COLECTING, PRESERVING AND IDENTIFIYING OF SOUTH EAST ASIAN PARASITIC WASPS ON LIRIOMYZA AND LEPIDOPTERAN LEAF MINERS*)

By

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INTRODUCTION

Parasitic wasps are one of the most diverse groups of Hymenoptera (bees, ants, wasps) in term of the number of species and their biology. At about more than 50.000 valid species of parasitic wasps world-wide have been described, however, these numbers represent only portion of true parasitic wasps diversity, and it is predicted that about 75% have yet to be described (LaSalle & Gauld, 1992), especially the micro parasitic wasps which are mostly belong to the superfamily of Chalcidoidea. The chalcids itself are about 18,600 valid species and 19,900 genera have been described (Noyes, 1990). Parasitic Hymenoptera, structurally and biologically, are probably as diverse as the rest of Hymneoptera put together and their biology are even more poorly than their taxonomy. Unfortunately, there was limited information of their biology and ecology are known for some species (Askew, 197; Waage & Greathead, 1986), many species are known only from very limited of collection information. Information on taxonomy alone is not enough to be served to utilize the species for biological control and in any purpose of conservation, so their biology and ecology information are needed which means the study on specific host on leaf-miner parasitoid is necessary to attempt to ensure their potential.

The extreme structural diversity of Parasitic wasp is reflected partly in the relatively large number of recognized families and genera, and in an historical instability of familial level classification. Goulet and Huber (1993) provides classification on Hemneoptera in family level and Boucek (1988) has discussed in chalcid wasps in more detail overview .

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*) This material contains mostly from the publication of Fisher, R. **Ubaidillah**, P. Reina and J. La Salle. **Liriomyza** Parasitoids of Southeast Asia. **ttp://www.ento.csiro.au/science/Liriomyza_ver3/index.html**

He stated that since as late as 1950 anywhere from 9 to 24 families have been recognized, though recently a consensus has been forming around 20 or 21 families, with remaining controversy as to whether the Mymarommatidae should be included in Chalcidoidea or excluded as its own superfamily.

However, Quicke et al. (1999) has studied on icneumonids and Heraty et al. (1997) has clarified several families of chalcids classification especially to support exclusion of mymarommatids. The 48 generally accepted families of Parasitica (Goulet and Huber, 1993) are given under Recognized Families, although the monophyly of many of the families remain in doubt due to they often seem to intergrade into each other family, and sometimes not being possessed by all members of the family, or being possessed by some members of other families. Consequently, at least some families appear to be more 'taxa of convenience' than monophyletic evolutionary lineages and some diverse families are likely paraphyletic relative to some of the smaller families, and perhaps even polyphyletic. There are even current uncertainties about the proper family placement of some genera, such as *Cynipencyrtus* Ishii (Tanaostigmatidae or ?), *Cales* Howard (Aphelinidae or ?), Is there any wonder why parasitic wasps remain such a fascinating group of study.

The classification does not stop here and the biology is also a fascinating subject for study, since all stage of insects host are subject to attack, we find some species are known as an egg parasitoids, other are larval parasitoids, others are pupal parasitoids and a few as an audlt parasitoids. Some species are as a larval ectoparasitoids (eg. Eulophidae and Braconidae) of leaf-mining flies (e.g. *Agromyza* sp., *Liriomyza* sp., and *Phytomyza* sp), or endoparasitoids (Eulophidae) of concealed larvae, especially in leaf mines of Lepidoptera (Gracillariidae, Nepticulidae, Leucopteridae, Tischeriidae) (Bouček and Askew, 1968). Most of them are polyphagous, feeding on several species of leaf miners (Askew, 1971). Some are also act as hyperparasitoids of other waps (Braconidae: *Apanteles* sp; Ichneumonidae: *Scambus calobatus*) Boucek and Askew, 1968)

Those the parasitic wasps are well known to be utilized as biological control agent and they have been used more intensive than predators in biological control program (Greathead, 1986). There were listed more than 393 species of parasitoid agents have been using in classical

biological program and 87% are parasitic Hymenoptera and it is known that parasitic wasp were responsible for providing effective in Biological control program (Greadhead, 1986). There were several succed in biological control program using parasitic wasps, forexamples, leaf-mining beetle in Fiji, Alfalfa blotch leafminers in eastern United Stated , purple scale in California (DeBach and Rosen, 1991) and Cassava mealybug (*Phenacoccus manihoti*) by encyrtid *Epidinacoccus manihoti* in Africa (Norrgard, 1988). Becouse of their important of parasitic wasps and poorly information taxonomically and biologically, the training on collecting preserving af parasitic wasp on spesific host are needed.

1. Collecting Parasitic wasps.

- *Equipment and Collecting methods*

Due to the biology and hosts of the parasitic wasps is very divers, vary broadly as to their proper collecting requirements and the way to collect. In the following training, we will explore some of the many recommended techniques and look at the varied equipment used by collectors. The emphasis will be parasitic wasps attacking leaf miners of Diptera and Lepidoptera, but much of what is included here will also pertain to other related leaf miners. It is also importance that the target species and how many specimens we collect depends on the purpose of the stady. For parasitic wasps on leaf miner comprehensive samples are required, however, when it is found only small samples with their host could be enough for identification. A sample of 5 specimens with their host should be considered the minimum, and even larger numbers is recommended. If adults and immatures are present, specimens should be collected of all life stages.

As we know that the parasitic wasps are innumerable and attack all stage of other insects and spiders (LaSalle and Gould, 1993). So, many species can be collected by Malaise traps but most of the smalles and arboreal species can be collected by sweep net or yellow pan traps, smaller species associated with leaf litter can be collected by Berlese extraction, same species associated with leaf miner have only simple take the leaf attacking by miner by rearing the host. The most comprehensive published review of methods to collect, preserve and mount parasitic wasps, especially the chacid wasps is by Noyes (1982).

a. Malaise traps

Malaise trap is tent-like traps made of fine mesh material and used primarily (Fig. 1) for trapping flying insect especially to collect flies (Diptera) and wasps (Hymenoptera). The trasp was found by Rene Malaise in 1937 and it is well known the most effective means of obtaining specimens in regard to the passive collecting method, however, the trap was developed by Towns (1962). Malaise traps is generally set out for long periods of time and checked at least weekly, or occasionally every other week. The structure of trap has two short end walls, one central wall, and a roof, which is only peaked on one end, or in some styles, both ends. The walls are generally black and the roof is usually white. The traps were usually used about 5 ft high at the front peak, 4 ft high in the back, about 6 ft long, and 3 feet wide (Fig 1.c).

To set up the trap is usually Poles, wooden or bamboo, are used to support the trap at each corner and at the peak in front. It is helpful if the front pole is adjustable so that the sample jar may be raised and lowered (Fig 1, a). The poles are in turn tied to stakes placed in the ground several feet away. If necessary, the strings may be tied to something. They are many variations on this basic design, but you get the picture (Fig.1). Insects hit the middle mesh wall and either fly upward or downward. Those insects that fly upward are funnel to the peak of the trap and eventually find their way into a jar with some sort of killing agent. We have found that alcohol works best for us because it preserves the insects over the course of a week well and also aids in keeping the inevitable lepidopteran scales from sticking to all of the other insects in the sample.

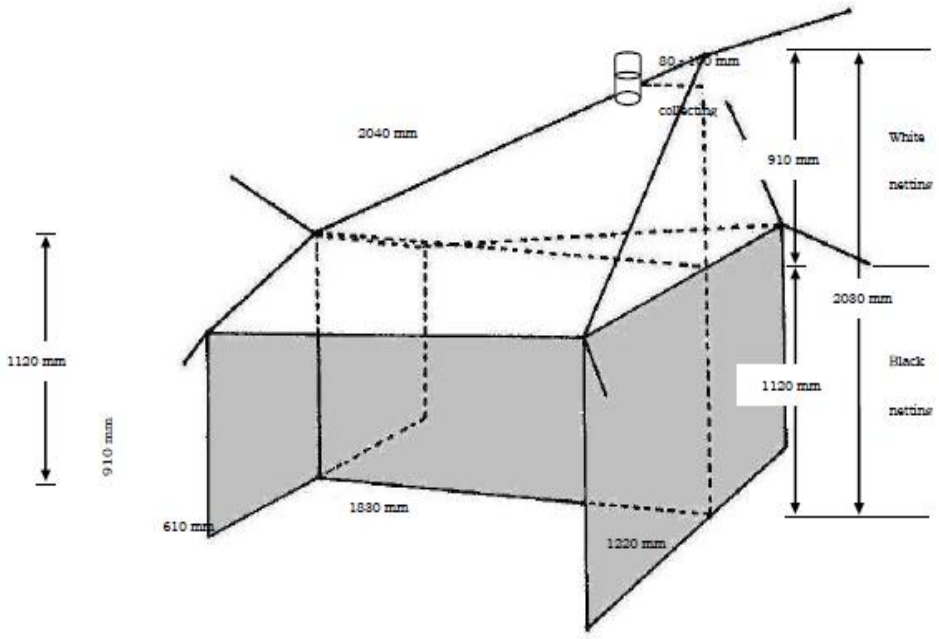


Fig. 1 a. Malaise traps stand in tropical forest, b. collecting insect obtaining from the trap, c. the actual size of Malaise traps (Town, 1962)

b. *Sweep net and sweeping*

Each group of parasitic wasps requires its own specific technique and equipment, so if it is taken in the wrong technique and the type of apparatus, the result of the collecting effort would be not optimum. It means, the correct type of sweep net can be used to collect of parasitic wasps more efficiently. The are many variation on the basic type/style of sweep net, however, the style of sweeping and net has been using in collecting parasitic more effectively is Noyes's type (1987). He has improved the type of this net for catches of other groups of insects notably those inhabiting grassland. To attain the correct style for sweeping a certain amount of practice is required. Other style of net of course is acceptable as far as it can be used special target of parasitic wasp. For more detail of the sweep net and the way to use the net see Noyes (1982).

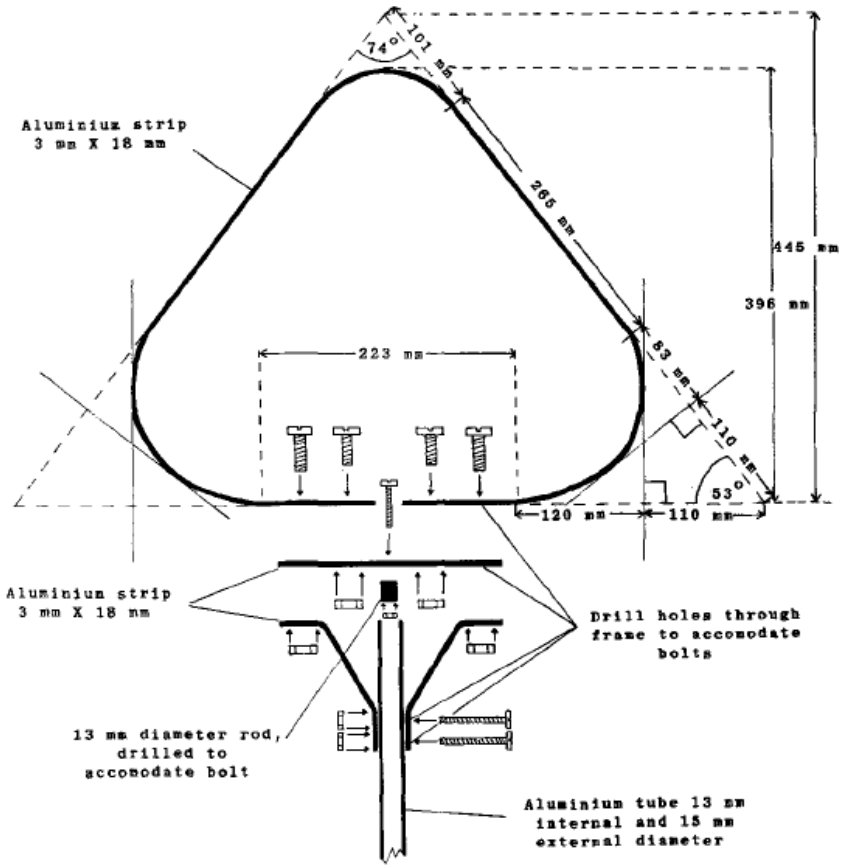
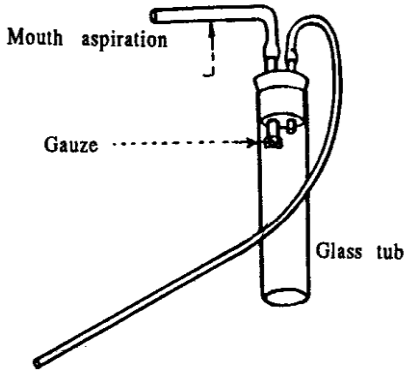


Fig 2. Structure of the sweep net for parasitic wasps developed by Noyes (1982)

c. Aspirator

Aspirator is an equipment for collecting smaller insects, especially her for parasitic wasp, by sucking through one tube and collecting insect through the other. The structure of the aspirator includes a plastic vial and a tight fitting rubber stopper, or other cap with two metal tubes running through it. One of the tubes has a rubber hose several inches long connected to it and a piece of fine mesh affixed to the other end of the tube inside of the vial (Fig.3a). To suck parasitic wasps, one sucks air through the rubber hose and points the other tube at the insect and the insect is sucked into the vial (Fig 3.b). Because the end of the tube that is used to draw air through has mesh over its end, insects in the vial are not sucked into . When not sucking up insects please an index finger over the end of the tube, or place a small piece of tissue paper in the end of the tube to prevent escape ones mouth. Also please do not suck any predatory arthropods, other hard chitin insects and moisture insect (even smaller size) , such us spider , ants, colleoptera,

orthoptera and others, which may causes smaller parasitic wasps specimens to be bitten and destroy or stick together. Collection in the aspirator is not more than one hundred micro- hymenoptera in one sample units, and please kill them directly by placing a piece of tissue paper which is dipping it in ethyl acetate first and putting it in to the entry tube of the aspirator.



a

b

Fig. 3. a. Aspirator (After Noyes, 1982), b. Collect insect using aspirator

C. *Yellow Pan trap.*

Pan traps are primarily used to capture micro Hymenoptera, especially mymarids, aphelinids and some eulophids, but also trap many other insects. The trap is design using a small yellow colored pan which it is usually a plastic bowls or plates using for food container (Fig.4). Use others different colored bowls such us blue, white, and ret is a good idea to catch a different insects. To use the trap, just place a bowl on the ground or is sunk into the ground , in a suitable habitat of parasitic wasps, such as a forest clearing, grassland or side of forest track. This pan is partially fill with water and a drop of dish liquid or other soap. The dish liquid is used to break the surface tension of the water, so the insects will fall through. If water only used then the pan traps need to be checked and emptied at least daily, especially in tropical habitat.

To collect the parasitic wasps captured, the water is poured through a fine aquarium mesh net. It is then rinsed with water into a jar of 70% ethanol.

Fig. 4. Yellow pan traps is setting in forest floor.

D. Rearing

Rearing is probably the most rewarding method of collecting parasitoids of leaf-miners, since information gathered may prove of great value to the taxonomist as well as to those working on biological programmes. Parasitized leaf mining larvae can be distinguished from helthy ones by their motionless, changed size and colouration. If collecting leaf-mining infested by parasitoids, it best to place them in a suitable receptacle, e.g. glass tube with cotton wool plug, gelatin capsule or brown paper bag to await the emergence of the parasitoids. Cut the location of leaf mining with the parasitoid in to small piece to fit the vials or the gelatin camsule. Noyes (1982) suggested to put the infested host by parasitoids just putting in an memergence box desgigned by him (Fig. 5). The emerging box is designed to attract the emergence adult of parasitoids in to the upside vials in the top of the box. The light is attracting the adult and collected into glass vials placed over an inverted tube filter-funnel stuck on the roof or sides of the box. To collect dead or live parasitic wasps, please use the mouth of aspirator and sucking them up.

