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# The preimaginal stages and bionomics of *Scythris sinensis* (Felder and Rogenhofer, 1875) (Lepidoptera, Scythrididae), a Borer in *Chenopodium album* L. (Chenopodiaceae)

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RESEARCH ARTICLE

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## ABSTRACT

The bionomics and distribution of *Scythris sinensis* (Felder and Rogenhofer, 1875) were studied in Hungary from 2004 to 2018. The host plant was found to be *Chenopodium album* L. The larva feeds on the leaves in a loose web. The length of the larval stage varies from 12 to 15 days, that of the pupal stage from 7 to 10 days of the summer generation. The species is generally bivoltine in Hungary, but in the southern, warmer areas a third partial generation may occur. Adults of the second and third generations have characteristic yellow patches on the forewing. The species overwinters as pupa in a white cocoon near the host plant. The immature stages and the adult are illustrated and a map of the Hungarian records is given with two Figures.

## KEYWORDS

Hungary, ruderals, *sinensis* species group, trivoltine, urban environment

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## INTRODUCTION

The family Scythrididae is known to contain altogether 885 described species (Passerin d'Entrèves and Roggero, 2007), divided into 63 species groups (Bengtsson, 1997). 186 species occur in Europe (Bengtsson, 2013). The most species-rich genus is *Scythris* Hübner, [1825] (Heppner, 2008), with more than 700 species (Bengtsson, 2014). In Hungary 31 species have been found hitherto (Pastorális and Buschmann, 2018). Four species are classified to the *sinensis* species group: *S. sinensis* (Felder and Rogenhofer, 1875), *S. dahurica* Sinev, 2001, *S. lvovskyi* Sinev, 2001 (Sinev, 2001), and *S. bicruris* Zhang and Li (2011).

Scythrididae feed on plants belonging to several plant families. The host plants of twelve species occurring in Hungary are still unknown (Table 1).

*Scythris sinensis* (Felder and Rogenhofer, 1875) was described by Felder and Rogenhofer (1875) as *Butalis sinensis* from China (Shanghai). The first European data are from Latvia in 1971 (Sattler, 1971; Šulcs, 1973); until then this species had been known only from East Asia: mainland China, Japan, Korea and Taiwan (Kanazawa and Heppner, 1992). In Europe *S. sinensis* has been hitherto found in Estonia (Martin, 1991), Germany (Sutter, 1994), Great Britain (Sattler, 1971), Hungary (Szabóky and Takács, 2004), Lithuania (Ivinskis, 2004), Poland (Malkiewicz and Dobrzański, 2011), and Ukraine (Bidzilya et al., 2017). It is also present in North America (Pennsylvania) where it was first found in 2011 (Landry et al., 2013).

The first Hungarian record of the species originates from the Tápió area in 2004, in the settlement of Tápióság (Szabóky and Takács, 2004).

## MATERIAL AND METHODS

Adults from Tápióság (3 ♂ and 2 ♀; 2MAY2016) were fed with inflorescences of *Erigeron annuus* and *Achillea ochroleuca* Ehch. One of the females laid 22 eggs, the other one 17 eggs. Of the 22 eggs 14 larvae pupated and 11 moths emerged (7 ♂, 4 ♀), the other clutch (17 eggs) resulted nine pupae and seven adults (4 ♂, 3 ♀). In Mártély 48 larvae (L1) were collected on 10OCT2017. Four insectariums (80 × 80 × 100 cm) were used for rearing this group. *Chenopodium album* L. was used as host plant. Overwintering occurred in natural conditions in a net cage. Altogether 31 larvae pupated from this group and 19 adults emerged (12 ♂, 7 ♀) from 3 to 8 May 2018. Images were prepared with a Canon 450D digital camera through a Zeiss stereomicroscope. The image on the ovum was prepared with an Olympus DP70 photographic microscope and its softwares DPController and DPManager.

## RESULTS AND DISCUSSION

### Host plant

We found larvae only on *Chenopodium album* L. in Hungary. This plant, regarded as a weed in agricultural areas, is widespread and frequent all over the country (Takács and Szabóky, 2009). *Chenopodium hybridum* L., *Ch. rubrum* L., *Ch. giganteum* D.Don, *Ch. vulvaria* L. and *Atriplex patula* L. were also checked for larvae; feeding on the last species was reported by Landry et al. (2013).

