

Distribution and New Host Plants of Seed Beetles (Col.: Chrysomelidae: Bruchinae) from Iran

L. Abbaszadeh Fard^{1*}, S. E. Sadeghi², H. R. Ghajariyeh³, V. R. Moniri², H. Yarmand², M. Shamszadeh⁴, A. Zarnegar⁵, A. Mohamad Poor⁶, S. A. Kalanitari⁷, S. R. Golestaneh⁸, M. Afrouzian⁹, M. Nikdel¹⁰, N. A. Rajabi-Mazhar¹¹, A. Salahi Ardekani¹² and A. Delobel¹³

1. Former M. Sc. Student, Aburyhan Agricultural faculty, Department of Plant protection, University of Tehran, Tehran, Iran, 2. Research Institute of Forests and Rangelands of Iran, Agricultural Research, Education and Extension Organization (AREEO), Tehran, P. O. Box 13185116 Iran, 3. University of Tehran, Aburyhan Agricultural Faculty, Department of Plant Protection, Tehran, Iran, 4. Yazd Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Yazd, Iran, 5. Gazvin Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Gazvin, Iran, 6. Qom Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Qom, Iran, 7. North Khorasan Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Bojnourd, Iran, 8. Bushehr Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Bushehr, Iran, 9. Khorasan Razavi Agricultural and Natural Resources Research Center, Agricultural Research, Education and Extension Organization (AREEO), Mashad, Iran, 10. East Azarbaijan Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Tabriz, Iran, 11. Hamedan Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Hamedan, Iran, 12. Kohgiluyeh and Boyer-Ahmad Agricultural and Natural Resources Research and Education Center, Agricultural Research, Education and Extension Organization (AREEO), Yasuj, Iran, 13. Muséum National d'Histoire Naturelle, Paris, Ile de France, France.

*Corresponding author, E-mail: ladan.abbaszadeh@gmail.com

Abstract

This report is part of a national project for gathering and classifying the arthropod seed feeders in different provinces of Iran between 2008–2014. In this paper, nineteen host species with their areas of distribution are presented for twelve species of seed beetles (Chrysomelidae: Bruchinae). Most of the identified host plants (84%) belong to the family Fabaceae (Leguminosae). In addition, all known hosts for these beetles are discussed. The identified species in this study were confirmed by Dr. Alex Delobel in the Natural history Museum of Paris.

The studied material is deposited in the arthropod collection of Research Institute of Forests and Rangelands.

Key words: Seed beetles, Bruchinae, Leguminosae, host plants, Rangeland

چکیده

پراکنش و گیاهان میزبان جدید سوسک‌های بذر ایران

لادن عباس‌زاده فرد، سیدابراهیم صادقی، حمیدرضا قاجاریه، وحیدرضا منیری، حمید یارمند، مهدی شمس‌زاده، علی زرنگار، علی محمدپور، سیدعلی‌اصغر کلانتری، سیدرضا گلستانه، مهدی افروزیان، مصطفی نیکدل، نورعلی رحیمی مظهر، عباس صلاحی و الکس دلویل

این تحقیق بخشی از طرح ملی جمع‌آوری و شناسایی حشرات بذرخوار گیاهان مرتعی و دشمنان طبیعی آن‌ها می‌باشد که طی سال‌های ۱۳۸۸ تا ۱۳۹۳ در استان‌های مختلف ایران انجام گرفته است. در این مقاله نوزده گونه میزبان گیاهی جدید برای دوازده گونه سوسک بذرخوار زیرخانواده Bruchinae با ذکر مناطق پراکنش آنها ارائه گردید. بیش‌تر گونه‌های میزبان (هشتاد و چهار درصد) متعلق به خانواده Fabaceae (Leguminosae) هستند. علاوه بر آن همه میزبان‌های شناسایی شده پیشین نیز مورد بحث و بررسی قرار گرفته‌اند. گونه‌های حشرات توسط دکتر الکس دلویل از پاریس مورد شناسایی و تأیید قرار گرفت. نمونه‌های بررسی شده در موزه حشرات گروه تحقیقات حفاظت و حمایت مؤسسه تحقیقات جنگل‌ها و مراتع کشور نگهداری می‌شوند.

