; puparium brownish-orange, posterior spiracles each with 3 flat processes again subdivided into 3 small, elongate pores (Fig. 21).

Holotype: ♂, Venezuela, Rancho Grande, Aragua, emerged 5-V-72 ex mine on *Phaseolus* 18-IV-72; El Valle, DF, 1 ♀, 24-II-50 ex "caraotas" (R. Hernández); Perú, Cariete, 1 ♂, 3 ♀, 20-VI-41 (E.J. Hambleton); La Molina, 2 ♂, 5 ♀, also 4 pupal cases, ex *Phaseolus vulgaris*, 21-IX-62 (Olave 89-62); Huara, 6 ♂, 4 ♀, 2-VI-67 (K. Raven); Lambayeque, 1 ♂, 1 ♀, "on cabbage", 16-V-66 (H. Torres). Leaf mines with larvae found in Costa Rica at Fraijanes, 1600 m, 22-I-82, and near Chitaría de Turrialba, 29-I-82; also empty mines at Llano Grande, 2100 m, above Cartago, 26-I-82. Holotype and paratypes in BM, further paratypes in USNM, collection of Universidad Agraria, Lima and Facultad de Agronomía, Maracay.

Remarks: This species was originally diagnosed by Spencer (1963:304) as *Japanagromyza* sp. (Perú) but was not formally described. It was later discovered again in Perú by C.A. Korytkowski and I found it in Venezuela (Spencer, 1973 b: 34; 1973c: 83 and

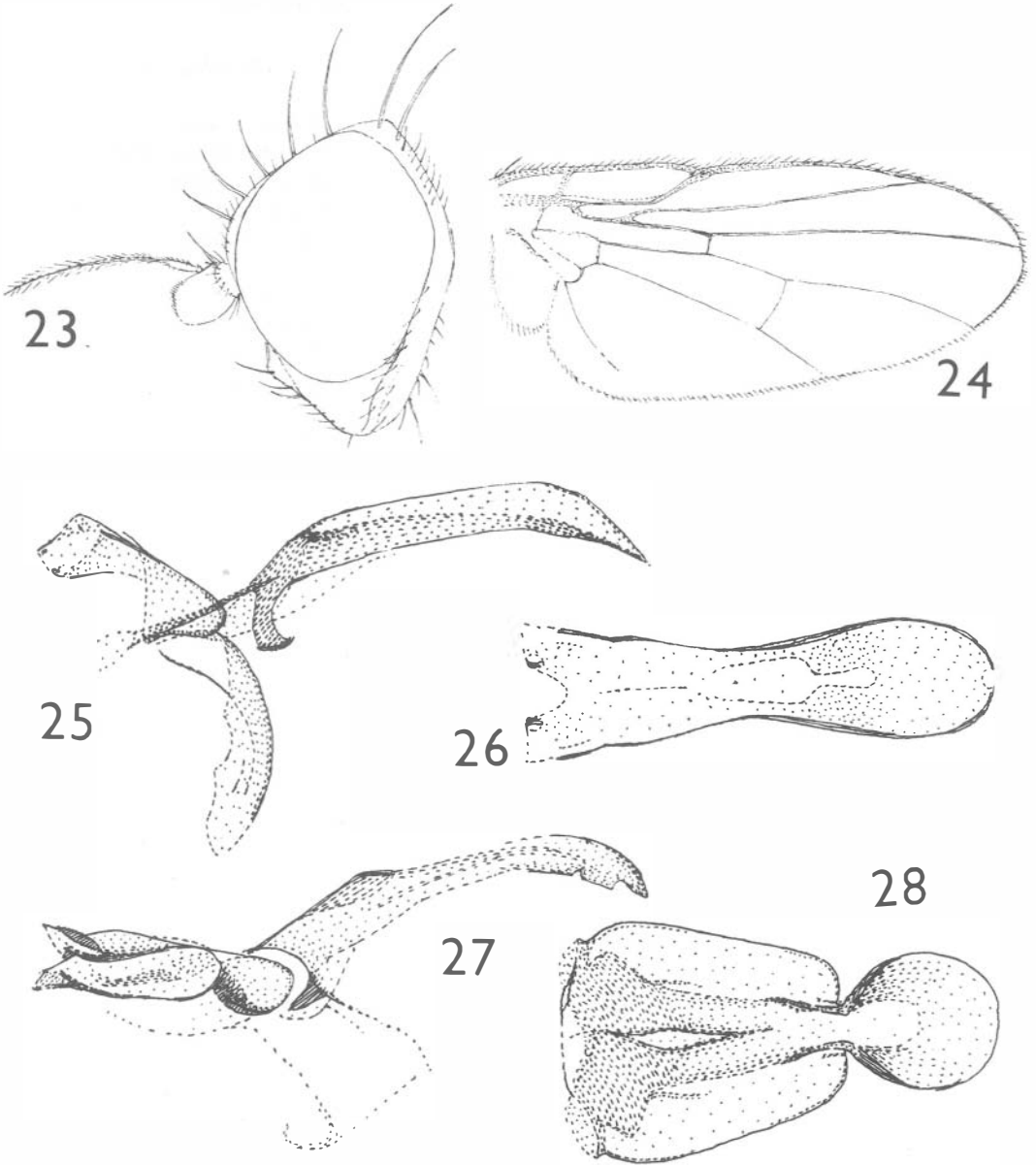


Figs. 17, 22. *Japanagromyza phaseoli*: 17. head; 18. aedeagus (holotype); 19. hypandrium; 20. epandrium, with A. surstylus, B. cercus; 21. posterior spiracles of puparium (*Chitaria*); 22. leaf mines on *Phaseolus* (*Chitaria*).

373). I had been proposing to describe the species at that time but agreed that the formal description should be prepared by Korytkowski. However, his description will not

now be published, as he has taken up other work and in view of the economic importance of the species, the description is published here.

The male genitalia of the specimen from Cariete (slide 439, USNM) have been re-examined and it can be confirmed that the illustration of the aedeagus (Spencer, 1963: Fig. 13d) is inaccurate, owing to the loss of the coiled end of the distiphallus during preparation (see Fig. 18).



Figs. 23, 24. *Agromyza venezolana*: 23. head; 24. wing.

Figs. 25, 26. *Phytobia dorsocentralis*: 25. aedeagus, side view; 26. distiphallus, ventral view.

Fig. 27, 28. *Phytobia picta*: 27. aedeagus, side view; 28. distiphallus, ventral view.

J. phaseoli appears to be widespread on *Phaseolus* in the Neotropical Region and was present at the three localities in Costa Rica

where *Phaseolus* was examined. The larva forms a relatively large blotch mine and several mines may be present in a single leaf. Plants attacked in this way must be considerably weakened, inevitably leading to some loss in yield. Young plants were seen to be completely destroyed in Venezuela (Spencer, 1973c: 373). Unfortunately no adults were reared from the puparia obtained in Costa Rica but the distinctive arrangement of the puparial spiracles (Fig. 21) is identical to that of

reared specimens from Venezuela and Perú.

The occurrence of this species on *Brassica oleracea* (cabbage) in Perú is puzzling and it remains to be established whether this was an isolated occurrence or whether this may serve as a regular alternate host.

Genus *Agromyza* Fallén

This large genus occurs predominantly in temperate areas of the northern hemisphere and over 150 species are known throughout the world. Only 6 species have been recorded in the Neotropical Region. Two species are known in Costa Rica, both certainly grass-feeders. A new record of *A. animata* is given below.

Key to Costa Rican *Agromyza* species

1. Squamal fringe pale, whitish *venezolana* Spencer
Note: Described from the Botanical Gardens, Caracas (Spencer, 1963) and later identified from two males from San José, La Caja (Spencer and Stegmaier, 1973: 139). The head and wing are shown in Figs. 23,24.
- Squamal fringe dark, brownish-black *animata* Spencer
Note: Described from a single male from Costa Rica, Higuito de San Mateo (Spencer, 1973a: 152). A female caught at Limón, 29-I-82 is accepted as representing this species.

