

Notes on *Lasioptera rubi* (Schrank) (Diptera: Cecidomyiidae) and its larval parasitoids (Hymenoptera) on raspberries in Russia

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In this paper, larva and pupa of *Lasioptera rubi* (Schrank) infected by hymenopteran parasitoids are illustrated. For the first time it is found that *Platygaster pelias* Walker is a solitary parasite and winters at the embryonal stage inside host larva of *L. rubi* reared from galls on *Rubus idaeus* stems in Russia. *Lasioptera rubi*, *Torymus eadyi* Graham & Gijswijt and *Platygaster pelias* Walker are recorded from Russia for the first time.

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1. Introduction

The raspberry stem gall midge *Lasioptera rubi* (Schrank, 1803) (Diptera, Cecidomyiidae) occurs from Western Europe to the Far East of Russia and Japan (Yukawa *et al.* 2014). In Russia, it is widely distributed in the middle and southern parts. It has also been recorded in western Siberia (the Yenisei Siberia) (Kolomoets *et al.* 1989, Gerasimchuk 2008) and near Krasnoyarsk (Gagne 2004).

The damage inflicted on raspberry (*Rubus idaeus* Linnaeus) by galls of *L. rubi* (Fig. 1a) inhibits the growth of plants and causes partial desiccation of stems, which may break due to strong winds. Galls may also reduce crop yields in raspberry. The raspberry stem gall midge (Fig. 2b) can fly for considerable distances (own unpublished data). The orange-red larvae (Fig. 3c) re-

side under the bark of young stems, creating fusiform or irregularly globular swellings. Larvae cocoon, pupate and overwinter in the galls on the stems of raspberries and blackberries. In central Russia, the lengths of gall midge larvae observed by Batysheva (1982) are equal to 2.0–3.0 mm in 56.3–86.3% of cases and to 0.7–1.6 mm in others.

In Europe, the complex of parasitoids reared from *L. rubi* comprises 16 species of Chalcidoidea and one species of Platygastriidae (Table 1). The assemblage includes four species of *Aprostocetus* and *Sigmophora brevicornis* (Eulophidae: Tetrastichinae), three species of *Eupelmus*, *Eurytoma* and *Torymus* each, one species of Pteromalidae and one of *Platygaster* (Platygastriidae).

Here we illustrate the larval instars of *L. rubi*, report the development of its parasitoids, and pro-

Table 1. Hymenopterous parasitoid species reared from *Lasioptera rubi* mines by different authors during 1966–2006.

Parasitoid family and species	Authors	Country
Eulophidae		
<i>Aprostocetus roesellae</i> Nees, 1834	Domenichini 1966, Herting 1978	Italy, Great Britain, Russia (Far East of Russia)
<i>A. rubi</i> Graham, 1987	Graham 1987, Jennings 2005	Czechoslovakia (the Czech Republic), Finland, France, Germany, Sweden, Yugoslavia (Serbia)
<i>A. rubicola</i> Graham, 1987	Graham 1987	Germany
<i>A. tymber</i> Walker, 1839	Domenichini 1966, Simova-Tosic & Dobrivojevic 1966, Bouek 1977, Viggiani & Mazzone 1978	Austria, Czechoslovakia (the Czech Republic), France, Germany, Great Britain, Hungary, Netherlands, Sweden
<i>Sigmophora brevicornis</i> (Panzer, 1804)	Thompson 1955	Germany, France
Eupelmidae		
<i>Eupelmus fulvipes</i> Förster, 1860	Bouček 1977, Herting 1978	Yugoslavia (Serbia)
<i>E. urozonus</i> Dalman, 1820	Simova-Tosic & Dobrivojevic 1966, Tudor & Neacsu 1983	Yugoslavia (Serbia)
<i>E. vesicularis</i> (Retzius, 1783)	Thompson 1955, Herting 1978, Viggiani & Mazzone 1978, Tudor & Neacsu 1983	Germany, France, Italy, Romania
Eurytomidae		
<i>Eurytoma aterrima</i> (Schrank, 1781)	Thompson, 1955	Germany, France
<i>E. curculionum</i> Mayr, 1878	Bouček 1977	Yugoslavia (Serbia)
<i>E. rosae</i> Nees, 1834	Bouček 1977, Popescu 2006	Yugoslavia (Serbia), Romania
<i>Sycophila submutica</i> (Thomson, 1876)	Herting 1978	Great Britain
Pteromalidae		
<i>Mesopolobus rhabdophagae</i> (Graham, 1957)	Herting 1978	Great Britain
Torymidae		
<i>Torymus chloromerus</i> (Walker, 1833)	Herting 1978, Stenseth 1978	Norway
<i>Torymus eadyi</i> Graham & Gijswijt, 1998	Graham & Gijswijt 1998, Popescu 2003, Zerova & Seryogina 2003	Great Britain, Ukraine
<i>T. rubi</i> (Schrank, 1781)	Bouček 1977, Herting 1978	Yugoslavia (Serbia)
Platygastridae		
<i>Platygaster pelias</i> Walker, 1836	Vlug 1995	England, Sweden, Spain, Norway, Finland, Estonia, Denmark

