

## Redescription of *Melanagromyza sojae* (Zehntner) from India and Nepal

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### Abstract

Six new species of other stem flies infesting mostly legumes were also discovered under the genus *Melanagromyza* (stem flies) from Pantnagar, Northern India. These were: *M. species new ex stems of Cassia* sp. (proposed name *M. pathaki* new species); *M. species new ex stems of Glycine max* (Linn.) Merril. (proposed name *M. glycini* new species); *M. species new ex stems of Medicago denticulata* Willd. (proposed name *M. denticulata* Willd. new species); *M. species new ex stems of Pisum sativum* Linn. (proposed name *M. pisiphaga* new species); *M. species new ex stems of Trifolium pratense* Linn., (proposed name *M. sehgali* new species) and *M. species new ex stems of Vicia faba* Linn. (proposed name *M. vicivora* new species). New names have been proposed to them as per International rules of Zoological Nomenclature. Other stem flies redescribed by author include: *Ophiomyia centrosematis* de Meijere, *Ophiomyia phaseoli* (Tryon) and *Ophiomyia cicerivora*. More than one thousand male genitalia slides were prepared for this study. Variations in morphology and genitalia characters have been described between and within the species. *Melanagromyza sojae* (Zehntner) has been redescribed here.

**Key words:** Leaf miners, stem fly, Diptera, Cyclorrhous, Agromyzidae

### Introduction

Species of the genus *Melanagromyza* belong to Cyclorrhous (Diptera) of the family Agromyzidae. They are internal plant feeders. Almost 75 percent of them are leaf miners and remaining one fourth feed inside the parts of plant, like stem miners, pod feeders and seed feeders. In the world, 83 species of leaf miners are feeding on leguminous host plants. Thapa (1991) has added 13 new species of legume feeders belonging to Agromyzidae from India. World record shows that there are more than 2000 species of leaf miners infesting cultivated as well as wild host plants.

*Melanagromyza sojae*, the stem borer in soybean and other cultivated legumes is gaining national importance due to heavy economic losses they inflict on their host plants. During the study, redescription of *Melanagromyza sojae* was done with illustrations of genitalia. Morphological and genitalic variations within this species has also been studied by Thapa (1991).

Thapa (1997, 2000) has reared this species from *Vigna radiata* (Linn.) Wilczek from Biratnagar, eastern Nepal. Poudyal (2003) has reared *M. sojae* from *Glycine max* (Linn.) Merr., *Pisum sativum* Linn. and *Vigna mungo* Linn. from Jhapa district, eastern Nepal.

Thapa (2005) during her study on Mung bean variety K85, produced and marketed by sunseed (India) Cooperation, Haryana India, determined 6 species of flies. She could rear 3 species of stem flies like: *Melanagromyza sojae*, *M. hibisci* Spencer, and *Ophiomyia centrosematis* (de Meijere). The various species were found infesting various stages of plants and the infestation was found to reach up to 100%. New host plants were also recorded.

Thapa (1991, 1997, 2000) has studied other stem flies mining stems of various host plants. These include *Ophiomyia centrosematis* de Meijere, *Ophiomyia phaseoli* (Tryon) and *Ophiomyia cicerivora*. These flies were also redescribed and illustrated. *Melanagromyza hibisci* Spencer and *M. cleomae* have been also reared from various host plants (Thapa, 2007, 2000; Thapa, 2005).

### Materials and Methods

The research was carried out at Govinda Ballabh Pant University of Agriculture and Technology, Pantnagar (Nainital), as well as at Biratnagar and Jhapa, eastern Nepal. The general concept used in this study has been adopted from Sasakawa (1960, 1961), Spencer (1973), Singh and Ipe (1973), Sehgal *et al.* (1980) and Spencer and Stayskal (1986).

An attempt was made to study all the existing species which could be reared during the survey. Apart from describing a new species, detailed morphological variations and differences in genitalia characters among the members within the species were also carefully evaluated and illustrated wherever felt necessary. Besides describing morphological and genitalia characters, their biology and host plants were also studied.

