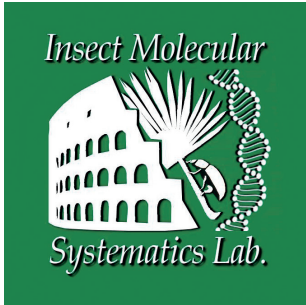




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The leaf-mining flies of the family Agromyzidae of the Maltese Islands are revisited and updated with new data and records (Diptera: Brachycera, Acalyptrata)

Martin J. EBEJER

Entomology Section, Department of Natural Sciences, National Museum of Wales, Cathays Park, Cardiff, United Kingdom - martin.ebejer@btinternet.com

Abstract

The Agromyzidae of Malta is reviewed and all 81 species are listed with additional data. Three genera are reported for the first time: *Japanagromyza* Sasakawa, *Aulagromyza* Enderlein and *Phytoliriomyza* Hendel. Two species in the genus *Aulagromyza* Enderlein and one in *Phytomyza* Fallén cannot be named at present. The commonest species on the islands, the pest species and 37 new records are indicated. The phenology of the species belonging to this family as applies to the Maltese Islands is tabulated and discussed.

Key words: Malta, Agromyzidae, faunistics, phenology, new records.

Introduction

The Agromyzidae is a large family of acalyptrate flies with at least 2800 named species from all zoogeographical regions except Antarctica. They vary in size (1–6 mm) although most are about 2–2.5 mm long. All are plant feeders where most of the species mine leaves or stems, but some feed in roots and seed heads, while a few form galls. A few species are of significant agricultural and horticultural importance, as a result of which, this family has been intensively studied. Those species that feed on invasive or noxious plants are considered beneficial and potentially useful biocontrol agents.

The agromyzid fauna of Malta has received some attention prior to this article with 44 species from 10 genera recorded in the literature. Spencer (1973a) recorded the first 18 species from the islands. For twelve of these he noted mines on various host plants and he described one species as new (*Liriomyza melitensis* Spencer, 1973). At the time, and based on his experience of Agromyzidae from other parts of the Mediterranean, he considered the 18 species as a good representation. This had to be a gross underestimate given the surprisingly diverse flora of the islands. Although pest species must have been present for many years, Saliba (1963) who wrote about insect pests of crop plants of Malta, listed no agromyzid species. Minkenberg & van Lenteren (1986) in their review of two pest species noted that the presence of *Liriomyza trifolii* (Burgess in Comstock, 1880) in Malta was known by 1977.

Dawah & Deeming (2002) confirmed the presence of the pest species *Liriomyza huidobrensis* (Blanchard, 1926), which is listed in CABI as an invasive species in Malta since 1989 but without further data or information as to the source. Gil-Ortiz et al. (2011a) recorded *Liriomyza richteri* Hering, 1927. More species were added to the list by Černý (2005) based on collections made independently by B. Merz and B. Petersen, bringing the total number of species to 44. Other references to species from Malta (Spencer 1973b; Schembri et al. 1991; Černý 2008, 2009, 2013, 2018; Černý & Merz 2006; Černý & Vála 2006; Černý & Bächli 2018; Gil-Ortiz et al. (2011b) were not based on additional material or new records.

In this article, the distribution of species is given only in summary. The *Fauna Europaea* database (https://fauna-eu.org/cdm_dataportal/taxon/27be1201-53d6-4518-8656-a0ed1af676e8; Pape et al. 2015) and the many recent comprehensive papers by Černý are easily consulted for details of zoogeographical and country occurrence of individual species and it serves no useful purpose to list each country here. The volumes on the Agromyzidae of Hungary (Papp & Černý 2015, 2016, 2017, 2019) were consulted for their identification keys, general information and illustrations to assist in the identification of many of the species listed here.

The systematic status of taxa within the large genus *Phytomyza* Fallén, 1810 has been a contentious issue for many years with many authors still accepting *Chromatomyia* Hardy, 1849, *Napomyza* Westwood, 1840 and *Ptochomyza* Hering,

1942 as genera in their own right (Tschirnhaus 2021). However, a study that included molecular work and a more critical appraisal of phylogeny and of what should constitute a monophyletic genus (Winkler et al. 2009) lends stronger weight to demoting *Napomyza* and *Ptochomyza* to subgenera of *Phytomyza* and synonymizing *Chromatomyia* with *Phytomyza*. This is followed here.

Material and Methods

Fieldwork, mainly by the author, was conducted semi-systematically, in that the islands were searched throughout the year for leaf-mines, and sweep-net sampling was done in all habitats to collect adults. This was repeated in all localities, but not all to the same extent and mostly between the years 1992 and 2002. Each month of the calendar year was divided into 2-week periods to ensure that habitats were visited at least once in each period over the years. The more productive sites were visited several times. Coupled with the rearing of some material from leaf-mines, the collections made during this period have resulted in many more species being added to the Maltese fauna. They are listed here along with those that had been already reported in order to give a complete picture. Some additional data is given for most species already reported if these were rare or if rearing records are now available. Distribution outside Malta is summarized and new records are indicated. Phenology (Tables 2,3 and 4) were compiled from my own records and those available in the literature.

The material is dry mounted. Specimen depository is given at the end of each data entry following the collector's and species identifier's initials unless these are of the author and the depository is the personal collection of the author. In this case no further mention is made after the date of collection and before the next specimen(s) data entry, which is separated by a semicolon.

Abbreviations: JCD – John C. Deeming; NMWC – National Museum of Wales, Cardiff, MC – Miloš Černý (Czech Republic); PG – Paul Gatt (Essex, UK).