واژگان کلیدی: سوسک‌های بذرخوار، لگومینوز، گیاهان میزبان، Bruchinae، مرتع

Introduction

The beetles of the subfamily Bruchinae belong to the family Chrysomelidae. Their larvae feed on the seeds of plants, especially legumes. Many species are considered as economically important pests for legume seeds and have the potential to be natural enemies for these plants (Derbel *et al.*, 2007).

They prevent the natural revival of rangeland plants by destroying their seeds. That is why during the past three decades Bruchinae subfamily is considered as one of the most important pests of rangeland plants

(Kingsolver, 2004). In this subfamily, about 30 species are important pests and at least 9 of them are noxious throughout the world because of their serious damages (Kingsolver, 2004).

Bruchidius Schilsky, 1905, with about 300 described species, is one of the largest and most diversified genera of this subfamily in the old world (Stojanova, 2010). Most Bruchinae species in Iran belong to this genus (about 54 species) which is about 50% of all Bruchinae recorded in Iran. Larval instars of most species of this genus feed inside of the seeds of

legumes (Fabaceae). Other species feed on the seeds of Caesalpiniaceae, Apiaceae and Asteraceae plants. Due to the damages caused by some of these species to the economically important plants, they are considered as pests (Stojanova, 2010).

Borowiec, in 1985 proposed a new group called *Astragali*-species for insects of *Bruchidius* genus which are morphologically similar to *Bruchidius astragali* (Boheman, 1829) and feed from seeds of various *Astragalus* species (Delobel *et al.*, 2004).

According to Johnson (1970), approximately 84% of the known hosts of Bruchinae belong to the family Leguminosae and the rest are of 31 other families (Kingsolver, 2004). In the most comprehensive study in Iran, about 1400 Bruchidae specimens were collected during three Czechoslovak-Iranian expeditions in 1970, 1973 and 1977 including 80 species, of which 22 were new Bruchidae species for Iran (Anton, 1998). According to the previous studies on the host plants of Bruchinae (Johnson, 1970; Anton, 1998; Kingsolver, 2004; Delobel *et al.*, 2004) and also the results of this paper, it seems that the genus *Astragalus* Linnaeus is a common host for Bruchinae in Iran. This genus, with more than 840 species, is the largest genus of the flora of Iran (Ranjbar and Karamian, 2003). One of the main goals of this study is determining which plant species or even families are under threat of seed beetles. In other words, it was supposed to find out the favorite diet of seed beetles. Also, the fauna of seed feeders of rangeland plants in different geographical regions of Iran and their related host plants and distribution were investigated.

Materials and methods

This study was carried out during 2008-2011 in Iranian rangelands. As the areas covered by the research project are situated in different ecological zones of the country (Fig. 1), sampling times for collecting seeds were different and depended on climate conditions of each zone.

For identifying or confirming scientific names of host plants, herbarium voucher samples of beetle host plants were collected, prepared and then transferred to botanists of the botanical department of the Research Institute of Forests and Rangelands. The seeds collected in different geographical zones of the country were sent to the Entomological laboratory of the Research Institute of Forests and Rangelands in Tehran. About 60 series of these samples were studied in this paper.

The collected seeds of each plant from every province (ecological zones) were kept in separated plastic boxes in laboratory conditions. Emerged adult insects from the seeds were killed using cyanide and transferred to 70% ethanol.

A preliminary identification of the subfamily Bruchinae based on the external morphology of adult beetles and male and female genitalia was carried out by the first author, using available keys by Anton *et al.*, 1997; Arora (1977); Anton (1998), and Borowiec (1987) (Fig. 2). The herbarium samples were sent to the botany laboratory for identification. Bruchinae beetles were identified and confirmed by Dr. Alex Delobel in Natural History Museum of Paris. As an example, Fig. 2. 1-5 illustrates a general view of the external body and genitalia of *Bruchidius astragali*.