*Table 1.* Host plants of the Hungarian *Scythris* species

| Species | Host plants | Plant Family | References |
|---|---|---|---|
| *S. aerariella* (Herrich-Schäffer, 1855) | *Astragalus* sp. | Fabaceae | Heckford and Beavan (2018) |
| *S. apicistrigella* (Staudinger, 1870) | unknown | unknown | |
| *S. bengtssoni* Patocka et Liska, 1989 | unknown | unknown | |
| *S. bifissella* (O. Hofmann, 1889) | *Silene otites* (L.) Wibel | Caryophyllaceae | Hausenblas (2009) |
| *S. buszkoi* Baran, (2004) | *Lycium barbarum* L. | Solanaceae | Baran (2004) |
| *S. cuspidella* ([Denis et Schiffermüller], 1775) | unknown | unknown | |
| *S. emichi* (Anker, 1870) | *Gypsophila fastigiata* L. | Caryophyllaceae | Bengtsson (1997) |
| *S. fallacella* (Schläger, 1847) | *Helianthemum nummularium* L. | Cistaceae | Schmid (1886) |
| *S. flavilaterella* (Fuchs, 1886) | unknown | unknown | |
| *S. fuscoaenea* (Haworth, 1828) | *Helianthemum nummularium* L. | Cistaceae | Schmid (1886) |
| *S. gozmanyi* Passerin d'Entrèves, 1986 | unknown | unknown | |
| *S. hungaricella* Rebel, 1917 | *Thymus* spp. | Lamiaceae | Bengtsson (1997) |
| *S. knochella* (Fabricius, 1794) | *Cerastium arvense* L., *C. semidecandrum* L. | Caryophyllaceae | Bengtsson (1997) |
| *S. laminella* ([Denis et Schiffermüller], 1775) | *Rhytidiadelphus squarrosus* (Hedw.) Warnst. | Hylocomiaceae | Fuchs (1901) |
| *S. limbella* (Fabricius, 1775) | *Chenopodium vulvaria* L., *Chenopodium hybridum* (L.) S. Fuentes, Uotila et Borsch, *Chenopodium* spp., *Atriplex* spp. | Amaranthaceae | Gartner (1865) |
| *S. obscurella* (Scopoli, 1763) | *Cerastium arvense* L. | Caryophyllaceae | Bengtsson (1997) |
| *S. palustris* (Zeller, 1855) | unknown | unknown | |
| *S. pascuella* (Zeller, 1855) | unknown | unknown | |
| *S. paullella* (Herrich–Schäffer, 1855) | *Polytrichum* spp. | Polytrichaceae | Schütze (1931) |
| *S. picaepennis* (Haworth, 1828) | *Lotus corniculatus* L., *Lotus* spp. | Fabaceae | Benander (1965), Bengtsson (1997) |
| *S. podoliensis* Rebel, 1938 | unknown | unknown | |
| *S. productella* (Zeller, 1839) | *Origanum vulgare* L. | Lamiaceae | Bengtsson (1997) |
| *S. punctivittella* (O. Costa, 1836) | unknown | unknown | |
| *S. siccella* (Zeller, 1839) | *Hieracium pilosella* L., *Rumex acetosella* L. | Asteraceae, Polygonaceae | Baran (2003) |
| *S. seliniella* (Zeller, 1839) | unknown | unknown | |

*(continued)*

**Table 1.** Continued

| Species | Host plants | Plant Family | References |
|---|---|---|---|
| *S. sinensis* (Felder et Rogenhofer, 1875) | *Chenopodium album* L., *Atriplex patula* L. | Amaranthaceae | Landry et al. (2013) |
| *S. subseliniella* (Heinemann, 1876) | unknown | unknown | |
| *S. subcinctella* (Bruand, [1851]) | *Helianthemum* spp. | Cistaceae | Delmas (2016) |
| *S. tabidella* (Herrich-Schäffer, 1855) | unknown | unknown | |
| *S. tributella* (Zeller, 1847) | *Securigera varia* (L.) Lassen | Fabaceae | Bengtsson (1997) |
| *S. vittella* (O. Costa, 1834) | *Helianthemum canum* (L.) Baumg. | Cistaceae | Krone (1905) |