Species list

Agromyzinae

Agromyza Fallén, 1810

Agromyza abiens Zetterstedt, 1848

Material examined: **Malta:** Migra l-Ferħa, 8 larvae mining leaves of *Echium* sp. collected on 16 Apr 1999, adults emerged: 2♂♂, 27 Oct 1999; 2♀♀, 29 Oct 1999; 2♀♀, 31 Oct 1999; 1♀, 6 Nov 1999; 1♀, 30 Nov 1999.

First recorded from Malta by Spencer (1973a) from leaf mines on *Borago officinalis*. A common and widespread species in the Palearctic including the Mediterranean area.

Agromyza apfelbecki Strobl, 1902

Material examined: one of the most frequently encountered species in this study. A common and predominantly Mediterranean species. First recorded from Malta by Spencer (1973a).

Agromyza frontella (Rondani, 1875)

Material examined: 1♂, **Malta:** Buskett, 22 Apr 1992; 3♂♂, 4♀♀, **Gozo:** Ramla dunes, 5 Apr 1999.

A common and widespread Holarctic species. A pest of alfalfa. **New record for the Maltese Islands.**

Agromyza graminicola Hendel, 1931

Material examined: 5♂♂, 1♀, **Malta:** Salina, 11 Apr 1994; 2♂♂, 2♀♀, Salina, 22 Apr 1994, JCD leg. & det. (NMWC, 1♂, MJE coll.); 4♂♂, 1♀, Fiddien, 20 May 1995, B. Merz; 2♂♂, 2♀♀, Salina, 7 May 2002.

An uncommon species though widespread in Europe. The host plant is *Phragmites*. **New record for the Maltese Islands.**

Agromyza hiemalis Becker, 1908

Material examined: 1♀, **Malta:** Balzan, 28 Mar 1977; 1♀, Balzan, 9 Mar 1992; 1♂, Buskett, 27 Mar 1997; 1♂, Salina, 10 Jan 1999; 2♂♂, Qormi, Ghemmieri, 11 Dec 1999.

A Mediterranean species first recorded from Malta by Spencer (1973a) from mines on *Urtica urens*.

Agromyza myosotidis Kaltenbach, 1864

Uncommon but widespread in the Palearctic. First recorded from Malta by Černý (2005). Not found in this study.

Agromyza nana Meigen, 1830

Material examined: 1♀, **Malta:** Fawwara, 18 Mar 1992; 1♂, 1♀, Ghadira, 9 Apr 1993, leg. and coll. PG.

A common species in the Mediterranean and first recorded from Malta by Spencer (1973a) from leaf mines on *Medicago*.

Agromyza nigrella Rondani, 1875

Material examined: 1♂, **Malta:** Rabat, Wied l-Isqof, 15 Nov 1992; 1♀, Ghadira, 19 Mar 1994.

A pest species on Poaceae widespread in the Holarctic region. **New record for the Maltese Islands.**

Agromyza nigrescens Hendel, 1920

Widespread in the Palearctic and first recorded from Malta by Spencer (1973a) from a leaf mine on *Geranium*. Not found in this study.

Agromyza nigripes Meigen, 1830

Material examined: 1♂, 1♀, **Malta:** Salina, 16 Apr 1977, MJE leg., JCD det. (NMWC).

A widespread Palearctic species. **New record for the Maltese Islands.**

Agromyza rondensis Strobl, 1900

Material examined: 1 ♀, **Malta:** Bahrija, 5 Jan 1987; 1 ♂, 1 ♀, Girgenti, 3 Mar 1991; 1 ♂, Ghadira, 9 Apr 1993; 1 ♀, Marfa Ridge, 22 Mar 1992; 2 ♂♂, Wied Qannotta, 20 Feb 1994; 1 ♀, Baħar iċ-Ċagħaq, Qrejtjen Point, 4 Oct 1997; 1 ♂, 1 ♀, Fomm ir-Riħ, 29 Oct 2014; 3 ♀♀, **Gozo:** Dahlet Qorrott, 2 Apr 1994; 1 ♀, Għarb, Wied il-Mielah, 30 Nov 1991; 1 ♂, Xlendi, 24 Feb 1999, C. Farrugia leg.

A widespread Palaearctic species but with only few records from the Mediterranean; found also in the Oriental Region. It is a pest of Poaceae. **New record for the Maltese Islands.**

Agromyza spenceri Griffiths, 1963

Material examined: 1 ♂, **Malta:** Siġġiewi, Wied Hanzir, 8 Nov 1998.

An uncommon species in Europe. Its host plant is *Phragmites*. First recorded from Malta by Černý (2005).

*Japanagromyza Sasakawa, 1958**Japanagromyza salicifolii* (Collin, 1911)

Material examined: 2 ♂♂, **Malta:** Mtarfa, Wied il-Qlejgha, reared from leaf mines on *Populus alba*, a third larva parasitized by a species of Pteromalidae (Hymenoptera), mines: 9 Apr 2000, adults: 1 May 2000; 1 ♀, Buskett, larva in leaf mine on *Populus alba*, 6 May 2002, puparium, 8 May 2002, adult, 21 May 2002.

Although this is a globally widespread genus only *J. salicifolii* is present in the West Palaearctic and mainly from the Mediterranean. **New record for the Maltese Islands.**

*Melanagromyza Hendel, 1920**Melanagromyza albocilia* Hendel, 1931

Material examined: 1 ♂, **Malta:** Balzan, 1 Jun 1977; 2 ♂♂, 1 ♀, Buskett, 25 Aug 1991.

Widespread throughout Europe and first recorded from Malta by Černý (2005).

Melanagromyza cunctans (Meigen, 1830)

Material examined: 2 ♂♂, **Malta:** Bahrija, 13 Jun 1993.

A widespread European and Mediterranean species first recorded from Malta by Černý (2005).