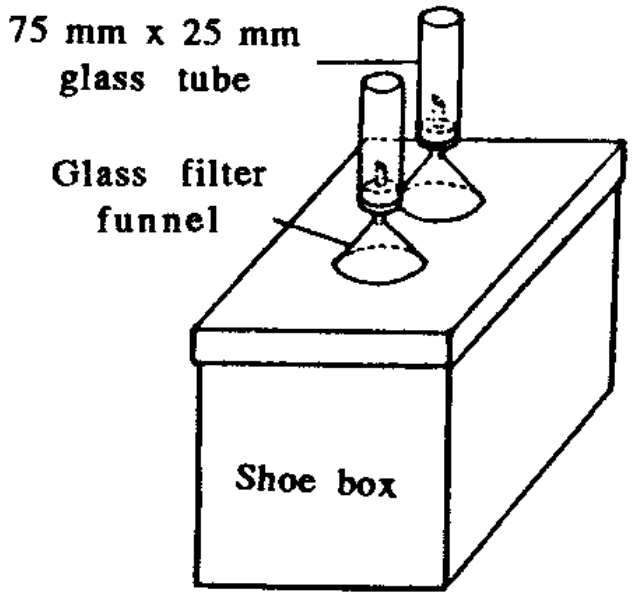


Fig. 5. Emerging box for reraring parasitic wasps (After Noyes, 1982).

Other methods for collecting may be used for special target taxa, however, for leaf-mining parasitoids, rearing of their host is one of the most productive. There are several methods that can be used for collecting parasitic wasps, but we have noticed them to be less effective than the ones just cited. For example, light traps, pitfall traps and Berlese funnels may prove useful but its rarelly to be used'

2. **Preserving Parasitic wasps**

Most of parasitics wasps are to small to be handled and to be mounted, so specimen preparation is one of the importance step for this training**.** Specimen preparation is definitely the important initial step of identification or taxonomic study work to be done perfectly. Basically, the specimens should be easily observable and secure storage. After the specimen is obtained from collection methods, mounting must be undertaken immediately. Mounting is the preparation of parasitic wasps or other insects that will be stored in a dry specimens or with a slide-mounting. Parasitic wasps larger for more than 1 mm (e.g., Braconidae, Ichneumonidae, Pteromalidae,

Eulophidae, and Chalcididae) can be mounted in dry form with pin or gluing on rectangles card or pointed card which an insect pin is placed, whereas for insects which size is less than 1 mm (e.g.,Aphelinidae, Encyrtidae, Trichogrammatidae ans small Eulophidae) are usually prepared with the slide-mounting over the object glass. We realize that of parasitic wasps are difficult to identify unless the specimens are mounted and preserved in good condition.

Mounting parasitic waps size over 2 cm could be pinned directly on the body or paste specimen on the insect pin precisely in the part epemeron(Fig.6-a). The needle should be straight vertical position with his body and only in part mesothorak left near the midline of the body that be pinned (Fig.6-a). The specimens affixed to the pin, the position should be perpendicular to the body and placed on the epemeron. While the specimen measuring between 2-9 mm mounted on paper taper (Fig. 6-b) or on pointed card (Fig. 6-b), insects attached to the edge of the paper in an upright position and affixed on the epemeron. On rectangles cards, insects placed on the two-thirds lengthwise in the middle of the paper , with insects position tilted 45 degrees to the left. The quality of the glue is required, it can be used Sakatin or good quality wood glue. For slide-mounting (Fig.6-c), more detail instruction can be read on the methodology written by Noyes (1982).

After mounting, the insects must be labeled (Fig.6-d) that contains information from which the insects collected (Country , Province / Island , district and location) ; date , month and year collected; collected method are used and who is the collector . Additional information such as the types of ecosystems ,host, predators or parasites on what needs to be included. Under the label of such information include the species name .

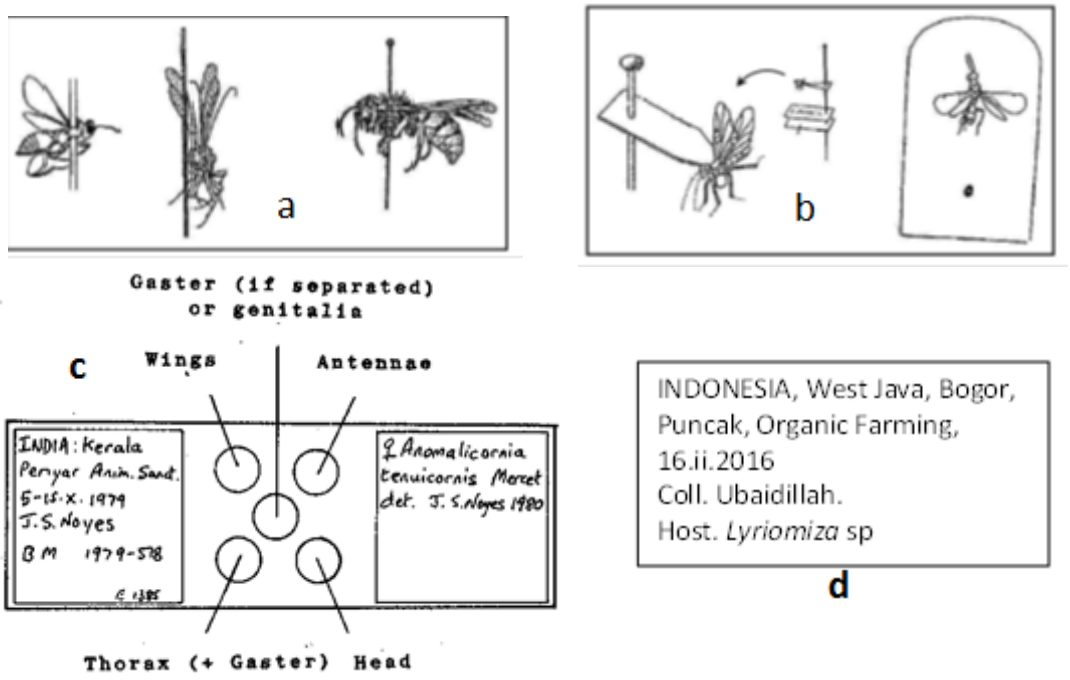
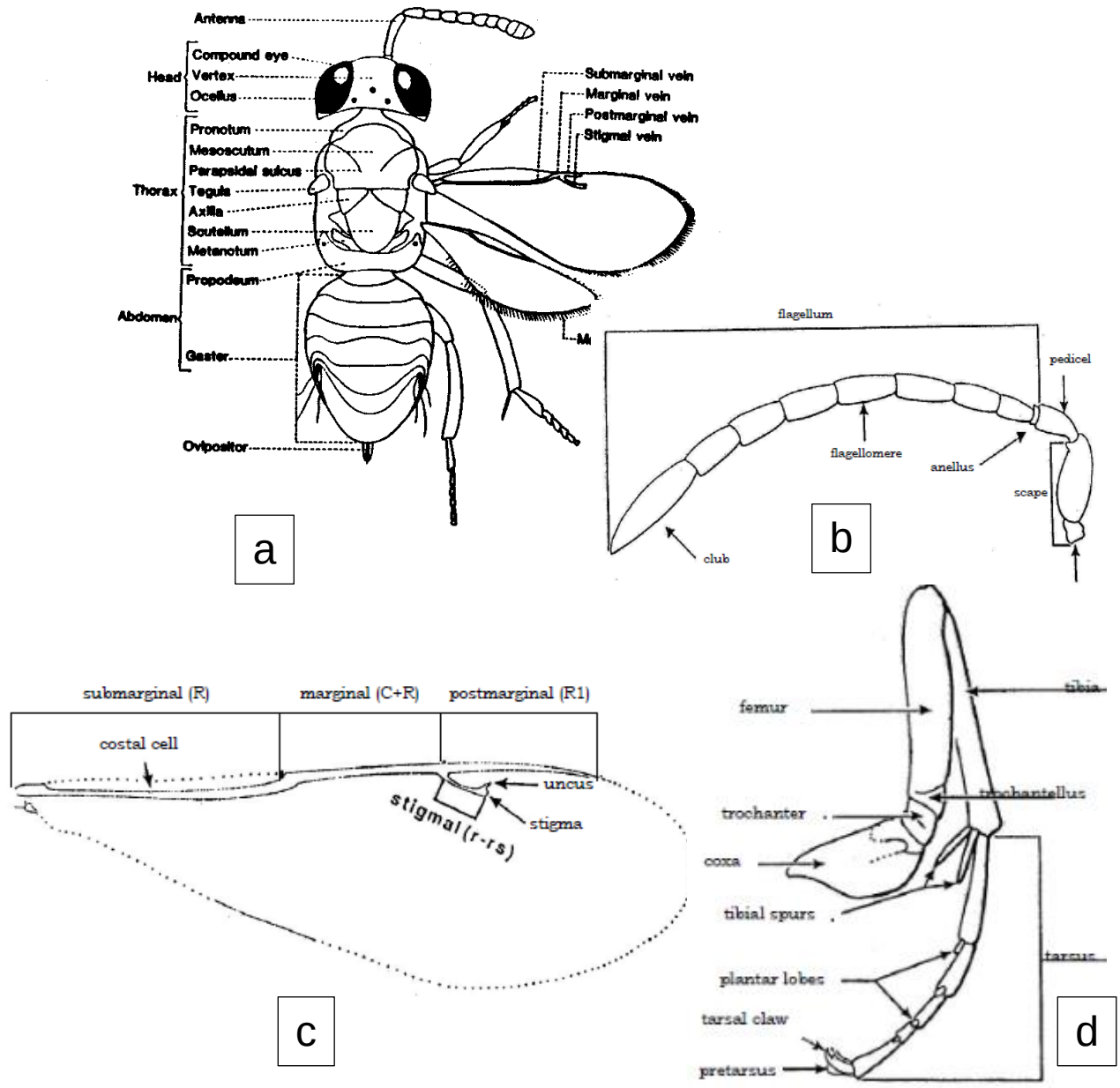


Fig. 5: a. speciemns directly pinned on body or paste on the insect pin; b, mounted at rectangle and pointed cards; c. slide mounting (After Noyes, 1982); d. Insect lable.

3. **Identifying Parasitic wasps on *Liriomyza* and *Phyllocnistis.***

The identification of parasitic wasps species according to the morphological concept represents a necessary step to the final determination of a true specific population entity. Whether or not the morphological criteria are sufficient, however, more detail study, using molecular will be decided later. Before identifying, the terminology of the wasps are required to understand .

The terminology used in this training follow, Boucek (1988) , Prinslo (1984) and Goulet and Huber (1993) and it is summarized below with the exception of the side view of habitus (from Prinslo, 1984). Most illustration are of a chalcids. Some of synonymous terminology, which you might found please just go back to the original cited above references.



7. a. Habitus of Parasitic wasp; b.antena; c, fore wing, d. hind leg

Superfamily **Chalcidoidea**

Family **Pteromalidae**

Subfamily **Pteromalinae**

1. Genus *Sphegigaster*.

Sphegigaster is known from all continents except South America, with about 50 described species (Noyes, 2002; 2003). Species are parasitoids of various Diptera, especially Agromyzidae mining in leaves and other soft plant tissues (Boucek, 1988; Noyes 2002; 2003). More than one undetermined species may be present in the region, although they are not common.

Sphegigaster sp. (Fig. 8)

There are at least two, and possibly more, species of *Sphegigaster* associated with leafminers in Southeast Asia. We have been unable to put species names on these species

Diagnosis: Petiole present and long. Gaster with second tergite the longest, distinctly longer than third (Fig. 8 1,b), and the hind margin of the first tergite usually concave. Occiput without carina (Fig, 8 d).

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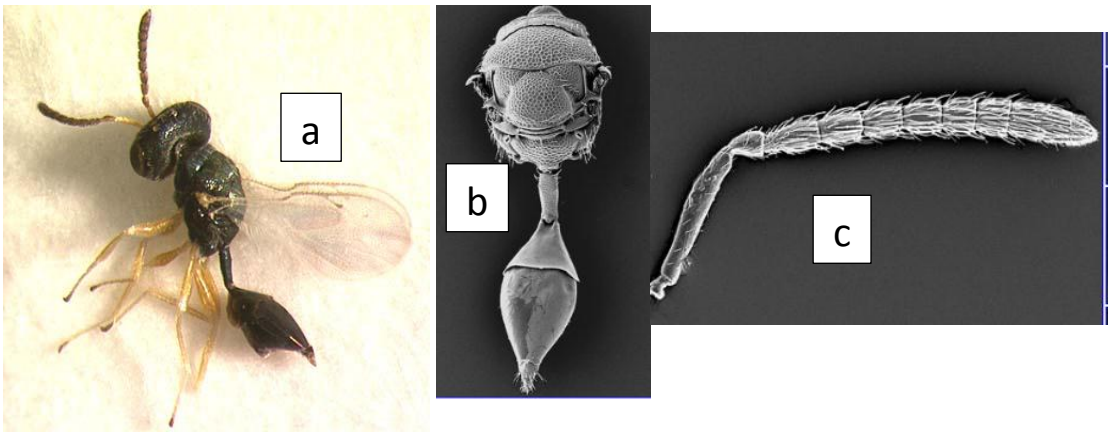


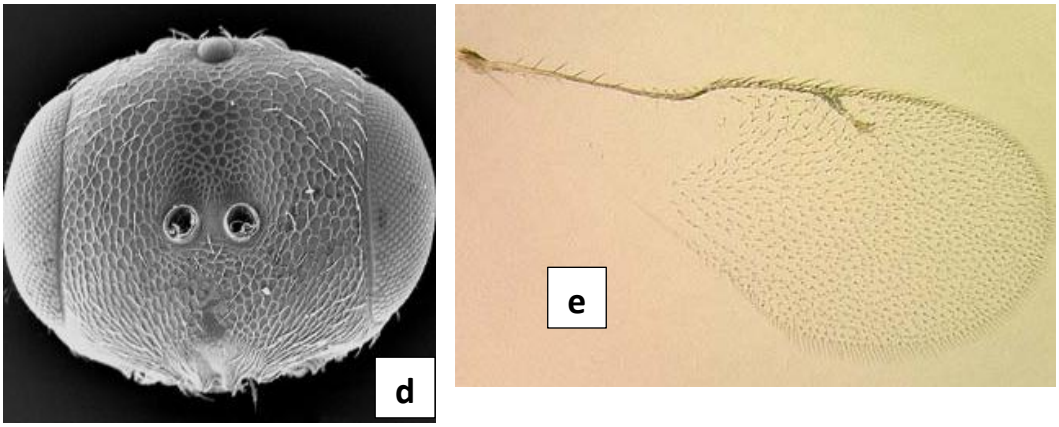


Fig. 8. A. Habitus;, b, mesosoma, petole and gaster; c, antenna, d, head frontal side; e. for wing

2. Genus ***Trichomalopsis*.**

***Trichomolopsis* spp (Fig 9.)**

Occiput with horseshoe shaped carina and petiole short and inconspicuous.

Tchomalopsis is known from all continents, with about 50 described species (Noyes, 2002; 2003). It has been extensively treated in earlier literature as Eupteromalus. Species are generally gregarious parasitoids or hyperparasitoids of Lepidoptera and Diptera, although they also attack various other hosts such as spider egg sacs and Pompilidae. Hyperparasitism through Braconidae and Ichneumonidae is common (Boucek, 1988; Noyes 2002; 2003). More than one undetermined species may be present in the region, although they are not common.

There are at least two, and possibly more, species of *Trichomalopsis* associated with leafminers in Southeast Asia. We have been unable to put species names on these species. These species are collected quite infrequently, and do not appear to play a major role in the system.

