

Chyliza leguminicola Melander, 1920 (Diptera: Psilidae) new to the Palaearctic fauna

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The Nearctic species *Chyliza leguminicola* Melander, 1920 has been found breeding in Denmark. It is reported here for the first time in the Palaearctic region. The first known Danish record is from 1991, and the species is well established at least in the eastern part of Jutland. Data on the distribution as currently known is presented. It is possible that *C. leguminicola* is actually established but has been overlooked also in other European countries.

The larvae of *C. leguminicola* live in the roots or stems of Garden Lupin (*Lupinus polyphyllus* Lindley, 1827). This plant is native to North America and occurs in Europe as an introduced species. It is spreading rapidly and in some areas considered invasive.

An updated key to the European species of *Chyliza* Fallén, 1820 is presented.

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Introduction

Members of the Diptera family Psilidae are slender flies with a characteristic wing venation (see below). Most of the species are rather inconspicuous with black- or brown-coloured bodies, but some are yellowish or partly red. The length of the body ranges from small to medium-sized, and the largest species of European Psilidae belong to the genus *Loxocera* and are up to 13 mm.

The larvae of Psilidae are phytophagous, and most of them feed on roots or stems of different plants. A few of the species are pests of crops. The economically most important agricultural pest is the Carrot Rust Fly, *Chamaepsila rosae* (Fabricius, 1794). Psilidae have a worldwide distribution but are mainly Holarctic. The family contains 6-8 genera and about 330 species (Freidberg & Shatalkin, 2008), with about 50 species occurring in Europe (Oosterbroek, 2006).

This paper reports *Chyliza leguminicola* Melander, 1920 for the first time in the Palaearctic region. Fig. 1 shows the general appearance of the imago. At present time the earliest known European record of *C. leguminicola* is from 1991 in Denmark, East Jutland, Nonneholt near Mariager. In the years 2003-2005 three specimens were collected on other localities. These specimens all remained unidentified until 2010, and they were kept among unsorted material in the private collections of the authors of this paper. An additional two specimens were collected in 2010, and they motivated our first attempt to identify the species. Keys to the Palaearctic species did not provide much help, and also



Fig. 1. *Chyliza leguminicola*. Frederikshavn, June 18th 2011. (Photo: R. Bygebjerg).

a search for similar material in the entomological collections in the zoological museums in Lund and Copenhagen did not give a solution to the problem of identification. The key to North American species (Melander, 1920) and a photo published on the Internet (<http://bugguide.net>) gave us the first clue regarding the identification. This was later confirmed by comparing Danish specimens with material from Oregon, USA, including a paratype on loan from National Museum of Natural History, Washington DC. The type specimens were swept from Garden Lupin (*L. polyphyllus*) by Mr. L. P. Rockwood, and he also found puparia of the species attached to the lower part of the host plant (Melander, 1920).

Among unidentified material in the collection of Naturhistorisk Museum in Aarhus we found four specimens collected in 2006-2010.

Distribution

In the Nearctic region *C. leguminicola* is known from USA and Canada on the west coast: The types are from Oregon (Melander, 1920), and on the Internet records are mentioned from California (<http://bugguide.net>) and British Columbia (<http://www.zoology.ubc.ca/bcdiptera/>). This distribution is well correlated with the native range of the host plant (Fremstad, 2010). The known distribution of *C. leguminicola* in Europe is at present time limited to Jutland, Denmark. Fig. 2 shows a map with the records marked in 10x10 km squares.

In 2011 we visited several sites in Denmark with stands of *L. polyphyllus* in search for *C. leguminicola*. On a few of the sites roots of the food plant were dug up and brought home in an attempt to hatch the flies. *C. leguminicola* was in 2011 recaptured on all except one of the localities, where we had collected it earlier. Nonneholt was not revisited in 2011.

The localities at Nonneholt and Dronninglund are forests, where lupines have spread from old gardens near houses earlier used by forest rangers. Many of the other localities are lupine stands along highways. The flies were found both in the immediate vicinity of the highways and on established stands spreading in different kinds of biotopes in adjacent nature. The Fuglslev and Øksenmølle localities are three small plots of lupines on

