

R. GIL-ORTIZ, J.V. FALCÓ-GARÍ, M.T. OLTRA-MOSCARDÓ,
M. MARTINEZ, J. MORENO-MARÍ & R. JIMÉNEZ-PEYDRÓ

New host-plants for Agromyzidae (Diptera) from Eastern Spain

Abstract - This study presents 27 new host-plants interactions for Agromyzidae established in 19 genera belonging to 8 botanical families. The interactions were established in three natural parks from Eastern Spain on 12 Agromyzidae species: *Ophiomyia beckeri* (Hendel, 1923); *Ophiomyia ononidis* Spencer, 1966; *Amauromyza (Cephalomyza) flavifrons* (Meigen, 1830); *Amauromyza (Cephalomyza) karli* (Hendel, 1927); *Chromatomyia horticola* (Goureau, 1851); *Liriomyza brassicae* (Riley, 1884); *Liriomyza bryoniae* (Kaltenbach, 1858); *Liriomyza cicerina* (Rondani, 1875); *Liriomyza orbona* (Meigen, 1830); *Liriomyza trifolii* (Burgess in Comstock); *Napomyza lateralis* (Fallén, 1823) and *Pseudonapomyza atratula* Zlobin, 2002. Six plant-genera are cited like new hosts for Agromyzidae.

Résumé - Nouvelles plantes-hôtes pour les Agromyzidae (Diptera) de l'Est de l'Espagne.

Dans cette publication sont données 27 nouvelles interactions Agromyzidae/Plantes-hôtes, celles ci établies dans 19 genres appartenant à 8 familles botaniques. Ces interactions ont été constatées chez 12 espèces d'Agromyzidae dans trois parcs naturels d'Espagne orientale: *Ophiomyia beckeri* (Hendel, 1923); *Ophiomyia ononidis* Spencer, 1966; *Amauromyza (Cephalomyza) flavifrons* (Meigen, 1830); *Amauromyza (Cephalomyza) karli* (Hendel, 1927); *Chromatomyia horticola* (Goureau, 1851); *Liriomyza brassicae* (Riley, 1884); *Liriomyza bryoniae* (Kaltenbach, 1858); *Liriomyza cicerina* (Rondani, 1875); *Liriomyza orbona* (Meigen, 1830); *Liriomyza trifolii* (Burgess in Comstock); *Napomyza lateralis* (Fallén, 1823) and *Pseudonapomyza atratula* Zlobin, 2002. Six genres botaniques sont signalés comme de nouveaux hôtes pour les Agromyzidae.

Riassunto - Nuove piante ospiti per Agromyzidae (Diptera) dell'Est della Spagna

In questo studio sono elencate 27 nuove interazioni Agromizidi/piante ospiti, riscontrate in 19 generi, appartenenti a 8 famiglie botaniche. Queste interazioni sono state osservate in tre parchi naturali dell'Est della Spagna con 12 specie di Agromizidi: *Ophiomyia beckeri* (Hendel, 1923); *Ophiomyia ononidis* Spencer, 1966; *Amauromyza (Cephalomyza) flavifrons* (Meigen, 1830); *Amauromyza (Cephalomyza) karli* (Hendel, 1927); *Chromatomyia horticola* (Goureau, 1851); *Liriomyza brassicae* (Riley, 1884); *Liriomyza bryoniae* (Kaltenbach, 1858); *Liriomyza cicerina* (Rondani,

1875); *Liriomyza orbona* (Meigen, 1830); *Liriomyza trifolii* (Burgess in Comstock); *Napomyza lateralis* (Fallén, 1823) e *Pseudonapomyza atratula* Zlobin, 2002. Sei generi botanici sono segnalati come nuovi ospiti per gli Agromizidi.

Key words : Diptera, Agromyzidae, Host-plants, New interaction, *Ophiomyia*, *Amauromyza*, *Chromatomyia*, *Liriomyza*, *Napomyza*, *Pseudonapomyza*, Palaearctic, Spain.

INTRODUCTION

Agromyzidae is a strict phytophagous family of Diptera. They exhibit an array of different feeding habits such as leaf-mining, stem-mining and stem-tunneling, cambium-mining, and parasitism of flower heads and fruits (Dempewolf, 2004). Leaf-mining is generally the most widespread feeding behaviour among Agromyzidae. The great majority (99.4%) of the Agromyzidae species show a high degree of host-plant specialization which makes these insects especially suitable for taxonomic-phylogenetic considerations (Spencer, 1990).

Generally damage is detected visually in the form of mines along leaves. Visual detection in stems, roots, floral heads, or fruits is more difficult. Mination reduces the photosynthetic capacity, the cambium area, the nutrient transport capacity, and the quality of commercial products (Zhang *et al.*, 2006). Development of secondary fungal pests in the galleries is subsequently produced. Damage is variable in function of the infestation. There is a lot bibliography about the control of Agromyzidae especially in horticultural and vegetable crops. The most recent systems to control them are the use of insecticides (Wu *et al.*, 2007; Ramesh & Ukey, 2007; Weintraub & Mujica, 2006; Wang *et al.*, 2006; Saradhi & Patnaik, 2006; Hossain & Poehling, 2006), the improvement of host-plant varietal resistance (Sharma *et al.*, 2007; Wu *et al.*, 2006; Jadhav *et al.*, 2006), the use of parasitoids (Tran *et al.*, 2006; Tokumaru & Abe, 2006; Tellez *et al.*, 2006; Hesami *et al.*, 2006; Yang *et al.*, 2005), and bacteriums (Tagami *et al.*, 2006).