Key to Costa Rican *Phytobia* species

1. Mesonotum and scutellum entirely black sp.1 (Costa Rica)
Note: One female seen from "Podrogoso" (as Pedregosa), Spencer and Stegmaier (1973: 179).
- Scutellum yellow; mesonotum partially yellow 2
- 2(1) Wings pictured *rabelloi* Spencer
Note: Described from Brazil (Spencer, 1966b: 145). A single female seen from La Suiza (near Turrialba). In view of the numerous species now known to exist in the Neotropical Region having marked wings, it is possible or even probable that this represents a misidentification and that this species is distinct and undescribed.
- Wings clear 3
- 3(2) Dark area of mesonotum solid, only semicircle adjoining scutellum yellow. sp. 2 (Costa Rica)
Note: One female seen from La Suiza de Turrialba (Spencer and Stegmaier, 1973: 180)
- Dark area of mesonotum extended into 2 bands at sides 4
- 4(3) Very large species, wing length 3.25-4 mm; male genitalia: aedeagus as in Figs. 25, 26 *dorsocentralis* (Frost)
Note: Described from Panamá by Frost (1936, Ann. Entomol. Soc. Amer. 29: 307); three males, one female seen from La Suiza, one male from Podrogoso (Spencer and Stegmaier, 1973: 175).
- Smaller species, wing length 2.4-3.1 mm; male genitalia: aedeagus as in Figs. 27, 28. *picta* (Coquillett)
Note: Described from Mexico by Coquillett (1902, J. New York Entomol. Soc. 10: 188). Three females seen from San Mateo, one from San José, La Caja (Spencer and Stegmaier, 1973: 176).

Sub-family Phytomyzinae

Genus *Phytobia* Lioy

This genus is now restricted to the mainly large species whose larvae bore internally in the cambium of trees. Five species are known in Costa Rica (Spencer and Stegmaier, 1973) but two have not been formally described in the absence of males.

Two species have been described from Ecuador and Perú (Spencer, 1977) and four are known from Brazil (Spencer, 1966b). However, the genus is apparently very large in the Neotropical Region. Dr. von Tschirnhaus recently informed me that he discovered 20 undescribed species in a rain forest in Perú at a single locality.

The larvae can cause considerable damage to wood used for the manufacture of furniture and other products. However, no trees have been identified as hosts in Costa Rica and no economic damage has yet been reported.

Genus *Amauromyza* Hendel
(Fig. 29)

This genus is poorly represented in the Neotropical Region, with only 4 species known out of the world total of 40. Of these, one was discovered in 1967 feeding on *Commelina* in Cuba and the formal description was to have been prepared by Dr. E. Rohdendorf, Prague, but this has never been done (Spencer and Stegmaier, 1973: 186). Twenty species are known in the United States. A distinctive character of all species in this somewhat diverse genus is the large, bowl-shaped base of the sperm pump, shown in *A. maculosa* in Fig. 29. In other species this is even more strongly developed.

Only the single species *A. maculosa* (Malloch) is known in Costa Rica and was recorded by Spencer (1973a). This large, black species is distinctive in having the halteres largely white but partially black below. Leaf mines were not uncommon in San José in January, 1982 on the common weed *Conyza*.

The larvae of *A. maculosa* form large blotch mines and the species has been recorded as a pest on lettuce in Trinidad and Venezuela. No large populations are known to have occurred on *Chrysanthemum* but the possibility of damage being caused cannot be excluded. Hosts are exclusively in the Asteraceae and many genera are attacked. This is the most widespread of all Neotropical species, occurring from Argentina and Chile to New York.

Material seen: San José, Hotel Irazú and roadside nearby, many mines on *Conyza apurensis* HBK, mostly empty. No adults obtained but two parasites, *Opius* sp.; emerged 7 and 11-II-82; Fraijanes, below Volcán Poás, 1600 m, empty mines on *Emilia fosbergi*, 21-I-82.

Genus *Nemorimyza* Frey
(Fig. 30)

Only a single species, *posticata* (Meigen), is known in this genus. Distribution is

predominantly Nearctic and Palearctic but small populations are present in Florida and one female has been seen from Costa Rica, San José, La Caja.

Hosts are exclusively in the Asteraceae, the main genera attacked being *Aster*, *Baccharis* and *Solidago*. The adults are large, with wing length of 2.7-3.3 mm, distinctive characters being the silvery lunule, a strong bristle on the fore-tibia, silvery-white squamal fringe and the yellowish abdomen of the male. The isolated position of this species is indicated by the male genitalia (Spencer and Stegmaier, 1973; Fig. 241).

Empty mines (Fig. 30) on an unidentified woody species of Asteraceae at the roadside West of San Ramón, 1-II-82, represent *N. posticata*.

Genus *Cerodontha* Rondani
New to Costa Rica

This large genus of world-wide distribution has been split into 7 subgenera, of which two are now recorded below. The genus reaches Chile where 7 species have now been recorded (Spencer, 1982) but 43 are known in U.S.A. The genus has been studied in detail in Europe, with 75 species now described.

Hosts are exclusively in the Monocotyledoneae and the two Costa Rican species are both well-known grass-feeders.

Subgenus *Cerodontha* Rondani

C. dorsalis (Loew) is a distinctive species with a conspicuous spine on the third antennal segment. It was described originally from Washington, D.C. but is now known to occur virtually throughout the United States. Its range extends in South America to Brazil, Bolivia and Chile (Spencer, 1982) and its occurrence in Costa Rica was to be expected.

The larvae feed on numerous genera of Poaceae, including all the main cereal crops. As many as eight generations in a year have been observed in southern California and the species is of some economic importance. Young plants can be damaged by numerous feeding punctures in the leaves but it has not been confirmed whether there is any actual reduction in yield (Spencer, 1973c: 293 ; 1981: 174).

Material seen: San José, waste ground near Hotel Irazú, 2 ♀, 25-I-82; below Volcán Barva, 2250 m, 1♂, 1♀, 27-I-82.

Key to Costa Rican *Liriomyza* species

1. Mesonotum yellow before scutellum 2
 - Mesonotum entirely dark, black or grey, before scutellum 5
- 2(1). Third antennal segment brownish, greatly enlarged in male *commelinae* (Frost)
 - Third antennal segment bright yellow, not enlarged in male 3
- 3(2). All bristles yellow; mesonotum largely yellow, dark areas at most faintly reddish-brown. *microglossae* Spencer
 - All bristles black; mesonotum with dark areas at least partially black 4
- 4(3). 2+1 dc; dark areas divided into distinct bands; in female ovipositor normal.
 *marginalis* (Malloch)
 - 3+1 dc; dark area largely solid, outer edges slightly divided toward scutellum; in female
 ovipositor greatly elongated *insignis* Spencer
- 5(1). Third antennal segment black or at least darkened, brownish 6
 - Third antennal segment yellow 9
- 6(5). Third antennal segment black 7
 - Third antennal segment brownish-yellow 8
- 7(6). Frons bright yellow *irazu* sp.n.
 - Frons brownish-orange *schmidtiana* Spencer
 Note: Described from San José, La Caja by Spencer (1973a), with illustrations of head
 and male genitalia.
- 8(6). Femora bright yellow, at most with slight blackish striations *lupini* Spencer
 - Femora more generally blackish, though yellowish below *huidobrensis* (Blanchard)
- 9(5). Third antennal segment with a fringe of white pubescence which is longer than basal
 width of arista 10
 - Third antennal segment with at most short pubescence 11
- 10(9). Mesonotal yellow patches large, inner post-alar on yellow ground; scutellum entirely yellow.
 *costaricana* sp.n.
 - Mesonotal patches smaller, inner post-alar on black; scutellum with small lateral black trian-
 gles *archboldi* Frost
- 11(9). Mesopleura largely black *sabazia* Spencer
 - Mesopleura at most black along lower margin 12
- 12(1). Mesonotum shining black *sativae* Blanchard
 - Mesonotum mat, greyish-black *trifolii* (Burgess)

Subgenus *Poemyza* Hendel

This subgenus is characterized by the high, narrow lunule. In Europe 24 species have been recorded and in U.S.A. 10. The subgenus has not previously been known in the Neotropical Region. A single male of *Poemyza* (Mg.) was caught at San José, waste ground near Hotel Irazú, 25-I-82. The species is distinctive, with the orbits partially yellow and the femora yellow on the distal third. The larvae feed on many genera of Poaceae.