In addition to re-describing 15 known species, including *M. sojae* (Zehntner), 13 species were described and new names have been proposed for them as per International rules of Zoological Nomenclature. *Melanagromyza sojae* is redescribed here.

### Results and Discussion

The redescription of *Melanogromyza sojae* was done as follows: *Melanagromyza sojae* (Zehntner); *Agromyza sojae* Zehntner (1900); *Agromyza prolifica* (Malloch, 1914); *Agromyza producta* (Malloch, 1914; Singh & Ipe, 1973); *Agromyza squamata* (Becker, 1903); *Melanagromyza sojae* (Zehntner) (de Meijere 1922; Sasakawa, 1961; Singh & Ipe, 1973; Thapa, 1991).

Comparison- The members of this species do not differ much in external morphology with those of a similar species *Melanagromyza vicivora* new species exstems of *Vicia faba* Linn (Thapa, 1991). However, characters of genitalia in *sojae* (Zehntner) are distinctive in having prominent loop, bladder do not curves much and extends beyond rear of Mesophallus. Morphological characters alone are not sufficient to distinguish the members of this species with those of other related species of this region. However, the distinctive characters of genitalia readily segregate them. The members of *sojze* (Zehntner) from same or different leguminous host-plants had remarkable differences in colouration and genitalia characters like relations of bladder and mesophallus (Pl. 1, Fig. 5; Pl. 6, Fig. 6) or lobes of basal part of distiphallus narrow (Pl. 7, Fig. 5) or broader (Pl. 5, Fig. 5; Pl. 7, Fig. 5; Pl. 8, Fig. 4) or coiled (Pl. 7, Fig. 5). Shape, size and position of bladder (Pl. 8, Fig. 4) remarkably varied among the members.

Another, closely related species of *M. sojae* (Zehntner) is *M. cunctans* (Meigen) known only from Southern and Western Europe, where it forms stem galls on *Lotus corniculatus* L. The two species can not be distinguished either by external characters or male genitalia but differ in biology (Spencer, 1973). Distinctive genitalia of *sojae* has been illustrated by Kato (1961), Sasakawa (1960) and Spencer (1973) and Thapa (1991).