According to Martinez (2004) the number of Agromyzidae species in Spain reach 236 of 906 European species. This number is actually up-dated to 287 (paper in composition). The ignorance of a high percentage of the Agromyzidae fauna of Spain is known worldwide.

On the whole 1285 Agromyzidae species are known of the 146 botanical families and 899 botanical genera (Benavent-Corai *et al.*, 2005). Approximately 50% of Agromyzidae have unknown host-plants of a total of 2800 world distributed species. Getting to know all interactions of Agromyzidae would be really important for establishing their ecology and phylogeny.

Detection of damaged flora and subsequent obtaining of miner species under bioclimatic conditions are developed in this study. The interactions established in different natural biotops of the Mediterranean Spain are presented, showing the great possibility of Agromyzidae development on wild flora. It is possible the approximation to the knowledge of the miner species identifying the damage produced on the flora present around the

crops due to the close coevolution of plants and miners. Vegetal covers management is an important cultural method for diminishing the attacks of Agromyzidae on agricultural and ornamental crops, by means of avoiding some and favouring others.

MATERIAL AND METHODS

Sampling areas

The sampling was carried out in three natural parks in the Community of Valencia: “Tinença de Benifassà” (Castellón), “Font Roja” (Alicante), and “Lagunas de La Mata-Torrevieja” (Alicante). Areas studied were selected based on their different environmental performance.

Tinença de Benifassà. Natural Park located in the North of the Community of Valencia bordering Tarragona and Teruel provinces. It has pine and oak forests composed predominantly by *Pinus halepensis* Mill. and *Quercus ilex* L. species. Such formations are specially protected in thirteen flora microreserves. The little anthropical influence

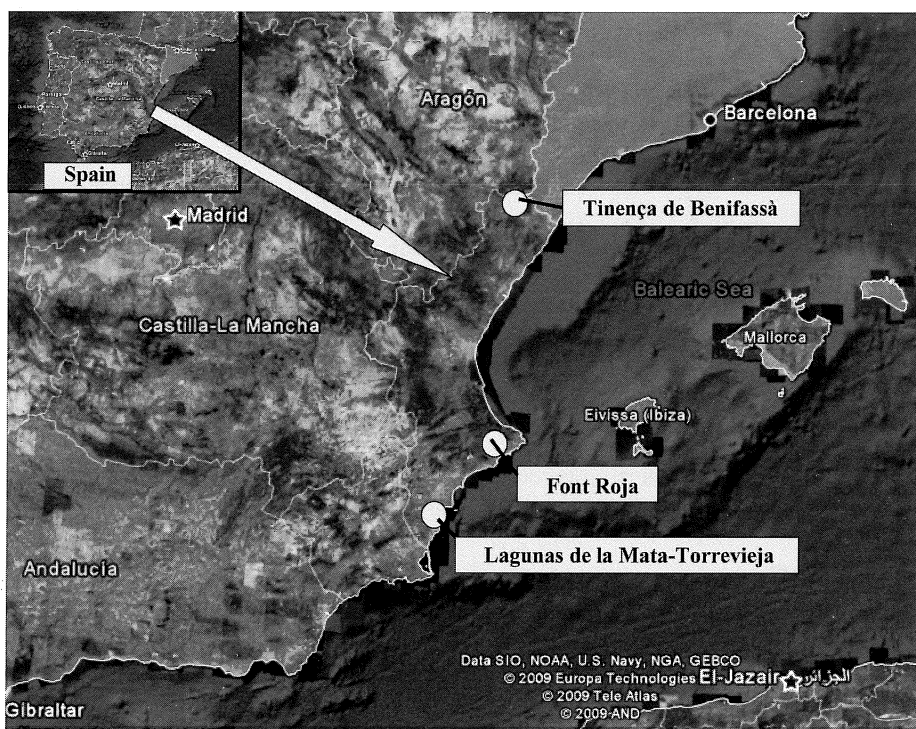


Fig.1 - Location of the areas studied in the Community of Valencia (Source: Google earth).

creates a particular preserved ecosystem. Sampling altitude was around 750 m a.s.l (above sea level). The annual rainfall in this area is usually around 450-500 mm.

Font Roja. Located between Alcoy (North-East) and Ibi (South-West). The botanical composition is formed by several landscape units composed of deciduous forests (predominantly *Quercus faginea* Lam., *Fraxinus ornus* L., *Acer opalus* Miller, *Sorbus aria* (L.) Crantz, and *Taxus baccata* L.), holm oak-groves (*Quercus ilex* L.), pinus (*Pinus halepensis* Mill.), sunny brushwoods, rock vegetation, rubble vegetation and crops. The craggy terrain inserted in a mountainous system provides high altitudes around 1000 m a.s.l. Annual precipitation is estimated around 350-450 mm.