## Preimaginal stages

**Egg.** Oval, yellow, densely covered with tiny, wart-like structures (Fig. 1d). Diameter of egg 0.2 mm, length 0.5 mm.

**Larva.** Four instars were observed in rearing. Head of L2 black, its body yellowish green. Head of L3 flat, elongated, brown with one lateral streak on each side, its body yellowish green, thoracic segments with brown stripes. Head of L4 brown with strong, black lateral streaks, its body reddish brown with longitudinal lines on each side and midline (Fig. 1e), very sparsely setose. Length of fully grown larva 20–22 mm. Length of larval stage varies from 12 to 15 days.

**Pupa.** Brown, in a dense, white cocoon (Fig. 1f). Caterpillars of the summer generation pupate on the host plant and overwinter near this individual plant. Length 6 mm, diameter 1.2 mm. The pupal stage lasts for 7–10 days in the summer generations.

Morphology of immature stages did not show any difference compared to the detailed illustration of Silviana (2018).

## Adult

Wingspan 12–14 mm (N = 52). Forewing of first generation (Fig. 1c) monochromatic black, hindwing greyish brown. Forewings of second (Fig. 1b) and third generations (Fig. 1g) with black ground colour and a yellow patch at apex and another one at base. Abdominal segments A1–3 of males black, A4–7 yellow, last segment with a tiny black dot (Fig. 1g). Colouration of female abdomen similar to that of male, but last segment without the tiny dot (Sattler, 1971).

## Bionomy

Habitats of this species include edges of arable land, ruderal places, wasteland, roadsides and city parks where the host plant, *Chenopodium album* L. is frequent.

The flight period in Hungary lasts from early May to early October, covering two or three generations, with males emerging 3–5 days before the females, according to field observations. Adults actively feed on flowers of Asteraceae species (Fig. 1a), both in captivity and in field. Females start calling three days after emergence, around 17h. Mating lasts for 30–60 minutes (Fig. 1c). Females readily make scent trails on solid surface (leaf, stem) by rubbing their