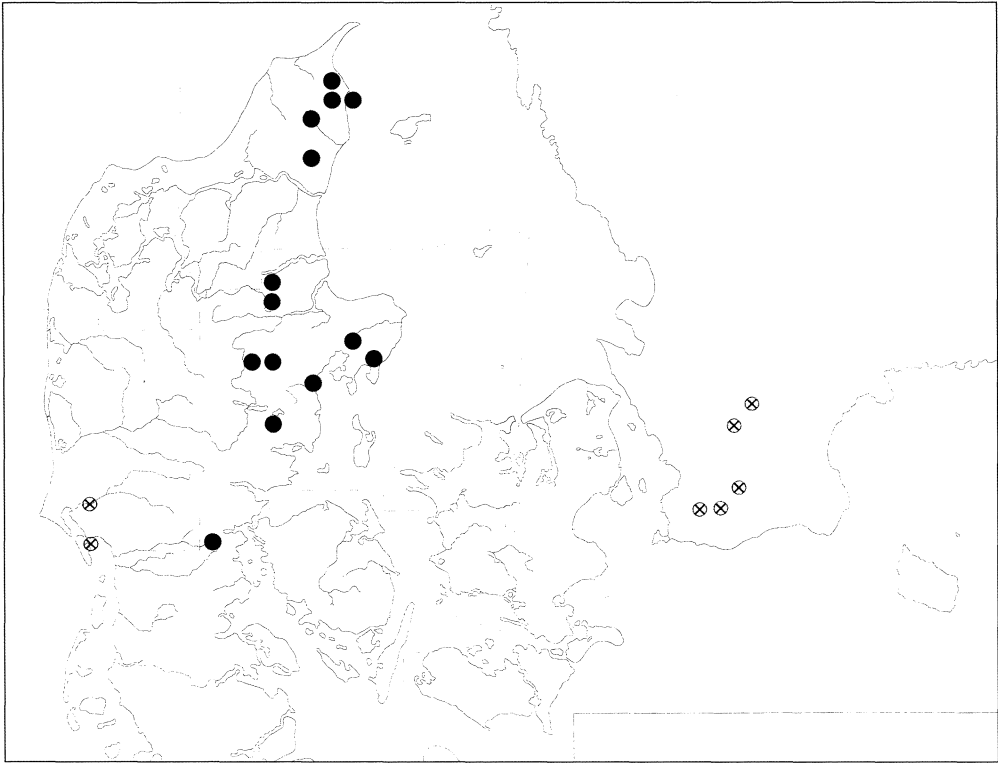


Fig. 2. Records of *Chyliza leguminicola* in Denmark (10x10 km UTM-squares). The filled symbols represent collected or observed imagines. Open symbols with "x" indicate Danish and Swedish localities with stands of lupines that were visited in May or June 2011, but where *C. leguminicola* was not found.

waste-land in open, abandoned fields on sandy soil among summer cottages. Figs 3 and 4 show two rather different types of localities for *C. leguminicola*.

In May and June 2011 we also visited several *Lupinus*-localities in Skåne (southernmost province of Sweden) and also a few sites in SW Jutland, but here the search for *C. leguminicola* was negative. The observations could indicate that *C. leguminicola* is not yet established in these areas. The best investigated of these localities are marked on Fig. 2.

Records of *C. leguminicola* in Denmark:

Bannerslund, Strandby, NJ87: 1 ♂ 16.vi. 2011 (R. Bygebjerg). Flade Kirke, NJ86: One specimen observed 18.vi. 2011 (R. Bygebjerg). Frederikshavn, NJ96: 2 ♀ 16.vi. 2011 and 1 ♂ 1 ♀ 18.vi. 2011 (R. Bygebjerg). Sæsing, NJ75: *Lupinus* plants brought home in spring 2011 for rearing; 13 ♂ 8 ♀ hatched 7.-14.v. 2011 (T. Munk & E. Thomsen). Dronninglund Storskov, Sømosen, NJ73: 1 ♂ 8.vi. 2005 and 3 ♂ 3 ♀ 15.vi. 2011 (R. Bygebjerg). Nonneholt, Mariager, NH57: 1 ♂ 25.vi. 1991 (R. Bygebjerg). Glenshøj, Hobro, NH56: 2 ♀ 26.v. 2010 (R. Bygebjerg), *Lupinus* plants brought home in spring 2011 for rearing; 10 ♂ 4 ♀ hatched 12.-17.v. 2011 (T. Munk). Kongensbro Grusgrav, NH43: 1 ♂ 27.v. 2010 (S. Tolsgaard). Frijsendal, NH53: 1 ♂ 1 ♀ 11.v. 2009 (S. Tolsgaard). Fuglslev, Ebeltoft, PH03: 1 ♀ 31.v. 2003, 1 ♂ 22.v. 2004, 2 ♂ 30.v. 2011 and 1 ♂ 2.-6.vi. 2011 caught in Malaise trap (T. Munk). Øksenmølle, Ebeltoft, PH03: 1 ♀ 7.iv. 2011 (J. Elnif). Rønne, NH94: 3 ♀ 10 ♂ 29.v. 2011 (T. Munk). Åbyhøj kolonihave, NH72: 1 ♂ 9.vi. 2006 (S. Tolsgaard).