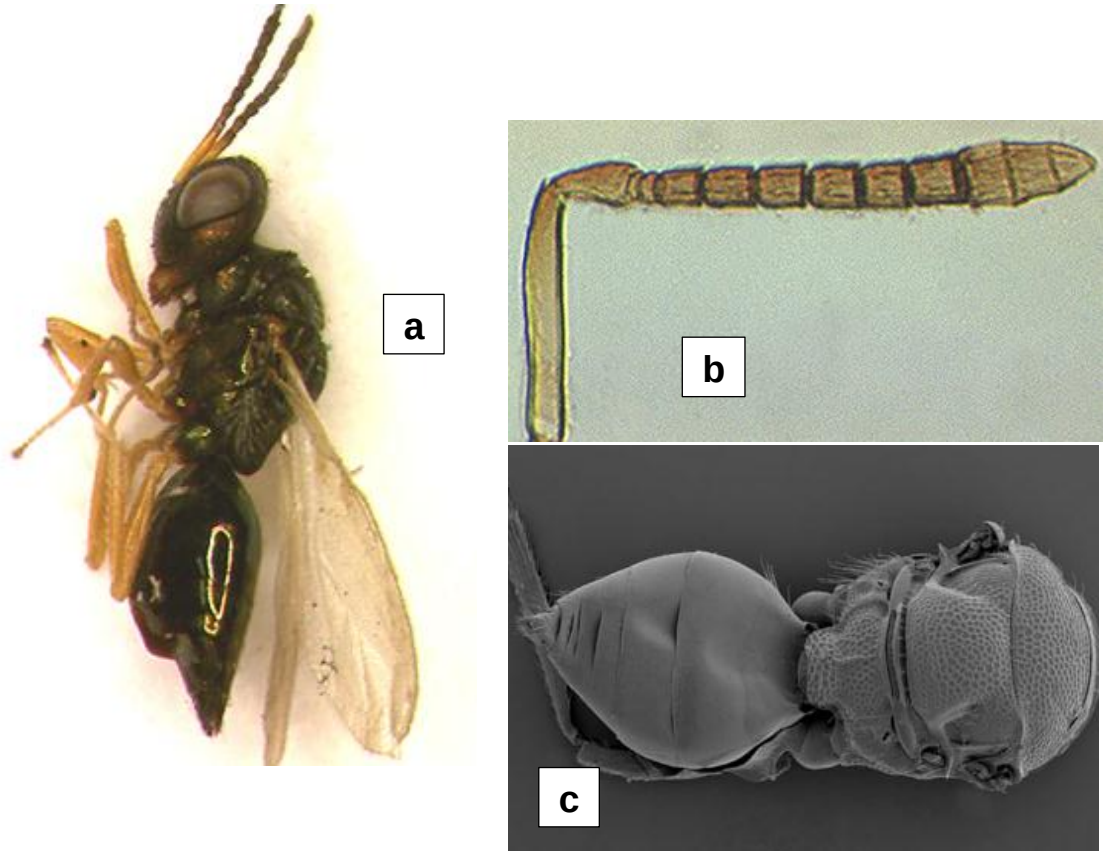


Fig. 9. a, habitus from lateral side; b, antenna; c, mesosoma and metasoma

3. Genus *Trigonogastrella*

Trigonogastrella parasitica **(10)**

Diagnosis : Petiole present and distinct (10.1,b). Second gastral tergite shorter than first tergite (Fig. 10 b). First gastral tergite not broadly concave. Occiput without a distinct semicircular carina

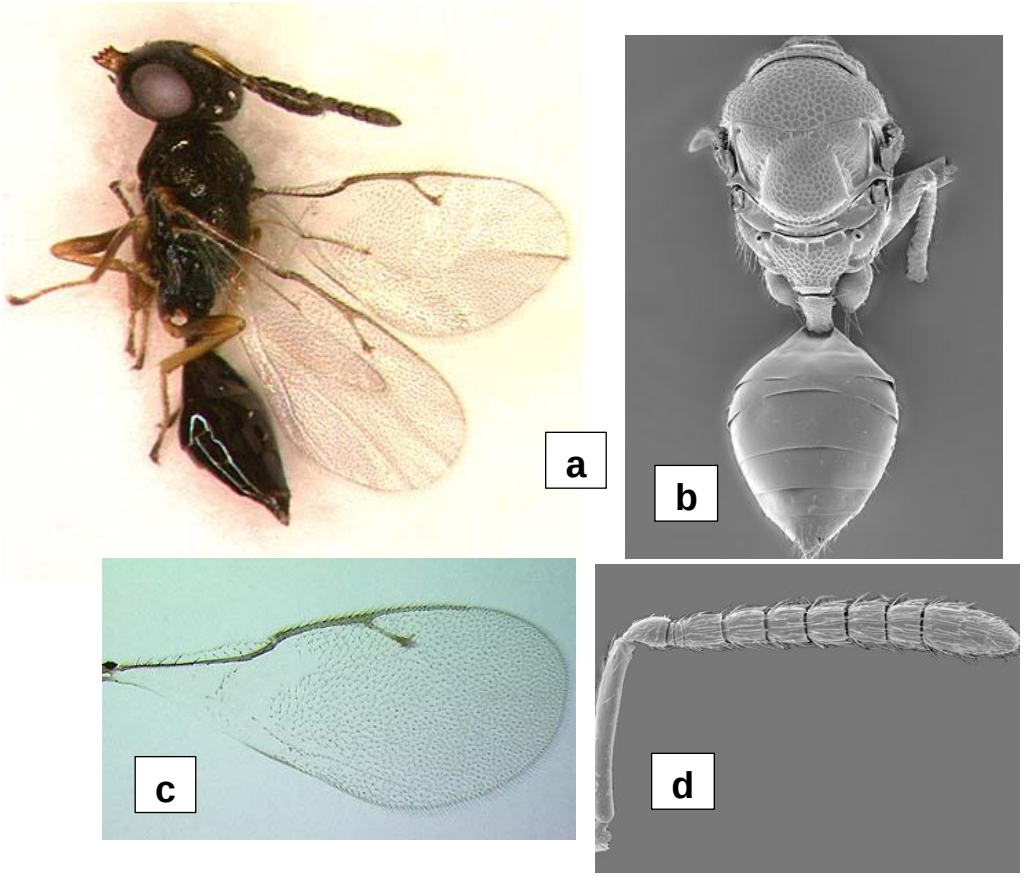


Fig. 10. a, habitus from lateral side; b, mesosoma and metasoma ; c,. fore wing and d, antenna;

Trigonogastrella is known only from eastern Australia, *T. parasitica* , found from Queensland to Victoria and Tasmania, however, although it has not yet been found in Southeast Asia. It might be useful as an imported biological control agent in Asia, and as a native natural enemy if the leafminer gets to Australia.

.Family **Eulophidae**

Subfamily **Eulophinae**

4. Genus *Hemiptarsenus*

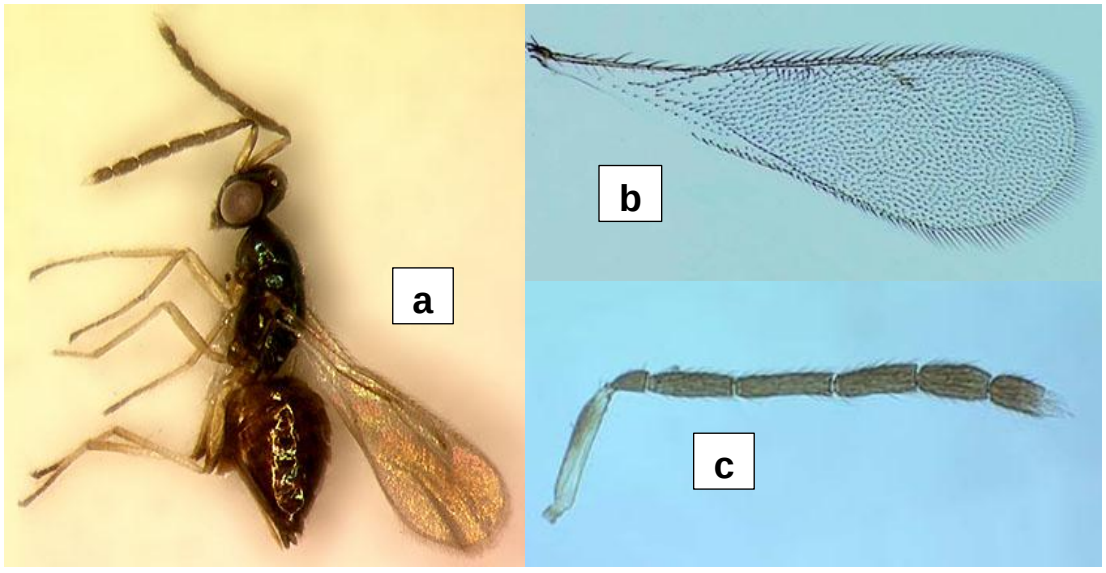
Fore wing with three or more setae on submarginal vein. Postmarginal vein (PMV) distinctly longer (2x or more) than stigmal vein (STV). Antenna with toruli inserted high on the face and also for this reason the slender scape, usually at least 5.5 times longer than wide, distinctly exceeds level of vertex. Flagellum with 1 anellus. Funicle 4-segmented. First 3 male funicular segments branched. Club with 1-2 segments. Vertex, frons, face and clypeus slightly sculptured. Malar sulcus present and straight. Notauli

absent or incomplete. Mesoscutum slightly sculptured, with a few setae. Scutellum slightly sculptured, with two pairs of setae and without longitudinal lines. Propodeum often long and flat, slightly longer than broad, but sometimes 2 or more times broader than long; median carina and plicae, nearly always indistinct or absent (except *H. unguicellus* (Zetterstedt)). Petiole distinct, though often short. Body colour usually brown to black or dark green metallic, sometimes with yellow markings on thorax and/or gaster.

***Hemiptarsenus varicornis* (Fig. 11)**

This is one of the most common *Liriomyza* parasitoids in the Australasian region. It is a primary, solitary, larval ectoparasitoid. Kumar *et al.*, 1998 suggested this species is endoparasitoid, which it most probably an erroneous and must be referring to a different species (probably an entedonine eulophid).

***Diagnosis*.** Male antenna with branched funicle and the branches on funicle 2 and funicle 3 arising from near apex of the segment (Fig. 11 d). Female antenna has a white tip and the the scape of the antenna always the level of vertex (Fig 11, c, e). Propodeum smooth without median carina, plicae or costula.



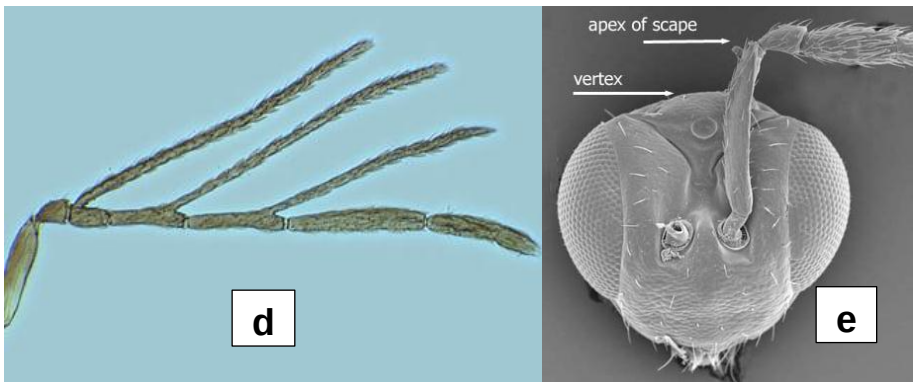


Fig. 11. a, habitus from lateral side; b, fore wing, c, female antenna; d, male antenna and d, head frontal side.

Distribution: This species is known to be very widely distributed Old World species, known from the Middle East; Afrotropical, Oriental and Australasian regions. Recorded from: Australia; China; Ethiopia; Fiji; Ghana; Guam; Hawaii; India; Indonesia; Japan; Kenya; Malaysia; New Caledonia; New Zealand; Pakistan; Saudi Arabia; Senegal; Seychelles; Sri Lanka; Sudan; Taiwan; Tanzania; Vanuatu (Noyes, 2002; 2003). It has been used in greenhouses in Japan and Spain (Noyes, 2002; 2003).

The hosts is *Liriomyza trifolii*; *Liriomyza* sp.; *Ophiomyia phaseoli*; *Ophiomyia* sp.; *Pseudonapomyza spicata*.

5. ***Genus Pnigalio***

Fore wing with submarginal vein with 3 or more setae dorsally. Postmarginal vein distinctly longer (2x or more) than stigmal vein (STV). Scape slender, sometimes reaching top of vertex. 1-2 anelli. Female funicle 4- and club 2-segmented (rarely funicle and club both 3-segmented). Male funicle 4-segmented with 3 long branches on the first 3 segments.

Vertex, frons, face and clypeus reticulate to smooth and shiny. Malar sulcus present and straight. Fronto-facial suture usually absent. Notauli absent or incomplete. Mesoscutum reticulate and the scutellum densely sculptured with two pairs of setae and without longitudinal lines. Propodeum smooth and shiny with median carina, plica and costula complete in female; sometimes costula absent or incomplete in male. Petiole not

distinct. Body colour mainly metallic-green or green with white to brown coloured markings on scape, legs and sometimes on some basal gastral segments.

***Pnigalio katonis* (Fig. 12)**

Diagnosis: Propodeum with distinct median carina, plica and costula (12, d, e). Notauli absent or incomplete. Scutellum without submedian lines (Fig. 12, e). Hind tibia wholly yellowish, or sometimes brownish distally (in this case the two colours are not sharply delimited)

Hind tarsi yellowish proximally, distal segment dark. Male antenna with funicular branches, each branch placed near the base of the funicular segment (12, c).

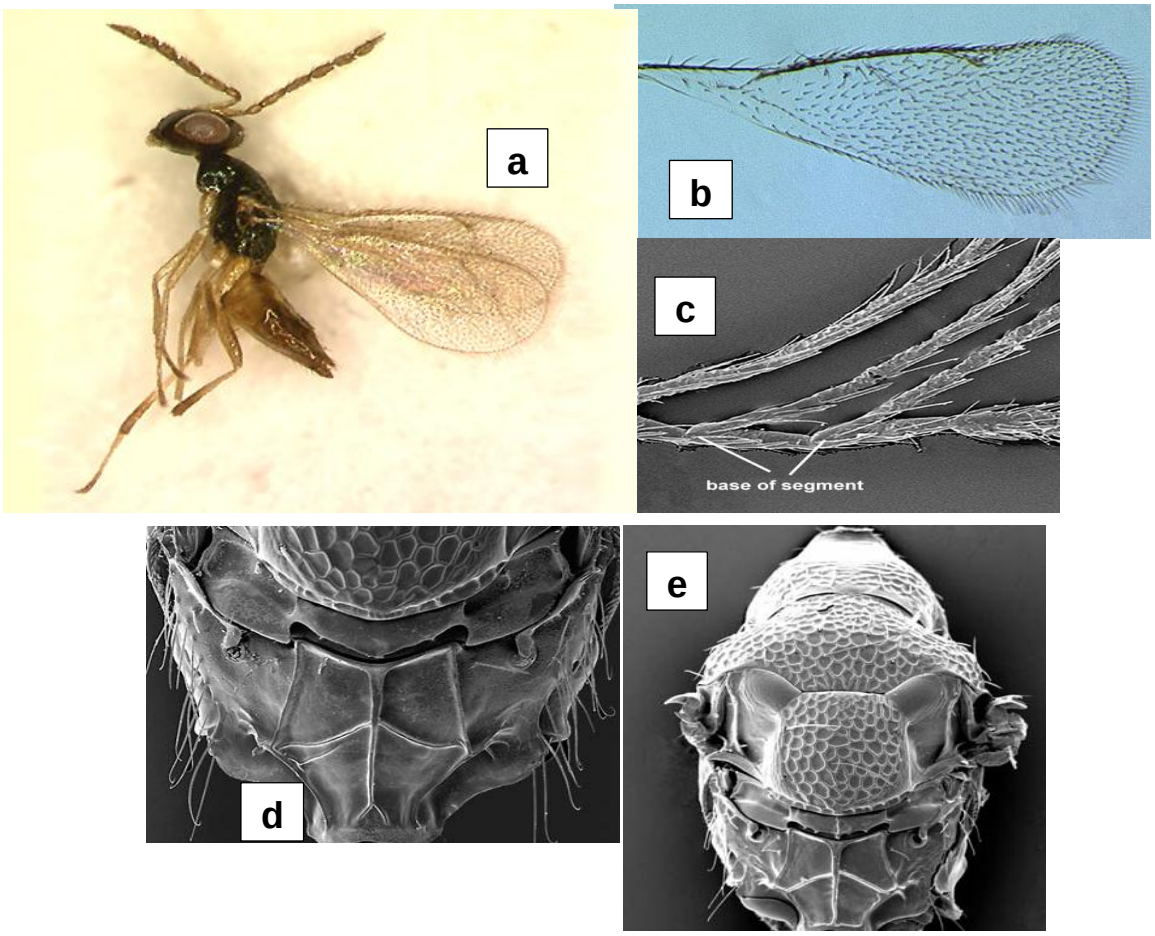


Fig. 12. a, habitus from lateral side; b, fore wing, c, male antenna; d,propodeum;; e, Mesosoma

P.katonis is a primary parasitoid of Agromyzidae: *Agromyza albipennis, A. oryzae, Chromatomyia horticola* and *C. syngenesiae* (Noyes, 2002; 2003). The genus has been recorded only from Japan and Russia (Noyes, 2002; 2003). In this study they were only recorded from Indonesia.