Lagunas de La Mata-Torrevieja. Located in the South of the Community of Valencia. It is characterized by salt marsh vegetation, rush plants and scrubland. The lagoons are surrounded by the best redoubts of dry and damp salt marsh vegetation. In the south there is hill vegetation consisting of *Pinus halepensis* Mill. and *Quercus coccifera* L., combined with typical dry Mediterranean vegetation. Practically located above sea level, with low annual precipitations (<300 mm) and high summer temperatures (>35°C).

Sampling

The experiment was carried out throughout 2006-07 years. Weekly visual detection of damages produced by Agromyzidae on the vegetation was carried out. Damage was observed due to the presence of mines in leaves and stems of wild plants.

Samples were caught and conserved into glass bags under refrigerated conditions. In the laboratory the mined leaves were selected and placed into glass boxes in a controlled environment chamber (25-26°C, 65-70% RH). The samples were revised every 2 days, and the specimens obtained were preserved for study in ethyl alcohol 70°.

Agromyzidae identifications were undertaken by means of the morphological study of the genitalia in males, and the external characters of females. Agromyzidae species were associated with their attacked botanical species.

Terminology used in this paper

s.: sampling date. e.: miners emergency date. Each interaction cited in this article is indicated into brackets []. New genera of host-plants are marked in bold.

Identifications

Identifications of all Agromyzidae species and host-plants were done by R. Gil-Ortiz. All Agromyzidae species were verified by the specialist M. Martinez.

RESULTS AND DISCUSSION

Twenty seven new Agromyzidae plant interactions for science, the distribution of miner species, the genera of host-plants plants attacked, and the material examined in this study are listed below. The interactions are submitted by genera and subfamilies Agromyzinae-Phytomyzinae.

Geographical distribution of Agromyzidae species is given according to Martinez (2004). The genera of host-plants listed are according to Benavent-Corai *et al.* (2005). Nomenclature of botanical species cited is based in Mateo & Crespo (2003).

AGROMYZINAE

Genus *Ophiomyia* Braschnikov, 1897

Ophiomyia beckeri (Hendel, 1923)

Distribution

Palearctic: Austria, Czech republic, Denmark, Germany, Great Britain, Ireland, Lithuania, North Africa, Poland, Sicily, Spain, Yugoslavia. Afrotropical region. Oriental region.

Genera of Host-Plants

Centaurea, *Coreopsis*, *Crepis*, *Launaea*, *Leontodon*, *Lepidium*, *Reichardia*, *Sonchus*, *Sysimbrium*, *Taraxacum*, *Urospermum*.

Material examined

[1] Font Roja: [2♀] s.21.ix.2006, 1♀ e.02.ix.2006 and 1♀ e.12.ix.2006. Host-plant: *Centaurea rouyi* Coincy

[2] Font Roja: [1♂] s.07.ix.2006, e.02.x.2006. Host-plant: *Lepidium draba* L.

[3] Tinença Benifassà: [1♂,4♀] s.22.v.2006, e.16.vi.2006. *Lagunas de La Mata-Torrevieja*: [1♂,1♀] s.06.vi.2006, 1♂ e.16.vi.2006 and 1♀ e.23.vi.06, TRV3. Host-plant: *Reichardia picroides* (L.)

[4] Font Roja: [1♀] s.24.v.2006, e.21.vi.2006. Host-plant: *Sysimbrium irio* L.

[5] *Lagunas de La Mata-Torrevieja*: [1♂] s.30.iv.2006, e.31.v.2006; [4♂,2♀] s.16.v.2006, 1♂ e.02.vi.2006 and 3♂2♀ e.09.vi.2006. [2♂,1♀] s.16.v.2006, e.02.vi.2006. Host-plant: *Urospermum picroides* (L.)

Note: *Ophiomyia beckeri* (Hendel, 1923) belongs to the most primitive *Ophiomyia*, where the larvae undermine the midrib, with short offshoots into the leaf blade. Three species of *Ophiomyia*: *beckeri*, *cunctata* (Hendel, 1920) and *pulicaria* (Meigen, 1830) appear to have identical larval feeding in common with many hosts.

***Ophiomyia ononidis* Spencer, 1966**

Distribution

Palaeartic: Czech republic, Germany, Great Britain, Lithuania, Spain.

Genera of Host-Plants

Lotus, *Medicago*, *Ononis*.

Materiel examined

[6] Font Roja: [1♂] s.29.vi.2006, e.10.vii.2006. Host-plant: *Lotus corniculatus* L.

Note: *Ophiomyia ononidis* is an oligophagous miner of Leguminosae. The adult closely resembles *Ophiomyia curvipalpis* (Zetterstedt, 1848), an oligophagous feeder on Compositae, which cannot be separated by external characters. However, the differences between the two species are clearly reflected in the genitalia and also in larval characters, with the posterior spiracles in *O. ononidis* having 6-7 pores on each process, while *O. curvipalpis* retains the plesiomorphous state of three.

PHYTOMYZINAE

Genus *Amauromyza* Hendel, 1931

***Amauromyza (Cephalomyza) karli* (Hendel, 1927)**

Distribution

Palaeartic: Czech republic, France, Germany, Hungary, Poland. Neartic region.

Genus of Host-Plant

Chenopodium

Materiel examined

[7] Tinença Benifassà: [1♂] s.19.vi.2006, e.17.vii.2006. Host-plant: *Chenopodium vulvaria* L.