P. muscina was described from Germany but is also widespread in Canada and U.S.A. It

presumably has a continuous distribution in the mountains from southern California (Spencer, 1981: 181) through México to Costa Rica.

Genus *Liriomyza* Mik

Only two species have hitherto been known in Costa Rica (Spencer, 1973a: 153) but the genus is well represented throughout the Neotropical Region. Two new species are described below and 9 species new to Costa Rica are recorded, including the three leaf-mining pests *L. huidobrensis*, *sativae* and *trifolii*. It was of considerable interest to

discover the host of *L. insignis*, which was previously only known from caught specimens, with the larvae feeding in the flower-heads of *Bidens pilosa*.

Liriomyza archboldi Frost
New to Costa Rica

Liriomyza archboldi Frost, 1962, Entomol. News 73: 51-3; Spencer and Stegmaier, 1973: 97.

An uncommon species with frons and antennae yellow, mesonotum shining black, yellow patches at hind-corners small, inner post-alar on black; legs with femora conspicuously yellow; a distinctive character is the long pubescence of the third antennal segment. The larva has once been recorded as forming a blotch mine on *Bidens pilosa*.

The only previous record is from Florida. Two males were caught on rough ground near Hotel Irazú, San José, 31-II-82, on which *Bidens* was growing.

Liriomyza commelinae (Frost)
New to Costa Rica

Agromyza commelinae Frost, 1931, Entomol. News, 42: 72-5.

Liriomyza commelinae Spencer, 1973b: 56; Spencer and Stegmaier, 1973: 101.

This is a most distinctive species, with the mesonotum yellow before the scutellum and the third antennal segment greatly enlarged in the male. The normal host is *Commelina* but larvae have also been found on *Tradescantia* (both Commelinaceae). A long linear mine is formed, with the black puparium remaining in the leaf, lying upside down with the anterior spiracles projecting through the lower epidermis.

Distribution extends from southern Florida to Argentina, with records from Cuba, Jamaica, St. Vincent and Venezuela. A single mine was found at Santa Ana, 3-II-82, on *Commelina diffusa* Burm. from which a male emerged 2-III-82.

Liriomyza costaricana sp.n.
(Figs. 31, 32)

Head: Frons 1.5 times width of eye, not projecting above eye in profile; 2 strong, equal ors, 2 weaker ori; orbital setulae sparse,

reclinate; jowls at rear 1/4 height of eye, this only slightly slanting; third antennal segment small, round, with fringe of conspicuous white pubescence with a longer than basal width of arista, this weakly pubescent.

Mesonotum: 3+1 strong dc, acr in 4 rows.

Wing: Length in male 1.6 mm, discal cell relatively large, last section of vein M3+4 almost twice length of penultimate.

Colour: Frons, orbits, jowls, face, palps and all antennal segments bright yellow, hind-margin of eye black, with both vertical bristles on black ground; mesonotum deep black, shining, yellow hind-corners large, with inner post-alar clearly on yellow ground; scutellum entirely yellow; side of thorax largely yellow, mesopleura with black triangle in lower front corner, upper margin of sternopleura broadly yellow; legs: coxae and femora bright yellow, tibiae and tarsi dark brownish; abdomen with front tergites yellow laterally; squamae yellowish-grey, margin and fringe black; halteres bright yellow.

Male genitalia: Aedeagus as in Figs. 31, 32; sperm pump with narrow blade but strongly pigmented; surstyli with 2 spines.

Holotype: ♂, Costa Rica, Nature Reserve, 15 km W. of Atenas, I-II-82, in AC.

Remarks: This species generally resembles *L. archboldi* but is paler, with the yellow mesonotal patches smaller, the dark area of the mesopleura larger and the scutellum having small lateral black triangles in *archboldi*. The aedeagus of the two species is entirely distinct.

Liriomyza huidobrensis (Blanchard)
New to Costa Rica
(Figs. 33-36)

Agromyza huidobrensis Blanchard, 1926, Rev. Soc. Entomol. Argentina, 1: 10-11.

Liriomyza huidobrensis, Blanchard, 1938, An. Soc. Cient. Argentina, 126: 356; Spencer, 1973b: 57; 1973c: 215; 1981: 241.

Liriomyza langei Frick, 1951, Pan-Pacif. Entomol., 21: 81.

Liriomyza dianthi Frick, 1958, Proc. Entomol. Soc. Wash., 60: 1-5.

This is an important pest species in California and Venezuela, particularly on the vegetables *Beta*, *Pisum* and *Vicia faba* and the ornamentals *Aster* and *Dianthus*. There is also a single record on chrysanthemums in Brazil. It is darker and slightly larger than the two more important pests, *L. sativae* and *L. trifolii*. The

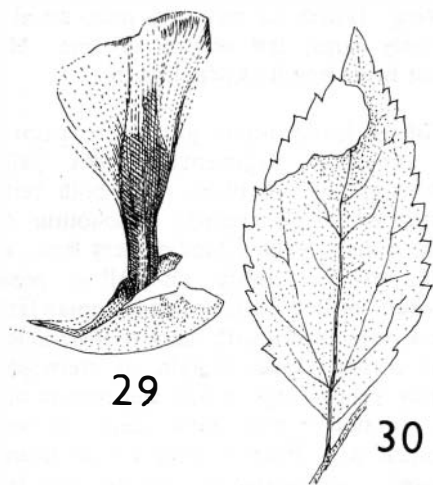


Fig. 29. *Amauromyza maculosa*: sperm pump.

Fig. 30. *Nemorimyza posticata*: leaf mine on unidentified bush (San Ramón).

third antennal segment is normally brownish, not bright yellow, and both mesopleura and all femora can be largely black. In the wing the discal cell is relatively large (Fig. 33). The male genitalia are shown in Figs. 34, 35.

The larva forms a characteristic leaf mine, normally following the midrib and the larger lateral veins. In both the larva and puparium the posterior spiracles each have an ellipse of 8 pores (Fig. 36), which permits the species to be readily distinguished from *L. sativae* and *L. trifolii*, which both have 3 pores.

No infestation was found on cultivated plants but mines were present on *Galinsoga caracasana* at Fraijanes, 21-I-82 and on *Dahlia imperialis* and *Tropaecolum* at Llano Grande, 26-I-82. A single female was caught on the latter host.

Liriomyza irazui sp.n.
(Fig. 37)

Head: Frons about twice width of eye (slightly shrunk in holotype), not projecting

above eye in profile; orbital bristles variable, normally 2 strong equal ors, 1 ori but sometimes a weak lower ori is present, less frequently only 1 strong ors and 1 strong ori, in 1 specimen seen this arrangement present on one side only; jowls angular, extended at rear, about 1/3 height of eye, this distinctly slanting; third antennal segment small, round, only finely pubescent.

Mesonotum: 3+1 strong dc, presutural dc equal to 3rd; acr in 4 irregular rows; no intra-alar.