vide new ecological and faunistic data on parasitoids associated with this gall midge. Although *Platygaster pelias* Walker is well-known as a parasitoid of *L. rubi*, its life history has not been described in details.

2. Materials and methods

The study was carried out in June 2009–July 2010 in two localities of the Ulyanovsk Region: the village of Staraya Mayna (68 km E from

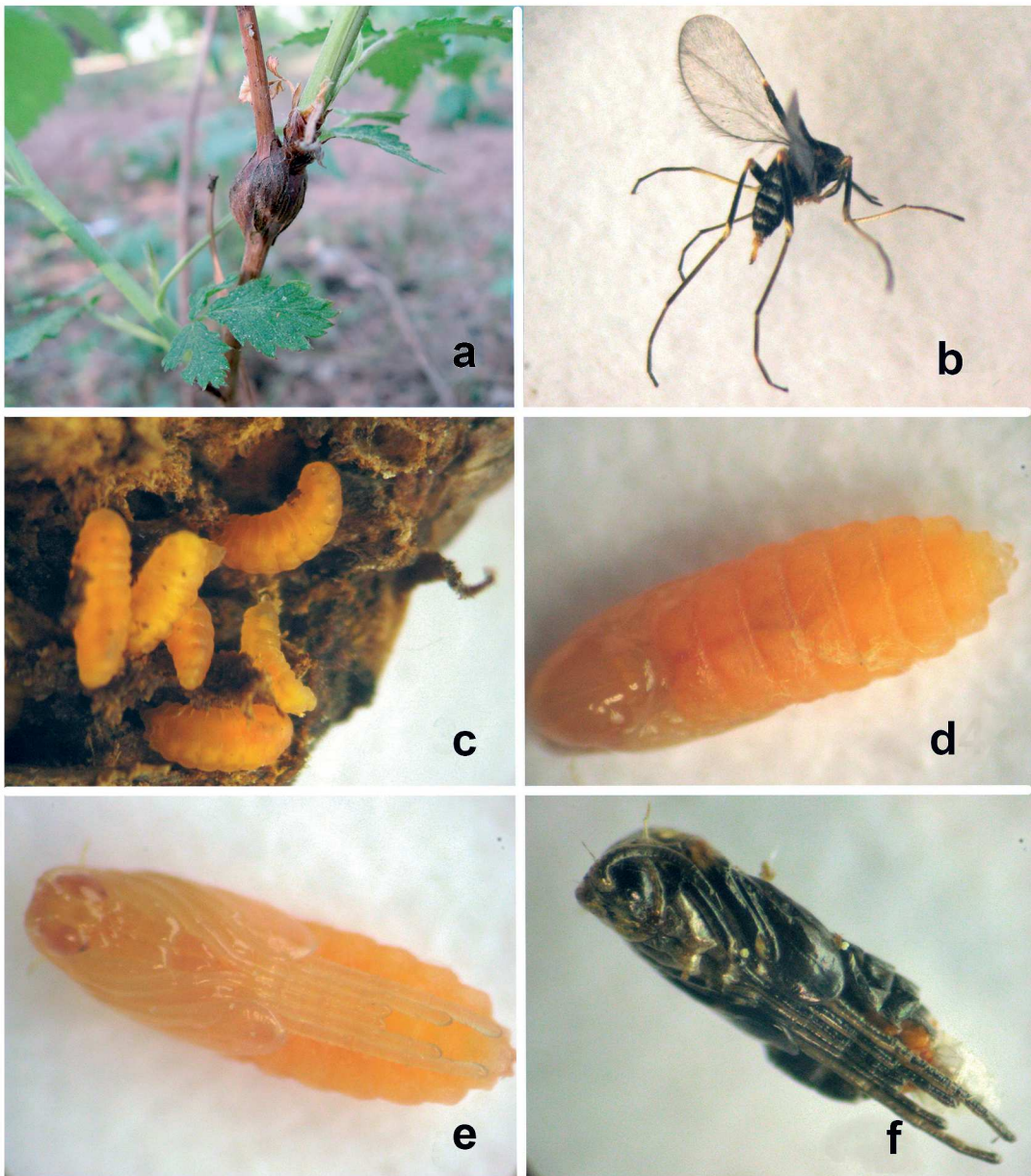


Fig. 1. Gall, male and immatures of *Lasioptera rubi*. – a. Gall on *Rubus idaeus* (6.6.2009, Ulyanovsk, Russia). – b. Male (reared from a gall). – c. Third instar larvae (opened gall). – d. Young pupa, dorsal view. – e. Young pupa, ventral view. – f. Mature pupa (ventral view).

Ulyanovsk, 54°36' N, 48°55' E) and the city of Ulyanovsk (the western bank of the river Volga, 54°19' N, 48°22' E). Altogether 530 galls of *L. rubi* were collected on raspberries from these localities.

Part of the stem, together with a gall, comprising 5–7 cm on either side of the gall, was cut from the lower and middle parts of the stem. After cut-

ting the stems, galls of *L. rubi* were placed in plastic vials (80×15 mm) with filter paper and were kept in the laboratory at a temperature of +20–22 °C and shaded from direct sunlight. Selected emergent adults were killed in 75% ethanol for identification.

A total of 153 galls were dissected to determine the number of larvae of *L. rubi* per gall. The