Note: This is the first appointment of the host-plant for *Amauromyza (Cephalomyza) karli*. *Chenopodium* is also mined by *A. (Cephalomyza) abnormalis* (Malloch, 1913), and *A. (Cephalomyza) chenopodivora* Spencer, 1971.

***Amauromyza (Cephalomyza) flavifrons* (Meigen, 1830)**

Distribution

Palaeartic: Albania, Belgium, Czech republic, Denmark, Finland, France, Germany,

Great Britain, Hungary, Italy, Lithuania, Norway, Poland, Romania, Spain, Sweden, The Netherlands, Turkey. Nearctic region.

Genera of Host-Plants

Agrostemma, *Beta*, ***Catananche***, *Cerastium*, *Dianthus*, *Gypsophila*, ***Lepidium***, *Moehringia*, *Saponaria*, *Silene*, *Spinacia*, *Stellaria*, *Vaccaria*.

Materiel examined

[8] Font Roja: [1♂] s.12.vii.2006, e.08.viii.2006. Host-plant: ***Catananche caerulea* L.**

[9] Font Roja: [1♂, 2♀] s.07.ix.2006, e.02.x.2006. Host-plant: ***Lepidium draba* L.**

Note: *Amauromyza* (*Cephalomyza*) *flavifrons* with normal host-plants in the Caryophyllaceae has regularly been found also on *Beta* and *Spinacia* (Chenopodiaceae), both families in the same order Caryophyllales, their feeding can best be considered as extended oligophagy.

Genus ***Chromatomyia*** Hardy, 1849

***Chromatomyia horticola* (Goureau, 1851)**

Distribution

Palearctic: Algeria, Austria, Belgium, Czech republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Lithuania, Malta, Morocco, Norway, Poland, Portugal, Republic of Moldova, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Tunisia, Turkey Yugoslavia. Afrotropical region. Nearctic region. Oriental region.

Genera of Host-Plants

Adonis, *Aethusa*, *Ageratum*, *Ajuga*, *Alliaria*, *Allium*, *Althaea*, *Alyssum*, *Amaranthus*, ***Anagallis***, *Anchusa*, *Andryala*, *Anethum*, *Anoda*, *Anthemis*, *Anthyllis*, *Antirrhinum*, *Apium*, *Arabidopsis*, *Arabis*, *Armoracia*, *Artemisia*, *Asperugo*, *Astragalus*, *Atriplex*, ***Avena***, *Ballota*, *Bertoreia*, *Beta*, *Bidens*, *Biscutella*, ***Blackstonia***, *Borago*, *Brassica*, *Coincya*, *Bunias*, *Bystropogon*, *Caccinia*, *Cakile*, *Calepina*, *Campanula*, *Cannabis*, *Capsella*, *Capsicum*, *Cardamine*, *Carduncellus*, *Carduus*, *Carthamus*, *Carum*, ***Catananche***, *Centaurea*, *Cephalaria*, *Cerastium*, *Cerinthe*, *Chaenorhinum*, *Chenopodium*, *Chrysanthemum*, *Cicer*, *Cineraria*, *Cirsium*, *Cissampelopsis*, *Cleome*, *Cochlearia*, *Collinsia*, *Conium*, *Convolvulus*, *Coreopsis*, *Coriandrum*, *Coringia*, *Coronopus*, *Cosmos*, *Cotinus*, *Cotula*, *Crambe*, *Crepis*, *Cucumis*, *Cucurbita*, *Cynara*, *Cynoglossum*, *Dahlia*, *Daucus*, *Descurainia*, *Diploaxis*, *Dipsacus*, *Doronicum*, *Echium*, *Elsholtzia*, *Emilia*, *Erigeron*, *Erucastrum*, *Eryngium*, *Erysimum*, *Eschscholzia*, *Euphorbia*, *Gaillardia*, *Galeopsis*, *Galinsoga*, *Gazania*, *Gerbera*, *Glaucium*, *Glycine*, *Gnaphalium*, *Gynura*, *Gypsophila*, *Helianthus*, *Helichrysum*, *Heliotropium*, *Hesperis*, *Hibiscus*, *Hirschfeldia*, *Holcus*, *Humulus*, *Hyoscyamus*, *Hypochaeris*, *Iberis*, *Impatiens*, *Inula*, *Isatis*, *Jasione*,

*Kitaibela, Knautia, Lactuca, Lagenaria, Lallemantia, Lamium, Lappula, Lathyrus, Launaea, Lavandula, Lavatera, Lens, Leonurus, Lepidium, Leucanthemum, Levisticum, Ligusticum, Limonium, Linaria, Linum, Lithospermum, Loasa, Lotus, Lupinus, Lycium, Lycopersicon, Lycopus, Malva, **Mantisalca**, Matricaria, Matthiola, Maurandya, Medicago, Melampyrum, Melilotus, Melissa, Mentha, Mimulus, Moluccella, Moricandia, Myagrum, Myosotis, Nepeta, Nicotiana, Nonea, Oenothera, Omphalodes, Origanum, Oxytropis, Palaua, Papaver, Pastinaca, Peltaria, Petroselinum, Petunia, Peucedanum, Phacelia, **Phagnalon**, Phaseolus, Phlox, Physalis, Phyteuma, Picris, Pisum, Plantago, Podonosma, Polygonum, Prunella, Pulmonaria, Raphanus, Reseda, Retama, Rhinanthus, Rhus, Rorippa, Rudbeckia, Ruta, Salicornia, Salvia, Satureja, **Scabiosa**, Scorpiurus, Scorzonera, Scrophularia, Scutellaria, Senecio, **Serratula**, Seseli, Silene, Sinapis, Sisymbrium, Solanum, Sonchus, Spinacia, Stachys, Stellaria, Symphytum, Tanacetum, Taraxacum, Teucrium, Thlaspi, Thunbergia, Tordylium, Torilis, Tragopogon, Trichodesma, Trifolium, Trigonella, Tropaeolum, **Urospermum**, Urtica, Valeriana, Valerianella, Verbascum, Verbena, Veronica, Vicia, Vigna, Viola, Withania, **Xeranthemum**.*