Melanagromyza eriolepidis Spencer, 1961

Material examined: 2 ♂♂, **Malta:** Gnejna, 11 Feb 1996; 4 ♂♂, Gnejna, 22 Feb 1998; 1 ♀, Bidnija, il-Qolla, 7 Mar 1999; 1 ♂, Buskett, 1 Apr 1999; 1 ♀, Mtahleb, 4 Mar 2001; 1 ♀, Buskett, 18 Mar 2001; 2 ♂♂, Buskett, 4 Mar 2003, JCD leg. & det. (NMWC).

This species is known from Britain, Germany, Poland and Switzerland. **New record for the Maltese Islands.**

Melanagromyza lappae (Loew, 1850)

Material examined: 1 ♀, **Malta:** Salina, 22 Apr 1994, JCD leg. & det. (NMWC); 1 ♂, Qormi, Wied il-Kbir, 22

May 1995, JCD leg. & det. (NMWC); 1 ♂, **Gozo:** Wied ir-Ramla, 21 Apr 1994, JCD leg. & det. (NMWC).

Widespread in Europe. **New record for the Maltese Islands.**

Melanagromyza siciliensis Spencer, 1966

Material examined: 2 ♂♂, **Malta:** Fiddien, 5 May 2002, B. Merz (NMWC); 1 ♂, 2 ♀♀, **Gozo:** Dwejra, 5 Apr 1999.

This species appears to have a distribution limited to a few areas in central Europe and the Mediterranean. **New record for the Maltese Islands.**

Melanagromyza sojae (Zehntner, 1900)

Material examined: 1 ♀, **Malta:** Marfa Ridge, 17 Apr 1992; 1 ♂, **Gozo:** Għarb, Wied il-Mielah, 30 Nov 1991; 1 ♂, Ramla dunes, 5 Apr 1999.

A widespread species in the Oriental and Australasian Regions; known from Saudi Arabia and North Africa. **New record for the Maltese Islands.**

Melanagromyza symphyti Griffiths, 1963

Material examined: 1 ♂, **Malta:** Qormi, Wied il-Kbir, 22 May 1995, JCD leg. & det. (NMWC).

In the West Palaearctic this is mainly a northern and central European species. It is found also in Kyrgyzstan and Uzbekistan. **New record for the Maltese Islands.**

*Ophiomyia Braschnikov, 1897**Ophiomyia alliariae* Hering, 1954

Material examined: 1 ♂, **Malta:** Buskett, 25 Aug 1991; 1 ♂, Bahrija, 25 Apr 1994, JCD leg. & det. (NMWC); 1 ♂, 1 ♀, Żebbuġ, Wied Qirda, 19 Apr 1998; 1 ♂, Wied Qannotta, 4 Nov 2001; 4 ♂♂, Wied il-Għasel, 21 Apr 2002; 4 ♂♂, 1 ♀, **Gozo:** Dwejra, 5 Apr 1999.

A mainly central European species first recorded from Malta by Černý (2005).

Ophiomyia asparagi Spencer, 1964

Material examined: 1 ♂, **Malta:** Salina, 22 Apr 1994, JCD leg. & det. (NMWC); 3 ♂♂, 1 ♀, Qormi, Wied il-Kbir, 22 May 1995, JCD leg. & det. (NMWC).

A Mediterranean species first recorded from Malta by Černý (2005). It is found also in China and Japan.

Ophiomyia beckeri (Hendel, 1923)

Material examined: 2 ♂♂, **Malta:** Bahrija, 13 Jun 1993; 2 ♂♂, Wied Incita, 6 Mar 1994; 1 ♂, 2 ♀♀, Wardija, 16 Nov 1997; 2 ♂♂, 1 ♀, Gnejna, 22 Feb 1998; 1 ♂, **Gozo:** Mgarr ix-Xini, 28 Nov 1993.

A widespread European, Afrotropical and Oriental species first recorded from Malta by Černý (2005).

Ophiomyia cunctata (Hendel, 1920)

Material examined: 2 ♂♂, **Malta:** Wied Incita, 19 Feb 1992; 1 ♂, 1 ♀, Wied Qannotta, 20 Apr 1994; 3 ♂♂, Qammieh, 19

Mar 1994; 1♂, Wied Qannotta, 26 Feb 1995; 1♂, 1♀, Ġnejna, 22 Feb 1998.

Widespread in Europe and the Mediterranean. **New record for the Maltese Islands.**

Ophiomyia curvipalpis (Zetterstedt, 1848)

Material examined: 1♂, **Malta:** Marfa Ridge, 17 Apr 1992; 1♀, Żebbuġ, Wied Qirda, 19 Apr 1998.

A common and widespread Palearctic species including North Africa. First recorded from Malta by Černý (2005).

Ophiomyia maura (Meigen, 1838)

Material examined: 2♂♂, **Malta:** Delimara, 24 Apr 1993. A common and widespread West Palearctic species.

Phytomyzinae

Amauromyza Hendel, 1931

Amauromyza s.s.

Amauromyza maltensis Černý, 2005

Material examined: 1♂, **Malta:** Haġar Qim, 15 Nov 1992, leg. and coll. PG; 1♂, Delimara, 24 Apr 1993; 1♂, Salina, 31 May 1993; 1♂, Qammieħ, 19 Mar 1994.

Described from three males and known only from Malta. These and the above are the only records known.

Subgenus *Cephalomyza* Hendel, 1931

Amauromyza luteiceps (Hendel, 1920)

Material examined: one of the most frequently encountered species in this study. Although a widespread Holarctic species, it is relatively uncommon on the continent but common in Malta. First recorded from Malta by Černý (2005).