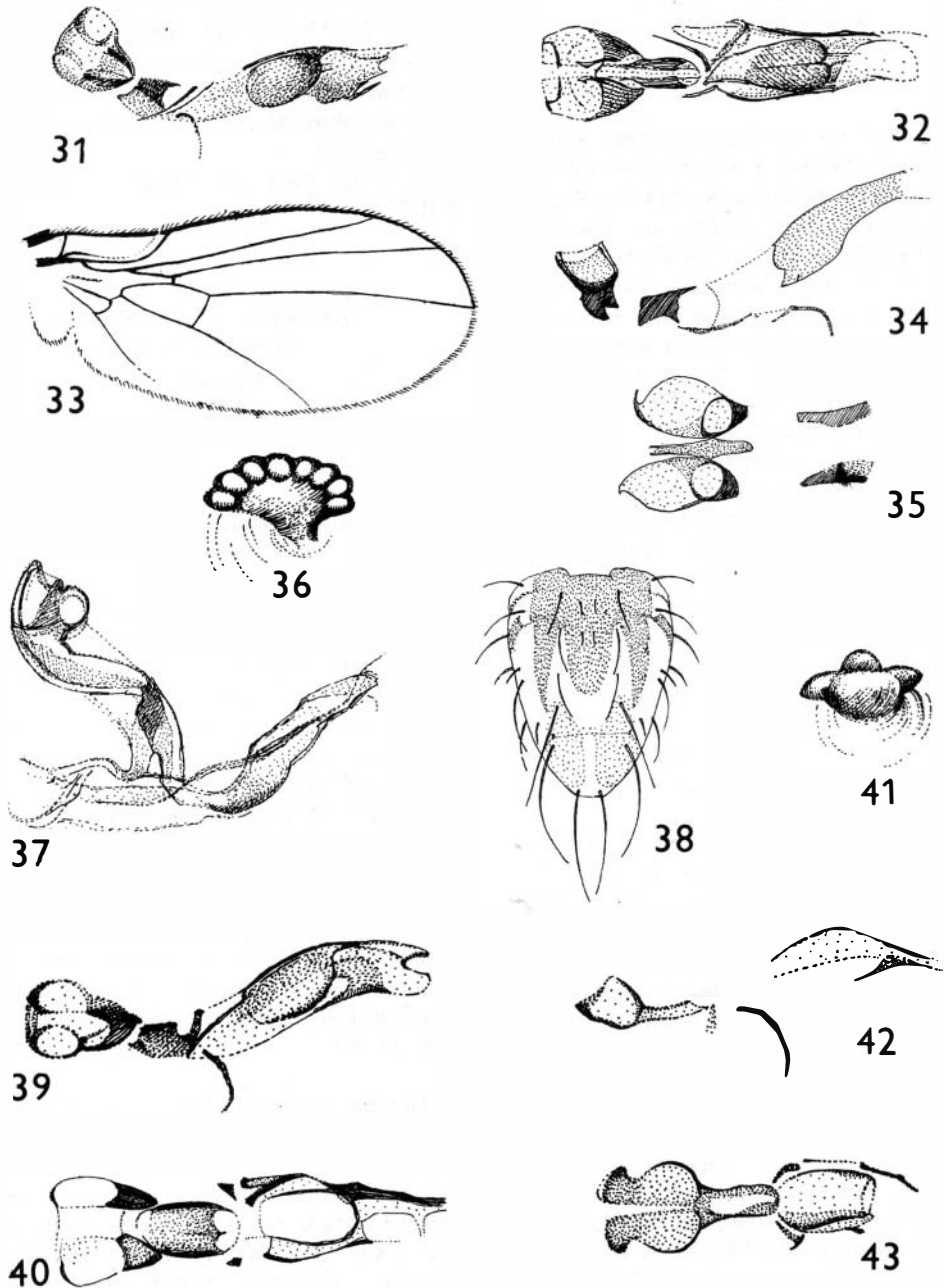
Wing: Length from 2.5-3.1 mm in male and up to 3.6 mm in female; discal cell large, last section of M3+4 at most 1.5 times length of penultimate.

Colour: Frons and jowls yellow, orbits entirely or at least in upper half black, with no yellow patches at hind-corners, moderately shining, scutellum largely bright yellow, narrowly black at sides; rear of humerus and notopleura bright yellow, pleura otherwise deep black; legs black apart from bright yellow tips of femora; abdomen largely black but hind-margin of tergites narrowly yellow; squamae yellowish-grey, margin and fringe black; halteres yellow.

Male genitalia: Aedeagus (Fig. 37) with distinctive curvature characteristic of grass-feeders; surstyli discrete, small with blunt area of sclerotization at end; sperm pump with large rounded blade and extended base.

Holotype: ♂, Costa Rica, 28-I-82, below Volcán Irazú near road marker "km 29, Ruta 6", 3120 m; paratypes: 1 ♂, 26♀, same data. Holotype in AC, paratypes in BM, USNM and Departamento de Entomología, Facultad de Agronomía, Universidad de Costa Rica.

Remarks: This species most closely resembles *L. schwabei* Spencer, 1963 which is known only in Chile; this is very similar in colour but substantially smaller, with wing length of 2 mm. In the male genitalia of *L. schwabei* the distiphallus is greatly enlarged (Spencer, 1982: Fig. 55), confirming that the two species are distinct. No comparable grass-feeders are known either in Venezuela or in the United States.



Figs. 31, 32. *Liriomyza costaricana*: 31. aedeagus, side view; 32. same, ventral view.

Figs. 33, 36. *Liriomyza huidobrensis*: 33. wing; 34. aedeagus, side view; 35. distiphallus, ventral view; 36. posterior spiracles of puparium.

Fig. 37. *Liriomyza irazui*: aedeagus, side view.

Fig. 38. *Liriomyza microglossae*: mesonotum.

Figs. 39, 40. *Liriomyza sabaziae*: 39. aedeagus, side view; 40. same, ventral view.

Fig. 41. *Liriomyza sativae*: posterior spiracles of puparium.

Figs. 42, 43 *Liriomyza trifolii*: 42. aedeagus, side view; 43. same, ventral view.

Liriomyza lupini Spencer
New to Costa Rica

Liriomyza lupini Spencer, 1981: 247.

This species has hitherto only been known from California where it is not uncommon at high altitudes in the Sierra Nevada and known to feed on four species of *Lupinus*. The larva forms an irregular, upper surface linear mine.

Leaf mines were common on *Lupinus ashbonnii* at 2820 m near the restaurant below Volcán Irazú, 28-I-82 but were already almost empty. A single female was reared, emerging on 19-II-82 and in addition 2 ♂ and 1 ♀ were caught on the plants.

This record represents an important extension of the range of the species. It is doubtless present elsewhere in Central America and Mexico at comparable altitudes. Five *Lupinus* species are known in Venezuela (Vareschi, 1970) and the genus extends further south along the Andes. It will be interesting to discover in due course how far south *L. lupini* has been able to follow its host plant.

Liriomyza marginalis (Malloch)
New to Costa Rica

Agromyza melampyga var. *marginalis* Malloch, 1913, Ann. Entomol. Soc. Amer., 6: 283.

Liriomyza marginalis, Spencer, 1963: 370; 1973b: 58; Spencer and Stegmaier, 1973: 102.

A largely yellow species, with variable dark bands on the mesonotum ranging from shining black to reddish brown; the mesonotum is broadly yellow adjoining the scutellum. Hosts are exclusively in the Poaceae, with records from *Digitaria*, *Panicum*, *Paspalum* and *Zea mays*. The puparium remains in the mine, with the enlarged anterior spiracles projecting through the upper epidermis.

Widespread in the Neotropical Region and southern Gulf states and Florida. A single male was caught on waste ground near Hotel Irazú, San José, 21-I-82.

Liriomyza microglossae Spencer
New to Costa Rica
(Fig. 38)

Liriomyza microglossae Spencer, 1963: 363.

A conspicuously pale species, with the mesonotum appearing either almost completely

yellow or the darker bands (Fig. 38) faintly reddish-brown. The type specimens were reared from *Solidago microglossa* at São Paulo, Brazil and the species has also recently been reared from *Baccharis* sp., near Córdoba, Argentina by G. Valladares.

A single male was caught at Santa Ana, 3-II-82.

Liriomyza sabaziae Spencer
New to Costa Rica
(Figs. 39, 40)

Liriomyza sabaziae Spencer, 1963: 366; 1973b: 60; 1981: 262.

Originally described from Brazil and Venezuela from *Sabazia*, later found on *Galinsoga* in Venezuela and more recently discovered to be widespread in California on a number of composite hosts, including *Baccharis*, *Carduus*, *Cirsium*, *Dahlia*, *Gnaphalium* and *Silybum*.

In Costa Rica the two main hosts are *Bidens pilosa* and *Galinsoga caracasana* but mines were also found on *Dahlia imperialis* and *Piqueria trinervia*. Empty mines on *Alomia microcarpa*, *Elvira biflora* and *Melanthera aspera* are also possibly referable to this species.

Important characters of this species are the largely black mesopleura, combined with the entirely yellow antennae and the bright yellow femora which are narrowly black basally; wing length is 1.7-2.1 mm; the aedeagus is shown in Figs. 39, 40.