Tribe **Cirrospilini**

6. Genus *Cirrospilus*

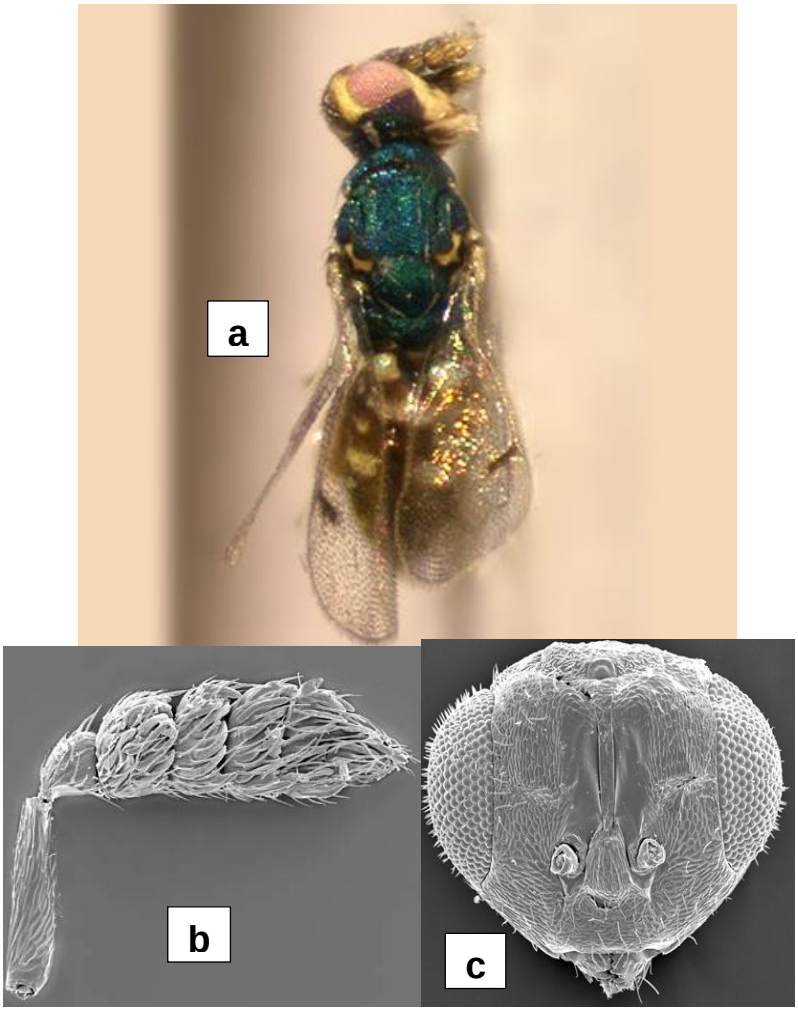
Fore wing with submarginal vein SMV (SMV) with 3 or more setae dorsally. Postmarginal vein (PMV) present: at most 1.25 times longer than stigmal vein, often equal or shorter. Scape slender and not exceeding apex of vertex. Club 3-segmented. Funicle 2-segmented in both sexes with usually 1-2 anelli. Fronto-facial suture adjacent anterior ocellus; usually also a transverse short groove from eye margin to scrobal cavity about halfway between ocellus and torulus. Malar sulcus present and straight. In species of *Cirrospilus " sensu strictu"* the vertex is not vaulted: i.e. extends less than 1/3 of eye length above the eye. However, in the *Cirrospilus "variegatus group*" the vertex is vaulted: i.e. extends more than 1/3 of eye length above the eye.
Notauli almost always complete to posterior margin of mesoscutum (however, the one Southeast Asian species included in this key, *C. ambiguus*, is the only species with notauli not reaching posterior margin of mesoscutum, but curving and extending to anterior margin of axilla). Propleura separated posteriorly and not covering prosternum. Scutellum with 2 pair of setae and with 1 pair of longitudinal grooves, although these may be sometimes faint and difficult to see. Propodeum usually with median carina, with or without plicae (plc). Petiole not distinct. Gaster with cercal setae short and subequal in length. Coloration variable, from dark to metallic to non-metallic and yellow.

***Cirrospilus ambiguous* (Fig 13)**

C. ambiguus is easily distinguished from all the other *Cirrospilus* by the notauli, which curve to meet the anterior margin of axilla, rather than extending to the hind

margin of mesoscutum (Fig 13. a). All other *Cirrospilus* have the latter character, which has generally been used as one of the main features to distinguish *Cirrospilus* from *Zagrammosoma* and *Diglyphus*. In the description of *C. ambiguus* (Hansson & La Salle, 1996), the authors preferred to place this species in *Cirrospilus* because it doesn't have other characters usually associated with *Zagrammosoma* or *Diglyphus* : it is mainly metallic in coloration and without a vaulted vertex, while *Zagrammosoma* has vaulted vertex and is always non-metallic; some yellow markings are present, while *Diglyphus* are always completely metallic.

Diagnosis: Notauli complete and curving to axilla (ax) at a distance well separated from posterior margin of mesoscutum; midlobe of mesoscutum with 2 pair of setae (Fig. 13. a, d). Body colour, dorsum of mesosoma predominantly metallic, with posterior half of axilla yellow and non-metallic (Fig. 13 a); head and metasoma with extensive yellow markings. Flagellum with 2 funicular segments in both sexes and club 3-segmented (Fig 13. b).



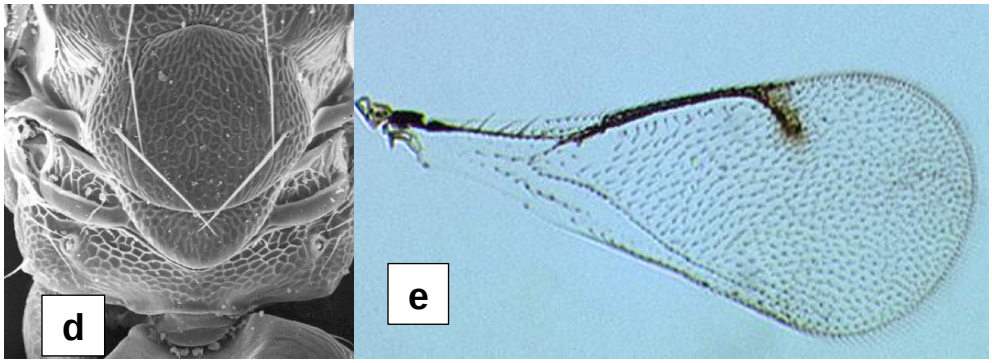


Fig. 13. a, habitus from dorsal side; b, female antenna; c, head frontal side; d. mesosoma; e. fore wing,

Distribution. This species is very wide in distribution from India, Malaysia, Taiwan, Vietnam to South Africa, Tanzania (Noyes, 2002; 2003).

7. Genus *Diglyphus*

Diglyphus contains about 35 species and is cosmopolitan in distribution; although the centre of diversity is clearly in the Holarctic realm (Noyes, 2002; 2003). Species are predominantly parasitoids of agromyzid leafminers, and this is one of the most important genera associated with pest leafminer species. Several species, e.g. *D. isaea and D. begini*, have figured prominently in biological control programs.Fore wing with submarginal vein (SMV) with 3 or more setae dorsally. Postmarginal vein (PMV) present: at most 1.25 times longer than stigmal vein (STV), often equal or shorter. Scape usually slender, sometimes swollen and not exceeding apex of vertex. Funicle 2-segmented and club 3-segmented both in male and female. Fronto-facial suture (ffs) adjacent anterior ocellus and one transverse groove (gr) between eye margin and scrobal cavity placed about halfway between ocellus and torulus. Malar sulcus present and straight. Propleura separated posteriorly and not covering prosternum. Notauli either incomplete, or complete and curving to meet axilla. Scutellum with 2 pair of setae and with 1 pair of longitudinal grooves. Propodeum with or without median

carina and always without plicae. Petiole not distinct and the coloration entirely or prevalently metallic.

7.1. ***Diglyphus albiscapus*** **(Fig 14)**

Diagnosis: This species can be distinguished by the scape entirely yellow, forewing with large speculum. Cubital vein not strongly curved at base. Males with yellow spot dorsally at the base of the gaster.

Fig. 14. a, habitus from dorsal side; b, fore wing; c, head frontal side.

Distribution: The species is distributed from Eastern Europe to China, Korea and Japan.(Noyes, 2002; 2003; Zhu *et al*., 2000b)to Vietnam. The host of the species are *Agromyza albipennis* Meigen, *Agromyza oryzae* (Munakata), *Chromatomyia horticola* (Goureau), *Phytomyza paniculatae* (Sasakawa); Ephydridae: *Hydrellia griseola* (Fallén) (Noyes, 2002; 2003)

7.2.***Diglyphus isaea*** **(Fig 15)**

This species can be easily to distinguish by scape entirely black.Forewing without bare area at base of wing disc (speculum). Cubital vein strongly curved anteriorly at base (Fig. 15. B). Males without yellow spot dorsally at the base of the gaster (Fig. 15. a).

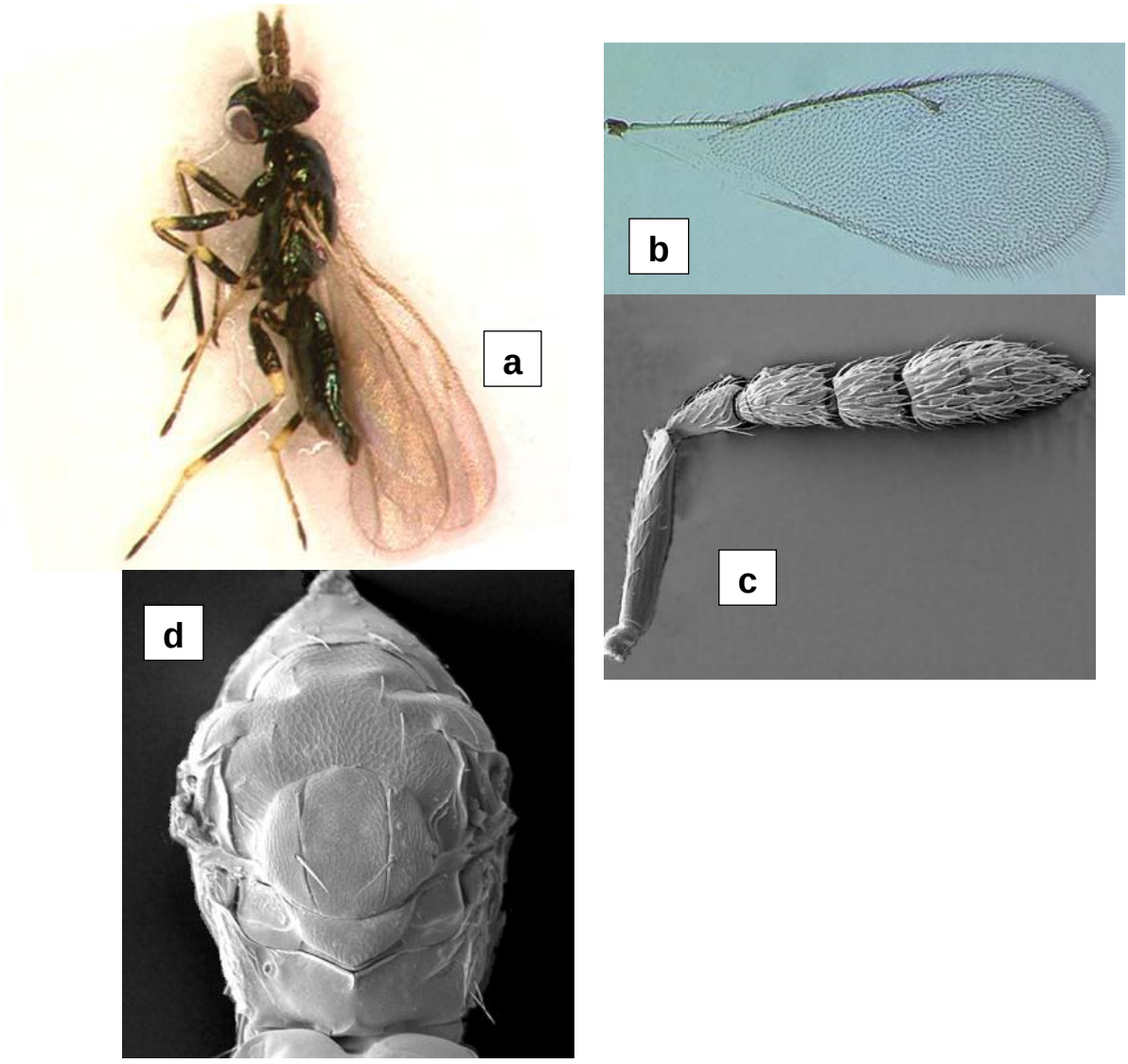


Fig. 15. a, habitus from lateral side; b. fore wing, c, antenna; d,. mesosoma;

Distribution: This species is widely distributed throughout the Holarctic Region; also known from Africa, Middle East, Orient and into Southeast Asia, Australia. The species is a highly polyphagous species, which attacks mainly agromyzids but will

more rarely attack other hosts. Noyes (2002; 2003) lists almost 40 different agromyzid hosts, as well as a Tephritidae, and Lepidoptera in the families Gracillariidae, Lyonetiidae, and Nepticulidae.

8. Genus *Zagrammosoma*

Zagrammosoma contains about 15 species and is mainly found in the Americas; although there are a few species from Africa, Europe and Australasia (Noyes, 2002; 2003). Species are mainly parasitoids of lepidopterous leafminers, although a few species are known to attack agromyzids. The characters are fore wing with submarginal vein with 3 or more setae dorsally. Postmarginal vein present but short: less than 0.5 stigmal vein (STV) length.