Aulagromyza Enderlein, 1936

Aulagromyza anteposita (Strobl, 1898)

Material examined: 1♀, **Malta:** Ġirgenti, 3 Mar 1991; 2♀♀, Buskett, 3 Mar 1992; 1♂, 1♀, Ġirgenti, 18 Apr 1993; 1♂, Mistra, 19 Mar 1994; 1♀, Buskett, 27 Mar 1997; 1♂, Salina, 10 Jan 1999.

A mainly central European species known also from the Balearic Islands, Spain. **New record for the Maltese Islands.**

Aulagromyza discrepans (van der Wulp, 1871)

Material examined: 1♂, **Malta:** Buskett, 22 Apr 1992; 1♀, Fiddien, 11 May 1992; 1♀, Ġirgenti, 18 Apr 1993; 1♂, Bahrija, 2 Feb 1994; 1♂, Bahrija, 25 Apr 1994, JCD leg. & det. (NMWC).

Widespread in central and southern Europe and the Mediterranean. **New record for the Maltese Islands.**

Aulagromyza orphanana (Hendel, 1920)

Material examined: 3♀♀, **Malta:** Buskett, 22 Apr 1992; 9♂♂, 5♀♀, Ġirgenti, 18 Apr 1993; 1♂, Wied Inċita, 6 Mar

1994; 2♂♂, Wied il-Mistra, 19 Mar 1994; 3♂♂, 3♀♀, Buskett, 27 Mar 1994; 3♀♀, Buskett, 24 Apr 1994; 1♂, Buskett, Apr 1994, JCD leg. & det. (NMWC); 8♂♂, 1♀, Buskett, 27 Mar 1997; 1♀, Żebbuġ, Wied Qirda, 19 Apr 1998.

A common species in much of Europe and the Mediterranean. Found also in Kazakhstan. **New record for the Maltese Islands.**

Aulagromyza sp. A

Material examined: 2♀♀, **Malta:** Ghadira, 17 Apr 1992 (and 2♀♀, **Israel:** Tel Aviv, 26 Mar 2000).

A large species that is possibly undescribed but males are required for a positive identification or description. These four females have the frons projecting significantly above and in front of the eye; gena as deep as the vertical diameter of the eye. Head yellow and with a broad yellow postocular margin; occiput black. Pleura with wide yellow borders to the dark grey markings on the sclerites; scutum with 2+5 dorsocentrals, acrostichals in 4 rows and three broad black vittae (ground colour) covered with pale grey pollinosity, these do not reach the entirely yellow scutellum. Wing, milky white with very pale veins; costa extending about 1/3 of the way between R4+5 and M; wing apex between these veins but closer to M; discal cell absent; squama and fringe white; legs are pale yellow except for minor brown irregular striations on femora.

Aulagromyza sp. B

Material examined: 1♀, **Malta:** Salina, 7 Jul 1987 (NMWC).

A small mainly shiny black species except for the bright yellow antenna and head; wing with relatively large discal cell present: distal section of vein M4 only about 1.7 times as long as proximal section; scutum with 1+3 dorsocentrals. This specimen clearly does not belong to any of the above. A male is required for a positive identification.

Calycomyza Hendel, 1931

Calycomyza humeralis (von Roser, 1840)

Material examined: one of the most frequently encountered species in this study. This species is almost cosmopolitan and it was first recorded from Malta by Černý (2005).

Cerodontha Rondani, 1861

Subgenus *Cerodontha* s.s.

Cerodontha denticornis (Panzer, 1806)

Material examined: numerous specimens from all over the islands.

A widespread and very common species throughout the Palearctic. First recorded from Malta by Černý (2005).

Subgenus *Butomomyza* Nowakowski, 1967

Cerodontha (Butomomyza) vignae Nowakowski, 1967)

Material examined: 2♂♂, **Malta:** Buskett, 9 Jul 1993; 7♂♂, 3♀♀, Girgenti, 18 Apr 1993; 6♂♂, 2♀♀, Buskett, 14 Jun 1999, from leaf mines on *Parietaria officinalis*, JCD leg. & MC det. (NMWC).

A mainly central European species. **New record for the Maltese Islands.**

Subgenus *Dizygomyza* Hendel, 1920

Cerodontha (Dizygomyza) crassisetata (Strobl, 1900)

Material examined: 1♂, **Malta:** Buskett, 27 Mar 1994; 1♂, Fomm ir-Riħ, 29 Oct 2014.

Widespread in Europe and parts of the Eastern Mediterranean. **New record for the Maltese Islands.**

Liriomyza Mik, 1894

Liriomyza brassicae (Riley, 1884)

Material examined: 1♀, **Malta:** Fiddien, 16 Jan 1994; 2♂♂, Buskett, 27 Mar 1994; 1♂, Fomm ir-Riħ, 18 Nov 2001; 1♂, **Gozo:** Ghasri, Oct 1994, from mine on *Brassica* sp., leg. C. Farrugia; 1♀, Ramla dunes, 5 Apr 1999.

A common and almost cosmopolitan species first recorded by Černý (2005) from a single specimen taken in Gozo.

Liriomyza bryoniae (Kaltenbach, 1858)

Material examined: many specimens reared from wild plants hosts and from horticultural and agricultural plants. A widespread Palaearctic species. First recorded from Malta by Spencer (1973a) from mines on *Mercurialis annua*.

Liriomyza cicerina (Rondani, 1875)

Material examined: 1♀, **Malta:** Wied Babu, 1 May 1993; 1♂, Fomm ir-Riħ, 20 May 1995, JCD leg. & det. (NMWC); 1♂, Ghar Lapsi, 7 Dec 1997, leg. and coll. PG; 1♂, **Gozo:** Wied il-Lunzjata, 11 Dec 1993, leg. and coll. PG.

