Blister Beetles (Coleoptera: Meloidae) in Nahavand County (Hamedan Province, Iran) and Their Ecological Relationship to Other Coleopteran Families

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**ABSTRACT**
Field collection in Nahavand county (Hamedan Province, Iran) revealed 9 blister beetle, (Col: Meloidae) species from three different tribes of subfamily Meloinae. In tribe Mylabrini, *Mylabris impressa* Chevrolat 1837, *Mylabris schreiberi* Reiche 1865, *Mylabris variabilis* (Pallas, 1781), *Mylabris guerini* Chevrolat 1837, *Lydoceras bilineatus* Thomas 1897 and *Croscherelia spp.* Pardo Alcâde identified; whereas in tribe Lytini *Alosimus smyrensis* (Maran 1942) and *Mazcime iranica* (Maran 1942) found. Another species was *Calydos alloushei* Kaszab 1960 of tribe Eupomphini. Two records of *Mylabris impressa* and *Mylabris schreiberi* are quite new for Iranian fauna. There are some interesting mimicry rings between meloid species and 8 species of other coleopteran families which indicates a remarkable Müllerian mimicry. Mimics of the following families have taken advantage of Meloid aposematism towards a better natural fitness: Cerambycidae, Cleridae, Pedilidae, Melyridae, Chrysomelidae, Cantharidae and Cicindelidae. Canthariphily of families Chrysomelidae, Cantharidae and Cerambycidae are new reports which have never been shown elsewhere.

**INTRODUCTION**
Blister beetle is a common name for members of family Meloidae (Order Coleoptera), whose adults are often found on flowers. They are soft bodied insects which are generally elongate (10-20 mm) and pronotum is usually narrower than the base of elytra. Elytra have very different colourfull patterns which make their fast identification a hard task. It is markedly constricted at postocciput to form a narrow neck. Antennae with 11 antennomeres, reduced to 7-10 in tribes Mylabrini and Cerocomicini. Abdomen soft with 6 visible sternae. Male genitalia with aedeagus elongate, either with 1-2 distal dorsal hooks and 1 ventral endophallic hook. Parameres fused at base only. Phallobase large. Female genitalia short; lacking long membranous tube-like ovipositor (1).

Meloids with about 3000 species in 120 genera (8) are widespread throughout the world except for New Zealand and the Antarctic and their diversity is greatest in arid or semiarid regions (1). Some groups are phytophagous and feed on leaves and flowers of several families of plants, particularly Compositae, Astraecoaceae, Leguminosae, Solanaceae and Umbelliferae, whereas larval instars are parasite and feed on the provisions and immature stages of bees and in subfamilies Epicautini and Mylabrini, the eggs of grasshoppers. Larvae of meloidae differ from those of most other Tenebrionoidea in lacking a mola and urogomphi. Larval development is hypermetamorphic with the various instars differing considerably in morphology and behaviour. Faunestic studies have been accomplished for North America (20), West Indies (25) and Mediterranean region (4), but the meloid fauna of Iran has been quite poorly known. The first report on Iranian fauna reflected in Redtenbacher article (23). Several publications by Z. Kaszab in 1950s and 1960s (13) have substantially contributed to our understanding of meloids in Iran. The last research on Iranian meloids performed by Axentiev (2).

The hemolymph and tissues of all developmental stages of meloid beetles contain a vesicating substance called Cantharidin. This defensive chemical is commonly released through reflex bleeding when adult beetles are disturbed (1, 5, 8, 9, 27). The present study achieved because of some reports on blistering problems among human population and also shortage of information in western Iran. This article first indicates meloid diversity in Nahavand county and then clarifies some interesting ecological relationship between members of this family and some other coleopteran families.

**MATERIALS AND METHODS**
Nahavand county (Hamedan Province) is an agricultural region, located in the south of Hamedan city in the latitude of 34.13 N and longitude of 48.21 E and enjoys mild summers whilst winters are usually cold. This county is also a mountainous region with plenty of rivers, streams and ponds. Most of the land is under cultivation and the rest covered by wild vegetation.