Results

Nineteen new host plants for the subfamily Bruchinae are recorded. All of them were collected on the seeds of rangeland plants and about half of them from *Astragalus* species. These plants are hosts for 12 reported species of the subfamily Bruchinae. Six of them belong to the genus *Bruchidius*, among which three species, namely *Bruchidius virgatus* Fahraeus (1839), *Bruchidius astragali* Boheman (1829) and *Bruchidius tragacanthae* Olivier (1795) are members of the *Bruchidius astragali*-species group.

New host plants for some of the species of the subfamily Bruchinae with their locations in Iran are reported below (Fig. 3.)

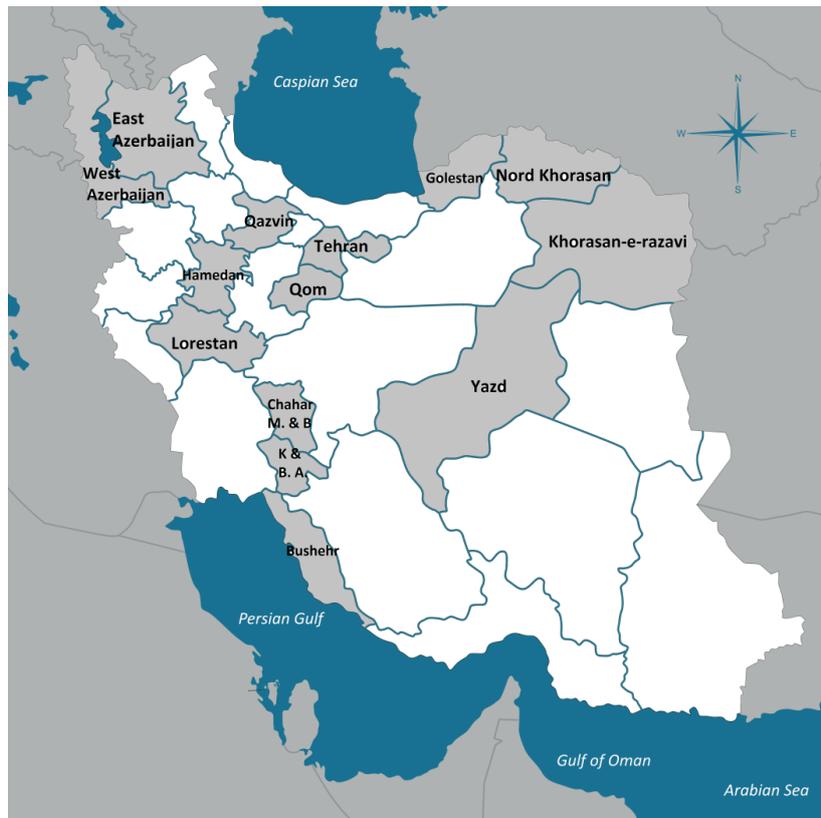


Fig. 1. Distribution of host plants.