A widespread European and North African species. **New record for the Maltese Islands.**

Liriomyza congesta (Becker, 1903)

Material examined: one of the most frequently encountered species in this study. A very common species throughout the Palaearctic. First recorded from Malta by Spencer (1973a).

Liriomyza endiviae Hering, 1955

A predominantly Mediterranean species first recorded from Malta by Černý (2005) from a single specimen. Not found in this study.

Liriomyza erucifolii de Meijere, 1944

Material examined: 1♂, **Malta:** Wied Babu, 1 May 1993; 1♂, **Gozo:** Ramla dunes, 5 Apr 1999.

A mainly central European species first recorded from Malta by Černý (2005) from a single specimen.

Liriomyza flaveola (Fallén, 1823)

Material examined: 1♂, **Malta:** Wied il-Ghasel, 21 Apr 2002; 1♂, Buskett, 4 Mar 2003, JCD leg. & det. (NMWC). A common and widespread Holarctic species. **New record for the Maltese Islands.**

Liriomyza huidobrensis (Blanchard, 1926)

Material examined: numerous specimens reared from the wild and greenhouses from all over the islands.

A common pest species that originated from the Neotropical Region and is now cosmopolitan. First recorded from Malta by Dawah & Deeming (2002).

Liriomyza melitensis Spencer, 1973

Material examined: 1♀, **Gozo:** Xlendi, 24 Jan 1999, leg C. Farrugia (MJE coll.)

Although a female, this specimen perfectly fits the original description given by Spencer (1973a). Probably endemic to the Maltese Islands.

Liriomyza orbona (Meigen, 1830)

Material examined: numerous specimens from all over the islands.

Common and widespread in Malta as it is in Europe, the Mediterranean and the Middle East. First recorded from Malta by Spencer (1973a).

Liriomyza pedestris Hendel, 1931

Material examined: numerous specimens from all over the islands.

A common and widespread West Palaearctic species, known also from Uzbekistan. First recorded from Malta by Spencer (1973a).

Liriomyza phryne Hendel, 1931

Material examined: 1♂, **Malta:** Wied il-Ghasel, 18 Mar 1996, JCD leg. & det. (NMWC).

A widespread species in Europe. **New record for the Maltese Islands.**

Liriomyza pusilla (Meigen, 1830)

Material examined: 1♂, **Malta:** Wied Inċita, 19 Feb 1995.

A species found right across the Palaearctic Region. **New record for the Maltese Islands.**

Liriomyza richteri Hering, 1927

Material examined: 1♀, **Malta:** Balzan, 3 Mar 1976; 1♂, 1♀, **Gozo:** Dahlet Qorrott, 2 Apr 1994.

First recorded from Malta by Gil-Ortiz et al. (2011a) as the senior synonym of *Liriomyza pedestris*, and this is most likely the species he referred to, it being far commoner in Malta than *L. richteri*. However, these taxa had been separated again into two species by Zlobin (2003). The specimens reported here key out to *L. richteri* in Papp & Černý (2017).

The differences in the male terminalia are minor and subtle. They are listed here under *L. richteri* with some doubt.

Liriomyza pedestris was described from specimens taken in Spain, Hungary, Finland and Kamchatka. *L. richteri* was described from Murmansk, Eastern Russia. No reliable distribution can be given for this species because of the difficulties resulting from *L. pedestris* being synonymized with *L. richteri* and then raised again from synonymy. Thus, many records may refer to either of these two species, but as far as can be judged, both may be equally widely distributed.

***Liriomyza sativae* Blanchard, 1938**

Material examined: 1♂, **Malta:** Qormi, Wied il-Kbir, 22 May 1995, JCD leg. & det. (NMWC).

This species originated from South America and is now cosmopolitan and a polyphagous pest of agricultural crops. **New record for the Maltese Islands.**

***Liriomyza sonchi* Hendel, 1931**

Material examined: 2♂♂, **Malta:** Qormi, Wied il-Kbir, 22 May 1995, JCD leg. & det. (NMWC).

A common species found across the Palaearctic. **New record for the Maltese Islands.**

***Liriomyza strigata* (Meigen, 1830)**

Material examined: 1♂, **Malta:** Ġnejna, 5 May 2002, JCD leg. & det. (NMWC).

This is a highly polyphagous species widespread in the West Palaearctic but extends also into parts of the Middle East, Central Asia and eastern Russia (Yakutia). **New record for the Maltese Islands.**

***Liriomyza taraxaci* Hering, 1927**

Material examined: 1♂, **Malta:** Wied Babu, 1 May 1993; 1♂, Fiddien, 2 Mar 1994, PG leg. and coll.; 1♂, Buskett, 1 Apr 1999.

A Holarctic species. **New record for the Maltese Islands.**

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

Material examined: 2♂♂, 3♀♀, **Malta:** Balzan, 29 Sep–2 Oct 1998, reared from *Heliotropium europaeum*.

A highly polyphagous species that originated in North America, but is now cosmopolitan and a significant horticultural pest. Recorded as new for Malta by Černý (2005), but this species has been known from the islands since 1976 (CABI, EPPO 1997).

Metopomyza Enderlein, 1936

***Metopomyza scutellata* (Fallén, 1823)**

Material examined: 2♂♂, **Malta:** Ġirgenti, 18 Apr 1993.

A common and widespread Palaearctic species that was first recorded from Malta by Černý (2005) from a single specimen.

Phytoliriomyza Hendel, 1931

***Phytoliriomyza arctica* (Lundbeck, 1901)**

Material examined: 1♀, **Gozo:** Ramla dunes, 2 Apr 1994. A widespread species found across the Holarctic and Neotropical Regions. **New record for the Maltese Islands.**

***Phytoliriomyza perpusilla* (Meigen, 1830)**

Material examined: 1♂, **Malta:** Marfa Ridge, 22 Mar 1992.