The region was three times visited in May, June and July 2001 and 273 specimens were totally collected which later pinned, labelled and preserved for further research. Adult of meloids are usually found on the top of flowers; but considering their aggregation tendency, it is rather difficult to locate them in the field. The best time for collecting meloids was from 10:00 to 15:30 when weather was sunny and warmer than 30 °C. Samples were randomly taken via handcatch and the materials transferred to a killing jar. During all trials in Nahavand county, the following districts were visited: Akbar-Abad, Saede Vaghas, Firoozan, Zappon,
Sarkan, Gamasiab, Bayan, Ghal-e- Ghobad, Gian, Varzool, Gil Abad, Hosein Abad and Mian Rood. Keys to the Fauna D'Italia (4) were mostly used for identification of collected meloids. In order to confirm the species, materials were compared to the types in Hungarian National History Museum (HNHM), Budapest. Other coleopteran families were also identified by accessible keys (11, 24, 26, 28).

Cantharidin detection was performed by a Carlo Erba Vega Series2 GC-6000 gas chromatograph equipped with a HT8 (non-polar) fused silica capillary column (Chrompack, FT 0.25 ., ID 0.32 mm, OD 0.43 mm) which in turn connected to a Finnigan MAT ITD (EI 70 ev) to quantify the detected amount. Total mass spectra analysed by X-Calibor 2000 and base peaks were compared by NBS registry of mass spectral data bank. Method of chemical detection and quatitation has been precisely described by the authors in the article entitled ‘Cantharidin Component of Iranian Blister Beetles (Col: Meloidae) : What is the difference between Iranian & Exotic Species?’.

**RESULTS**

Family Meloidae is divided into two subfamilies: Meloinae and Nemognathinae which most of meloids are placed in meloinae. Subfamily Meloinae includes 7 tribes (4), while collected materials belong to only 3 tribes. Identification of adults showed all collected specimens were from sub family Meloinae. Identified species and their tribes are listed below:

**Tribe Mylabrini**

1. *Mylabris Eumylabris impressa* Chevrolat 1837
2. *M. (s. str.) schreibersi* Reiche 1865
3. *M. (s. str.) variabilis* (Pallas 1781)
4. *M. (s. str.) guerini* Chevrolat 1837
5. *Lydos syriacus* (Thomas 1897)
6. *Croscherichia spp.* Pardo Alcaide

**Tribe Lyttini**

1. *Alosimus smyrnensis* (Maran 1942)
2. *Mazimes iranicus* (Maran 1942)

**Tribe Eupomphini**

1. *Calydos Calydoniae alloushei* Kaszab 1960

Regarding all published materials (2, 4, 10, 13, 14, 18, 19) and meloid collection in Hungarian Natural History Museum (HNHM), Budapest, *Mylabris impressa* and *Mylabris Schreibersi* should be new records for Iranian fauna. Kaszab listed 70 species of Meloidae from Iran (13), but taking into account numerous earlier papers with separate new taxa and also our records, the fauna reaches a total of 142 known meloid species. However a considerable part of the fauna needs revision, because many forms seem to be synonyms or homonyms. That is why, the most recent classification by Bologna (4), followed here to prevent prior problems. Nevertheless, synonyms have been also indicated.

**Synonyms**

1. *Mylabris impressa*
   
   *Zonabris vaucheri*

   *Zonabris aini*

   *Mylabris Mylabris impressa*

   *Mylabris Mesolaevigata impressa*

   2. *Mylabris schreibersi*

   *Mylabris terminata*

   3. *Mylabris variabilis*

   *Mel e cichorii*

   *Mel e variabilis*

   *Zonabris variabilis*

   *Mylabris lacera*

   *Mylabris mutans*

   *Mylabris hypocrita*

   *Mylabris similus*

   *Zonabris erivania*

   4. *Mylabris guerini*

   *Mylabris rubripennis*

   *Mylabris variabilis*

   *Mylabris quadrupunctata*

   5. *Alosimus smyrnensis*

   *Alosimus syriacus*

   *Lydos syriacus*

   *Oenas syriacus*

   *Mel e syriacus*

   6. *Mazimes iranicus*

   *Micromerus iranicus*

   7. *Calydos*

   *Caloenas*

   *Mylabris*

   *Zonabris*

   *Oenas*

Thirteen districts in Nahavand county visited; whereas meloids found only in 6 districts, which have been indicated in table 1. Meloids have aggregation tendency and usually concentrate in specific localities. Considering vegetation type, altitude, distance or environmental conditions, these localities have no significant difference from nearby ones; that is why, it still remained to be a question on the ecology of blister beetles.