Materiel examined

[10] Tinença Benifassà: [1♀] s.07.vi.2007, e.21.vi.2007. Host-plant: *Anagallis arvensis* L.

[11] Lagunas de La Mata-Torrevieja: [1♂,1♀] s.05.iv.2006, e.20.iv.2006. Host-plant: *Avena byzantina* C. Koch

[12] Tinença Benifassà: [1♂,1♀] s.27.vi.2006, e.30.vii.2006. Host-plant: *Blackstonia perfoliata* (L.)

[13] Font Roja: [1♀] s.14.vi.2006, e.23.vi.2006. Host-plant: *Catananche caerulea* L.

[14] Font Roja: [1♂] s.24.v.2006, e.10.vi.2006; [1♂,2♀] s.14.vi.2006, e.23.vi.2006. [3♂,1♀] s.07.vi.2006, e.23.vi.2006; [1♂] s.04.vii.2007, e.30.vii.2007. Host-plant: *Mantisalca salmantica* (L.)

[15] Lagunas de La Mata-Torrevieja: [2♂,1♀] s.14.iii.2007, e.22.iii.2007. Host-plant: *Phagnalon saxatile* (L.)

[16] Tinença Benifassà: [1♂,5♀] s.19.vi.2006, e.29.vi.2006. [2♀] s.21.v.2007, 1♀ e.02.vi.2006 and 1♀ e.16.vi.2006. Host-plant: *Scabiosa atropurpurea* L.

[17] Font Roja: [3♀] s.20.iv.2006, 2♀ e.26.iv.2006 and 1♀ e.08.v.2006. [5♂,5♀] s.11.v.2006, e.17.v.2006; [1♂,2♀] s.07.vi.2006, e.21.vi.2006. Host-plant: *Serratula pinnatifida* (Cav.)

[18] Lagunas de La Mata-Torrevieja: [1♀] s.07.iii.2007, e.22.iii.2007; [1♂2♀] s.30.iv.2007, e.18.v.2007. Host-plant: *Urospermum picroides* (L.)

[19] Font Roja: [1♂] s.11.v.2006, e.26.v.2006; [2♂,1♀] s.15.v.2006, e.26.v.2006. Host-plant: *Xeranthemum inapertum* (L.)

Note: *Chromatomyia horticola* species appear to have dispersed naturally across temperate areas of Africa to South Africa, it is common in parts of India and has reached Eastern Asia but is entirely absent from Australian and Neotropical region. It is equally, or even

more widespread than *Chromatomyia syngenesiae* Hardy, 1849 on the Compositae and it has been, at this time, recorded on 239 genera in 39 families. It is the most polyphagous species in the Agromyzidae, comparable only to *Liriomyza strigata* (Meigen, 1830) and *Liriomyza trifolii* (Burgess in Comstock, 1880).

Genus *Liriomyza* Mik, 1894

***Liriomyza brassicae* (Riley, 1884)**

Distribution

Palaeartic: France, Germany, North Africa, Romania, Spain, Turkey. Afrotropical region. Australian region. Nearctic region. Neotropical region. Oriental region.

Genera of Host-Plants

Barbarea, *Brassica*, *Cakile*, *Cleome*, ***Diplotaxis***, *Hirschfeldia*, *Isatis*, *Lepidium*, *Matthiola*, *Moricandia*, *Pisum*, *Raphanus*, *Reseda*, ***Silene***, *Sinapis*, *Sisymbrium*, *Tropaeolum*.

Materiel examined

[20] Tinença Benifassà: [1♂, 2♀] s.20.ix.2006, e.02.x.2006. Host-plant: ***Diplotaxis eruroides* L.**

[21] Tinença Benifassà: [1♂] s.20.ix.2006, e.02.x.2006. Host-plant: ***Silene vulgaris* (Moench)**

Note: *Liriomyza brassicae* was described in the United States on *Brassica* and is now known on 16 further genera. It is semi-cosmopolitan present throughout the Old World Tropics, particularly on Capparaceae and *Tropaeolum* (Tropaeolaceae), a favourite host, on which it occurs commonly in Australia, including Tasmania. It occurs occasionally on Resedaceae and an unusual switch is represented by its occasional occurrence on *Pisum*, on which it has been found on several occasions in Kenya and India. The male genitalia suggests a possible relationship with *Liriomyza baccharidis* Spencer, 1963 (Compositae). Although *L. brassicae* cannot be reliably distinguished from the important pest *Liriomyza sativae* Blanchard, 1938 on external characters, the genitalia is entirely distinct.