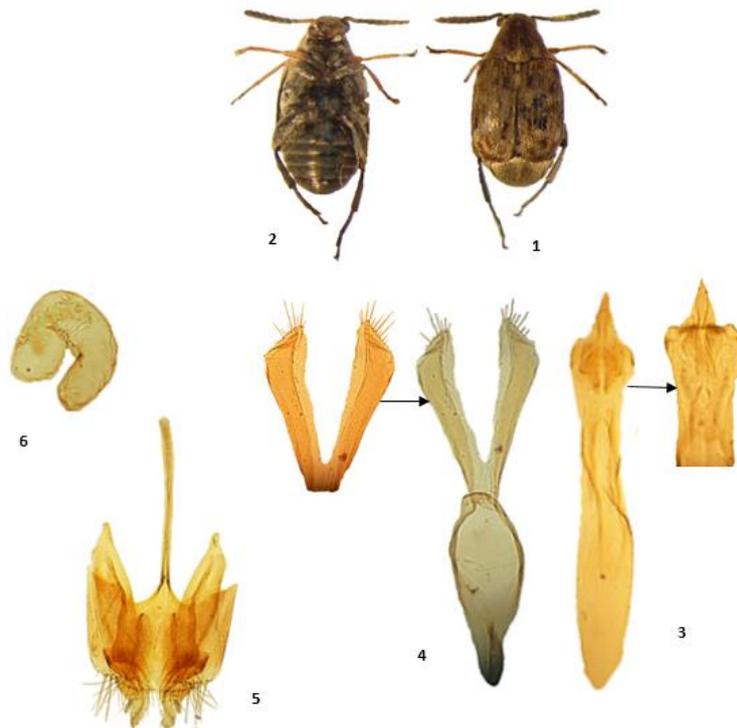


Fig. 2. 1-5. *Bruchidius astragali* 1. Dorsal aspect 2. Ventral aspect 3-4. Male genitalia 3. Median lobe 4. Lateral lobes 5-6. Female genitalia 5. Ovipositor 6. Spermatheca.

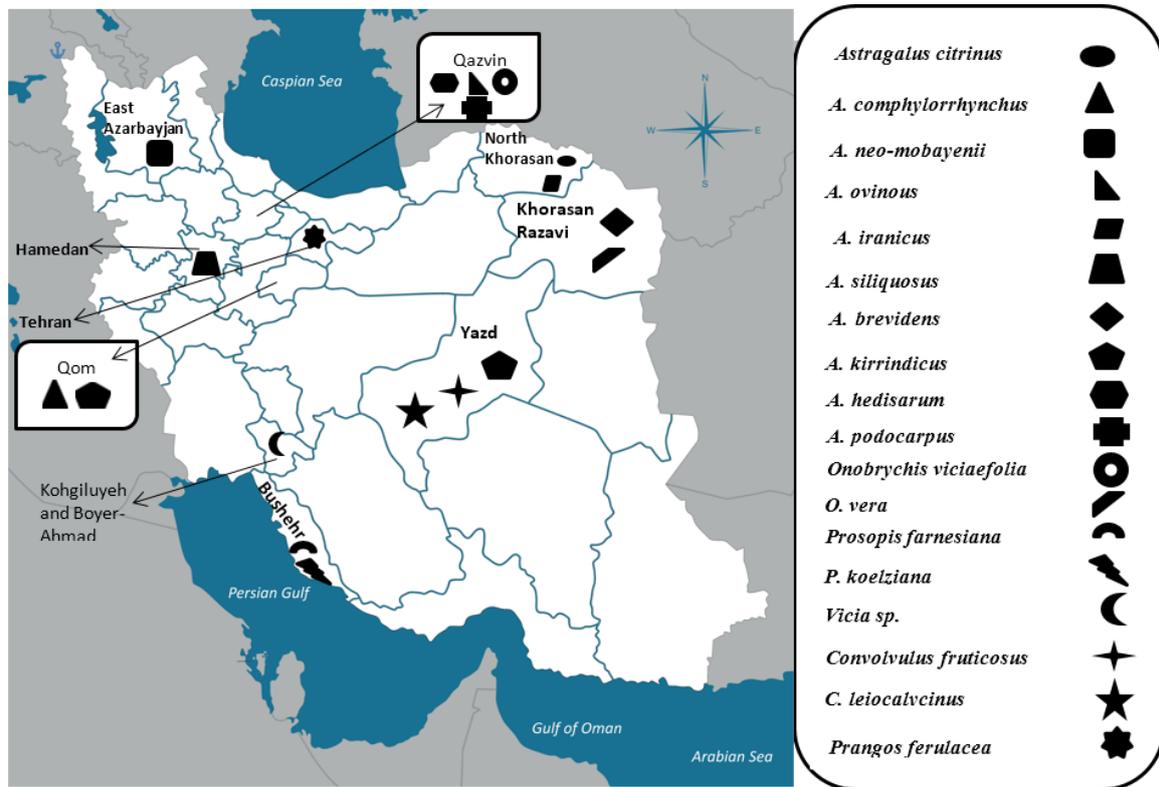


Fig. 3. Distribution of host species.