Scape not reaching apex of vertex. Antenna with usually two anelli; funicle 2-segmented in both sexes and club 3-segmented (Fig. 16. b). Head usually without fronto-facial suture and with a transverse short groove from eye margin to scrobal cavity about halfway between ocellus and torulus. Malar sulcus present and straight. Vertex strongly vaulted: it extends more than 1/3 of eye length above the eye. Mesosoma usually with fine dense reticulation. Axillae (ax) situated anteriorly to the posterior margin of the mesoscutum and elongated. Notauli (not) curving to axillae (ax). Scutellum with 2 pair of setae and with 1 pair of longitudinal grooves, which however may be sometimes faint and difficult to see. Propodeum usually without a complete median carina and without plicae and petiole not distinct. Coloration generally yellowish to brownish, with longitudinal black stripes

Zagrammosoma latilineatum (Fig. 16)

Z. latilineatum occurs throughout Southeast Asia, but it never seems to occur in population densities high enough to expect it to supply good levels of biological control.

This species can be distinguished by the combination of generic characters and an addition to Body mainly yellow, with longitudinal black stripes. Median black stripe on scutellum wider than yellow stripe on either side (Fig., 16 a).

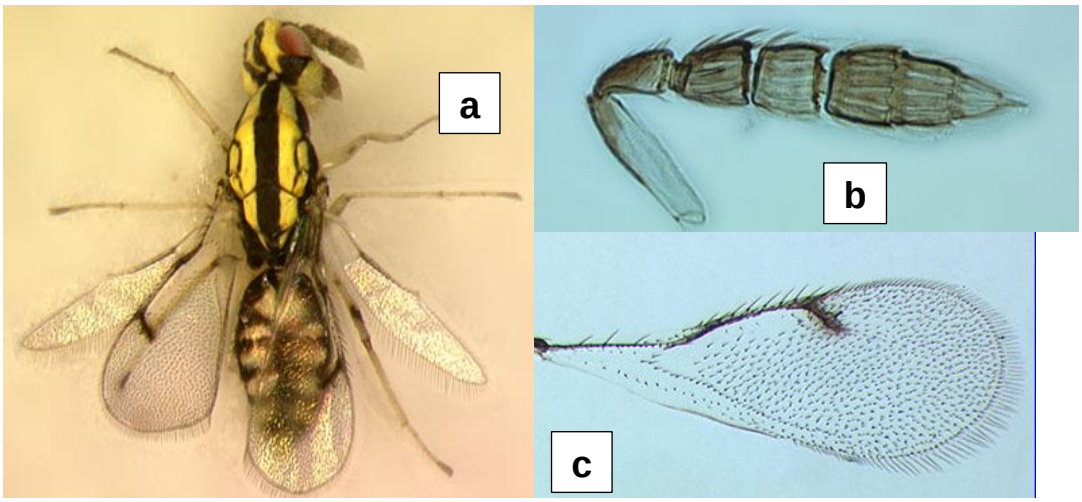


Fig. 16, a, habitus from dorsal side; b, antenna; c, fore wing.

Distribution: This species is distributed only from Southeast Asia and Australia (Noyes 2002; 2003). The host is only known from agromyzid leaf-miners, although other members of the genus *Zagrammosoma* attack a wider range of leaf-miners (e.g. Lepidoptera, Coleoptera as well as Diptera).

Subfamily **Entedoninae**

9. Genus *Asecodes*

This genus is mostly very tiny and weak sclerotized and the member of species with or without rows of setae radiating from stigmal vein; however, all species recorded on leafminers have fore wing with 2 or 3 row of setae radiating from stigmal vein. Submarginal vein (SMV) with 2 setae dorsally. Postmarginal vein (PMV) very short, usually shorter than stigmal vein (STV). Flagellum usually with 2 funicular segments and club 3-segmented, although it is sometimes difficult to separate funicle from club. Male scape with sensory area on scape restricted placed ventrally.

Head with distinct occipital groove; fronto-facial suture distinctly separated from anterior ocellus and V or Y-shaped (Fig 17 d). Mesosoma usually slightly sculptured. Pronotum very short and without transverse carina. Notauli usually incomplete (Fig 17 e). Mesoscutum and scutellum without longitudinal grooves; scutellum with one pair of setae. Propodeum smooth, shiny and without median carina and plica. Petiole not distinct. Coloration green to dark, usually metallic.

9.1.. ***Asecodes delucchii*** **(Fig. 17)**

This species is a common parasitoid of *Liriomyza* in Southeast Asia, and in some cases may build up to numbers where it has an impact on leafminer population levels. This species seems to attack earlier, smaller host stages. Like other Entedoninae, it is an endoparasitoid

Diagnosis: In addition to characters for the genus *Asecodes*. Forewing with 3 distinct lines of setae radiating from stigmal vein: two towards apex of wing, and one towards base of wing (Fig. 17 c). Dorsum of thorax metallic green (Fig. 16 a).

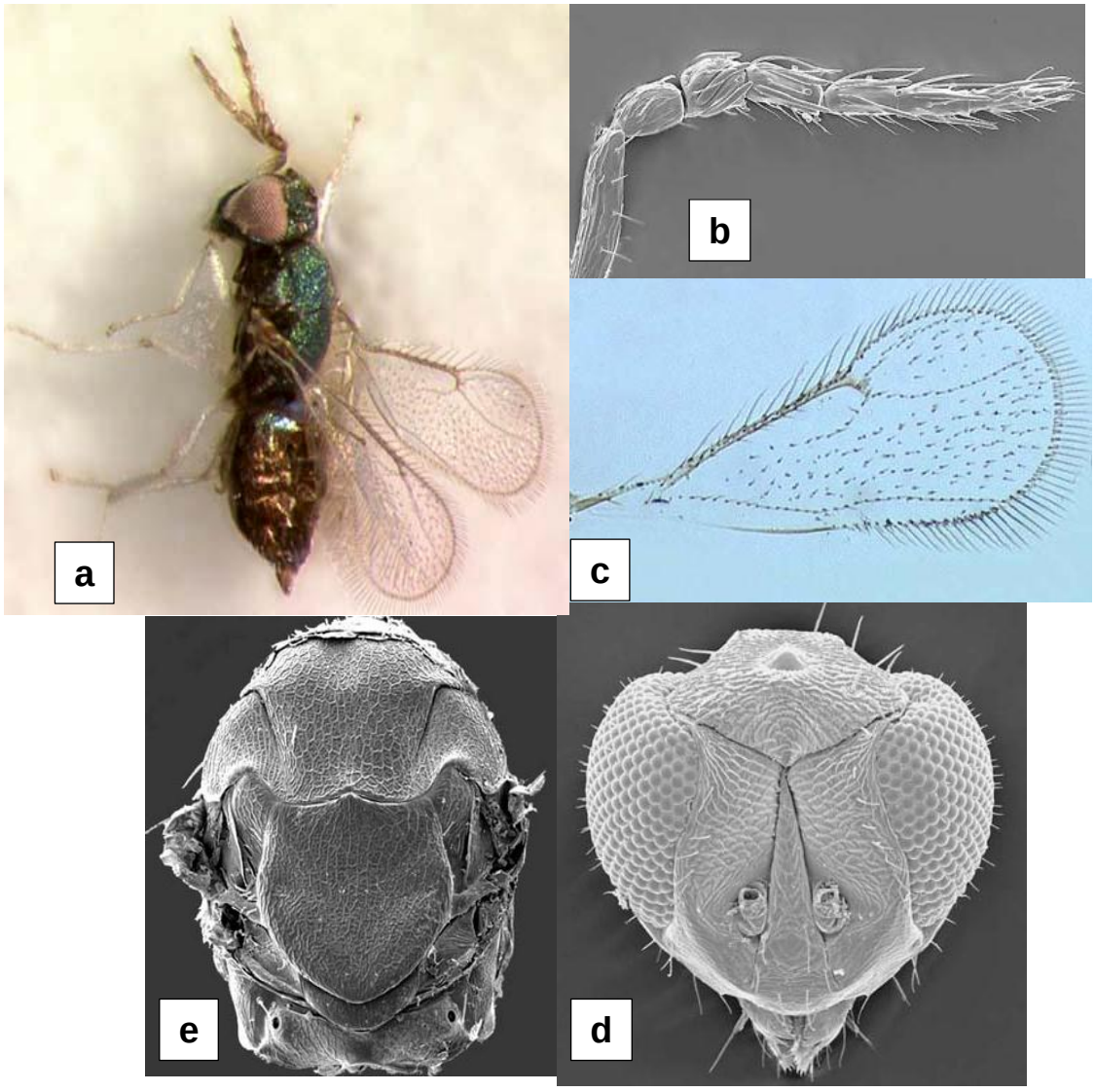


Fig. Fig. 17. a, habitus from lateral side; b, female antenna; c. fore wing d, head frontal side; e. mesosoma;,

Distribution This species is known from the Palaearctic Region. It is newly recorded in Southeast Asia (Indonesia, Malaysia and Vietnam) as part of this study. Host is mostly dipterous leafminers, however, this species is knownalso as a parasitoid of a variety of leafminers in the family Tenthredinidae (Hymenoptera), and Gracillariidae, Lyonetiidae, and Nepticulidae (Lepidoptera).

9.2. ***Asecodes erxias*** **(Fig 18)**

This species is known from throughout the Holarctic Realm, and is newly recorded in Southeast Asia (Vietnam) in these studies.

Diagnosis: addition to characters for the genus *Asecodes*. Forewing with 2 distinct lines of setae radiating from stigmal vein towards apex of wing, without a line of setae radiating towards base of wing (Fig. 18 b). Dorsum of thorax black, with at most a very slight metallic shine (Fig. 18 a, c).

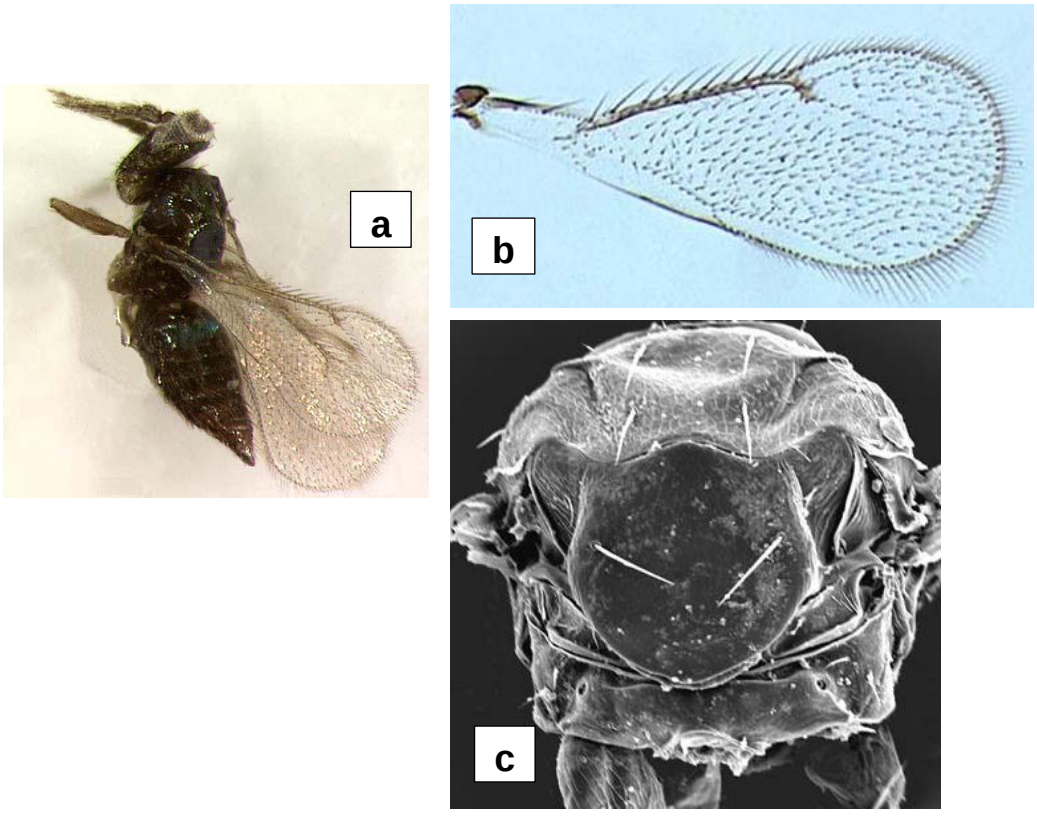


Fig. 18, a, habitus from lateral side; b, fore wing; c, mesosoma.

This species has a quite wide host range, including leafminers in the Agromyzidae (Diptera), Gracillariidae, Lyonetiidae, Yponomeutidae (Lepidoptera) and Tenthredinidae (Hymenoptera); as well as the eggs of Cerambycidae and Chrysomelidae (Coleoptera) Noyes 2002; 2003.

10. Genus *Chrysocharis*

Chrysocharis is a large genus containing about 130 species. It is cosmopolitan in distribution, although it is most common in the Holarctic region (Noyes, 2002; 2003). Species are primarily endoparasitoids of leafmining Lepidoptera, Diptera and Hymenoptera.

This genus can be distinguished by several of characters mainly, fore wing with submarginal vein (SMV) with 2 setae dorsally. Postmarginal vein (PMV) present and at least 1.5 times as long as stigmal vein length (STV). Flagellum with 3 anelli, of which the 3rd is enlarged, triangular and usually with setae. Funicle with usually 3 funicular segments and club 2-segmented. Male scape with sensory area on scape on ventral margin. Head without a sulcus surrounding ocellar triangle. Fronto-facial suture distinctly separated from anterior ocellus and usually V or Y-shaped, rarely transverse. Antennal scrobes joining below fronto-facial suture in female.

Mesosoma slightly to strongly sculptured. Pronotum with or without transverse carina. Notauli usually incomplete. Mesoscutum and scutellum without longitudinal grooves; scutellum with a single pair of setae. Propodeum smooth, shiny and usually without complete median carina, although sometimes it may be difficult to define whether in same cases the propodeal median carina is complete or not. Plica normally absent. Petiole distinct, short or very long. Coloration mainly green metallic, without yellow markings.

Chrysocharis pentheus

The species is known from throughout the Palaearctic Region, and is newly recorded in Southeast Asia (Vietnam) as part of this study.

Diagnosis: An addition to characters for the genus *Chrysocharis*. Pronotal collar with transverse carina. Reticulation on entire frons (above and below frontal fork) about the same strength. Hind femur completely white, or pale brown only at base.

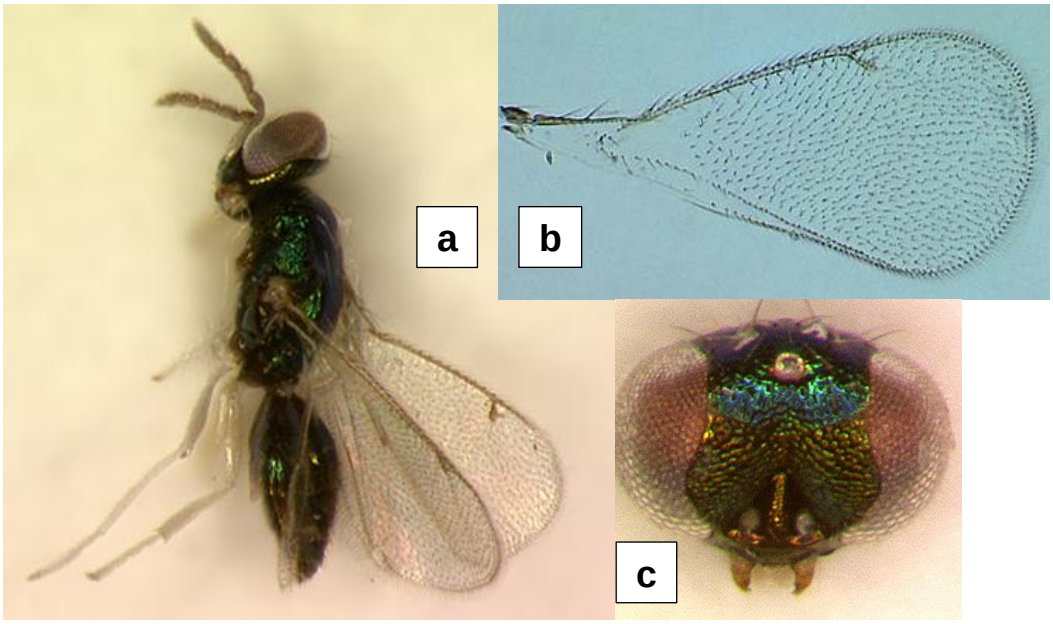


Fig. 18, a, habitus from lateral side; b, fore wing; c, head frontal side.