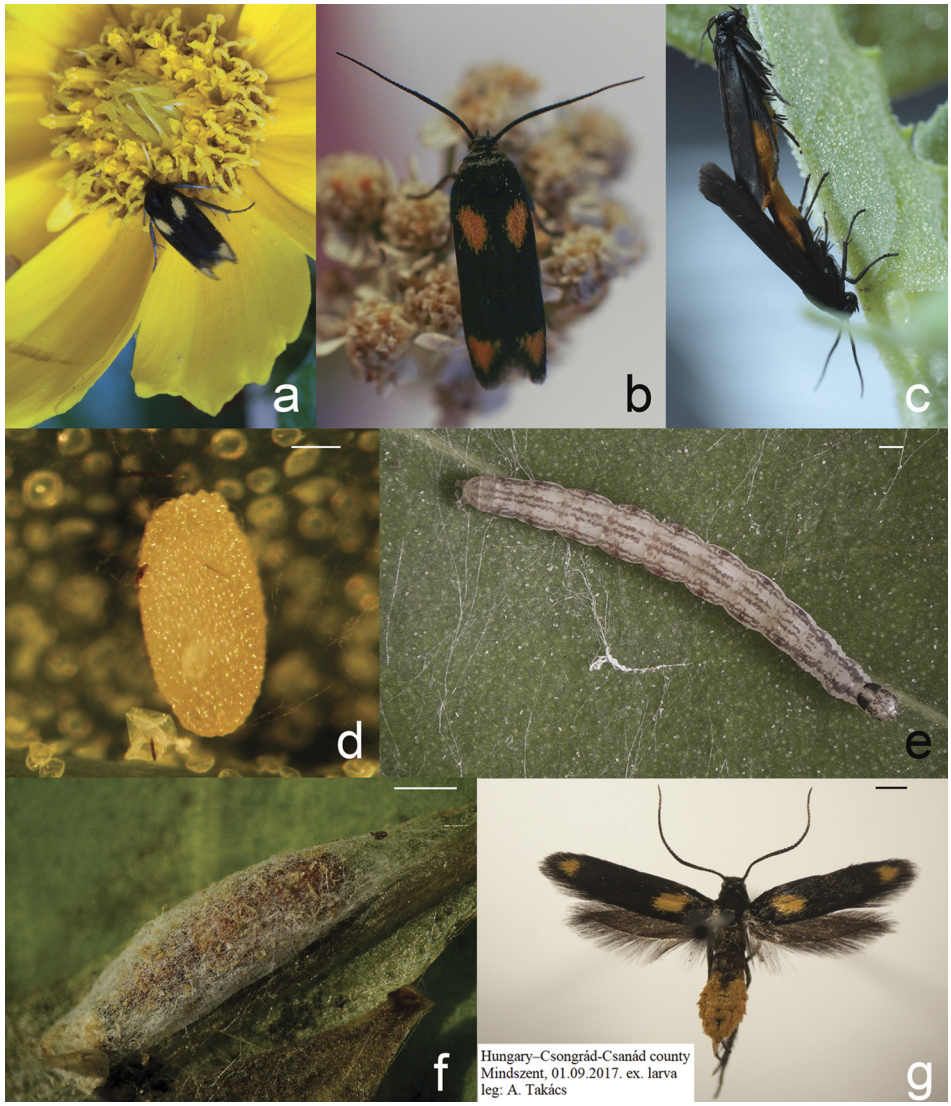


*Fig. 1.* Adults and preimaginal stages of *Scythris sinensis* (Felder and Rogenhofer, 1875) from Hungary: a: feeding adult, Tápióság, 20.vii.2009, b: adult of 2nd generation; forewing with two yellow patches, Budapest, 20.vii.2019, c: copula, Tápióság, 15.vi.2008, d: egg, Budapest, 10.vi.2006, e: larva, L4 stage, Budapest, 18.vi.2014, f: pupa, Velence, 20.vi.2018, g: set adult specimen, 3rd generation, Mindszent, 1.ix.2017. Scale bar of Fig. 1d: 0.1 mm, of Figs 1e–g: 1 mm. Fig. 1b: photo by Tamás Marsi, 1d: photo by Tibor Csővári, remaining by Attila Takács. All specimens: leg. Attila Takács

abdomen against the surface, and these are followed by walking males. One female can mate with 2–3 males (in separate days) before oviposition. Oviposition occurs at the base of a shoot of the host plant, 3–6 eggs are laid at each occasion.

Larvae hatch from 9 to 11 days after egg laying at laboratory conditions. They feed in a loose web from June to July, in August, and from September to October. The web never contains frass, the larvae defecate outside the web, in a pile.

Larvae in L1–L2 stages peel shoots and young leaves in a group. As a result, the shoot apex will be bent by ca. 45°. Larvae L3–L4 feed one by one exclusively on the leaf blade, leaving the nervation intact. According to Sattler (1971) and Bengtsson (1997) larvae feed also on seeds, however, this behaviour was not observed by us.

The fully grown larva makes a strong, white cocoon before pupation, pupae of the autumn generation overwinter in this cocoon. Moths of the first generation (without yellow patch on forewing: Fig. 1c) fly in May and June, those of the second generation in July and the partial third one (Fig. 1g) in September and October (adults of the two latter generations with yellow patches on the forewing).

## Earlier records and further data

On 25 June 2005, two larvae were found in the 16th district of Budapest. Overwintering of these larvae was successful, two adults emerged on 19 April 2006. In the Tápió area, close to Farmos, a pair in copula was found on 7 June 2006. The female was collected and laid five eggs in captivity, but rearing was unsuccessful. On 7 June 2007 three larvae were found in Debrecen, East Hungary, all of them were parasitized. On the next day, 8 June, one female and 35 larvae were found. We reared these larvae in captivity where 25 pupated within 5–6 days, the others died. In the same year, on 27 June, five adults emerged, showing the wing pattern of the second