Widespread in Europe, European Russia and Yakutia, Arabia, and North and South Africa. **New record for the Maltese Islands.**

Phytomyza Fallén, 1810

Subgenus *Napomyza* Westwood, 1840

***Phytomyza (Napomyza) bellidis* Griffiths, 1967**

Material examined: 1♂, **Malta:** Wied il-Mistra, 19 Mar 1994; 1♂, Bidnija, il-Qolla, 7 Mar 1999; 1♂, 1♀, Buskett, 1 Apr 1999.

A West Palaearctic species first reported from Malta by Černý (2005) from a single specimen.

***Phytomyza (Napomyza) carotae* Spencer, 1966**

A widespread and common Palaearctic species first recorded from Malta by Spencer (1973a). Not found in this study.

***Phytomyza (Napomyza) cichorii* Spencer, 1966**

Material examined: 4♂♂, 3♀♀, **Malta:** Mtahleb, 4 Mar 2001; 1♂, Salina, 11 Apr 1994; 1♂, Salina, 22 Apr 1994, JCD leg. & det. (NMWC).

A widespread Palaearctic species. **New record for the Maltese Islands.**

***Phytomyza (Napomyza) lateralis* (Fallén, 1823)**

Material examined: many specimens from several localities. A Holarctic species first recorded from Malta by Černý (2005).

***Phytomyza (Phytomyza) anemones* Hering, 1925**

This is a European species. Recorded from Malta by Spencer (1973a). Not found in this study.

***Phytomyza (Phytomyza) bellidina* Hendel, 1934**

A European species found mainly in the southwest. First recorded from Malta by Spencer (1973a) from leaf mines on *Bellis*. Not found in this study.

***Phytomyza (Phytomyza) clematidis* Kaltenbach, 1859**

Material examined: 1♂, **Malta:** Wied il-Mistra, 19 Mar 1994; 1♂, Wied Inċita, 19 Feb 1995; 1♀, Wied il-Ghasel, 7 Feb 1999; 3♂♂, **Gozo:** Wied il-Lunzjata, 12 Mar 1994, leg. and coll. PG.

A Palaearctic species occurring mainly in Western Europe. Spencer (1973a) recorded it from Malta under the synonym *P. mallorcensis* Spencer, 1969.

***Phytomyza (Phytomyza) conyzae* Hendel, 1920**

Material examined: many specimens from many localities. This is a common and widespread Palaearctic species particularly around the Mediterranean. First recorded from Malta by Spencer (1973a).

Phytomyza (Phytomyza) ferulae Hering, 1927

A circum-Mediterranean species first recorded from Malta by Spencer (1973a). Not found in this study.

Phytomyza (Phytomyza) ferulivora Griffiths, 1956

Material examined: 1♂, 2♀♀, **Malta:** Wied il-Ghasel, leaf mines on *Ferula* collected 7 Feb 1999, adults emerged 5-6 Mar 1999.

A west and central Mediterranean species also known from Iraq. First recorded from Malta by Spencer (1973a) from leaf mines on *Ferula*.

Phytomyza (Phytomyza) gymnostoma Loew, 1858

Material examined: 1♀, **Malta:** Mizieħ, 31 Mar 1993; 1♂, 1♀, Manikata, 9 Apr 1993; 1♂, 1♀, Wied Qannotta, 20 Feb 1994.

A widespread Palaearctic species. **New record for the Maltese Islands.**

Phytomyza (Phytomyza) horticola (Goureau, 1851)

Material examined: numerous specimens reared and examined from a wide range of host plants, both wild and horticultural, and from all over the islands.

An almost cosmopolitan and very common polyphagous species. First recorded from Malta by Spencer (1973a).

Phytomyza (Phytomyza) orobanchia Kaltenbach, 1864

Material examined: several specimens from multiple localities. Widespread Palaearctic species and very common around the Mediterranean. First recorded from Malta by Spencer (1973a).

Phytomyza (Phytomyza) plantaginis Robineau-Desvoidy, 1851

Material examined: 1♂, **Malta:** Bahrija, 3 Nov 1991; 1♂, Fiddien, on *Plantago major*, puparium 30 Jan 2001, adult Feb 2001.

A widespread Palaearctic species that has also been recorded from Yemen. **New record for the Maltese Islands.**

Phytomyza (Phytomyza) ranunculi (Schrank, 1803)

Material examined: 1♀, **Malta:** Girgenti, 18 Apr 1993; 2♂♂, Wied il-Mistra, 19 Mar 1994; 1♂, Mistra, 17 Mar 1996; 1♂, Żebbieħ, 15 Feb 1998; 1♂, 1♀, Wied il-Ghasel, 7 Feb 1999; 1♂, il-Qolla, Bidnija, 7 Mar 1999.

A Holarctic species. **New record for the Maltese Islands.**

Phytomyza (Phytomyza) rufipes Meigen, 1830

Material examined: 1♀, **Malta:** Buskett, 18 Nov 1993; 1♂, Żebbuġ, Wied Qirda, 19 Apr 1998; 1♂, Bahrija, 24

Dec 1998; 1♂, **Gozo:** Mgarr ix-Xini, 23 Apr 1992.

A species found in most of Europe and parts of North Africa. Recorded also from Canada. **New record for the Maltese Islands.**

Phytomyza (Phytomyza) sp. cfr. spoliata Strobl, 1906

Material examined: 1♂, **Malta:** Wied Inċita, 27 Feb 1994; 1♂, Wied il-Mistra, 19 Mar 1994; 2♂♂, Mistra, 17 Mar 1996.