remaining 377 galls were kept in containers for further rearing: 20% of them became moldy (76 galls), and the rest yielded a total of 582 *L. rubi* adults, 178 specimens of *Platygaster pelias* (Proctotrupoidea: Platygasteridae), 28 specimens of *Aprostocetus rubi* (Chalcidoidea: Eulophidae) and 17 specimens of *Torymus eadyi* (Chalcidoidea: Torymidae). The parasitoids were identified using the keys provided by Trjapitzin (1978), Storozheva *et al.* (1995) and Buhl (2006). Voucher specimens are deposited in the Zoological Institution of Russian Academy of Sciences (ZISP), St.-Petersburg, Russia.

3. Larval and pupal stages of *Lasioptera rubi*

Dissected galls revealed different numbers of the raspberry stem gall midge larvae (3–5 larvae in 32 cases, 6–8 in 61 cases, 9–11 in 45 cases and 13–14 in 15 cases). Most galls (69%) contained from 6 to 11 larvae (average = 7.91, *S. D.* = 3.15, *n* = 153).

The third instar larva of *L. rubi* is initially orange-yellow (Fig. 1c). At 3.0–3.5 mm length it begins to pupate and young pupa is still orange-yellow dorsally and ventrally (Fig. 1d, e). The pupa is subsequently turning dark-brown and matures (Fig. 1f).

4. Hymenopteran parasitoids infecting larvae of *L. rubi*

No hymenopterous pupal parasitoids were found in this study.

4.1. *Platygaster pelias* Walker, 1836 (Platygasteridae)

Material. The species was represented by 178 specimens: 110♀, 10♂, reared from galls of *L. rubi* on stems of *R. idaeus* 15.7.2009, Ulyanovsk, 6.6.2009 E. N. Yegorenkova leg.; 50♀, 8♂, reared from galls of *L. rubi* on stems of *R. idaeus* 20.7.2010, Staraya Mayna, Ulyanovsk province, 14.VI.2010 E. N. Yegorenkova leg.