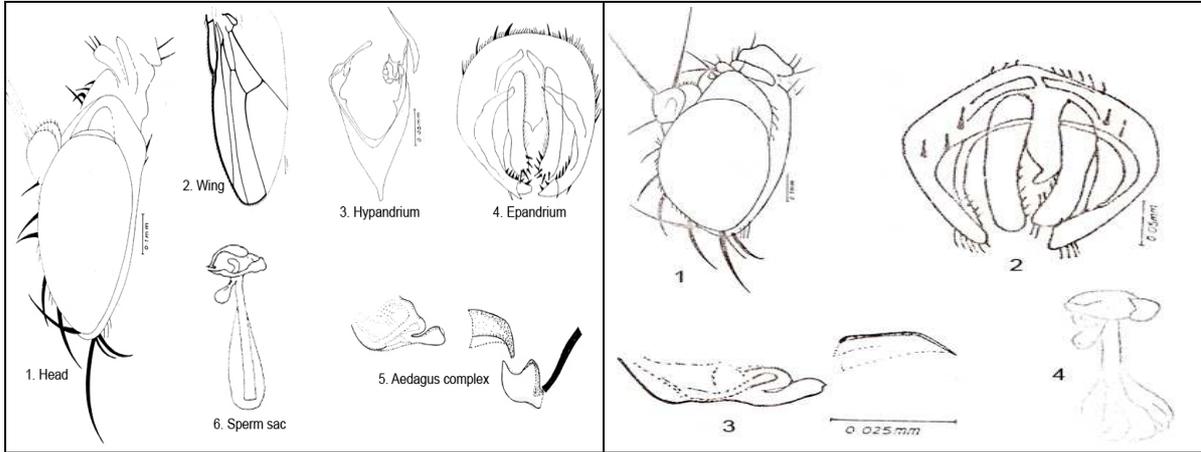


Plate 1

Plate 2

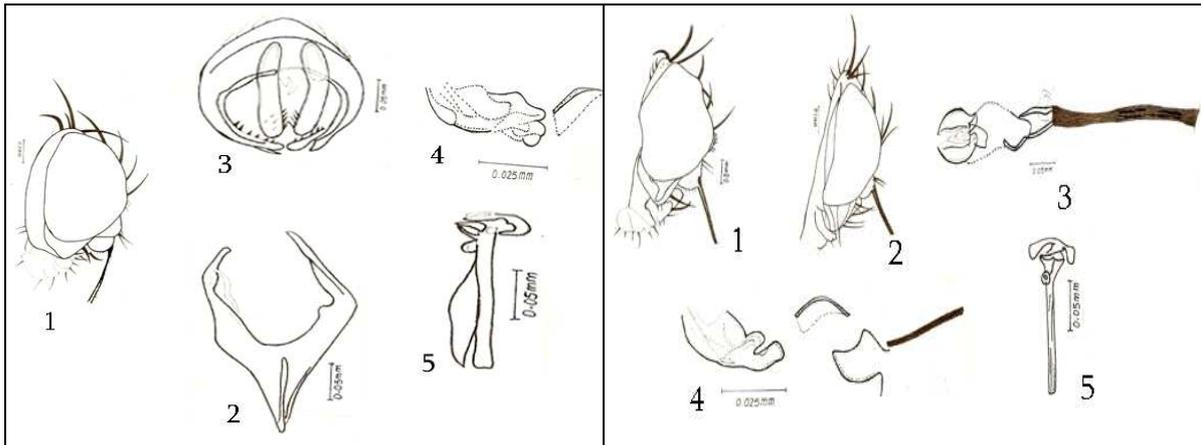


Plate 3

Plate 4

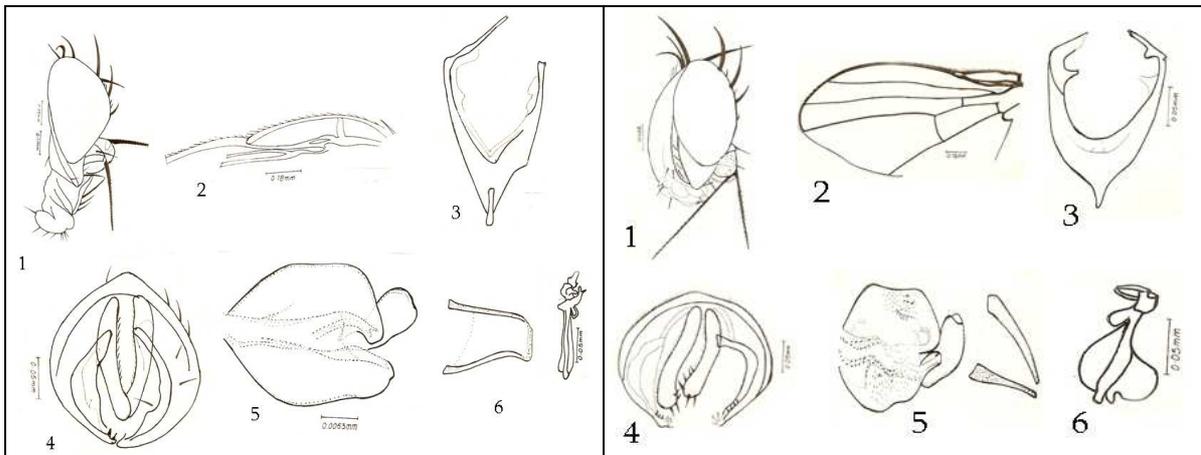


Plate 5

Plate 6

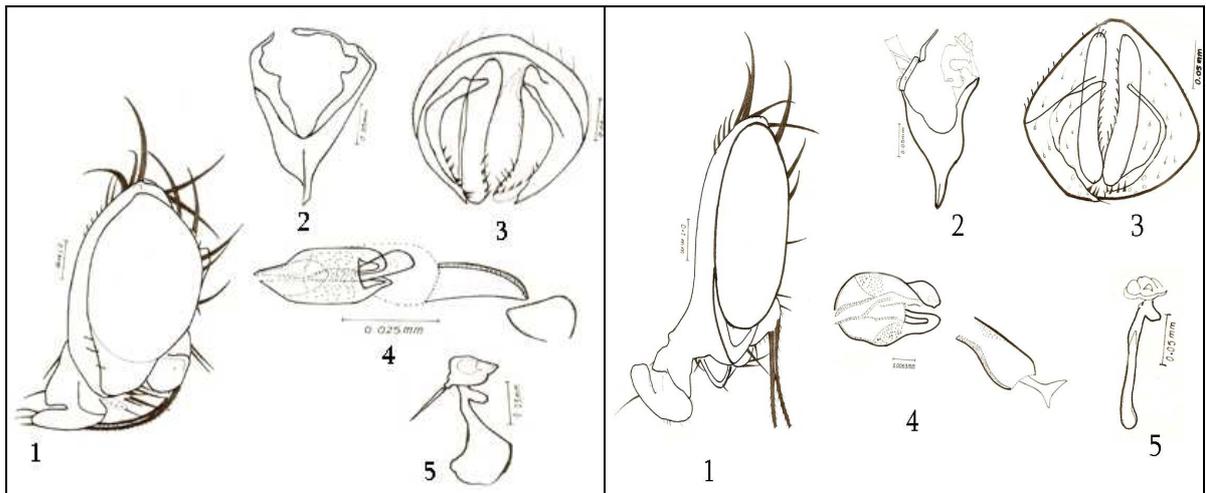


Plate 7

Plate 8

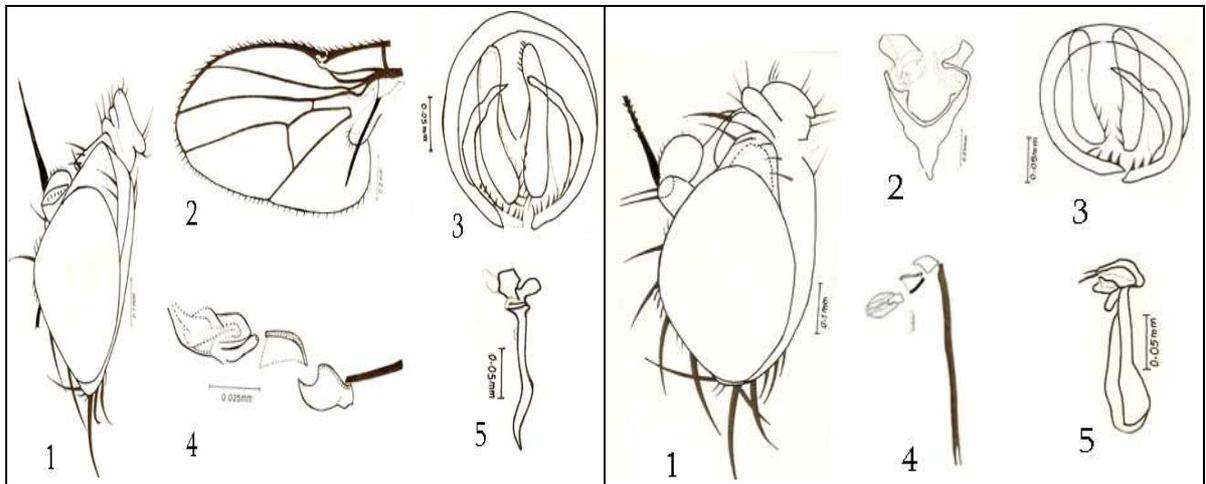


Plate 9

Plate 10

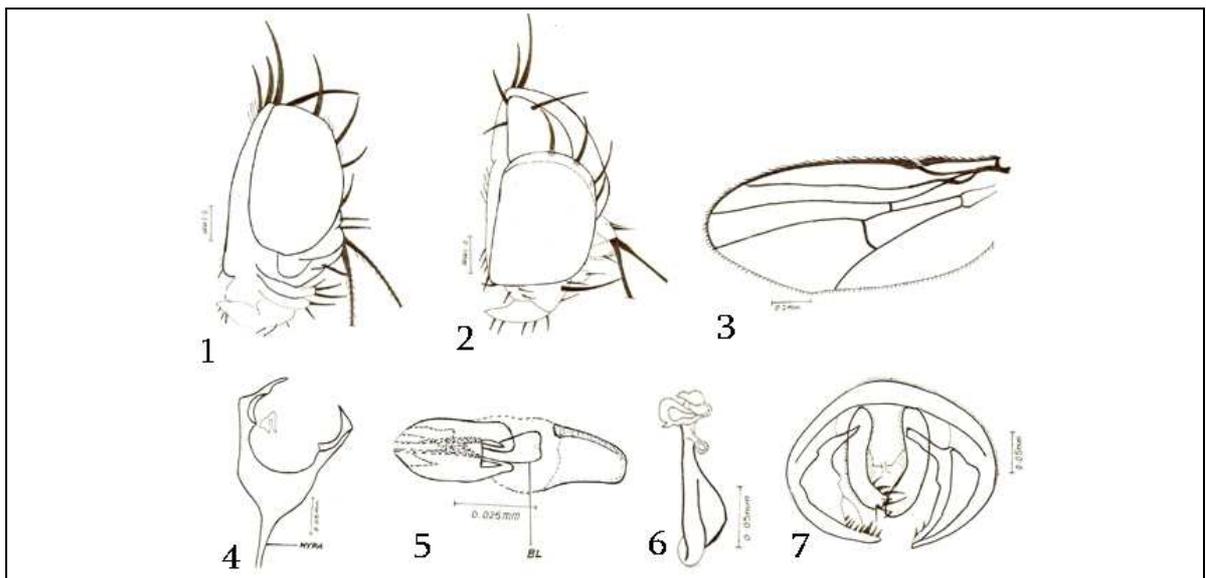


Plate 11

Diagnostic characters: The members of this species are small, with black mesonotum and green abdomen, wing length 1.68-2.26 mm in males; third and 4<sup>th</sup> costal segments are unequal; gena  $\frac{1}{4}$ -1/7.66 vertical height of eye; arista slightly pubescent to bare; squamae whitish to brownish, margin and fringes white; halteres black or greyish. However, typical *sojae* (Pl. 2, Fig. 1) is characterized by frons slightly wider (1.16 times) than the width of eye; eyes 1.91 times higher than their lengths; gena 1/7.6 vertical height of eye; wing length 1.97 mm in male, arista virtually bare; frons and orbit not projected in profile.