***Liriomyza cicerina* (Rondani, 1875)**

Distribution

Palaeartic: Austria, Czech republic, Denmark, Great Britain, France, Germany, Greece, Italy, Lithuania, North Africa, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Turkey, Ukraine, Yugoslavia.

Genera of Host-Plants

Cicer, *Hymenocarpus*, ***Medicago***, *Melilotus*, *Ononis*.

Materiel examined

[22] Font Roja : [1 ♂] s.04.x.2006, e.19.x.2006. Host-plant: ***Medicago sativa* L.**

Note: *Liriomyza cicerina* feeds mainly on *Cicer arietinum* L. in the Mediterranean area, on which it can be a serious pest. The genitalia shows that it is related to species on Compositae, for example *Liriomyza sonchi* Hendel, 1931.

***Liriomyza orbona* (Meigen, 1830)**

Distribution

Palearctic: Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Lithuania, Malta, North Africa Poland, Spain, Sweden, Switzerland, The Netherlands, Turkey, Yugoslavia.

Genera of Host-Plants

Avena, *Deschampsia*, ***Hordeum***, *Poa*

Materiel examined

[23] Font Roja : [1 ♀] s.21.ix.2006, e.12.x.2006. Host-plant: ***Hordeum murinum* L.**

Note: *Liriomyza orbona* has been described on Avenae and Poeae, this species is common from early spring to end autumn. Male genitalia indicating a close relationship with many others *Liriomyza* species feeding on Poaceae (e.g. *Liriomyza phryne* Hendel, 1931).

***Liriomyza trifolii* (Burgess in Comstock, 1880)**

Distribution

Palearctic: Austria, Belgium, Bulgaria, Cyprus, Czech republic, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Malta, Monaco, North Africa, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, The Netherlands, Turkey, Yugoslavia. Afrotropical region. Australian region. Nearctic region. Neotropical region. Oriental region.

Genera of Host-Plants

Abelmoschus, *Ageratum*, *Agrimonia*, *Ajuga*, *Allium*, *Alstroemeria*, *Amaranthus*, *Ambrosia*, *Anemone*, *Anethum*, *Anthriscus*, *Antirrhinum*, *Apium*, *Arachis*, *Arctium*, *Artemisia*, *Asclepias*, *Aster*, *Avena*, *Baccharis*, *Basella*, *Bellis*, *Beta*, *Bidens*, *Brachycome*, *Brassica*, *Bryonia*, *Cajanus*, *Callistephus*, *Callistephus*, *Canavalia*, *Capraria*, *Capsella*, *Capsicum*, *Cardiospermum*, *Carthamus*, *Cassia*, *Celosia*, *Centaurea*, *Centranthus*, *Cestrum*, *Chelone*, *Chenopodium*, *Chrysanthemum*, *Cirsium*, *Citrullus*, *Conoclinium*, *Convolvulus*, *Conyza*, *Crataegus*, *Crotalaria*, *Cucumis*, *Cucurbita*, *Dahlia*, *Datura*, *Daucus*, *Dendranthema*, *Dianthus*, *Dimorphotheca*, *Erechtites*, *Erigeron*, *Eupatorium*, *Fallopia*, *Flaveria*, *Fuchsia*, *Gaillardia*, *Galinsoga*, *Gazania*, *Gerbera*, *Gladiolus*, *Glycine*, *Gna-*

phalium, *Gossypium*, *Gypsophila*, *Helianthus*, *Helichrysum*, *Hibiscus*, *Holmskioldia*, *Hordeum*, *Hydrocotyle*, *Hymenopappus*, *Ipomoea*, *Kallstroemia*, *Lactuca*, *Lamium*, *Lansea*, *Lantana*, *Lathyrus*, *Launaea*, *Leucanthemum*, *Linaria*, *Lycopersicon*, *Medicago*, *Melilotus*, *Moluccella*, *Momordica*, *Nepeta*, *Ocimum*, *Passiflora*, *Pastinaca*, *Peperomia*, *Peristrophe*, *Petroselinum*, *Petunia*, *Phaseolus*, *Phlox*, *Piper*, *Pisum*, *Plantago*, *Polygonum*, *Portulaca*, *Primula*, *Pupalia*, *Ranunculus*, *Raphanus*, *Ricinus*, *Rumex*, *Ruspolia*, *Salvia*, *Scaevola*, *Senecio*, *Solanum*, *Solidago*, *Sonchus*, *Spilanthes*, *Spinacia*, *Stellaria*, *Synedrella*, *Tagetes*, *Tanacetum*, *Taraxacum*, *Thlaspi*, *Tithonia*, *Trachelium*, *Tragopogon*, *Tribulus*, *Tridax*, ***Urospermum***, *Vernonia*, *Vicia*, *Vigna*, *Withania*, *Xanthium*, *Zinnia*.

Materiel examined

[24] Lagunas de La Mata-Torrevieja: [2♂, 2♀] s.16.v.2007, e.02.vi.2007. Host-plant: ***Urospermum picroides* (L.)**

Note: *Liriomyza trifolii* was described from Washington, D.C. and is now known as one of the most polyphagous species in the Agromyzidae, with records on 33 families (Benavent-Corai *et al.*, 2005). It has also developed a greater degree of resistance to insecticides than any other species and has been introduced widely to many countries, primarily with infested *Chrysanthemum* cuttings. This capacity is associated to its ability to adjust to the many chemicals present in its wide range of hosts.