Comments. This species is distributed in Eng-

land, Sweden, Spain, Norway, Finland, Estonia and Denmark (Vlug 1995, Austin *et al.* 2005, Buhl 2006), and in this study as a new record in Russia.

Biology. The species is a larval parasitoid of Orthoptera, Hemiptera, Neuroptera, Coleoptera, Diptera and Lepidoptera. Among Cecidomyiidae (Diptera), *L. rubi* has also been mentioned (Vlug 1995).

Platygaster pelias, an egg-larval parasitoid, has never been mentioned from Russia (Buhl 2006). We observed the eggs and larvae of *L. rubi* infected by *P. pelias* (Fig. 2a). It means that the parasitoids overwinter as embryos. In spring of the following year, the parasitoids develop and emerge in July. Sex ratio (males:females) for adults of *P. pelias* reared in laboratory was 18:160. A dark yellow-brownish pre-pupa of *P. pelias* is clearly visible inside the *L. rubi* larva, to which it is attached by a filament (Fig. 2b). The sternal spatula of *L. rubi* is also visible in ventral view. The adult of *P. pelias* breaks through the head of the *L. rubi* larva using its mandibles to make a hole (Fig. 2c). In all cases there was one *P. pelias* pupa per prepupal larva of the host that formed a single parasitoid (Fig. 2b, c). This suggests that only one parasitoid larva develops in each host, and therefore it is a solitary parasitoid. Several larvae of *L. rubi* were found with *P. pelias* that had reached the adult stage. So this species of *Platygaster* is monembryonic as for example *Platygaster matsutama* Yoshida & Hirashima that has been reared from *Thecodiplosis japonensis* (Diptera: Cecidomyiidae) (Jeon *et al.* 1985). We establish solitary parasitism of *P. pelias* in *L. rubi* for the first time.

4.2. *Torymus eadyi* Graham & Gijswijt, 1998 (Torymidae)

Material. The species (Fig. 2f) was represented by 21 specimens: 14♀, 3♂, reared from galls of *L. rubi* on *R. idaeus* stems, 15.VII.2009, Ulyanovsk, 6.VI.2009 E. N. Yegorenkova leg.; 1♀, 3♂, reared from galls of *L. rubi* on *R. idaeus* stems, 20.VII.2010, Staraya Mayna, Ulyanovsk province, 14.VI.2010 E. N. Yegorenkova leg.

Comments. The species is distributed in Bulgaria, France, Netherlands, Romania, Ukraine