This species answers to the description of *P. spoliata* rather well in that it matches the body and leg chromatic characters perfectly, has no acrostichals, has an elongate first flagellomere and a medially displaced upper orbital. However, it differs fundamentally from *spoliata* in that the first flagellomere is more elongate and yellow with only a small dark patch at its middle, rather than completely black, and by the very different male terminalia. It may be an undescribed species, but more study is required.

Subgenus *Ptochomyza* Hering, 1942

Phytomyza (Ptochomyza) asparagivora Spencer, 1964

Material examined: 1♂, 2♀♀, **Malta:** Buskett, 22 Apr 1992; 1♂, Mistra, 19 Mar 1993; 1♂, 1♀, Mizieħ, 31 Mar 1993.

A predominantly Mediterranean species, it has been recorded from Hungary and Switzerland. **New record for the Maltese Islands.**

Phytomyza (Ptochomyza) czernyi (Strobl, 1909)

Material examined: 1♂, **Malta:** Mtahleb, puparium 20 Oct 1991, adult 9 Nov 1991, on *Ferula communis*; 1♂, Wied il-Mistra, 23 Apr 1994, JCD leg. & det. (NMWC); 11♂♂, Qormi, Wied il-Kbir, 22 May 1995, JCD leg. (8 in NMWC, 3♂♂ in MJE coll.); 1♂, **Gozo:** Ghasri, Wied Sara, 3 May 2002, B. Merz.

A mainly central Mediterranean species which so far seems to have a limited distribution. First recorded from Malta by Černý (2005).

***Pseudonapomyza* Hendel, 1920**

Pseudonapomyza atra (Meigen, 1830)

Material examined: 1♂, **Malta:** Marfa Ridge, 22 Mar 1992; 2♂♂, Mizieħ, 31 Mar 1993.

A Holarctic species, commoner in the north and first recorded from Malta by Černý (2005).

Pseudonapomyza lacteipennis (Malloch, 1913)

A north American and west European species first recorded from Malta by Černý (2005).

Not found in this study.

Pseudonapomyza vota Spencer, 1973

A Mediterranean species first recorded from Malta by Černý (2005).

Not found in this study.

Discussion

Although 81 species are now known to be present on Malta, some remain poorly known, localized or taken only once or twice. The commonest and most widespread species found on the Maltese Islands are shown in Table 1. These are species that turn up almost every time and everywhere on the islands when sampling is done.

Spencer (1973a) judging that the vegetation was past its peak in early March, suggested that more species might have been found earlier in the year. My own data coupled with any that could be found in the literature shows that the opposite is true. The phenology of the Agromyzidae on the islands (Tables 2, 3 and 4) shows the typical Mediterranean pattern of a large spring peak (April) and a second smaller peak in the autumn (November), but with a few species, particularly the polyphagous *Liriomyza bryoniae* and *Phytomyza horticola* being around as larvae or as adults almost throughout the year. More than half of all species (45/81) can be found in just the month of April, whereas just four species were found in the very hot summer months of July and August. In winter, end November to end January, rather more Agromyzinae than Phytomyzinae were found. In the Agromyzinae, half the number of species are found in November compared to April whereas in the Phytomyzinae only a quarter of the species are found. Grasses and cereals grow in winter and this may explain the Agromyzinae being more frequent during this season, since more of the species in this subfamily have larvae that develop in Poaceae. Furthermore, the presence of so many species found both in spring and autumn indicates that they have more than one generation a year.

When Černý (2005) reported on the species known from Malta, he suggested that about 20–25 more species could be found on the islands. He based this estimate on what was known at the time of faunal lists from neighbouring countries, but these lists were themselves very inadequate, since they were all based on *ad hoc* and random sampling. It is

thus no surprise to see the list of species from Malta doubled as a consequence of some intensive effort spanning the whole year and repeated over a number of years. Despite this, six species that previously were recorded by others were not found again during this study. This suggests that possibly more species should come to light over time; some can be so easily overlooked owing to their short flight period or localized habitats as determined by their host plants.

With the addition of another 37 species the total number of Agromyzidae of the Maltese Islands now stands at 81. So far, two – *Amauromyza maltensis* and *Liriomyza melitensis* are known only from the islands. There are several common species that are widespread around the Mediterranean and could easily occur on Malta. Population densities fluctuate and species colonize, disappear and recolonize specific localities at variable frequencies. Only systematic monitoring will clarify the status of several of these species and likely discover new ones. In this article, field work over a relatively brief period of ten years is reported. Modified horticultural and agricultural practices (including the continuous introduction of new alien invasive species due to international trade in vegetables and ornamental plants), loss of much semi-natural habitat, and now also climate change will influence the diversity of many insect groups including the Agromyzidae. This article should not be taken as the final word on Maltese Agromyzidae, but only as a baseline for further investigation and monitoring of this interesting and important family of flies.

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Common Agromyzinae	Common Phytomyzinae	Pest species
<i>Agromyza abiens</i>	<i>Aulagromyza orphana</i>	<i>Agromyza rondensis</i>
<i>Agromyza apfelbecki</i>	<i>Cerodontha denticornis</i>	<i>Liriomyza bryoniae</i>
<i>Agromyza rondensis</i>	<i>Chromatomyia horticola</i>	<i>Liriomyza huidobrensis</i>
<i>Melanagromyza eriolepidis</i>	<i>Liriomyza bryoniae</i>	<i>Liriomyza sativae</i>
<i>Ophiomyia cunctans</i>	<i>Liriomyza huidobrensis</i>	<i>Liriomyza strigata</i>
	<i>Liriomyza orbona</i>	<i>Liriomyza trifolii</i>
	<i>Liriomyza pedestris</i>	
	<i>Liriomyza trifolii</i>	
	<i>Phytomyza conyzae</i>	
	<i>Phytomyza lateralis</i>	
	<i>Phytomyza ranunculi</i>	