This species is known from a very wide range of hosts, including Agromyzidae (Diptera); Curculionidae (Coleoptera); Tenthredinidae (Hymenoptera); Coleophoridae, Gelechiidae, Gracillariidae, Lyonetiidae, Nepticulidae, Tischeriidae (Lepidoptera) (Noyes, 2002, 2003).

:

11. Genus *Closterocerus*

This genus contains over 100 species, and is cosmopolitan in distribution (Noyes, 2002; 2003). Species are endoparasitoids of a wide range of hosts, but these include quite a few species which are parasitoids of leafmining Lepidoptera, Diptera, Coleoptera and Hymenoptera. Gumovsky (2001) synonymised *Neochrysocharis*, *Asecodes*, *Hispinocharis* Boucek and *Mangocharis* Boucek with *Closterocerus*. Further study will be required to gain a complete understanding of relationships in these groups; until that time, we are considering *Neochrysocharis*, *Asecodes* and *Closterocerus* as separate genera.

The genus can be distinguished by several characters, including the fore wing with a single row of setae departing from stigmal vein, and quite often with transverse dark stripes. The submarginal vein (SMV) with 2 setae dorsally. Postmarginal vein

(PMV) present and at most as long as stigmal vein (STV). Antennal scape and flagellum generally slightly flattened. Flagellum with usually 2 (sometimes 3) funicular segments and club 3-segmented (club 2-segmented if funicle has 3 segments). Male scape with sensory area on scape restricted to a small area on apical part of scape (difficult to recognize on normal microscope).

Head with fronto-facial suture distinctly separated from anterior ocellus and V- or Y-shaped. Pronotum most of the time without a distinct transverse carina, although it is present in *C. trifasciatus* Westwood. The condition of the notauli in *Closterocerus* can be difficult to interpret: although generally incomplete, they may appear complete, or rarely curving to axillae. Mesoscutum and scutellum usually strongly sculptured and without longitudinal grooves; scutellum with a single pair of setae. Propodeum smooth, shiny and without median carina and plica. Petiole not distinct. Coloration mainly dark-blue metallic.

Closterocerus mirabilis **(Fig 19.)**

This species is mainly known from Australia, although we have seen specimens from Southeast Asia (Indonesia) (Edwards & La Salle, 2004).

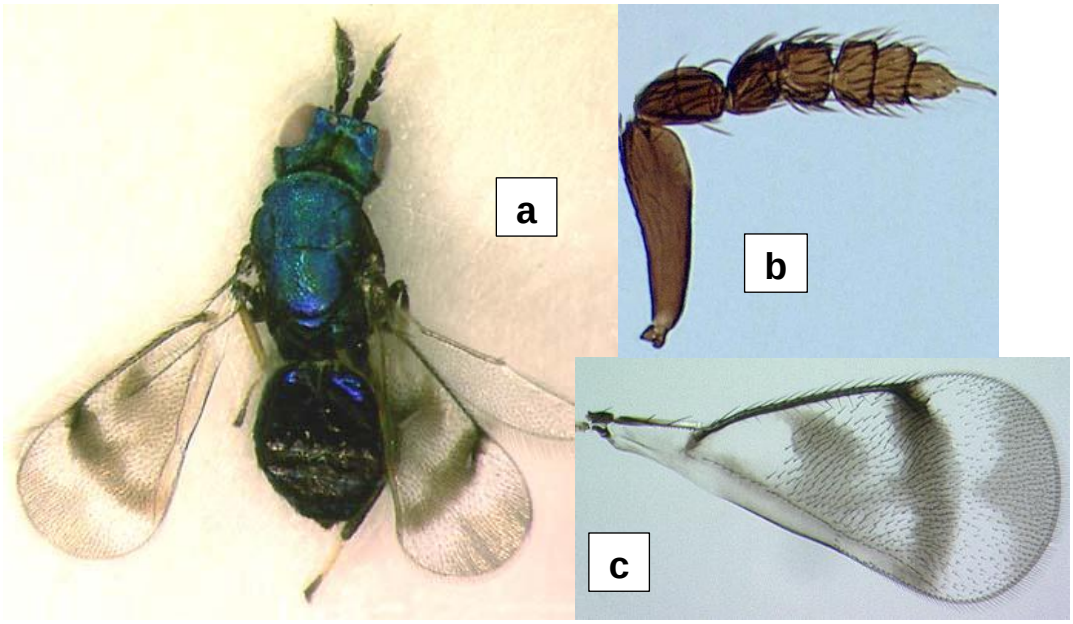


Fig. 19, a, habitus from dorsal side; b, antenna; c, fore wing.

Diagnosis: In addition to characters for the genus *Closterocerus*. Forewing with characteristic infuscate pattern (Fig. 19 c); body bright metallic blue to blue-green (Fig 19. A); antenna compressed, scape widest at apex, and funicular segments wider than long (Fig. 19 b); dorsum of mesosoma with very strong reticulate sculpture;

This species is known only from a few species of Agromyzidae: *Chromatomyia syngenesiae, Liriomyza chenopodii, Liriomyza brassicae* (Edwards & La Salle, 2004).Although *C. mirabilis* can be relatively common in Victoria, it is not common in Southeast Asia, and will probably not supply substantive levels of leafminer control in that region

12. Genus *Neochrysocharis*

This genus contains about 45 species, and is cosmopolitan in distribution (Noyes, 2002; 2003). As for *Closterocerus*, species are endoparasitoids of a wide range of hosts, but these include quite a few species which are parasitoids of leafmining Lepidoptera, Diptera, Coleoptera and Hymenoptera. Fore wing with submarginal vein with 2 setae dorsally. Postmarginal vein (PMV) present and at most as long as stigmal vein (STV). Flagellum both in male and female with usually 2 funicular segments and club with 3 fused segments. Male scape with sensory area on scape placed on ventral margin. Head with fronto-facial suture distinctly separated from anterior ocellus and V or Y-shaped.

Mesosoma usually quite sculptured. Pronotum without transverse carina. Notauli usually incomplete, although some species, as *N. formosa* (Westwood), have notauli complete to posterior margin of mesoscutum. Mesoscutum and scutellum without longitudinal grooves; scutellum with a single pair of setae. Propodeum smooth, shiny and without median carina and plica; callus with 2 setae (sometimes 3).

Petiole not distinct and Coloration mainly green metallic without yellow markings

12.1. *Neochrysocharis formosa* (Fig. 20)

This species is common and widely distributed, and is known from throughout the Holarctic, as well as Mexico, north Africa and Southeast Asia (Noyes, 2002, 2003)

Diagnosis:

In addition to characters for the genus. The Forewing with a small area of infumation in association with the stigmal vein (Fig. 20 c). Thorax with distinct reticulate sculpture and the gaster with some reticulate sculpture on basal tergites (Fig. 20 a). Transepimeral sulcus straight dorsally.

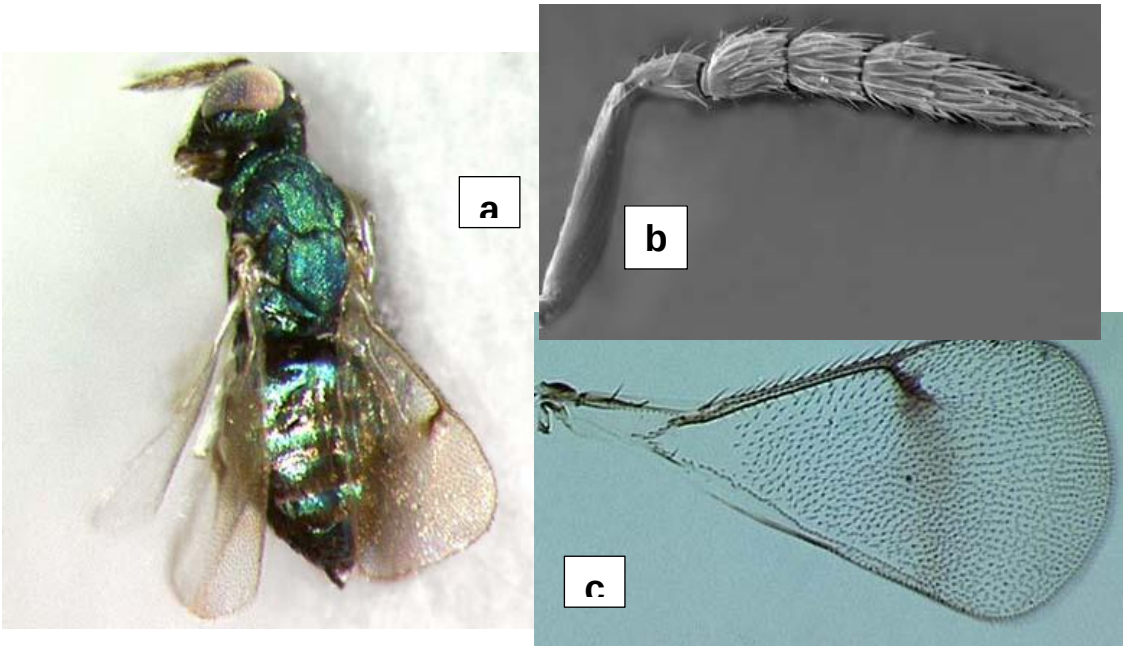


Fig. 20, a, habitus from dorsal side; b, antenna; c, fore wing.

This species is a generalist known from a very wide range of hosts, including Agromyzidae (Diptera); Chrysomelidae, Curculionidae (Coleoptera); Cimbicidae, Diprionidae, Pamphiliidae, Tenthredinidae (Hymenoptera); Argyresthiidae, Coleophoridae, Elachistidae, Gelechiidae, Gracillariidae, Lyonetiidae, Nepticulidae (Lepidoptera) (Noyes, 2002, 2003). The species species can be found in large numbers (either singly or in combination) in some samples from Southeast Asia. They have the potential to be part of a complex of species contributing to biological control of leafminers in the region

12.2. ***Neochrysocharis okazakii*** **(Fig. 21)**

This species was known only from eastern Asia (China, Japan, Taiwan) (Noyes, 2002, 2003). Also found commonly in Southeast Asia, and rarely in Australia,

Diagmosis: In addition to characters for the genus *Neochrysocharis*. Gaster and thorax relatively smooth and shiny, without distinct reticulate sculpture (Fig. 21 d). Hind legs usually entirely yellow, with last tarsal segment dark brown to black (Fig 21 a). Transepimeral sulcus curved posteriorly dorsally

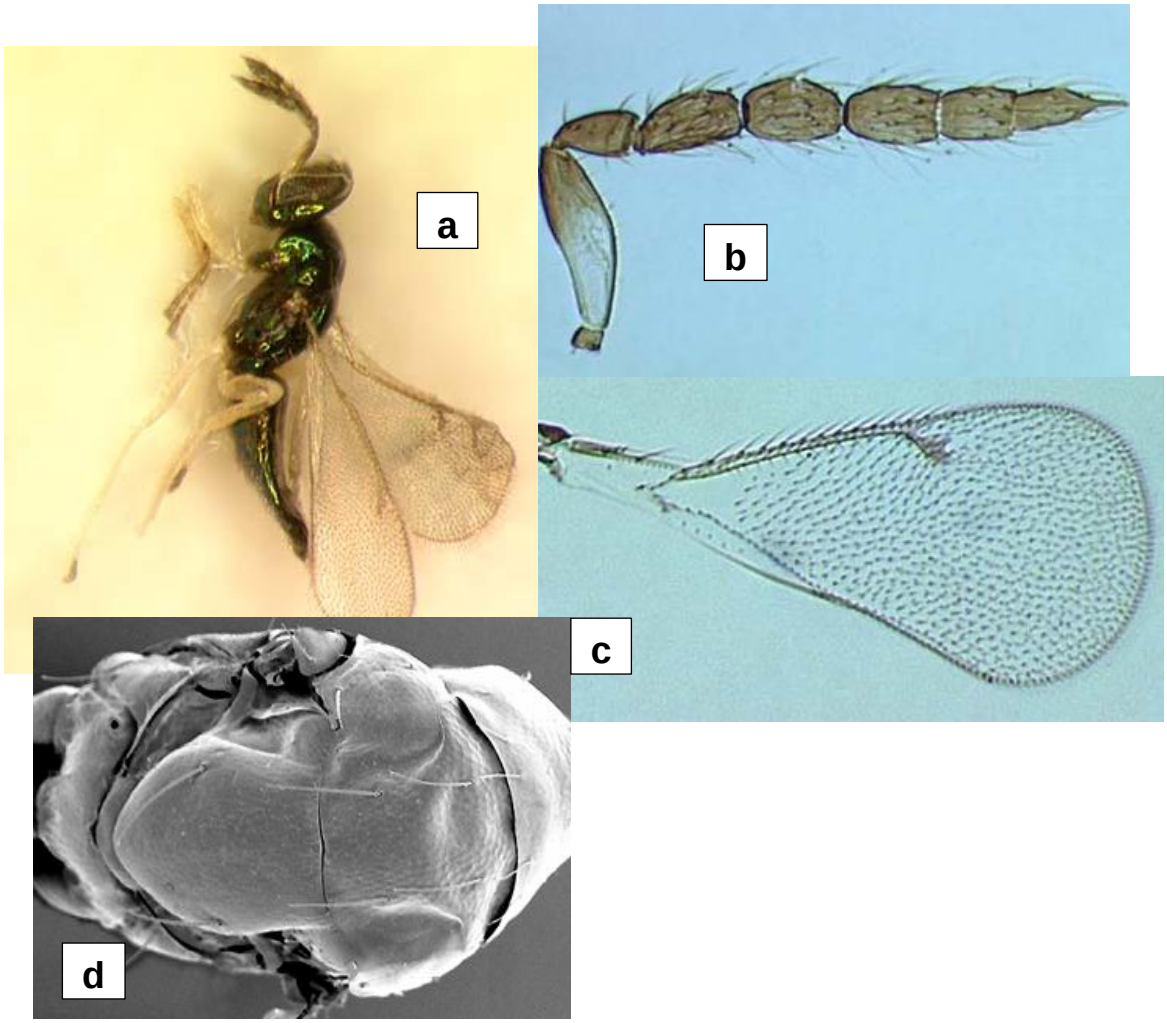


Fig. 21, a, habitus from lateral side; b, antenna; c, fore wing; d, Mesosoma

The host of this species is known from a few species of Agromyzidae: *Agromyza oryzae*, *Liriomyza sativae*, *Liriomyza trifolii* (Noyes, 2002, 2003)

12.3. ***Neochrysocharis beasleyi* (Fig. 22)**

This species is known only from Southeast Asia and it has been reared in association with the leafminers of *Liriomyza huidobrensis*

Diagnosis; In addition to characters for the genus *Neochrysocharis*.

Forewing completely hyaline and without a small area of infumation in association with the stigmal vein (Fig. 22 b). Gaster and thorax relatively smooth and shiny, without distinct reticulate sculpture. Transepimeral sulcus curved posteriorly dorsally (Fig. 22c).