Bruchidius Schilsky

Astragalus comphylorrhynchus Fisch. & C. Mey was identified as a new host for *Bruchidius poecilus* Germar in Qom province.

A. citrinus Bunge, *A. neo-mobayenii* Maassoumi and *A. ovinous* Boiss. collected from North Khorasan, East Azarbaijan, and Qazvin provinces, respectively, are new host plants for *B. virgatus*.

Onobrychis viciaefolia Scop is reported as a new host plant for *B. lutescens* Blanchard from Qazvin province.

Prosopis farnesiana (L.) Willd. is reported as a new host plant for *B. raddianae* Anton & Delobel from Bushehr province.

Astragalus iranicus Bunge, *A. siliquosus* Boiss, and *A. brevidens* Freyn & Sint were collected from North Khorasan, Hamedan, and Razavi Khorasan provinces, respectively. They are reported as new host plants for *B. astragali*.

The only new host plant for *B. tragacanthae* is *Astragalus kirrindicus* Boiss that was collected in Qom & Yazd provinces.

Paleoacanthoscelides Gyllenhal

Astragalus hedisarum L. and *A. podocarpus* C.A.Mey from Qazvin province and *Onobrychis vera* Sirj from Razavi Khorasan province are reported as new host plants for *Paleoacanthoscelides gilvus* Gyllenhal.

Spermophagus Schoenherr

S. calystegiae Lukjanovitsh & Ter- Minassian, was reared from *Vicia* sp. a new host plant for this beetle from Kohgiluyeh and Boyer-Ahmad province.

S. canus Baudi was reared from *Convolvulus fruticosus* Pallas, a new host plant from Yazd province.

S. caricus Decelle was reared from *C. leiocalycinus* Boiss. a new host plant for this beetle from Yazd province.

S. decellei Borowiec was reared from *C. fruticosus*, a new host plant for this species from Yazd province.

Caryedon Schoenherr

Prangos ferulacea (L.) Lindl and *Prosopis koelziana* Burkart are reported as new host plants for *Caryedon mesra* Johnson from Damavand and Bushehr Provinces, respectively.

Discussion

In this study, the family Fabaceae (Leguminosae), with 25 species, is hosting about 84% of seed beetles, similarly to Johnson (1970) who estimated that approximately 84% of the known hosts of the subfamily Bruchinae belong to this plant family.

One new host plant, *Astragalus comphylorrhynchus*, is recorded for *Bruchidius poecilus* in this study. But *Astragalus contortuplicatus* L. was previously reported as a host for this species in France and Italy (Delobel *et al.*, 2004; Kergoat *et al.*, 2005a). It seems that the insect has a limited host plant diet and can be considered as a monophagous species.

Three species from *Astragalus*, *A. citrinus* Bunge, *A. neo-mobayenii* Maassoumi and *A. ovinous* Boiss, are recorded as new host plants for *B. virgatus* in this paper. Anton (1998) recorded *Astragalus talyshensis* as a host plant for this species from: Caucasia, Turkey, north of Iran (Alborz & Damavand), Syria, and Lebanon. Also *Astragalus monspessulanus* L., *A. sieversianus* Pall, and *A. pinetorum* Boiss have been reported as hosts (Delobel *et al.*, 2004). As far as all of the host species belong to the genus *Astragalus* the insect is considered a monophagous species.

Bruchidius lutescens was previously collected from *Onobrychis caput-galli* L. (Anton, 1998; Delobel, 2004). *O. viciaefolia* is a new host for this monophagous insect.