Description: Head (Pl. 1, Fig. 1): Width of frons 0.105-0.294mm, 0.66-1.6 times wider than the eye at the level of front median ocellus, slightly projected or not projected beyond eye in profile; ori 2-3, unequal directed slightly upwards or strong, directed upwards; orbital setulae sparse to numerous, reclinate, apart from 1 or 2 hairs in front proclinate; eyes oval, bare; lunule broad and semi circular antennal bases approximate, in 6 specimens widely separated, fascial keel absent, narrow fascial keel present in 6 specimens, vibrissae numerous; eyes 0.399-0.525 mm, 1.3-2.2 times higher than their lengths; gena 0.063-0.105 mm,  $\frac{1}{4}$  -1/7.66 vertical height of eye; ocellar triangle small, ocellar bristles strong; orbits normal, raised from the plane of frons, not projected in front of eye margin in profile; third antennal article round with an angle, pubescence normal, arista long slightly pubescent to virtually bare. Mesonotum: Two strong dc; acr numerous. Wing (Pl. 1, Fig. 2). Length 1.68-2.26 mm in males; subcosta joining R<sub>1</sub>; costa extended to M<sub>1+2</sub>; costal segments 2-4 in the ratio 1:0.25: 0.17-1:0.32:0.22; cross vein m-m present; distal section of M<sub>3+4</sub> 0.44-0.86 times basal portion. Male genitalia: Hypandrium (Pl. 1, Fig. 3) Y shape with long and broad side arms in few specimens U shaped (Pl. 6, Fig. 3) with short side arms, apodeme varies from short, narrow (Pl. 4, Fig. 5) to long and broad (Plate 2, Fig 4); epandrium (Pl. 1, Fig. 4) cerci long and broad with bristles, surstyli with spines; aedeagus (Pl. 5, Fig. 5) basiphallus widely separated from distiphallus complex; ventral bladder is characteristically asymmetrical. On the basis of characters of genitalia, the specimens with one lobe narrow and another broad are treated here as typical *sojae* (Pl. 2) and the rest (Pls. 1, 3, 4, 5, 6, 7, 8, 9, 10, 11) are treated as variants of *sojae*. Aedeagus may be asymmetrical or symmetrical. Colour: Frons black, in few specimens greyish; orbits black, in few specimens greyish, ocellar triangle black; lunule black, in few specimens greyish, antennae black, covered with white pubescence; mesonotum black; scutellum black; halteres in most specimens black, but greyish in 14 specimens or brownish in 4 specimens or pale in 1 specimen; legs black; squamae white but brownish in 25 specimens; margin and fringes white, in few specimens margin with reddish tinge.