Fig. 3. Dronninglund Storskov. Habitat for *Chyliza leguminicola*. (Photo: R. Bygebjerg).

Ejer Bavnehøj, NH50: 3 ♂ 2 ♀ 4.vi. 2011 and 4 ♂ 4 ♀ 5.vi. 2011 (T. Munk). Hylkedal, Kolding, NG24: 2 ♂ 1 ♀ 4.vi. 2011 (T. Munk).

Localities with *Lupinus* stands that were visited and searched in May or June 2011 but with no observations of *C. leguminicola*:

Sweden, Skåne: Sturup, Holmeja, Karup Nygård, Vomb, Hovdala Slot (R. Bygebjerg). Höör centrum, Stenskogen near Höör (T. Munk). Denmark: Varde, Esbjerg (T. Munk).

Identification

Family: In general flies of the family Psilidae are recognisable by a transparent line across the basal part of the wings. This line runs from a break in the costa towards the posterior margin of the wing, it is a sort of weakening in the structure, and when at rest the wings are slightly bent downwards. Fig. 1 shows a specimen of *C. leguminicola* with the typical posture of the wings. The wing venation is otherwise characteristic with the following combination of characters: Incomplete subcosta, anal cell closed with a straight cross vein, anal vein not reaching wing margin. The body is without pleural bristles, and the head is without vibrissae.

Genus: The genus *Chyliza* Fallén, 1820 is the only member of the subfamily Chylizinae (Shatalkin, 1989; 1997). The world fauna has a total of 116 species (Freidberg & Shatalkin, 2008). The Palaearctic fauna includes 26 species (Shatalkin, 1997). The main part of these are described from the eastern parts of Russia (Shatalkin, 1989). Recent publications on new species from the Asian fauna include Iwasa (1989), Wang (1995) and Shatalkin (1997).

Soós (1984) lists 6 species from the Palaearctic region, but one of these, *C. gracilis* Loew, 1854, does not belong to the genus (Shatalkin, 1997). From the European part of Russia no additional species occurs (Stackelberg, 1988). The European fauna thus now consists of a total of 6 species: *C. annulipes* Macquart, 1835, *C. extenuata* (Rossi, 1790),



Fig. 4. Rønede. Habitat for *Chyliza leguminicola*. (Photo: J. Elnif).

C. leguminicola Melander, 1920, *C. leptogaster* (Panzer, 1798), *C. nova* Collin, 1944 and *C. vittata* Meigen, 1826.

The *Chyliza* species possess the following unique combination of morphological characters: Enlarged callus-like anatergal area of laterotergite, anal cell shorter than second basal cell (i.e., the cross-vein closing the second basal cell is distinctly closer to the wing apex than the cross-vein closing the anal cell), head not triangular in profile, postcoxal bridge present, face not strongly retreating, surstyli present but parameres absent.

Keys to genera of Psilidae are published e.g. by Séguy (1934), Hennig (1941), Collin (1944), Lyneborg (1964), Steyskal (1987), Stackelberg (1988) and Buck (2010). The European keys to genera in general do not work very convincingly with specimens of *C. leguminicola*: Most of these keys mention three pairs of scutellar bristles as a distinguishing character for *Chyliza*, but several specimens of *C. leguminicola* (including the studied paratype) have only two pairs of scutellar bristles and show no trace of the third pair (notice that these bristles are easily broken off, but then the sockets are visible). Other specimens have three pairs or an asymmetrical array with five bristles. The numbers of scutellar bristles in a sample of 28 dry-mounted Danish specimens are as follows: 8 specimens have three pairs (3 females and 5 males), 12 have two pairs (4 females and 8 males), 8 have five setae (1 female and 7 males). The shape of the head is also used as a character in the keys, but *C. leguminicola* has a somewhat different head-shape compared with the native European species. Sternite 6 of males is bilobed, without the median sclerite as is present in the native Palaearctic species (Shatalkin, 1997).

The key in Buck (2010) is recommended. A key to Nearctic species is published by Melander (1920) together with the description of *C. leguminicola*.