Material obtained: San José, waste ground near Hotel Irazú, 2 ♂, 2 ♀, sweeping, 21-31-I-82, host certainly *Bidens pilosa*, on which many empty mines present; Llano Grande, 2000 m, above Cartago, 1 ♂, 1 ♀, 26-I-82, empty mines also seen on *Dahlia imperialis* and *Piqueria trinervia*; Fraijanes, beside chrysanthemum nursery, below Volcán Poás, 1600 m, 2 ♂, 3 ♀, emerged 5-II-82 from mines on *Galinsoga caracasana* 21-I-82; empty mines seen on *G. quadriradiata* above Fraijanes, 6-II-82.

Mines possibly referable here: Alajuela, garage near airport, *Melanthera aspera*, 3-II-82; catarata de Caracha near Alajuela, *Elvira biflora*, 21-I-82; San José de la Montaña, *Alomia microcarpa*, 27-I-82.

Liriomyza sativae Blanchard

New to Costa Rica

(Fig. 41)

Liriomyza sativae Blanchard, 1938, An. Soc. Cient. Argentina, 126: 354; Spencer, 1973b: 61; 1973c: 219; 1981: 264.

Liriomyza murda Frick, 1957, Pan-Pacif. Entomol., 33:61; Spencer and Stegmaier, 1973: 104 (synonymy with *sativae* established by Spencer, 1973c).

L. sativae is one of the most important leaf mining pests in Latin America, with large populations in Argentina, Brazil, Chile and Venezuela, and it is widespread in the southern states of U.S.A., causing serious damage to many vegetables, particularly in California and Florida. The species is highly polyphagous but occurs most frequently on genera of the families Cucurbitaceae, Leguminosae and Solanaceae. It is a major pest of tomatoes in Venezuela, Florida and California.

The adult has the mesonotum shining black and the hind-margin of the eye largely black, these two characters distinguishing the species from the other widespread *Liriomyza* pest, *L. trifolii*. The larva forms an irregular linear mine, with the posterior spiracles each having 3 pores (Fig. 41).

This species is probably widespread in Costa Rica and was noted at 4 localities.

Material seen: San Rafael de Ojo de Agua, numerous larvae on beans and young tomatoes, 3-II-82, producing adults by 28-II-82; at same locality old mines seen on *Cucumis sativus*; Santa Ana, 3-II-82, empty mines on *Capsicum annum*; Alajuela and San Juan de Poás, empty mines on tomato, 25 and 31-I-82; San José, waste ground near Hotel Irazú, mines mostly empty but some with larvae on *Ricinus communis*, 25-I-82.

Liriomyza trifolii (Burgess)

New to Costa Rica

(Figs. 42, 43)

Oscinis trifolii Burgess, 1880, in Rep. U.S. Dept. Agric. for 1879, p.200.

Liriomyza trifolii, Frick, 1952, Univ. Calif. Pubs. Entomol., 8:405; Spencer, 1973b: 64; 1973c: 226; 1981: 281; Spencer and Stegmaier, 1973:109.

During the past 5 years *L. trifolii* has developed into the most important leaf-mining

pest in Florida, from where it has spread to California, East Africa, most countries in Europe, and also Israel. Very large populations are present on chrysanthemums in Colombia and it also causes damage to garlic in Venezuela.

I found that there is a large population of *L. trifolii* at the two main chrysanthemum nurseries in Costa Rica at Fraijanes and San José de la Montaña. It is also present on onions at Santa Ana and on both beans and tomatoes at San Rafael de Ojo de Agua. Specimens were almost certainly introduced to Costa Rica with shipments of new varieties of chrysanthemums supplied from U.S.A. in recent years but it is also probable that the species occurs naturally in Costa Rica in small numbers on wild hosts.

L. trifolii is readily recognisable by its colour, with the mesonotum being dull greyish-black and the hind-margin of the eye largely yellow; the male genitalia, with distinctive curvature at the distal end of the aedeagus, are shown in Figs. 42, 43.

Material seen: Fraijanes, 1600 m, below Volcán Poás, some larvae and numerous adults on chrysanthemum, mainly variety Flamenco, 21-I-82; San José de la Montaña, 1800 m, above Heredia, small populations on chrysanthemum, 27-I-82; Santa Ana, large populations with both larvae and adults on onion, 3-II-82; San Rafael de Ojo de Agua, W of Alajuela, small populations on *Phaseolus vulgaris* and young tomatoes, 3-II-82.

Genus *Calycomyza* Hendel

Over 50 species are known in this genus, mainly in the Nearctic and Neotropical Regions. This is the largest genus known in Venezuela, with 21 species (Spencer, 1973b); only 10 species are known in California (Spencer, 1981). Three species have been known in Costa Rica. One new species is described below and in addition four species are recorded as new to Costa Rica.

Identification of species in this genus is difficult but many are host-specific on different plants and the blotch mines formed by the larvae are conspicuous. Fortunately the male genitalia are highly differentiated (cf. Figs. 44, 48) and an important generic character is the presence of a patch of bristles at the hind-corner of the epandrium (Fig. 46).

Key to Costa Rican *Calycomyza* species

1. Third antennal segment yellow *meridiana* (Hendel)
 Note: Described from Alajuela as *Agromyza meridionalis* Malloch, 1914 but with *meridionalis* preoccupied, renamed *meridiana* by Hendel (1923, Konowia, 2: 123) and transferred to *Calycomyza* by Frick (1952, Univ. Calif. Publ. Entomol., 8: 433). The species has since been found in British Guiana, México and Venezuela (Spencer, 1973b) and also two further localities in Costa Rica—San José, La Caja and Surubres.
- Third antennal segment black 2
- 2(1). Squamal fringe entirely or partially pale, whitish-yellow *verbenivora* Spencer
 — Squamal fringe dark, brown or black 3
- 3(2). Frons brownish 4
 — Frons yellow 5
- 4(3). Frons 1.5 times width of eye (If yellow, see couplet 7) *devia* Spencer
 — Frons narrower, equal to width of eye *obscura* Spencer
 Note: Described by Spencer in Spencer and Stegmaier, 1973: 87 from Florida, Jamaica and San José, La Caja. This species closely resembles the dark form of *C. devia* (couplet 3) but the male genitalia of the two species are quite distinct.
- 5(3). Third antennal segment with fringe of distinct pubescence, at least equal to basal width of arista.
 *caguensis* Spencer
 — Third antennal segment with short, normal pubescence 6
- 6(5). Orbits conspicuously black at least to lower ors 7
 — Orbits dark only to upper ors 8
- 7(6). Femora entirely black *devia* Spencer
 — Femora bright yellow at apex *addita* sp.n.
- 8(6). Orbits black to upper ors *sidae* Spencer
 — Orbits entirely yellow or at most slightly brownish to upper ors *hyptidis* Spencer

Calycomyza addita sp.n.
 (Figs. 44-47)

yellow apically; squamae yellowish white, margin and fringe black; halteres white.

Head: Frons narrow, equal to width of eye, narrowly projecting above eye in profile; 2 ors, 2 ori, orbital setulae sparse, reclinate; jowls 1/5 height of eye; third antennal segment small, round, with short, normal pubescence; arista long, equal to vertical height of eye, distinctly pubescent.

Mesonotum: 3+0 dc, third small; acr in about 8 rows.

Wing: Length in male 1.9 mm; discal cell relatively large, last section of vein M 3 + 4 just over twice length of penultimate.

Colour: Frons, jowls and face bright yellow; orbits black to lower ors; all antennal segments and palps black; mesonotum and scutellum moderately shining black; notopleura and upper hind-corner of mesopleura bright yellow; legs black but femora on fore-legs narrowly

Male genitalia: Aedeagus (Figs. 44, 45) with distiphallus enlarged, not divided; mesophallus narrowing adjoining distiphallus; anterior ventral lobes weakly pigmented, indistinct, posterior lobes asymmetrical, with a narrow, strongly pigmented sclerite between; hind-corner of epandrium (Fig. 46) with characteristic patch of strong bristles.

Host: Unconfirmed, possibly *Melampodium divaricatum* (Fig. 47).