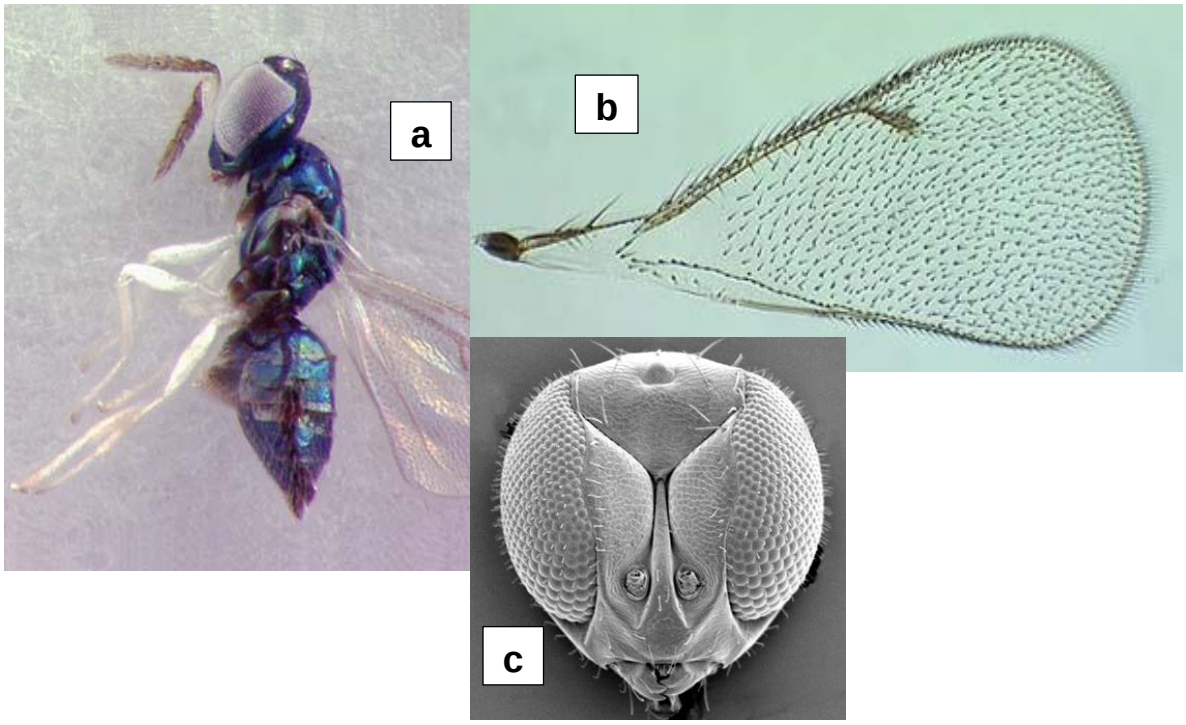


Fig. 22, a, habitus from lateral side; b, antenna; c, fore wing; d, Mesosoma

13. Genus *Pediobius*

Pediobius is a large genus containing almost 200 species. It is cosmopolitan in distribution, although it is very well represented in the Old World tropics region (Noyes, 2002; 2003). Species have an extremely wide host range, and there are only a very few species which are associated with agromyzid leaf-miners, however genera (Reina & La Salle, 2003)

The genus can be distinguished by the combination of characters, fore wing with submarginal vein (SMV) with 2 setae dorsally. Postmarginal vein (PMV) present and slightly longer than stigmal vein (STV). Antenna with 3 funicular segments and club 2-segmented. Usually funicular segments are distinct and well-separated. Male scape with sensory pores placed on the ventral margin.

Head with fronto-facial suture distinctly separated from anterior ocellus and Y-shaped. Mesosoma usually strongly sculptured. Pronotum with transverse carina. Notauli usually incomplete, although sometimes complete or with distinct grooves or depressions posteriorly. Mesoscutum without median longitudinal groove. Scutellum with a single pair of setae and without longitudinal grooves. Propodeum with 2 median carinae diverging posteriorly and with plica. Petiole distinct.

Coloration dark to dark-green metallic.

Pediobius metallicus **(Fig.23)**

This species distributed mostly in the Palaearctic region. It has been introduced to the USA as a biological control agent of Hessian fly, *Mayetiola destructor* (Cecidomyiidae) (Noyes, 2002, 2003).

This is one the only one known species which is associated with leafminers, and has been reared from a variety of leafminers as well as other types of hosts, including the families Agromyzidae, Anthomyiidae, Cecidomyiidae, Chloropidae (Diptera), Elachistidae, Gracillariidae, Nepticulidae, Tortricidae (Lepidoptera) (Noyes, 2002, 2003). *P. metallicus* is noted as an endoparasitoid of earlier stages of its hosts.

Diagnosis: In addition to characters for the genus *Pediobius*.

Scutellum entirely reticulate, with elongate reticulation anteriorly and more uniform reticulate posteriorly (Fig. 23, c). Entire mesoscutum, including notaular furrows, reticulate. Face bluish-black, not bright green.

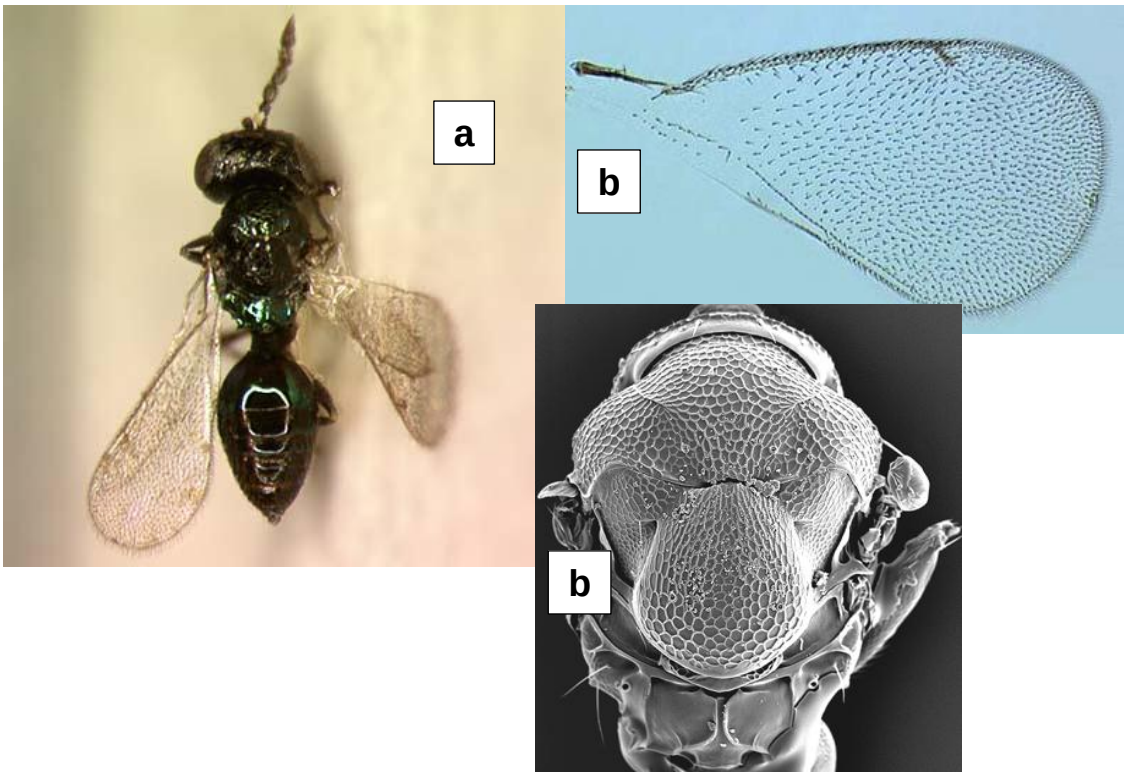


Fig. 23, a, habitus from lateral side; b, fore wing; d, Mesosoma and propodeum

Subfamily **Tetrastichinae**

Genus *Quadrastichus*

14. Genus *Quadrastichus*

This genus can be recognized by several characters, including, fore wing with a single seta on submarginal vein. Postmarginal vein short: usually, less than 1/3 the length of the stigmal vein (STV). Female funicle 3- and male 4-segmented. Antenna of female with 1 to 3 anelli, the first transverse, the second and third, when present, laminar. Male antenna with 1 or 2 anelli, with scape not swollen and with short to very long ventral plaque, and usually with basal whorls of very long setae present on all the funicular segments. All funicular segments, especially in female antenna, are distinctly longer than wide. Club 3-segmented in both sexes.

Fronto-facial suture near anterior ocellus. Malar sulcus straight and sometimes with fovea below eye, although species living on leafminers usually have a distinctly curved malar sulcus without fovea. Notauli complete. Midlobe of mesoscutum usually with a single adnotaular seta on each side, placed in posterior half, and with or without median groove. Scutellum with two pairs of longitudinal lines and two pairs of setae. Propodeum without Y-shaped paraspicular carina; propodeal spiracles small to moderate-sized, close or fairly close to metanotum, with their rim exposed. Median carina on propodeum present or absent. Ovipositor sheaths not or only slightly projecting beyond last tergite of gaster; cercal setae usually unequal in length, with one being distinctly longer than the others. Colour of the body metallic or non metallic, with or without pale markings; the leafminers parasitoid species, belonging to the "*anysis group*", are mainly yellowish.

Quadrastichus liriomyza **(Fig. 24)**

The species species has been recorded from *Liriomyza trifolii* (Hansson & La Salle, 1996)

Diagnosis: In addition to characters for the genus *Quadrastichus*. Speculum indistinct, area just distal to basal vein almost completely setose; area behind marginal vein setose for entire its length Dorsellum (at least 0.4 times as long as broad) flattened and extending posteriorly over the propodeum Pronotum entirely dark dorsally
Ventral plaque on male scape about 0.6 times as long as scape length

Q. liriomyzae is never found in sufficiently high numbers to indicate that it might be an effective control agent of leafminers in the region.

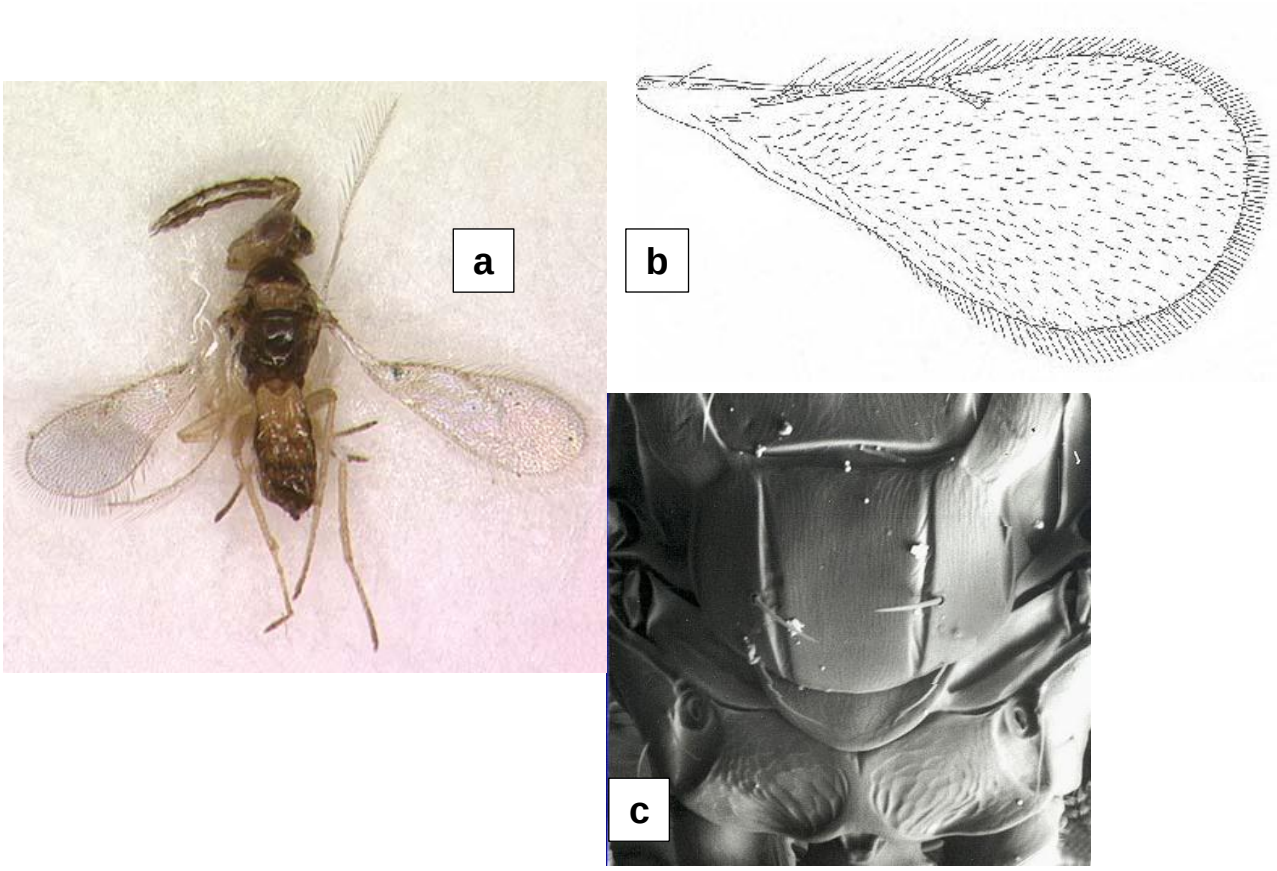


Fig. 24, a, habitus from dorsal side; b, fore wing; d, Scutellum and propodeum

Superfamily **Ichneumonoidea**

Family **Braconidae**

Subfamily **Alysiinae**

15. Genus *Dacnusa*

There are about 65 species have been described so far and mostly distributed in Holarctic. Those species are parasitoids of leafmining Agromyzidae and Drosophilidae and, like all alysiine braconids, are koinobiont endoparasitoids which oviposit in the egg or larval stages and emerge from the puparia (Wharton, 1997c). This genus is yet to be recorded from Southeast Asia; the only Australian species of *Dacnusa* is the introduced *Dacnusa areolaris* (Wharton & Austin, 1991)

Mandibles exodont, pointing outwards and not coming close to meeting medially. Stigma long and narrow, at least 10 times longer than wide. Vein r arising in basal 1/5 of stigma.

***Dacnusa areolaris* (Fig. 25)**

Dacnusa areolaris is widely distributed in the Palaearctic Region. Although it is not yet known from Southeast Asia, I am presenting this species in this training as I predict this is occurred in South Asia. It has been accidentally introduced to Australia, and it is now known from South Australia, Victoria, Tasmania, ACT and New South Wales (Wharton & Austin, 1991).