Biology: The larvae of this species feed inside stem of various host-plants. Pupation also occurs inside the stems. The members of *sojae* have been reared from various legume host-plants: *Aeschynomene americana*; *A. indica*; *Cyamopsis psoralioides*; *Glycine max*; *Lathyrus pratense*; *Medicago denticulata*; *Medicago lupulina*; *Melilotus alba*; *Melilotus indica*; *Pisum sativum*; *Sesbania aculeata*; *Trifolium alexandrinum*; *T. repens*; *Trigonella corniculata*; *Trigonella foenum-graecum*, *Vigna mungo*; *V. radiata*; *V. sinensis* and *V. umbellata* during the months of October, November, December, January, March and April. More flies were reared during the months of Oct-November. Maximum number of ♂ flies were reared from *Glycine max* and *Pisum sativum*. It is interesting to note that only few adult ♂ of this species could be reared from *Vigna mungo* and *V. radiata*.

Sehgal (1965) has reared this species from the stems of *Glycine max*; *Melilotus* sp.; *Vigna mungo* and *V. radiata* at Pantnagar, Delhi (soybean) and Ludhiana (*Melilotus*), during the rainy season crops. In the northern India, its biology has also been discussed by Bhattacharya and Rathore (1977) on soybean, and Singh and Beri (1973) on *Vigna* spp. (= *Phaseolus* spp.) who also described the immature stages. Singh and Ipe (1977) has listed *Phaseolus mungo* and *P. radiatus* as leguminous hosts of this species. Singh (1982) has described the immature stages of this species. He has also listed *Dolichos biflorus*, *Cajanus indicus*, *Glycine max*, *G. soja*, *Indigofera suffruticosa*, *Melilotus* sp., *Phaseolus calcaratus*, *P. sublobatus*, *P. radiates*, *P. mungo*, *Pisum* sp., *P. sativum* and *Vigna catjang* as leguminous hosts of this species. Kato (1961) had also described the adults and immature stages of this species from Japan. Spencer (1973) has listed *Cajanus*, *Indigofera*, *Phaseolus swainsonia* and *Medicago* as hosts of *sojae*. Vander Goot (1930) recorded *Aeschynomene*, *Flemingia* and *Phaseolus* as wild legume hosts in Java. Sasakawa (1960) had also studied the biology of this species on *Glycine soja* Sieb and Zucc (Sehgal, 1965).

Geographical distribution: The members of this species are known from Africa, Australia, Asia, India, Nepal, China and Japan. Materials were also examined by Thapa (1997-2000), Poudyal (2003) and Thapa (2005) from Biratnagar and Jhapa, eastern Nepal.