Holotype: ♂, Costa Rica, San José, waste ground near Hotel Irazú, 31-I-82, in AC. A female caught at the same locality, 21-I-82, possibly represents the same species but differs in the less dark orbits, the largely black fore-femora and the less numerous acrostichals and is not treated as a paratype.

Whitish blotch mines (Fig.47) were not uncommon on *Melampodium divaricatum*

growing where this species was caught. Some larvae were obtained but none produced adults and the association of *C. addita* with these mines seems probable but requires confirmation from reared adults.

Calycomyza caguensis Spencer, 1973b
New to Costa Rica
(Fig. 48)

This species has hitherto only been known from a single male from Venezuela. A further male was caught at the roadside near Chitaría, east of Turrialba, 29-I-82. The aedeagus agrees exactly with that of the holotype (Fig. 48).

A number of species are known with rather similar elongated tubules of the distiphallus (*C. ecliptae* Spencer, 1963, host *Eclipta*; *C. hyptidis* Spencer, 1966a, host *Hyptis*; *C. verbenivora* Spencer, 1963, host *Verbena*; *C. verbesinae* Spencer, 1963, host *Verbesina*). However, small differences in the external characters of the adults, associated with the different hosts and differences in the leaf mines confirm that the species are distinct.

Calycomyza devia Spencer, 1973b
(Figs. 49, 50)

This species was described from two localities in Venezuela and it was found, following examination of male genitalia, that one of a series of 20 specimens from San José, La Caja, which were identified as *C. obscura* (Spencer and Stegmaier, 1973: 86) in fact represented *C. devia*. The two species have in common the brownish frons and darker than normal notopleural area but are distinguishable by the broader frons in *C. devia*.

A further male was obtained at the Nature Reserve west of Atenas, 1-II-82. In this specimen the frons appears almost yellow but the orbits are conspicuously black. The male genitalia agree exactly with those of the holotype (Figs. 49, 50).

Calycomyza hyptidis Spencer
New to Costa Rica
(Fig. 51)

Calycomyza hyptidis Spencer, 1966a: 16;

Spencer and Stegmaier, 1973: 74; 1973b: 42.

The larvae of this species form a characteristic blotch mine with irregular offshoots and the frass deposited in the centre of the mine (Fig. 51). One mine was found on *Hyptis capitata* at the Nature Reserve west of Atenas, 1-II-82.

Although the adults closely resemble *C. malvae*, the male genitalia are of different form, with the distiphallus ending in long paired tubules (cf. *C. caguensis*, Fig. 48) in *C. hyptidis*, while in *C. malvae* the aedeagus generally resembles that of *C. devia* (Figs. 49, 50) and *C. sidae* (Figs. 52, 53).

Calycomyza sidae Spencer
New to Costa Rica
(Figs. 52, 53)

Calycomyza sidae Spencer and Stegmaier, 1973: 88; Spencer, 1973b: 48.

This species is widespread in the Caribbean area, is common in southern Florida and has also been recorded in Venezuela and Brazil. The specimen from Río de Janeiro was originally misidentified as *C. malvae* by Spencer, 1963 and the illustrations of the genitalia (Figs. 52, 53) were later used in the description of *C. sidae*.

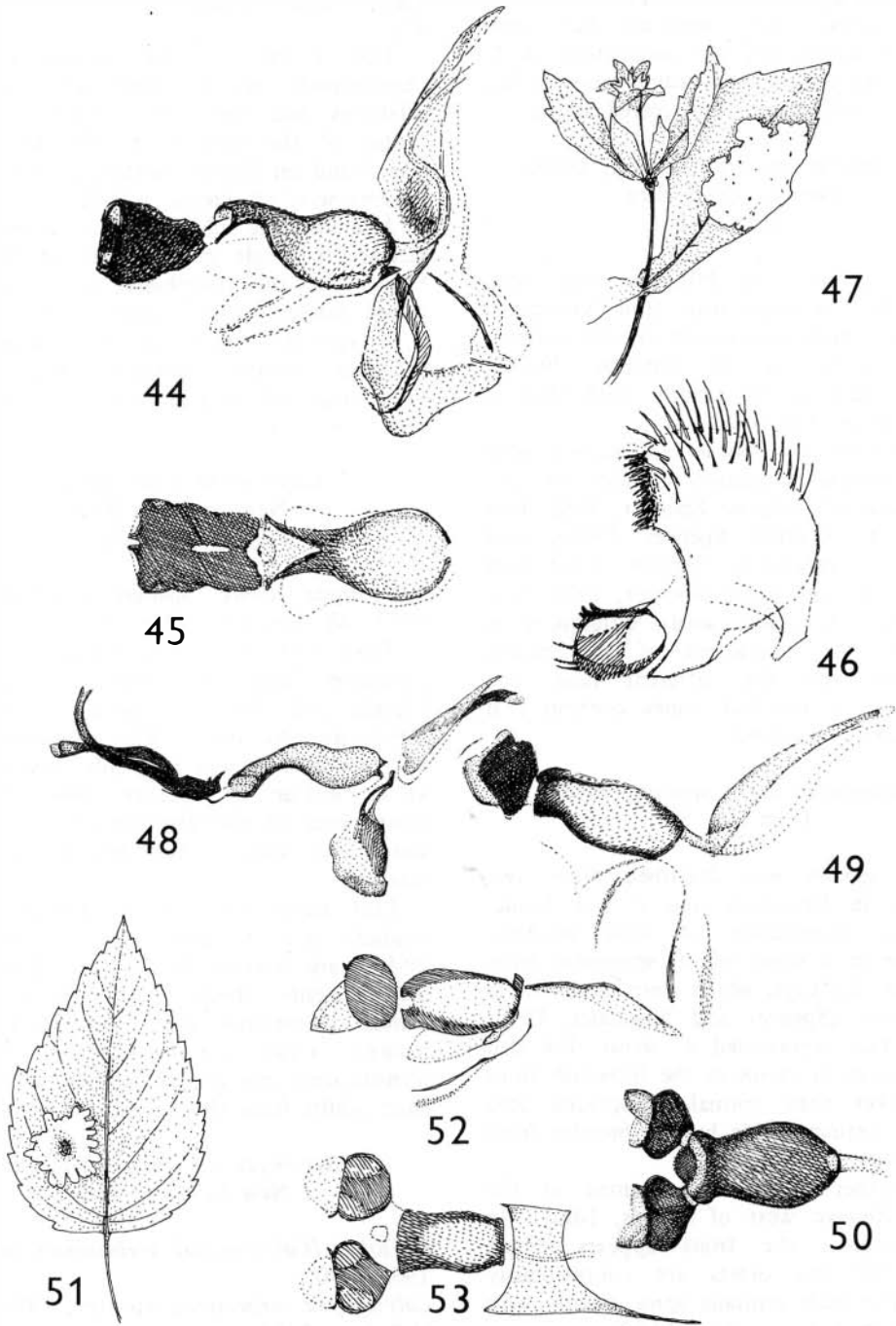
Leaf mines on *Sida* sp. found at the roadside near Chitaría, east of Turrialba, 29-I-82 are referred to *C. sidae*. The mines are generally shorter than those of *C. malvae* (sometimes even blotch-like). It is hoped that confirmation of this identification can in due course be obtained from adults from this locality.

Calycomyza verbenivora Spencer
New to Costa Rica

Phytobia (*Calycomyza*) *verbenivora* Spencer, 1963: 350.

Calycomyza verbenivora Spencer, 1973b: 49; Valladares, 1982.

This species was described from Caracas, Venezuela from leaf mines on *Verbena litoralis*. It has also recently been found on this host at Córdoba, Argentina and also on *V. bonariensis* and *Glandularia hybrida* by Valladares, (1982).



Figs. 44-47. *Calycomyza addita*: 44. aedeagus, side view; 45. distiphallus, ventral view; 46. epandrium and surstylus; 47. leaf mine on *Melampodium divaricatum*.

Fig. 48. *Calycomyza caguensis*: aedeagus, side view (Venezuela).

Fig. 49, 50 *Calycomyza devia*: 49. aedeagus, side view; 50. same, ventral view.