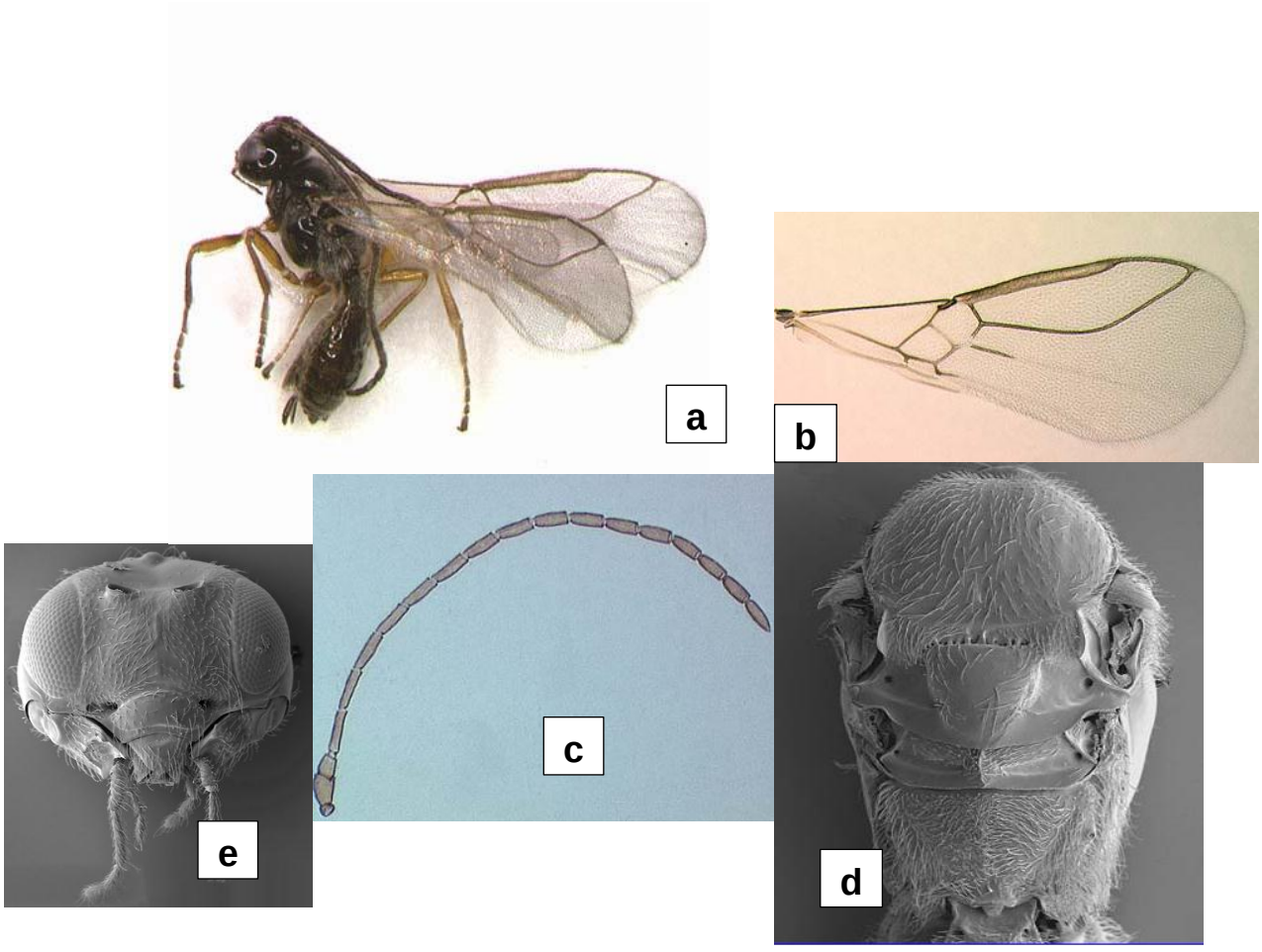


Fig. 25, a, habitus from lateral side; b, antenna; c, fore wing; d, Mesosoma; e. Head frontal view

Diagnosis: Mandibles exodont (Fig. 25 e), pointing outwards and not coming close to meeting medially.Stigma long and narrow, at least 10 times longer than wide. Vein r arising in basal 1/5 of stigma (Fig. 25 c). The species are koinobiont endoparasitoids which oviposit in the egg or larval stages and emerge from the puparia (Wharton, 1997).

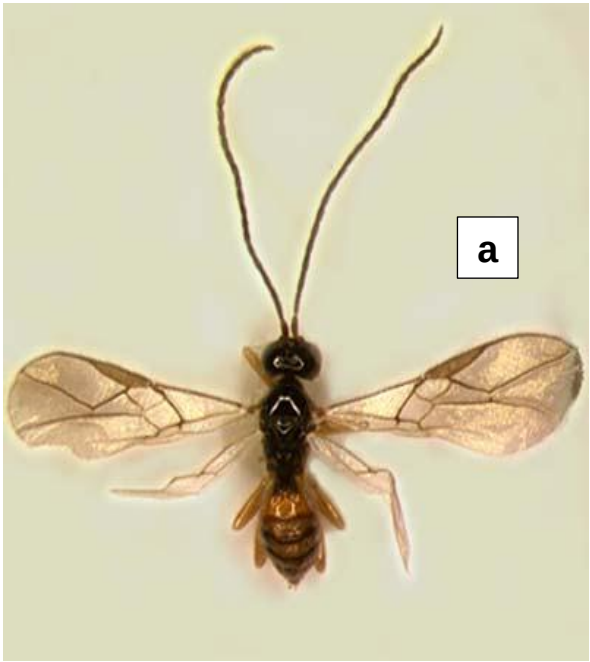
Subfamily **Opiinae**

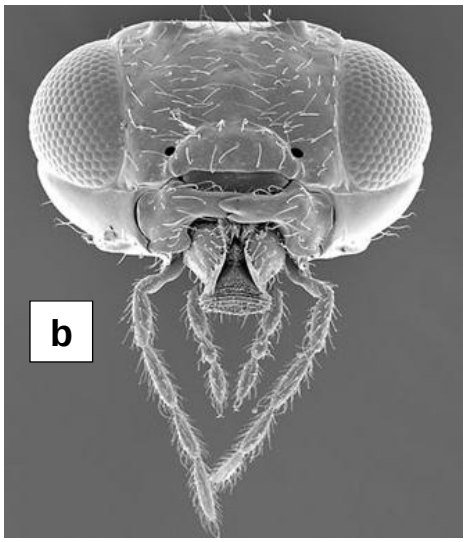
16. Genus *Opius*

Opius is a large and taxonomically difficult genus. Species are widely distributed on all continents, with over 550 described species. *Opius* species attack Diptera, mainly leaf-mining Agromyzidae and fruit-infesting Tephritidae; they oviposit in egg or larval stages and emerge from host puparia (Wharton, 1997b). They can be identified by using several characters, mainly mandibles normal, pointing inwards and meeting medially.
Stigma vein less than 8 times longer than wide. Vein r arising distal to basal 1/3 of stigma

***Opius chromatomyiae* (Fig. 26)**

Opius is a quite common genus, and it is very likely that other species of *Opius* are present in Southeast Asia. Belokobylskij *et al*. (2004) provided a key to Australian species of *Opius* associated with leaf-mining Agromyzidae.





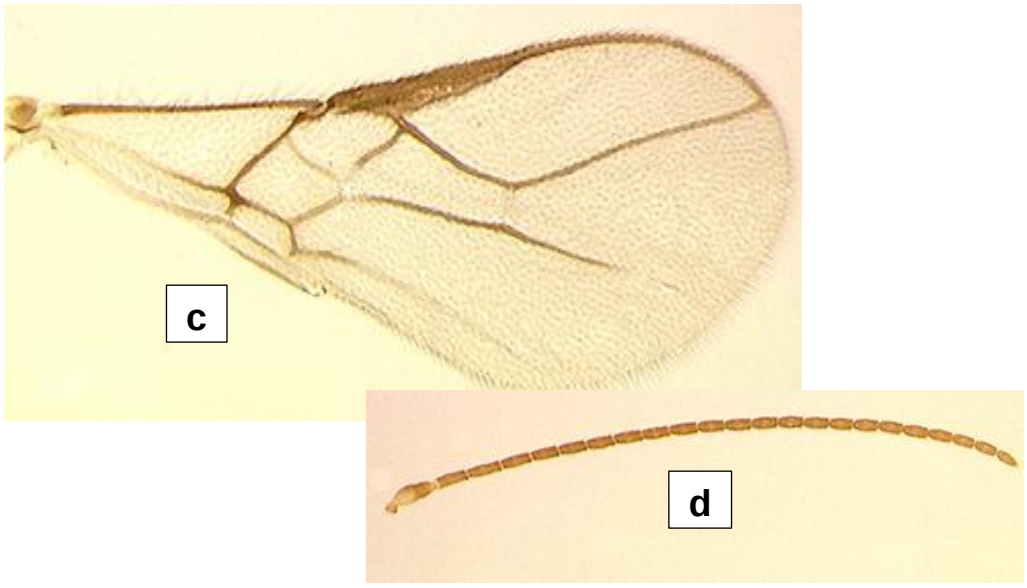


Fig. 26, a, habitus dorsal lateral side; b, Head frontal view; c, fore wing; d, antenna

Diagnosis: Manndibles normal, pointing inwards and meeting medially (Fig. 26 b). Stigma vein less than 8 times longer than wide. Vein r arising distal to basal 1/3 of stigma. *Opius chromatomyiae* is known from Malaysia, Indonesia and Vietnam and it found dominant parasitoid in *Liriomyza* in same location

Superfamily : Cynipoidea

Family : Figitidae

Subfamily : Eucoilinae

17. Genus **Gronotoma**

Species of *Gronotoma* are parasitoids of Agromyzidae. Buffington (2002) provided a list of included species. This genus is mainly known from the New World and Africa, although species are known from the Pacific and the Philippines. This genus can be identified by the notaulices well developed. Thorax in lateral view with the scutellar plate high, well above the height of the mesoscutum.

Gronotoma micromorpha (Fig. 27)

Gronotoma micromorpha is known from the Pacific (Hawaii, Guam) and Florida. It is also recorded from Indonesia, although it is not clear whether this was an introduction or part of its natural distribution

Diagnosis: This species is easily distinguished by seeing the characters of notaulices with well developed (Fig 27.b). Thorax in lateral view with the scutellar plate high, well above the height of the mesoscutum (Fig. 27 a, d).

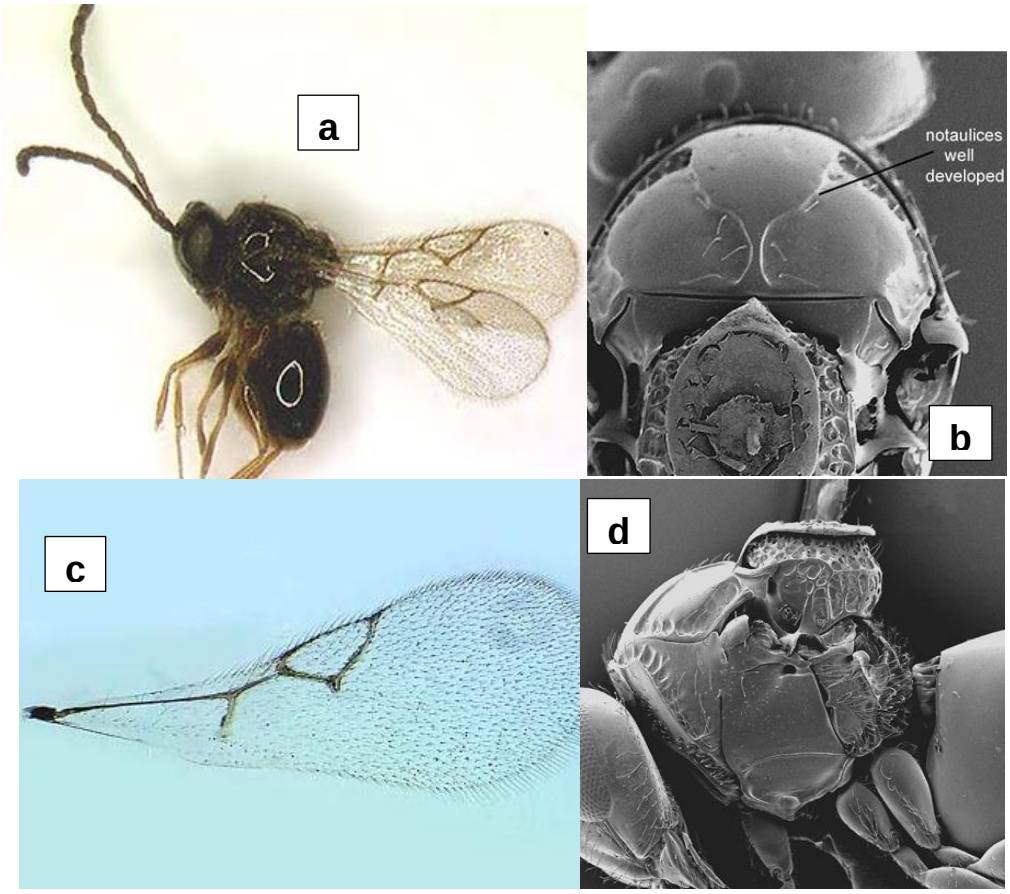


Fig. 27. a, habitus from lateral side; b, Mesosoma from dorsal view with notauli, c, fore wing ; d, Mesosoma from lateral view

18. Genus *Nordlanderia*

This species belong to this genus are parasitoids of leafmining Agromyzidae. Quinlan (1986) placed three species in this genus when he described it. Another two species were subsequently described by Miller (1989); however, these species were not considered to belong to this genus by Buffington (2004).

This genus has the notaulices weakly developed to absent. Thorax in lateral view with the scutellar plate low, about equal to the height of the mesoscutum

Nordlanderia plowa (Fig. 28)

Nordlanderia plowa is known from Africa (Nigeria, Zaire, Zambia, Zimbabwe) and it was also found it in Vietnam and Indonesia, although it is not clear whether this was an introduction or part of its natural distribution. This has been reared from leafminers on mustard leaf and French bean, although the exact species of host is not known. is a rare parasitoid in Southeast Asia, and it is unlikely to be an effective control agent

Diagnosis: The notaulices weakly developed to absent (Fig 28 a, c). Thorax in lateral view with the scutellar plate low, about equal to the height of the mesoscutum (Fig. 28 c).

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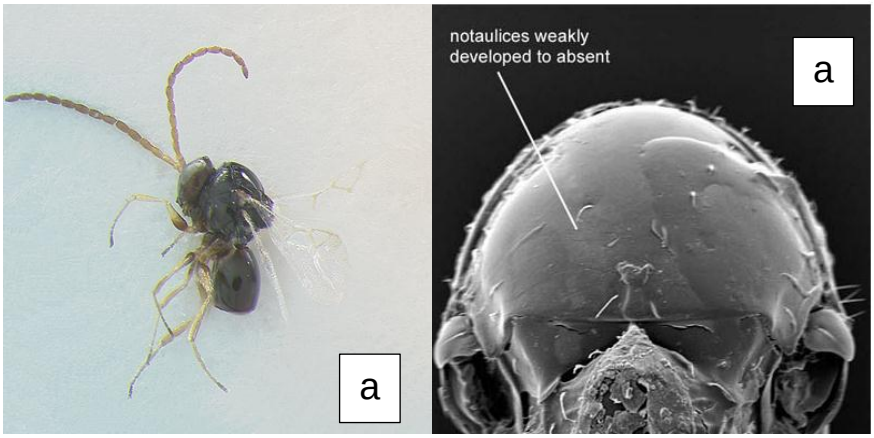

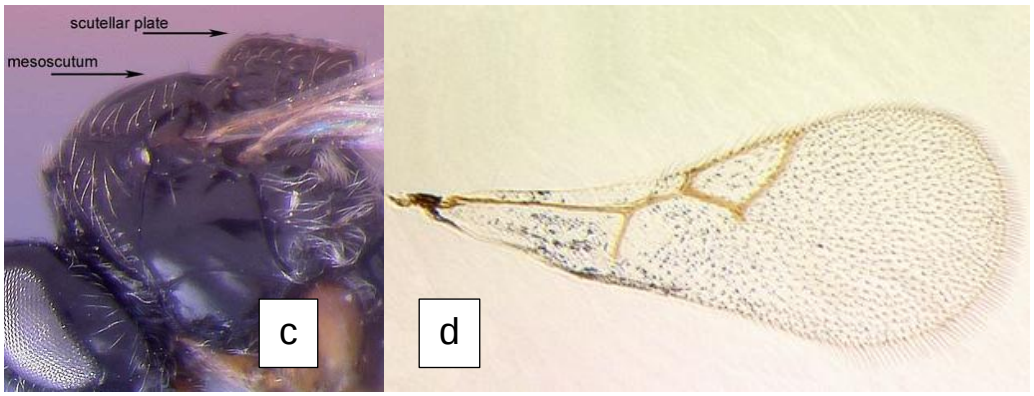

Fig. 27. a, habitus from lateral side; b, Mesosoma from dorsal view with notauli, c, Mesosoma from lateral view ; d, fore wing

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