Diagnosis/redescription of *C. leguminicola*:

Male: Head large, as wide as thorax and at least as long as half the length of the thorax, its height is about 4/5 height of thorax. Eye clearly shorter than height of head, its long axis more transverse, making an angle with posterior margin of head of about 45°. Third antennal segment small, yellow, elongate rectangular, about 1,5 x as long as its width.



Fig. 5. *Chyliza leguminicola*. Fuglslev, May 2011. (Photo: J. Elnif).

Arista with pubescence as long as width of its thickened basal part. Eye margins in dorsal view parallel or slightly diverging anteriorly. Frons, in front of ocelli, as long as wide. Distance from posterior ocelli to hind margin of vertex is equal to length of ocellar triangle. Head in dorsal view red brown, with a black stripe near eye margin, a black patch behind it on the vertex, and the ocellar triangle also black; sometimes a line in front of ocellar triangle darkened, and often a more or less pronounced black, transverse line is present slightly in front of middle of frons; palpi black. Thorax and abdomen black except for a broad red brown margin of scutellum. Mesoscutum covered with an array of dense light golden setae, whirling in different directions; in anterior half a dark line is formed on each side near the median line; in posterior half a dark line is situated more laterally. Scutellum most often with two pairs of bristles, nearly as often three pairs, and more rarely an asymmetric condition with five bristles, with no trace of the sixth. The apical pair of scutellar bristles is long and strong, the second pair about half as long. Third pair of bristles, when present, only half as long as second pair and often pale. Wings darkened almost throughout, darkest along anterior margin between costa and R_1 ; veins blackish, except for the extreme base of the wing; cross-vein between R_{4+5} and M_{1+2} is about 2x the thickness of the vein. Femora black with apices yellow; tibia 1 and 2 yellow, tibia 3 more or less black in apical 2/5, sometimes the black colouring is reduced to a dark anterior spot near apex; tibiae stout, especially tibia 3, the latter more or less curved in basal half; sixth sternite bilobed, without a median sclerite and without strong bristles or spines; surstyli narrow, straight and nearly parallel-sided. Length 6-7,5mm.

Female: Similar to male, but legs with the dark colouring more reduced; hind femur may be nearly reddish yellow, with a weak dark stripe anteriorly, sometimes tibia 3 is completely yellow.

Fig. 5 shows some of the mentioned characters in detail.



Fig. 6a. *Chyliza leguminicola*, head in profile. (Photo: J. Elnif).



Fig. 6b. *Chyliza annulipes*, head in profile. (Photo: J. Elnif).

Key to European species of *Chyliza*

- 1 Eyes small in relation to head and head profile as in Fig. 6a. Wings dark, especially darkened along costa (Fig. 7). Femora typically all predominantly black (on some specimens the black area is reduced on the hind pair). Male genitalia as in Fig. 8. Often only 2 pairs of bristles on scutellum *leguminicola*
- Eyes large in relation to head. Head profile as in Fig. 6b. Wings predominantly hyaline; apex darkened, but the dark area along costa is restricted to at most apical half of the wing. Femora all predominantly yellow. Male genitalia different. 3 pairs of bristles on scutellum (or very rarely 4 pairs) 2
- 2 Arista with dense black pubescence *extenuata*
- Arista with normal white pubescence 3
- 3 Thorax yellow with brown or blackish brown longitudinal stripes laterally and sometimes dorsally. Back of the head and frons entirely or mostly yellow. Legs yellow (or with brownish sub-apical band on hind femora) *vittata*
- Thorax black (except humeri and scutellum). Back of the head and frons all or mostly black 4
- 4 Femora yellow with black rings near tip *annulipes*
- Femora yellow 5
- 5 Male front tibia with row of small black erect spines (Fig. 9). Male sternite 6 with central part narrow and with large spines posteriorly (Fig. 10).

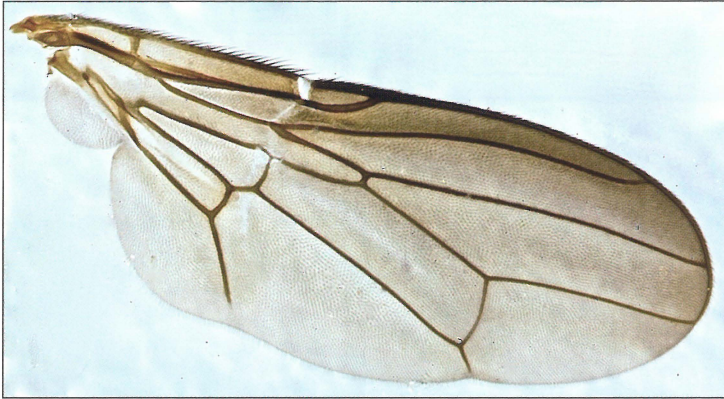


Fig. 7. Wing of *Chyliza leguminicola*. (Photo: Munk & Elnif).