Fig. 51. *Calycomyza hyptidis*: leaf mine on *Hyptis pectinata* (Florida)

Figs. 52, 53. *Calycomyza sidae*: 52. aedeagus, side view; 53. same, ventral view (Brazil).

Key to Costa Rican *Phytoliriomyza* species

- 1. Outer cross-vein lacking; minute species, wing length 1.1-1.25 mm in male. *conjunctimontis* (Frick)
 Note: Described by Frick (1952, Univ. Calif. Publ. Entomol., 8:413) from California and subsequently recorded from Dominica and Costa Rica, San José, La Caja (Spencer, 1973a). A further male has now been seen from San José, waste ground near Hotel Irazú, 21-I-82. The species is distinctive both in the lack of the outer cross-vein and in its small size, the specimen now seen having wing length of 1.1 mm.
 - Outer cross-vein present; slightly larger species 2
- 2(1). Third antennal segment with a fringe of long pubescence 3
 - Third antennal segment with normal short pubescence 4
- 3(2) Third antennal segment yellowish *pilosella* Spencer
 Note: Described by Spencer in Spencer and Stegmaier, 1973: 116 from Puerto Rico, Florida and San José, La Caja (6 ♂, 16 ♀). Although closely resembling *P. jurgensi* sp.n., the aedeagus with the long coiled distiphallus (cf. Spencer and Stegmaier, Figs. 297) show that the two species are not closely related (contrast Fig. 57 below).
 - Third antennal segment largely black *jurgensi* sp.n.
- 4(2). All antennal segments black *costaricensis* (Spencer)
 Note: Described from 3 males from San José, La Caja by Spencer in Spencer and Stegmaier (1973: 188). The distinctive aedeagus and epandrium are shown in Figs. 54, 55. This species was described in the genus *Lenurimyza*, which was synonymised with *Phytoliriomyza* by von Tschirnhaus (1971, Beitr. Entomol., 21: 563).
 - Third antennal segment brownish-yellow, first and second more yellowish . . *imperfecta* (Malloch)

Leaf mines, mostly empty, were not uncommon on *Verbena litoralis* near Hotel Irazú, San José, 24-I-82. The larva forms a linear mine in the first instar but later produces a blotch, which quickly turns brown. Unfortunately no adult was obtained from the single larva found.

This species has previously been known from Chile, Florida and California. Two specimens have now been seen from Costa Rica: San José, waste ground near Hotel Irazú, one male, 31-I-82; Paso Llano, above Heredia, 1900 m, one female, 27-I-82.

The elongated, paired black tubules of the distiphallus (Fig. 56) are distinctive.

Genus *Phytoliriomyza* Hendel

Two species have hitherto been known in Costa Rica. One new species from San José is now described below and a further species, *P. imperfecta* (Mall.) which is widespread from Chile to Florida and California, represents a new record.

Throughout the Neotropical Region 15 species are known, 6 of which were recently described from Chile by Spencer (1982). Only three species are known in Venezuela (Spencer, 1973b).

Phytoliriomyza imperfecta (Malloch)

New to Costa Rica
 (Fig. 56)

Agromyza imperfecta Malloch, 1934: 475, Agromyzidae in Diptera of Patagonia and South Chile, British Museum.

Phytoliriomyza imperfecta, Spencer and Stegmaier, 1973: 115; Spencer, 1981: 324.

Phytoliriomyza jurgensi sp.n.
 (Figs. 57, 58)

Head: Frons broad, twice width of eye; 2 ors, 1 ori (missing one side in holotype); orbital setulae virtually lacking, reduced to 1 or 2 below ori; jowls narrow, 1/5 height of eye, this large, only slightly slanting; third antennal segment small, round, with fringe of conspicuous pubescence; arista long, dropping, distinctly pubescent, equal in length to height of eye.

Mesonotum: 3+1 dc, acr sparse, in 2 rows.

Wing: Length in male 1.4 mm; discal cell relatively large, last section of M3+4 slightly less than twice length of penultimate.

Colour: Head yellow, apart from black third antennal segment and palps;

mesonotum predominantly pale grey but central band between line of dc brownish; scutellum greyish, with faint yellow undertone; side of thorax largely yellow, with only central area of humerus, a small bar at upper margin of mesopleura and lower half of sternopleura grey; legs: coxae and femora bright yellow, tibiae and tarsi brownish-black; squamae yellow, margin and fringe dark; halteres yellowish below, knob distinctly darkened above.

Male genitalia: Aedeagus divided distally, cup-shaped at end (Fig. 57); sperm pump minute, blade weakly pigmented, base slightly extended on one side; no apparent surstyli but inner margin of epandrium bearing about 15 short, stout spines (Fig. 58).

Holotype: ♂ Costa Rica, San José, waste ground near Hotel Irazú, 31-I-82; paratype ♂ same locality, 3-II-82, both in AC.

Genus *Phytomyza* Fallén

This large, predominantly north temperate genus has hitherto been represented in Costa Rica by the single species *P. loewii* Hd. Five species only are known in Chile (Spencer, 1982) and one known only from leaf mines on *Daucus* (Umbelliferae) in Venezuela (Spencer, 1973b: 75). Throughout the world over 450 species are known and in the United States 49.

Empty leaf mines (Fig. 59) were found on *Myrrhidendron donnell-smithii*, a tall, distinctive species of Umbelliferae over 2 m in height, growing beside the road from the rim of Volcán Poás to the parking area, 22-I-82. Many species occur on Umbelliferae but this is certainly undescribed and it is to be hoped that adults can be obtained in due course.

Key to Costa Rican *Phytomyza* species

1. Host: *Clematis* (Ranunculaceae); entirely black species *loewii* (Hendel)
Note: The holotype of *Phytomyza centralis* Frost from San José (1963, Ann Entomol. Soc. Amer., 29: 317) has been examined and this species is now synonymised with *P. loewii*, syn. nov. Known also from one male from San José, La Caja (Spencer and Stegmaier, 1973: 192). The larva forms a short linear mine on *Clematis* spp. Recorded from Quebec, D.C. and California in U.S.A., also Cuba.
- Host: *Myrrhidendron* (Umbelliferae); adult unknown sp. (*Myrrhidendron*).

Genus *Chromatomyia* Hardy New to Costa Rica

This is also an essentially north temperate genus with approx. 100 species now known. On external characters the adults cannot be separated from *Phytomyza* but the distinctive method of pupation, with the puparium lying upside down and the anterior spiracles projecting ventrally through the epidermis and particularly the form of the male genitalia, have been treated as of generic significance in revisionary studies of this group by Griffiths (1974, Quaest. Entomol., 10: 35-69 and 1980, Entomol. Scand. Suppl. 13: 1-61).

Only 3 species have hitherto been known in the Neotropical Region (*C. platensis* Brethes feeding on Labiatae in Argentina and Chile, cf. Spencer, 1982 and two species known in Venezuela originally placed in *Phytomyza*, cf. Spencer, 1973b:

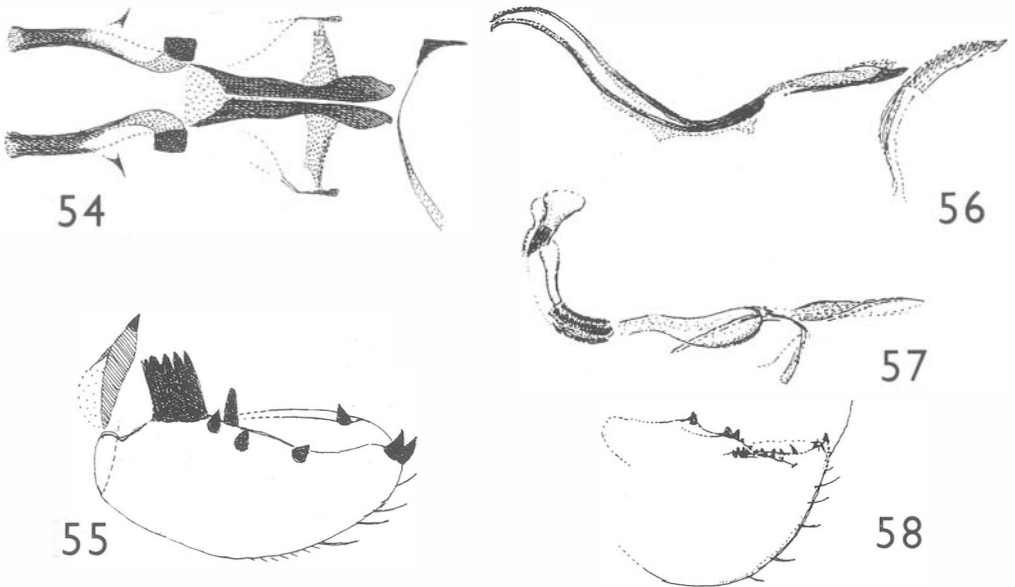
73). In U.S.A. 27 species are known.