| Table 1. List of visited districts in Nahavand county, Hamedan Province (Iran) and ones where any meloid has been found (May- July 2001) |
|---|---|
| Districts | Result |
| 1. Akbar- Abad | - |
| 2. Saede Vaghas | - |
| 3. Firoozan | + |
| 4. Zappan | - |
| 5. Sarkan | + |
| 6. Gamasiab | + |
| 7. Bayan | - |
| 8. Ghel-e- Ghobad | - |
| 9. Gian | + |
| 10. Varzool | - |
| 11. Gil Abad | + |
| 12. Hosein Abad | - |
| 13. Mian Rood | + |
Description of dentified Species

*Mylabris impressa*
Elytra convex with yellow-black pattern and short black hairs. Body opaque black, length 11-16 mm. Head is strongly divided with little parallel temples about 1/3 of longitudinal diameter of eyes. Forehead with one oblique depression towards base of the head and 2 oval red spots, convergent ahead. Frontal suture little arched but obvious. Labrum medium advanced and is nearly straight up to front margin. Antenna short (11 segmented), segments not compressed, uniform in length, the last five antennomeres are clubbed. Scutum semi oval, smooth. Mesosternal suture a little bit visible. Elytral surface with fine and little deep punctuations. Elytra are not shining black with 3 rows of spots, rarely merging into narrow sinuate bands or rather reduced or even absent. Last abdominal sternite in male is visible with posterior margin closely and deeply reduced.

*Mylabris schreibersi*
Body parallel, little convex, dorsally black with yellowish elytra which punctuated by black patterns. Length 10-20 mm. Head strongly transverse with parallel temples and a little bit rounded off behind longitudinal eyes. Eyes of medium dimension and little convex. Forehead with two light oblique depressions towards base of the head and one round or cordiform red spot. Frontal suture quite obvious, labrum advanced. Antenna 11 segmented, black and long. Maxilla and maxillary palps not modified. Pronotum with small transverse anterior depression. Mesosternum lengthened posteriorly with small scutum, hairy in posterior. Mesopleuron is wide and little quadrato posteriorly, compressed on the scutum. Elytra with subrogose surface and pattern composed of 2 series of 2 punctiform spots and very narrow apical border, other spots larger. Patterns of elytra have not so much variation. Frequently, some spots can disappear in some populations or the two front and medium spots can join together to form sinus bands. Last abdominal sternite in male is visible with posterior margin to some extent deeply recorded. Aedeagus in lateral view with cylindrical parameters. Median lobe of parameres with 2 incised, strongly various. Parameres slightly widened laterally. Terminal lobe short and thick, weakly curved anteriorly, distal hook of median lobe short, almost perpendicular to axis of aedeagus.

*Croscherichia*
Outer spur of metatibiae longer than inner one, rather spartulate and transversally cut at apex. Mesosternum without middle scutum; mesosternal suture not very distinct and rather angulate. Body black or red, never metallic. Parameres of aedeagus elongate, narrow; almost subequal, far from apex, this latter subsquare and dorsally oblique. Length 7-23 mm.

*Alosimus smyrnensis*
Body black, covered with hairs; however the hairs of head and pronotum are longer than elytra. Pronotum red, subrounded, much wider than length, never with two black rounded spots. Elytra blue-green metallic. Length 6-20 mm. Head black without distinguished metallic reflection, with a small frontal red spot. Temples approximately 1 ½ of longitudinal diameter of eye, increased externally and rounded off behind with maximum width in front. Vertex wide and depressed. Antenna 11 segmented. Pronotum with a wide depression on the middle and the base. Pronotum punctuated with small but not deep spots. Aedeagus in dorsal view with flagellum and parameres. Paramer lobes covered by dispersed hairs. Females are different in antenna. Outer border of middle tibiae neither depressed nor densely setose; posterior femor larger than middle ones.

*Mazimes iranicus*
Pronotum subtrapezoidal, always red with two parallel black rounded spots in middle. Outer border of middle tibiae depressed and densely setose. Head red with rather extensive black colouring inferiorly and on frons. Elytra green or metallic blue. Legs red or apically dark. Length 17-38 mm.