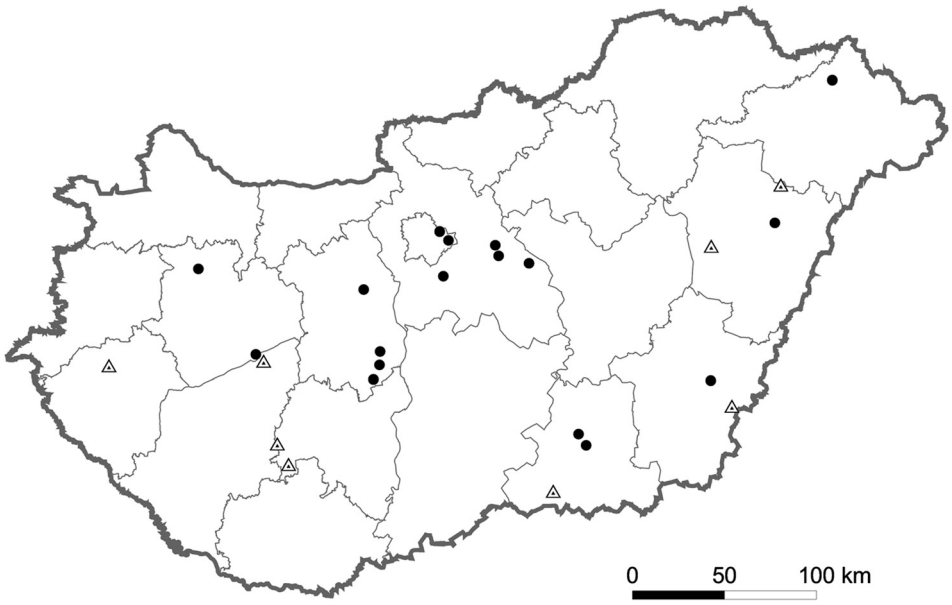


*Fig. 2.* Localities of *Scythris sinensis* in Hungary. Dots: localities discovered by the authors; triangles: data from Károlyi (2020). Map by Kristóf Antal

generation. The remaining pupae overwintered, adults emerged from 17 to 20 April 2008 (13 ♂, 7 ♀) (Takács and Szabóky, 2009).

Further records (Fig. 2): Tihany, 14DEC2009 (emerged in captivity); Pápa, 14MAY2012; Budapest 17th district, 2JUNE2015; Kisvárda, 25JUNE2016; Mindszent, 1AUG2017; Mártély, 10OCT2017; Alsószentiván, 15JUNE2018; Mezőfalva, 15JUNE2018; Nagykarácsony, 5JUNE2018; Velence, 16JUNE2018. All specimens: leg. A. Takács.

For data of other authors see Fazekas (2008), Szabóky (2019) and Károlyi (2020).

## CONCLUSIONS

*Scythris sinensis* (Felder and Rogenhofer, 1875) lives in xerothermic and urban areas, disturbed land, thus occurs in isolated patches. Its host plant is *Chenopodium album* L., a widespread and frequent weed in Hungary. In spite of the status of the host plant, the moth is not frequent. *Scythris sinensis* was found to be bivoltine in Hungary at the time of its discovery (Takács and Szabóky, 2009), however recent observations revealed that it can develop a partial third generation, similarly to Asian populations. Potential feeding on *Atriplex patula* L. (Landry et al., 2013) cannot be confirmed by our studies.

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## REFERENCES

Baran, T. (2003). Life history and description of the preimaginal stages of *Scythris siccella* (Zeller, 1839) (Lepidoptera: Scythrididae). *Entomologica Fennica*, 14(4): 211–219.

Baran, T. (2004). *Scythris buszkoi* sp. n., a new species of Scythrididae from Europe (Gelechioidea). *Nota Lepidopterologica*, 26(3–4): 89–98.

Benander, P. (1965). Notes on the larvae of Swedish micro–lepidoptera. II. *Opuscula Entomologica*, 30(1–2): 1–23.

Bengtsson, B. Å. (1997). *Scythrididae, microlepidoptera of Europe 2*. Apollo Books, Stenstrup, 301 pp.