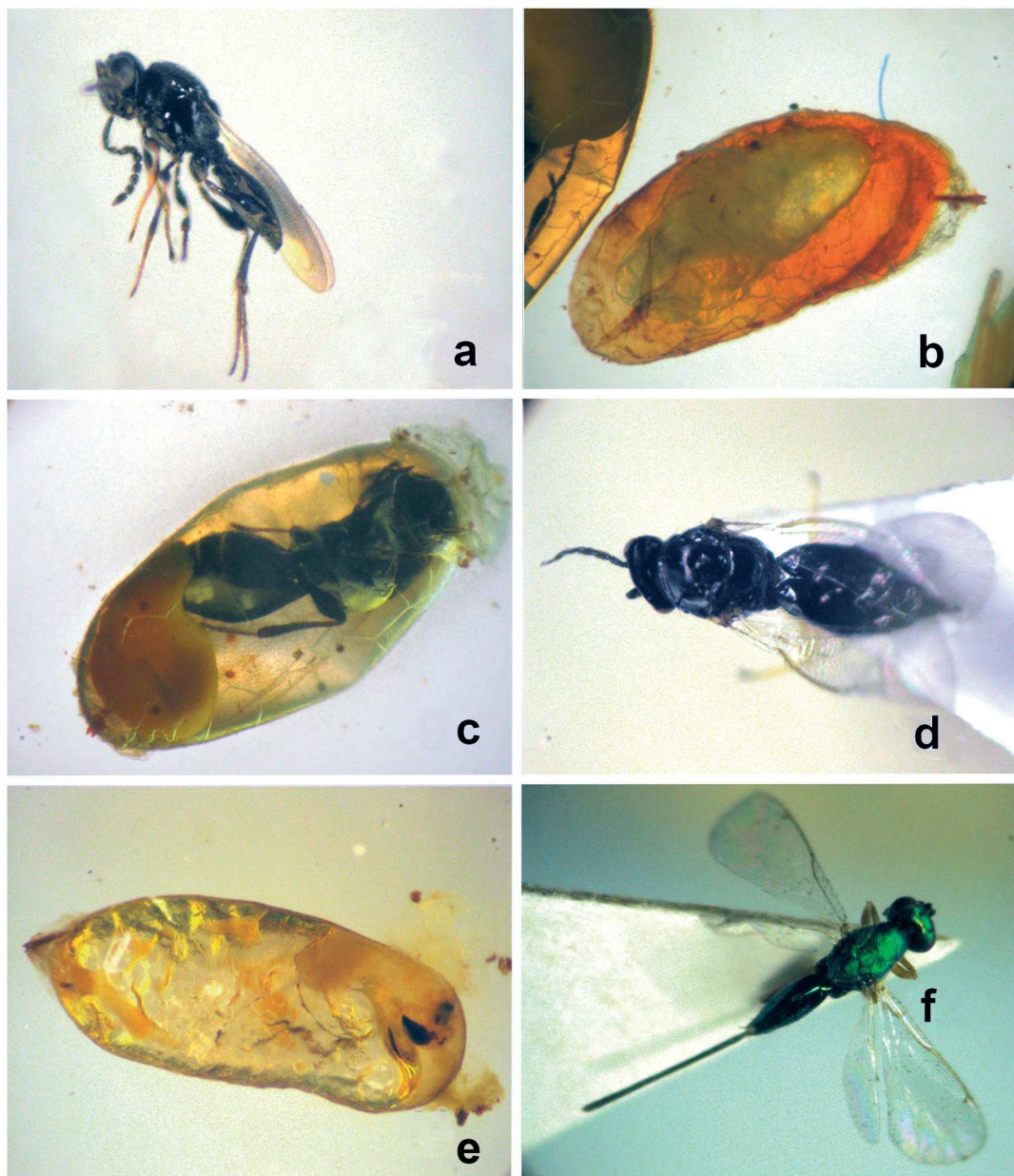


Fig. 2. Parasitoids of *Lasioptera rubi*. – a. Male *Platygaster pelias*. – b. Pre-pupa *P. pelias* inside larva of *L. rubi* (ventral view). – c. Hatching adult of *P. pelias* from larva of *L. rubi* (dorsal view). – d. Female *Aprostocetus rubi*. – e. Pre-pupa of *A. rubi* (lateral-ventral view) inside larva of *L. rubi* (head of parasitoid larva visible). – f. Female *Torymus eadyi*.

and England (Graham & Gijswijt 1998, Zerova & Seryogina 2003), and in this study as a new record in Russia as it has not been recorded from the Middle Volga Region and Russia earlier (Zerova & Seryogina 2003).

Lasioptera rubi has always been mentioned as the only host of *T. eadyi* (Graham & Gijswijt 1998, Popescu 2003, Zerova & Seryogina 2003). Female:male ratio for reared adults was 15:6.