*Caldos alloshei*
Body black, head with small, round front spots, tibia and tarsi, as well as the base of antennae brown, rarely the center of pronotum is darkly brownish-red. Elytra yellow-red with black pattern: always with two rounded spots in the first quarter of elytra and a complete transverse band behind the center, which in the back is more strongly
serrated than in front and finally the apex broadly black (*Forma typica*). Head rounded, with densely black hairs, behind the eyes most broadly. The eyes are bean shape. Vertex into the center flattened or somewhat depressed. Neck oval, approximately in the center most broadly, to the rear less.

Integument appendices consist of obvious dots with smooth and shining area among the dots.

Antennae has not been thickened, the 3rd antennomer stretched, two times longer than the 2nd and more than 1.5 times longer than the 4th. The 4th and 5th are of equal length. 6th one somewhat longer and more broadly, 7th even longer and more broadly, approximately triangular, Segments 9 and 10 as long and broad as the 8th one, but rather roundish, the last one is long and egg shape, nearly twice as long as the 10th and the point sharply rounded off.

Scutellum broadly triangular. Elytra long and parallel, with traces of hardly recognizable longitudinal lines, very closely and finely dotted.

Last Abdominal sternite of the male simply visible. Legs have long hairs, hairs of inside of the front tibia are yellow. Tarsi at the end with long setae. Tarsi of the front legs in males with densely yellow hairs. The 1st tarsal segment of the last pair of the legs not longer than claw. The claws are very characteristic, because the lower tooth is short and broad and also completely rounded. Length: 15-18.5 mm.
DISCUSSION
Apart from those meloid species precisely identified, there are still four other species which remained unknown. The first one is a *Mylabris* and the second is a *Onyctenus* species while the two others are very difficult to be identified. Since, there is only one available specimen of these four species, it is not reasonable to dissect them and go further. There is no record of genus *Onyctenus*, so regardless of forthcoming information, number of new records for Meloidae fauna of Iran will reach three. In genus *Croscherichia*, there are lots of complexities in classification and nomenclature, which make two species of the genus difficult to be identified. However the basic aim of our field trial was meloid collection, some other coleopteran specimens were also found. They were collected mostly because of considerable similarities between some of the meloids and non-meloid taxa. These taxa apparently indicate mimicry and it was not possible to differentiate them in the field. Eight species of 7 coleopteran families were precisely identified (3, 7, 11, 16, 17, 22, 28, 29, 30, 31, 32) which are listed as follow:
i. Family Cerambycidae  
   *Phymatodes testaceus*

ii. Family Cleridae  
   *Trichodes olivieri*  
   *Trichodes ephippiger*

iii. Family Pedilidae  
   *Pedilus sp.*  
   *Eurygenius sp.*

iv. Family Melyridae  
   *Malachius bipustulatus*

5. Family Chrysomelidae  
   *Oulema melanopus*

6. Family Cantharidae  
   *Cantharis sp.*

There was only one species in family Cicindellidae which we haven’t been able to identify it exactly. It was sent to British Natural History Museum (BNHM) for species determination. *Phymatodes testaceus* (Cerambycidae), *Pedilus sp.* & *Eurygenius sp.* (Pedilidae), *Oulema melanopus* (Chrysomelidae) and the Cicindelid specimen were found in natural habitats of the meloid species, *Alosimus smyrnensis*. All were collected in large number from noon to 17:00 PM on different compositae flowers. Interestingly, two species of family Cleridae, *Trichodes olivieri* and *T. ephippiger* were exactly found in the same habitats as the meloid species, *Mylabris impressa*. Both mentioned groups are very similar in size, elytral pattern and general colouration to blister beetles. Using of cantharidin contained hemolymph in meloids has already proved to be a potent deterring device against invasive arthropods (5, 6, 8, 9). Experiments by GC-MS revealed that all referred mimics had traces of cantharidin in their body. The quantity of cantharidin in mimics is not comparable to producing taxa; so they should be only canthariphilous insects, not producing ones (Unpublished data). All these data show an interesting ecological relationship between the two cantharidin producing insects (*Alosimus smyrnensis* and *Mylabris impressa*) and mentioned coleopteran species. Regarding the physical and chemical similarities, it is now clear that there is a Müllerian mimicry ring among these insects which provide them a natural fitness. Previous reports of *Pedilus* and *Trichodes* predation on blister beetles or melyrid attraction to cantharidin baits (12, 15) support our idea in canthariphily of these insects. Besides, origin of cantharidin in non-producing taxa will be better cleared. Canthariphily in Chrysomelidae, Cantharidae and Cerambycidae is a new report which has never been shown elsewhere.
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