Genus *Napomyza* Westwood, 1840

Napomyza lateralis (Fallén, 1823)

Distribution

Palearctic: Austria, Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greek mainland, Hungary, Ireland, Italy, Latvia, Lithuania, Madeira, North Africa, Poland, Sicily, Slovakia, Spain, Sweden, Switzerland, The Netherlands, Turkey, Yugoslavia. Nearctic region.

Genera of Host-Plants

Anthemis, *Bellis*, *Bidens*, *Calendula*, *Carduus*, *Centaurea*, *Cirsium*, *Crepis*, *Helichrysum*, *Hypochaeris*, *Inula*, *Lactuca*, *Linum*, *Lupinus*, *Matricaria*, *Senecio*, ***Urospermum***.

Materiel examined

[25] Font Roja: [1♂, 1♀] s.07.ix.2006, 1♀ e.15.ix.2006 and 1♂ e.02.x.2006. Host-plant: ***Urospermum picroides* (L.)**

Note: *Napomyza lateralis* is considered a species highly oligophagous or pre-polyphagous. Its high similarity to other species present on Compositae, as well as in other close families can indicate they were a group of different species.

Genus *Pseudonapomyza* Hendel, 1920

Pseudonapomyza atratula Zlobin, 2002

Distribution

Palaearctic: Tunisia. New for Spain.

Genus of Host-Plant

Avena

Materiel examined

[26] Lagunas de La Mata-Torrevejia: [2♀] s.30.iv.2007, 1♀ e.18.v.2007 and 1♀ e.31.v.2007. Host-plant: *Avena barbata* Pott ex Link

[27] Lagunas de La Mata-Torrevejia: [1♂] s.30.iv.2007, e.26.v.2007. Host-plant: *Avena fatua* L.

Note: *Pseudonapomyza atratula* Zlobin, 2002 was found for the first time in Tunisia (1976). On external characters and especially in the structure of male genitalia *P. atratula* is most closely related to the *P. atra* (Meigen, 1830). Both species can be separated by some peculiarities in the shape of aedeagus and spermathecae (Zlobin, 2002).

Annexes I and II

The additional list to the catalogue of the host-plants of the world Agromyzidae (Benavent-Corai *et al.*, 2005) is presented below. It is included 27 new interactions for science broken down by miners and botanical families (Annexe I and II). The botanical families listed are Caryophyllaceae Juss., Chenopodiaceae Vent., Compositae Giseke (Asteraceae), Cruciferae Juss. (Brassicaceae), Gentianaceae Juss., Gramineae Juss. (Poaceae), Leguminosae Juss. (Fabaceae) and Primulaceae Batsch ex Borkh. They highlight the plant-genera *Anagallis* L., *Catananche* L., *Mantisalca* Cass., *Phagnalon* Cass., *Scabiosa* L. and *Urospermum* Scop. reported like new for Agromyzidae. Also an important endemism of Font Roja natural park, *Centaurea rouyi* Coincy, is reported like new host-plant of *O. beckeri*. According to the list added the host-genera of the catalogue of host-plants of the world for Agromyzidae reach the figure of 926.

The Agromyzidae miners listed report species of economic importance like *Chromatomyia horticola*, *Liriomyza brassicae*, *L. cicerina*, *L. orbona*, *L. trifolii* and *Napomyza lateralis* (Benavent-Corai *et al.*, 2004). These include important species typical of greenhouses (Cabello *et al.*, 1990 and Moreno *et al.*, 1993) that use the wild flora like reservoirs for their development when crops are not present. Avoiding the alternative flora of Agromyzidae is key to succesful in the pest control.

An important effort have to be done for knowing all host-plants for Agromyzidae of the world. In fact we have constated the presence of a total of 153 interactions established in 94 genera belonging to 27 botanical families in overall study carried out in the three natural parks. The problem of obtaninig the miners from plants makes that a wide range

of host-plants of Agromyzidae lack of known miners. Also the difficult of female identifications make that a lot specimens remain identified only at genera level.

Annexe I : Additional list of Agromyzidae species and their host-plants

AMAUROMYZA Hendel, 1931

Subgenus *CEPHALOMYZA* Hendel, 1931

Genera and Species	Distribution	Host-plants Genera
<i>Am. (Ceph.) flavifrons</i> (Meigen, 1830)	Nea, P	<i>Catananche, Lepidium</i>
<i>Am. (Ceph.) karli</i> (Hendel, 1927)	Nea, P	<i>Chenopodium</i>

CHROMATOMYIA Hardy, 1849

Genera and Species	Distribution	Host-plants Genera
<i>Chr. horticola</i> (Goureau, 1851)	Afr, Nea, Ori, P	<i>Anagallis, Avena, Blackstonia, Catananche, Mantisalca, Phagnalon, Scabiosa, Serratula, Urospermum, Xeranthemum</i>