Following materials from Pantnagar, Nainital, India were examined in the present study: One ♂ from stem of *Aeschynomene americana*, Coll. 29.x.87, emerged 31.x.87; 2♂♂ from stem of *Aeschynomene indica*, coll. 21. xi.87, emerged 25-29.xi.87; 1♂ from stem of *Cyamopsis psoralioides*, coll, 26.ix.87, emerged 10.x.87; 2♂♂ from stems of *Glycine max*, coll. 29.viii.87, emerged 1.ix.87; 2♂♂ same host, coll. 29.viii.87, emerged 4.ix.87; 10♂♂ same host, coll. 4.ix.87, emerged 6-9.ix.87; 5♂♂ same host, Coll. 23.ix.87, emerged 24-26.ix.87; 2♂♂ same host, Coll. 28.ix.87, emerged 1-2.x.87; 1♂ same locality and host, Coll, 2.x.87, emerged 5.x.87; 1♂ same host, Coll. 2.x.87, emerged 6.x.87; 1♂ same host, Coll. 2.x.87, emerged 7.x.87; 1♂ same host, Coll. 2.x.87, emerged 17.x.87; 1♂ same host, Coll. 10.x.87. emerged 22.x.87; 1♂ same host, Coll, 10.xi.87, emerged 18.xi.87; 22♂♂ same host, Coll. 24.x.87, emerged 2-31.xi.87; 1♂ same host, Coll. 20.x.87. emerged 23.x.87; 1♂ same host, coll. 26.xii.87, emerged 15.i.88; 1♂ from stem of *Lathyrus pratense*, Cool. 20.xi.87, emerged 28.xi.87; 1♂ same host, Coll 1.iv.88, emerged 4.iv.88; 1♂ from stem of *Medicago denticulata*, Coll 19.iv.87 emerged 29.iv.87; 1♂ same host, Coll. 10.v.87, emerged 13.v.87; 1♂ from stem mine of *Medicago lupulina*, Cool. 29.iii.88, emerged 6.iv.88; 3♂♂ from stems of *Melilotus alba*, Coll. 2.iv.88, emerged 5-17.iv.88; 11♂♂ from stems of *Melilotus indica*, Coll. 2.iv.88, emerged 6-14.iv.88; 11♂♂ from stems of *Pisum sativum*, Coll. 4.xi.87, emerged 13-19, 14.xi.87, emerged 15-27; 1♂ same host, Coll. 26.xi.87, emerged 28.xi.87; 3♂♂ same host, Coll. 26.xi.87, emerged 1-7.xiii.87; 3♂♂ same host, Coll 3.xii.87, emerged 11-27.xii.87; 2♂♂ same host, Coll. 3.xii.87, emerged 2-15.xii.87; 2♂♂ same host, Coll. 15.iii.88, emerged 5-9.iv.88; 4♂♂ same host, Coll, 15.iii.88, emerged 29.iii.88; 1♂ from stem of *Sesbania aculeate* 26.ix.87, emerged 8.x.87; 3♂♂ from stems of *Trifolium alexandrinum*, Coll. 26.iii.87, emerged 1-7.iv.88; 2♂♂ from stems of *Trifolium repens*, Coll. 23.iv.87, emerged 1.x.87; 2♂♂ from stems of *Trigonella corniculata*, Coll 2.v.87, emerged 7-9.v.87; 1♂ same host. Coll. 10.v.87, emerged 14.v.87; 1♂ same host, Coll. 30.xi.87, emerged 8.xii.87; 18♂♂ same host, Coll. 26.iii.88, emerged 4-7.iv.88; 1♂ from stem of *Trigonella foenum-graecum*, Coll. 26.iii.88, emerged 30.iii.88; 9♂♂ same host, Coll. 26.iii.88, emerged 3-13.iv.88; 1♂ from stem of *Vigna mungo*, Coll. 2.x.87, emerged 12.x.87;

2♂♂ same host, Coll. 7.xii.87, emerged 30.xii.87; 1♂ same host, Coll, 7.xii.87, emerged 10.i.88; 2♂♂ same host, Coll 5.i.88, emerged 10.i.88; 1♂ from stem mine of *Vigna radiata*, Coll. 17.x.87, emerged 19.x.87; 1♂ same host, Coll, 24.x.87, emerged 26.x.87; 1♂ same host, Coll. 16. viii.87, emerged 19.viii.87; 1♂ from stem of *Vigna sinensis*, Coll. 16.xii.87, emerged 27.i.88; 1♂ from stem of *V. umbellata*. Coll. 5.i.88, emerged 25.8.88.

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