- Female with second antennal segment brownish above, and dorsal side of humeri usually entirely black *leptogaster*
- Male front tibia with row of small black adpressed “humpback-shaped” spines (Fig. 9). Male sternite 6 with central part broad and somewhat triangular, and with only small spines (Fig. 10).
 Female with second antennal segment yellowish above and dorsal side of humeri usually yellow *nova*

The key is modified and augmented from the keys of Lyneborg (1964) and Andersson (1990). These publications also include data on the distribution of *Chyliza* species in Denmark and Sweden respectively. Records from Norway are published in Greve & Midtgaard (1989) and Greve (2009). Keys to European species have also been published by Hennig (1941), Collin (1944), van der Goot & van Veen (1987) and Stackelberg (1988).

In the key by Shatalkin (1997) with a review of the Asian species of *Chyliza*, specimens of *C. leguminicola* will key out with *C. annulipes*.

Danish specimens of *C. leguminicola* are deposited in the collections of Statens Naturhistoriske Museum, Copenhagen, Naturhistorisk Museum, Aarhus, and Museum of Zoology, Lund.

Notes on the biology

Observations of plant associations of the European species of Psilidae are given by Chandler (1975). The plant associations of the European species *Chyliza* species can be summarized as follows: The larvae of *C. annulipes* have been found living under the bark of *Picea* spp. and *Pinus* spp. The eggs are laid in cracks or along the edge of wounds in the bark (Lyneborg, 1987). *C. extenuata* is associated with species of *Orobancha* spp. (Chandler, 1975). The larvae of *C. leptogaster* have earlier been mentioned producing woody nutlike galls on the stem of *Spiraea* sp., but the information is questionable (Collin, 1944; Chandler, 1975). The larvae of *C. vittata* attack the roots of Orchids, *Neottia* spp. (Chandler, 1975; Greve, 2009). The larval biology of *C. nova* is unknown.

The larva of *C. leguminicola* is undescribed. Imagines have been bred from *L. polyphyllus*, and it is assumed that the larvae are eating the roots or stems of this plant. At present time we have no observations of the egg laying behaviour of females, but on one occasion two eggs and a first instar larva of a dipteran species were found under the most basal leaves of a *Lupinus* plant, and these are presumably *C. leguminicola* (R. Bygebjerg, leg.).



Fig. 8. *Chyliza leguminicola*, male genitalia. Surstyli in posterior view. (Photo: J. Elnif).

From two locations we brought home roots: The locality at Sæsing is a windy place on a slope at the road-side. The soil is heavy clay with almost no sand content; six lupine plants were dug up and brought home during April (T. Munk, E. Thomsen). Larger roots were cut into smaller pieces and placed in 12 plastic bags, with soil still attached to the roots. From May 7th to 14th, 21 adult specimens (13 males and 8 females) emerged with 3 or 4 flies from larger root-pieces, and none from small roots. The Glenshøj locality is partly sheltered by bushes, and the soil is very rich in humus. Five roots were brought home during April (T. Munk) and placed in eight plastic bags. 12 specimens emerged (8 males and 4 females) from May 12th to 17th. Roots were removed from the bags every day, shaken and beaten over a white tray. Newly emerged flies walked about and were reluctant to fly away. No empty puparia were observed, and the roots were not examined for work of the larvae.

On several localities both males and females of *C. leguminicola* were observed while they were walking around on leaves or stems of the host plant. They can also be found by sweeping the vegetation with an insect net.

The Danish imagines of *C. leguminicola* were recorded from early April to late June (with a peak in late May and early June). In April only a single specimen was found.

Discussion

In Denmark *L. polyphyllus* was originally introduced as an ornamental plant in gardens and parks. Today it is common and naturalised in many parts of the country (Kollmann et al., 2010). In several places it is spreading rapidly. It was introduced to Europe in 1826 (Fremstad, 2010). In Sweden it was first mentioned as a garden escape in Skåne in 1870 (Hylander, 1971). It is now on the “black list” of the Danish Nature Agency, Naturstyrelsen, together with other invasive and introduced species, that are potential threats to the original Danish flora (<http://www.naturstyrelsen.dk/Naturbeskyttelse/invasivearter/Arter/Plantearter/Plantearter.htm>). It has to some extent been deliberately sown along highways to avoid erosion after construction work.