Leaf mines with puparia (Fig. 60) were found on the grass *Brachiaria mutica* beside the airport near the coast at Limón, 29-I-82. Unfortunately both puparia were parasitized and no adults were obtained. The species is certainly undescribed.

Leaf Mines of unidentified species

1. *Bomariera* sp. (Amaryllidaceae), above Llano Grande in gully on E side of road, 2280 m, 26-I-82. Many mines found, all with dead larvae, mine white, narrow, normally closely following a vein (Fig. 61).
Almost certainly a *Liriomyza* sp.n., related to *L. smilacinae* Spencer, known from western Canada and California, feeding on *Smilacina* spp. (Liliaceae).
2. *Browallia demissa* L. (= *americana* L.) (Solanaceae), San José, near Hotel Irazú, 24-I-82 and 15 km W of San

- Ramón, 1-II-82. Irregular white linear mines (Fig. 62), all empty. Probably a *Liriomyza* sp.n.
3. *Conyza canadensis* (L.) Cronquist (Asteraceae), below Volcán Poás, 1950 m, 6-II-82. Short, white linear mine, possibly *Liriomyza* sp.n.
 4. *Elvira martyni* Cass. (= *biflora* DC) (Asteraceae), Catarata de Caracha, N of Alajuela, 21-I-82. White linear mines, in part following veins, all empty, possibly *Liriomyza huidobrensis*.
 5. *Salvia* sp. (Labiatae), above Llano Grande, 2280 m., 26-I-82. Linear mine, with the channels short and adjoining, forming a secondary blotch. Probably *Liriomyza* sp.n.
 6. *Solanum nigrum* L. (Solanaceae), Fraijanes, 1600 m, 21-I-82. Irregular linear mines, all empty. Possibly *Liriomyza sativae*.
 7. *Stachytarpheta* sp. (Verbenaceae), 15 km E of Atenas, Nature Reserve, 1-II-82. Narrow, irregular, white linear mines, all empty. Probably *Liriomyza* sp.n.
 8. *Vernonia canescens* HBK, (Asteraceae), 15 km W of Atenas, Nature Reserve, 1-II-82. Blotch mine, empty. Probably *Calycomyza* sp.
 9. *Viguiera sylvatica* Klatt (Asteraceae), 15 km W of San Ramón, 1-II-82. Both blotch mines and linear mines, empty, former probably *Calycomyza* sp., latter *Liriomyza* sp.
 10. Genus, sp. indet., large-leaved species, (Asteraceae), above Llano Grande, Cartago, in gully on E side of road, 2280 m, 26-I-82. Long, white linear mines, some with larvae (Fig. 63). Probably *Liriomyza* sp.n.



Figs. 54, 55. *Phytoliriomyza costaricensis*: 54. aedeagus, ventral view; 55. epandrium.

Fig. 56. *Phytoliriomyza imperfecta*: aedeagus (San José).

Fig. 57, 58. *Phytoliriomyza jurgensi*: 57. aedeagus, side view; 58. epandrium.

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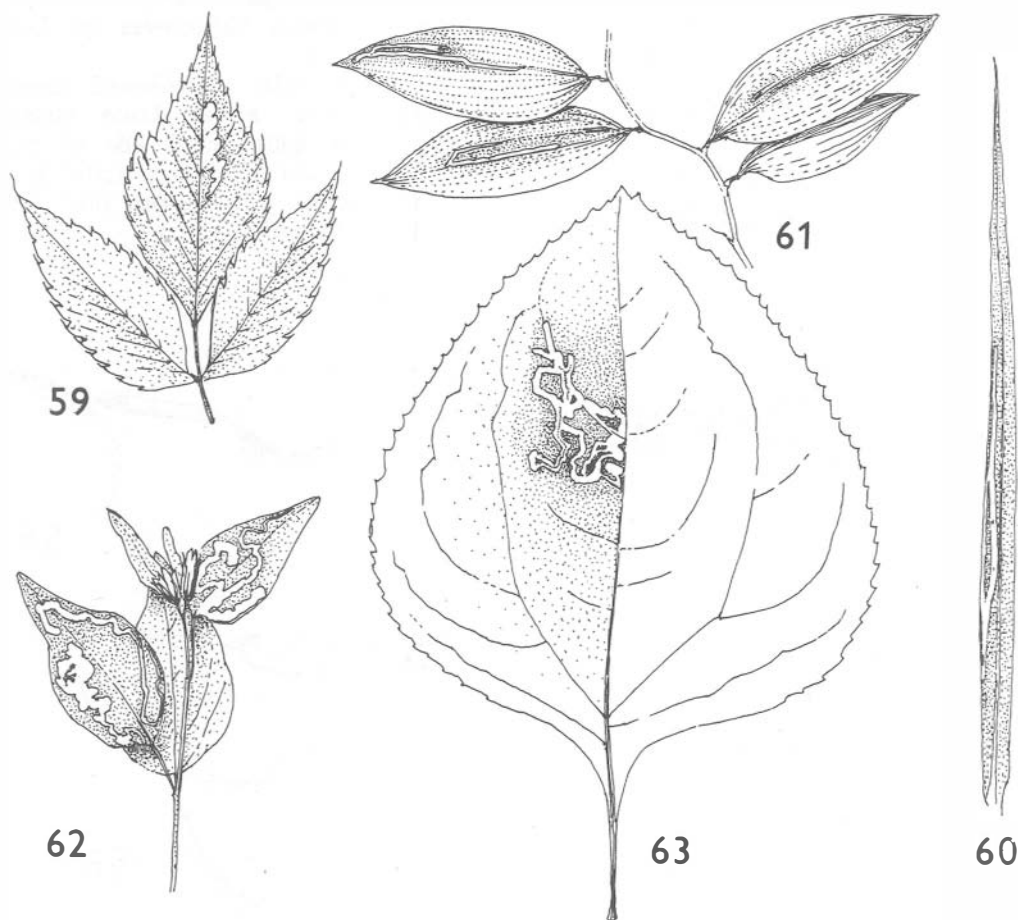
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Figs. 59, 63. Leaf mines: 59. *Phytomyza* sp. on *Myrrhidendron donnell-smithii*, Volcán Poás; 60. *Chromatomyia* sp. on *Bracharia mutica*, Limón; 61. *Liriomyza* sp. on *Bomarea* sp., above Llano Grande; 62. *Liriomyza* sp. (?) on *Browallia demissa*, San José; 63. *Liriomyza* sp. (?) on gen., sp. indet. (Asteraceae) above Llano Grande.

RESUMEN

En un estudio de 3 semanas en Costa Rica entre enero y febrero de 1982, fueron

descubiertas 9 especies nuevas de Agromyzidae que fueron descritas en los géneros *Melanagromyza*, *Ophiomyia*, *Japanagromyza*, *Liriomyza* y *Phytoliriomyza*. También se encontró 18 especies nuevas para Costa Rica incluyendo 3 que son plagas de importancia económica: *Liriomyza huidobrensis*, *L. sativae* y *L. trifolii*. Se colectó minas en hojas de 10 plantas: 2 representan especies hasta ahora no descritas

y 6 probablemente especies no descritas. Se presenta claves para 13 géneros y 53 especies hasta ahora conocidas en Costa Rica. *Phytomyza centralis* Frost se coloca en sinonimia con *Phytomyza loewii* Hendel.

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