Bengtsson, B. Å. (2013). Fauna Europaea: Scythrididae. In: Karsholt et, O. and van Nieukerken, E. J. (Eds), *Fauna Europaea: Lepidoptera, moths*. Fauna Europaea version 2017.06, https://fauna-eu.org.

Bengtsson, B. Å. (2014). The Afrotropical Scythrididae. *Esperiana Memoir*, 7: 1–365.

Bidzilya, O. V., Budashkin, Y. I. and Zhakov, V. A. (2017). Checklist of scythridid moths (Lepidoptera, Scythrididae) of Ukraine with description of two new species. *Zootaxa*, 4291(3): 481–503. https://doi.org/10.11646/zootaxa.4291.3.3.

Delmas, S. (2016). Examination of the Scythrididae in the Bruand d'Uzelle collection: faunistic and taxonomic implications for the genus Scythris (Lepidoptera, Scythrididae). *Nota Lepidopterologica*, 39(2): 151–167.

Fazekas, I. (2008). A *Scythris sinensis* Felder et Rogenhofer, 1875 új lelőhelye Magyarországon (Microlepidoptera: Scythrididae) [New record of the *Scythris sinensis* Felder et Rogenhofer, 1875 in Hungary (Microlepidoptera: Scythrididae)]. *Acta Naturalia Pannonica 3. Supplementum*, 2: 169–172.

Felder, R. and Rogenhofer, A. F. (1875). Plate 140. In: Felder, C., Felder, R. and Rogenhofer, A. F. (Eds). *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. von Wüllerstorf-Urbair. Zoologischer Theil. Zweiter Band. Zweite Abtheilung. Lepidoptera. Atlas*. Kaiserliche Akademie der Wissenschaften, Carl Gerold's Sohn, Vienna, pp. 1–140.

Fuchs, A. (1901). Vier neue kleinfalter der Europäischen fauna. *Stettiner Entomologische Zeitung*, 62: 382–387.

Gartner, A. (1865). Die Geometrinen und Mikrolepidopteren des Brünner Faunen-Gebietes. *Verhandlungen des Naturforschenden Vereines in Brünn*, 4: 48–270.

Hausenblas, D. (2009). Korrekturen und Ergänzungen zur Mikrolepidopterenfauna Baden-Württembergs und angrenzender Gebiete – 2. Beitrag. *Mitteilungen Entomologischer Verein Stuttgart*, 44: 81–107.

Heckford, R. J. and Beavan, S. D. (2018). *Scythris aerariella* (Herrich-Schäffer, 1855) (Lepidoptera: Scythrididae): discovery of the larva in Croatia, and observations on the male genitalia. *Entomologist's Gazette*, 69(4): 268–274.

Heppner, J. B. (2008). Flower moths (Lepidoptera: Scythrididae). In: Capinera, J. L. (Ed.), *Encyclopedia of entomology*. Springer, Dordrecht, pp. 1488–1489.

Ivinskis, P. (2004). *Lepidoptera of Lithuania. Annotated catalogue*. Institute of Ecology of Vilnius University, Vilnius, 380 pp.

Kanazawa, I. and Heppner, J. B. (1992). Gelechiidae. In: Heppner, J. B. and Inoue, H. (Eds), *Lepidoptera of Taiwan*, vol. 1, Part 2. Gainesville, Florida, p. 276.

Károlyi, B. (2020). Ízeltlábúak.hu – segítünk egymásnak megismerni Magyarország ízeltlábú élővilágát [Ízeltlábúak.hu – we help each other to explore the arthropod fauna of Hungary]. https://www.izeltlabuak.hu/faj/aranyfaru-zoldmoly.

Krone, W. (1905). Über die bisher unbekannten ersten Stände einiger Microlepidopteren. *Wiener Entomologischer Verein*, 15: 93–103.

Landry, J. F., Nazari, V., Dewaard, J. R., Mutanen, M., Lopez-Vaamonde, C., Huemer, P. and Hebert, P. D. N. (2013). Shared but overlooked: 30 species of Holarctic Microlepidoptera revealed by DNA barcodes and morphology. *Zootaxa*, 3749(1): 1–93. https://doi.org/10.11646/zootaxa.3749.1.1.