Table 1 – Agromyzidae that are very frequently encountered on the Maltese Islands in a diversity of habitats, and pest species whether or not in open fields or in greenhouses.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Agromyza abiens</i>			x	x	x					x	x	
<i>Agromyza apfelbecki</i>	x		x	x								x
<i>Agromyza frontella</i>				x								
<i>Agromyza graminicola</i>				x	x							
<i>Agromyza hiemalis</i>	x		x									x
<i>Agromyza myosotidis</i>					x							
<i>Agromyza nana</i>		x	x									x
<i>Agromyza nigrella</i>			x								x	
<i>Agromyza nigrescens</i>			x									
<i>Agromyza nigripes</i>				x								
<i>Agromyza rondensis</i>	x	x	x	x						x	x	
<i>Agromyza spenceri</i>					x						x	
<i>Japanagromyza salicifolii</i>					x							
<i>Melanagromyza albocilia</i>							x	x				
<i>Melanagromyza cunctans</i>					x	x						
<i>Melanagromyza eriolepidis</i>		x	x	x								
<i>Melanagromyza lappae</i>				x	x							
<i>Melanagromyza siciliensis</i>				x	x							
<i>Melanagromyza sojæ</i>				x							x	
<i>Melanagromyza symphyti</i>					x							
<i>Ophiomyia alliarie</i>				x				x			x	
<i>Ophiomyia asparagi</i>				x	x							
<i>Ophiomyia beckeri</i>		x	x		x	x					x	
<i>Ophiomyia cunctata</i>		x	x	x								
<i>Ophiomyia curvipalpis</i>				x				x				
<i>Ophiomyia maura</i>				x								
total species number per month	3	5	10	15	11	2	1	3	0	2	7	3

Table 2 – Phenology of Agromyzidae Agromyzinae on the Maltese Islands based on new records and records from the literature.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Amauromyza luteiceps</i>				x	x		x		x			
<i>Amauromyza maltensis</i>			x	x	x							
<i>Aulagromyza anteposita</i>	x		x	x								
<i>Aulagromyza discrepans</i>		x	x	x								
<i>Aulagromyza orphana</i>			x	x								
<i>Aulagromyza sp. A</i>				x								
<i>Aulagromyza sp. B</i>							x					
<i>Calycomyza humeralis</i>				x	x	x						x
<i>Cerodontha denticornis</i>				x	x	x						
<i>Cerodontha (B.) vignae</i>				x		x	x					
<i>Cerodontha (D.) crassiseta</i>			x							x		
<i>Metopomyza scutellata</i>				x	x							
<i>Phytoliriomyza arctica</i>				x								
<i>Phytoliriomyza perpusilla</i>			x									
<i>Phytomyza (N.) bellidis</i>			x	x	x							
<i>Phytomyza (N.) carotæ</i>		x	x		x							

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Phytomyza (N.) cichorii</i>			x									
<i>Phytomyza (N.) lateralis</i>			x	x	x						x	x
<i>Phytomyza anemones</i>			x									
<i>Phytomyza bellidina</i>			x									
<i>Phytomyza clematidis</i>		x	x									
<i>Phytomyza conyzae</i>			x	x	x					x	x	x
<i>Phytomyza ferulae</i>			x									
<i>Phytomyza ferulivora</i>		x	x							x	x	x
<i>Phytomyza gymnostoma</i>		x	x	x								
<i>Phytomyza horticola</i>		x	x	x	x	x				x	x	x
<i>Phytomyza orobanchia</i>			x	x								
<i>Phytomyza plantaginis</i>		x									x	
<i>Phytomyza ranunculi</i>		x	x									
<i>Phytomyza rufipes</i>				x							x	x
<i>Phytomyza sp. aff. spoliata</i>		x	x									
<i>Pseudonapomyza atra</i>			x	x	x							
<i>Ps. lacteipennis</i>				x	x	x						
<i>Pseudonapomyza vota</i>				x		x						
<i>Phytomyza (Pt.) asparagivora</i>			x	x								
<i>Phytomyza (Pt.) czernyi</i>				x	x						x	
total species number per month	1	9	23	23	13	6	3	0	1	4	7	6

Table 3 – Phenology of Agromyzidae Phytomyzinae (*Liriomyza* excluded) on the Maltese Islands based on new records and records from the literature.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Liriomyza brassicae</i>	x		x	x	x					x	x	
<i>Liriomyza bryoniae</i>			x		x	x		x		x		
<i>Liriomyza cicerina</i>					x							x
<i>Liriomyza congesta</i>			x	x								
<i>Liriomyza endiviae</i>					x							
<i>Liriomyza erucifolii</i>				x	x							
<i>Liriomyza flaveola</i>			x									
<i>Liriomyza huidobrensis</i>			x			x						
<i>Liriomyza melitensis</i>	x		x									
<i>Liriomyza orbona</i>		x	x	x								
<i>Liriomyza pedestris</i>		x	x	x							x	x
<i>Liriomyza phryne</i>			x									
<i>Liriomyza pusilla</i>		x										
<i>Liriomyza richteri</i>			x	x								
<i>Liriomyza sativae</i>					x							
<i>Liriomyza sonchi</i>					x							
<i>Liriomyza strigata</i>					x							
<i>Liriomyza taraxaci</i>			x	x	x						x	
<i>Liriomyza trifolii</i>					x				x	x		
total species number per month	2	3	11	7	10	2	0	1	1	3	3	2

Table 4 – Phenology of Agromyzidae Phytomyzinae (*Liriomyza*) on the Maltese Islands based on new records and records from the literature.

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