C. leguminicola has only been bred from *L. polyphyllus* and is probably monophagous on lupines. Whether it is strictly monophagous on the species *L. polyphyllus* is not known. It could possibly also be able to live on other species of lupines including hybrids. Originally *C. leguminicola* must have been transported to Europe from North America some time before 1991, where the first known European specimen was found. The history of the introduction to Europe is not known at present time.

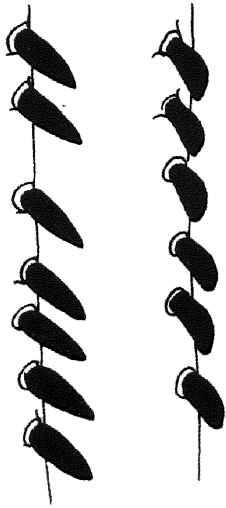


Fig. 9. Row of spines on male front tibia of *Chyliza leptogaster* (left) and *C. nova* (right). (From Andersson (1990)).

The aphid *Macrosiphum albifrons* Essig is another example of an introduced Nearctic insect species associated with lupines. It was first found in England near London, and has later been found both in Denmark and Sweden (Heie, 1991; 1994). The origin of the aphid infestations in England is not known. Stroyan (1981) suggests accidentally transport by transatlantic aircraft.

It is very possible that *C. leguminicola* is already established but overlooked in many other European countries. Hopefully this paper will inspire other entomologists to look for this species both in the field and in collections.

Our observations indicate that in some parts of Sweden and Denmark *C. leguminicola* does not occur, although the host plant is abundant. The reason for this could very well be relatively slow dispersal. The observed behaviour of imagines of *C. leguminicola* suggests that the dispersal ability of the species by its own power might not be particularly good. The rate of dispersal into new areas is likely to have increased in the latest decades because of the constant increase in traffic (cars, trains). In particular, immature stages of the species are likely to be introduced into new localities when people dig up whole plants and move them to their gardens for decoration.

The most likely scenario for *C. leguminicola* in the near future is that it will expand its area of distribution in Europe. It shall be interesting to follow this expansion in the coming years.

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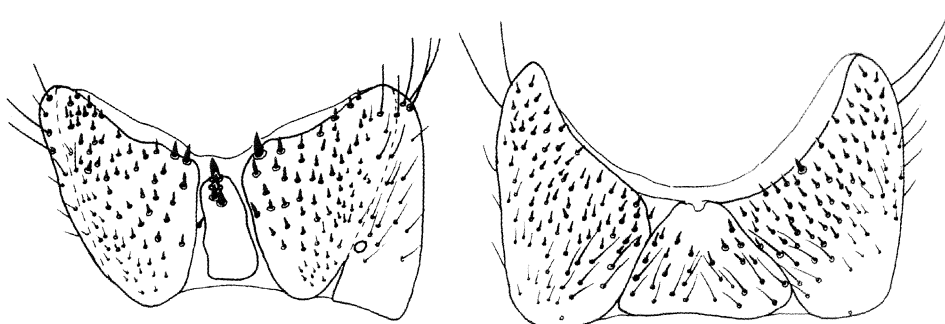


Fig. 10. Male sternite 6 of *Chyliza leptogaster* (left) and *C. nova* (right). (From Andersson (1990)).

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Dansk sammendrag

***Chyliza leguminicola* Melander, 1920 (Diptera: Psilidae) ny for den palæarktiske fauna**
Den nordamerikanske rodflue, *Chyliza leguminicola* Melander, 1920, er fundet ynglende i Danmark. Arten rapporteres i denne artikel som ny for den palæarktiske region. Det tidligste kendte danske fund er fra 1991. Arten er etableret i det østlige Jylland og forekommer her udbredt og ganske almindelig på mange lokaliteter. Det er meget muligt at *C. leguminicola* er etableret men hidtil overset også i andre europæiske lande.

Larven lever på mangebladet lupin, *Lupinus polyphyllus* Lindley, 1827. Denne plante stammer oprindeligt fra Nordamerika men er introduceret til Europa. Planten er almindelig i det meste af Danmark, og i nogle områder er den under kraftig spredning, og den kan være en trussel for den lokale flora.

En opdateret nøgle til de europæiske arter i slægten *Chyliza* præsenteres.