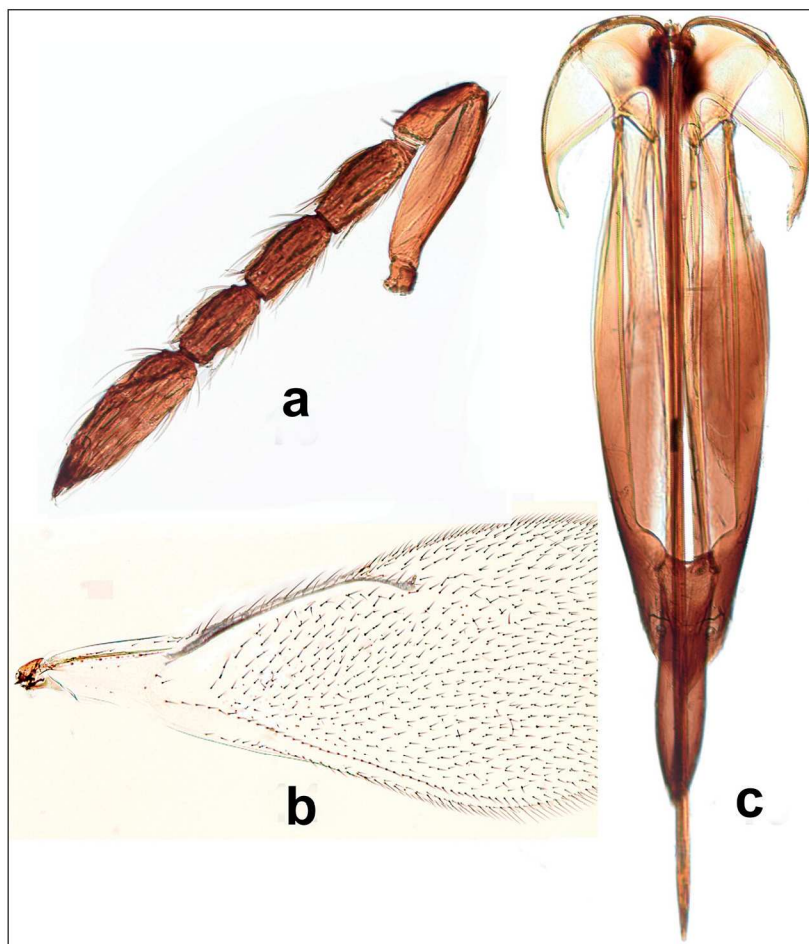


Fig. 3. Details of *Aprostocetus rubi* female.
– a. Antenna. – b. Forewing. – c. Ovipositor.

4.3. *Aprostocetus rubi* Graham, 1987 (Eulophidae)

Material. Only females were reared: 28 ♀, reared from galls of *L. rubi* on *R. idaeus* stems, 10.–12.VIII.2009, Ulyanovsk, 6.VI.2009 E. N. Yegorenkova leg.

Other material examined. 1 ♀, Germany Baden, Wurttemberg, Heilbronn, 3.V.2006 ex *Lasioptera rubi*, K. Schrameyer leg., S. Schmidt det. 2007.

Additions to original description (Graham 1987). Female (Fig. 2d) (length 1.3–1.9 mm) (1.8–2.5 mm in Graham 1987). Body black. Antennae fuscous. Legs yellowish with black coxae. POL (The minimum distance between the posterior ocelli) 2.0 times as OOL (The minimum distance between the eye margin and the nearest posterior ocellus). Antenna with 3 anelli (Fig. 3a).

Propodeum 3.1–3.2 times as broad as long, strongly reticulate with median carina, callus with 1 seta. Distance between submedian lines 1.4 times that between submedian and lateral lines. Dorsellum 1.25 times as long as propodeum. Forewing (Fig. 3b): Marginal vein of forewing with 10–11 setae (10–15 in Graham 1987). Last tergite as long as broad (1.0–1.4 in Graham 1987). Ovipositor sheaths projecting by 0.26 × length of last tergite (0.2–0.5 in Graham 1987).

Genitalia (Fig. 3c): outer plates of ovipositor (T9+T10) 3.1 times as long as broad, 1.3 times as long as inner plates of ovipositor, and 3.3 times as long as ovipositor sheaths. First and second valvulae 1.1 times as long as projecting part of sheaths.

Comments. The species is distributed in the Czech Republic, Finland, France, Germany, Netherlands, Sweden, United Kingdom, Yugo-

slavia (Serbia) (Graham 1987)) and Far East of Russia (Storozheva *et al.* 1995, Yefremova 2002) and has been mentioned as a host of *L. rubi* (Graham 1987, Jennings 2005) and *Diastrophus rubi* (Bouché 1834) (Hymenoptera: Cynipidae) (Askew *et al.* 2006). *Aprostocetus rubi* has not been reared from galls in the Middle Volga Region earlier, it had been collected only by sweeping (Yegorenkova *et al.* 2007). In some cases the prepupa of *A. rubi* may occupy almost 90% of the volume of the host body (Fig. 2e). It means that it is a solitary endoparasitoid. In Fig. 2e, a well-developed head of a parasitoid is adjacent to the head of the host larva, whose dark-coloured eyes are clearly visible.

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