Malkiewicz, A. and Dobrzański, X. (2011). *Scythris sinensis* (Felder & Rogenhofer, 1775) – the first record in Poland, and some new regional records of Scythrididae (Lepidoptera). *Polish Journal of Entomology*, 80: 517–521. https://doi.org/10.2478/v10200-011-0040-1.

Martin, M. (1991). *Catalogus Microlepidopterorium Estoniae*. Eesti pisiliblikate nimestik. Abiks Looduse-vaatiejale. 91. Eesti Teaduste Akadeemia, Tartu, 56 pp.

Passerin d'Entrèves, P. and Roggero, A. (2007). Scythrididae. In: Heppner, J. B. (Ed.). *Lepidopterorum catalogus, new series, vol. 3(44)*. Association for Tropical Lepidoptera and Scientific Publishers, Gainesville, Florida, p. 1−85.

Pastorális, G. and Buschmann, F. (2018). Magyarországon előforduló molylepke-fajok névjegyzéke. Checklist of the Hungarian Micro-Moths (Lepidoptera). *Microlepidoptera.hu*, 14: 1−256. https://doi.org/10.24386/Microlep.2018.14.1.

Sattler, K. (1971). On *Scythris sinensis* (Felder & Rogenhofer) and *S. chrysopygella* Caradja (Lepidoptera, Scythrididae). *Reichenbachia*, 14: 39–45.

Schmid, A. (1886). Die Lepidopteren-Fauna der Regensburger Umgegend mit Kehlheim und Wörth. *Schluss. Correspondenz-Blatt des naturwissenschaftlichen Vereines in Regensburg*, 40(10–12): 165–224.

Schütze, K. T. (1931). *Die Biologie der Kleinschmetterlinge unter besonderer Berücksichtigung ihrer Nährpflanzen und Erscheinungszeiten – Handbuch der Microlepidopteren – Raupenkalender – geordnet nach der Illustrierten deutschen Flora von H. Wagner*. Verlag des Internationalen Entomologischen Vereins e.V., Frankfurt am Main, 235 pp.

Silviana, E. (2018). Scythrididae: Scythris sinensis (Felder & Rogenhofer, 1875) – ciclo completo. In: *Acta Plantarum, forum*. Available at: http://www.floraitaliae.actaplantarum.org/viewtopic.php?f=152&t=105679 (Accessed: 23 February 2021).

Sinev, S. Y. (2001). New and little-known species of the genus *Scythris* Hbn. (Lepidoptera, Scythrididae) from the Asiatic part of Russia. *Proceedings of the Zoological Institute RAS*, 291: 3–26.

Šulcs, A. (1973). Neue und wenig bekannte Arten der Lepidopteren-Fauna Lettlands. 5. Mitteilung. *Annales Entomologica Fennica*, 39: 1–16.

Sutter, R. (1994). Beiträge zur Insektenfauna Ostdeutschlands: Lepidoptera – Scythrididae. *Beiträge zur Entomologie*, 44: 261–318.

Szabóky, Cs. (2019). *A Bakony molylepkefaunája [Micromoth fauna of the Bakony Mts.]*. Orbiculosa Kiadó, Budapest, 477 pp.

Szabóky, Cs. and Takács, A. (2004). Közép-Európa faunájára új molylepke: *Scythris sinensis* Felder et Rogenhofer, 1875 [Microlepidopteran species new for the fauna of Central Europe: *Scythris sinensis* Felder et Rogenhofer, 1875] (Lepidoptera Scythrididae). *Folia Entomologica Hungarica*, 65: 253–254.

Takács, A. and Szabóky, Cs. (2009). Az aranyfarú zöldmoly (*Scythris sinensis* Felder & Rogenhofer, 1875; Lepidoptera, Scythrididae) életmódja és elterjedése Magyarországon. [Bionomics and distribution of Scythris sinensis Felder et Rogenhofer, 1875 (Lepidoptera, Scythrididae) in Hungary]. *Növényvédelem*, 45(7): 356–358.

Zhang, J. and Li, H. (2011). Review of the sinensis group of the genus *Scythris* (Lepidoptera: Scythrididae) from China. *Entomological News*, 121(1): 63–69. https://doi.org/10.3157/021.121.0113.