LIRIOMYZA Mik, 1894

Genera and Species	Distribution	Host-plants Genera
<i>L. brassicae</i> (Riley, 1884)	Afr, Aus, Nea, Neo, Ori, P	<i>Diploaxis, Silene</i>
<i>L. cicerina</i> (Rondani, 1875)	P	<i>Medicago</i>
<i>L. orbona</i> (Meigen, 1830)	P	<i>Hordeum</i>
<i>L. trifolii</i> (Burgess in Comstock, 1880)	Afr, Aus, Nea, Neo, Ori, P	<i>Urospermum</i>

NAPOMYZA Westwood, 1840

Genera and Species	Distribution	Host-plants Genera
<i>N. lateralis</i> (Fallén, 1823)	Nea, P	<i>Urospermum</i>

OPHIOMYZA Bražnikov, 1897

Genera and Species	Distribution	Host-plants Genera
<i>O. beckeri</i> (Hendel, 1923)	Afr, Ori, P	<i>Centaurea, Lepidium, Reichardia, Sysimbrium, Urospermum</i>
<i>O. ononidis</i> Spencer, 1966	P	<i>Lotus</i>

PSEUDONAPOMYZA Hendel, 1920

Genera and Species	Distribution	Host-plants Genera
<i>P. atratula</i> Zlobin, 2002	P	<i>Avena</i>

The abbreviation used to indicate the biographic areas are as follows (Benavent-Corai *et al.*, 2005):

Afr = Afrotropical (or Ethiopian) region; Aus = Australian region; Ori = Oriental region; P = Palearctic region; Nea = Nearctic region and Neo = Neotropical region.

Annexe II : Additional list of host-plants and Agromyzidae associated

CARYOPHYLLACEAE Juss.

Host-plants genera	Agromyzid species
<i>Silene</i> L.	<i>Liriomyza brassicae</i>

CHENOPODIACEAE Vent.

Host-plants genera	Agromyzid species
<i>Chenopodium</i> L.	<i>Amauromyza</i> (<i>Cephalomyza</i>) <i>karli</i>

COMPOSITAE Giseke (Asteraceae)

Host-plants genera	Agromyzid species
<i>Catananche</i> L.	<i>Amauromyza</i> (<i>Cephalomyza</i>) <i>flavifrons</i> , <i>Chromatomyia horticola</i>
<i>Centaurea</i> L.	<i>Ophiomyia beckeri</i>
<i>Mantisalca</i> Cass	<i>Chromatomyia horticola</i>
<i>Phagnalon</i> Cass.	<i>Chromatomyia horticola</i>
<i>Reichardia</i> Roth.	<i>Ophiomyia beckeri</i>
<i>Serratula</i> L.	<i>Chromatomyia beckeri</i>
<i>Urospermum</i> Scop.	<i>Chromatomyia horticola</i> , <i>Napomyza lateralis</i> , <i>Ophiomyia beckeri</i>
<i>Xeranthemum</i> L.	<i>Chromatomyia horticola</i>

CRUCIFERAE Juss. (Brassicaceae)

Host-plants genera	Agromyzid species
<i>Diplotaxis</i> DC.	<i>Liriomyza brassicae</i>
<i>Lepidium</i> L.	<i>Amauromyza</i> (<i>Cephalomyza</i>) <i>flavifrons</i> , <i>Ophiomyia beckeri</i>
<i>Sysimbrium</i> L.	<i>Ophiomyia beckeri</i>

GENTIANACEAE Juss.

Host-plants genera	Agromyzid species
<i>Blackstonia</i> Hudson.	<i>Chromatomyia horticola</i>

GRAMINEAE Juss. (Poaceae)

Host-plants genera	Agromyzid species
<i>Avena</i> L.	<i>Chromatomyia horticola</i> , <i>Pseudonapomyza atratula</i>
<i>Hordeum</i> L.	<i>Liriomyza orbona</i>

LEGUMINOSAE Juss. (Fabaceae)

Host-plants genera	Agromyzid species
<i>Lotus</i> L.	<i>Ophiomyia ononidis</i>
<i>Medicago</i> L.	<i>Liriomyza cicerina</i>

PRIMULACEAE Batsch ex Borkh.

Host-plants genera	Agromyzid species
<i>Anagallis</i> L.	<i>Chromatomyia horticola</i>

ACKNOWLEDGEMENTS

This manuscript has been supported by the Ministry of Education and Science of the Spanish government and by European Regional Development Fund (ERDF) (project CGL2004-02711) CGL2004-02711 directed by Dr. Ricardo Jiménez-Peydró.

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RICARDO GIL-ORTIZ, DR. JOSE VICENTE FALCÓ-GARÍ, DRA. MARÍA TERESA OLTRÁ-MOSCARDÓ, DRA. JOSEFA MORENO-MARÍ, DR. RICARDO JIMÉNEZ-PEYDRÓ - Instituto Cavanilles de Biodiversidad y Biología Evolutiva, Universitat de València (Estudi general) (Spain), Aptdo. de correos 22085; 46071 - Valencia (SPAIN). Tel. (+34) 96 354 35 94. E-mail: ricardo.gil@uv.es

MICHEL MARTINEZ - INRA - UMR CBGP 1062, 2, place Viala 34060 Montpellier (FRANCE). Cedex 1. Tel. (+33) 04 99 61 26 79. E-mail: martinez@supagro.inra.fr.

Accettato il 30 aprile 2009