B. raddianae is one of the African species in the *B. centromaculatus* group (Anton & Delobel, 2003). The insect has never been reported on the *Prosopis* genus before. It has already been reported on *Acacia*

tortilis Forsk. in Senegal and Yemen and on *A. gerrardii* Benth and *A. ehrenbergiana* Hayne (Anton & Delobel, 2003; Kergoat *et al.*, 2005b; Alvarez *et al.*, 2006). It should be noted that according to Anton and Delobel (2003) several samples of *A. senegal* (L.), *A. sieberiana* DC. and *Dichrostachys cinerea* (L.) collected in Senegal did not host *B. raddianae*. Based on the new found genus, *Prosopis*, of the family Fabaceae, it seems that it should be considered as an oligophagous insect.

Three new host species from *Astragalus* genus are reported for *Bruchidius astragali* in our study. The insect has been reported on *Astragalus mollis* M. Bieb, *A. ponticus* Pall. and *A. testiculatus* Pall. (Delobel *et al.*, 2004). As far as host plants of this beetle are limited to one plant genus, it can be considered as a monophagous species.

There is nothing mentioned in Borowiec, 1985 and Anton, 1998, regarding the specific species of *Astragalus* genus which are attacked by *Bruchidius tragacanthae*. Also, *A. kirrindicus* is here reported as the insect's host plant for the first time. Borowiec, (1987, 1985) and Anton, (1998), reported that the distribution of this insect was only in Iran, and mentioned the genus *Astragalus* as its host plant and classified it in the *Bruchidius astragali* group. Delobel (*et al.*, 2004) believed that some species of seed beetles like *B. lucifugus* Bohemann, *B. tragacanthae* and *B. virgatoides* Lukjanovitch & Ter-Min were not reared from *Astragalus* seeds, and maybe only the adults feed on them and are caught on *Astragalus* plants. But as the insect species emerged from several seed samples of the genus *Astragalus* in different parts of the country in this study, it can be said that this is a host for the monophagous insect.

It should be noted that the adult bruchines are attracted to flowers of some plants. Therefore, collecting them from these plants does not mean that these plants are hosts for the insect's larva (Decelle & Lodos, 1989).

Several plant species, including *Hedysarum capitatum* Burm. in Algeria, *H. coronarium* L.,

Onobrychis vaginalis C.A. Mey., and *O. vicifolia* Scop. in Sicily, *H. spinosissimum* L. in France, *O. radiata* Desf. *O. sativa* Lam., *O. schahuensis* Bornm. in Iraq, and unidentified plants in Tajikistan and France have been reported as hosts of the species *Paleoacanthoscelides gilvus* (Anton, 1998; Alvarez *et al.*, 2006; Kergoat *et al.*, 2007). The present report, with three hosts belonging to *Astragalus* and *Onobrychis* confirms that it is an oligophagous insect.

Vicia sp., of the family Fabaceae, is introduced as a host plant for *Spermophagus calystegiae* for the first time. Seeds of this genus are usually the *Bruchus* species' diet (Delobel and Sadeghi, 2014). The plant species *Calystegia sepium* (L.), *Calystegia soldanella* (L.), *Convolvulus sepium* (L.), and *Convolvulus soldanella* (L.), of the family Convolvulaceae are known as host plants for the species (Borowiec, 1991; Anton, 1998). This new host which belongs to a different family indicates that the insect is to be considered polyphagous.

In the literature, host plants for *Spermophagus caricus* were not mentioned. In this study *Convolvulus leiocalycinus* Boiss. is introduced as a host for this monophagous insect for the first time.

Spermophagus decellei was previously reported only from Iran (Borowiec, 1987, 1991; Anton, 1998), and before the present study its host plants were unknown. We reared adults of this species from

Convolvulus fruticosus seeds and this plant is reported as its host plant for the first time.

Convolvulus fruticosus is reported as a new host plant for *Spermophagus canus*. The new species, *Spermophagus shamszadehi*, that was recently described, was reared from seeds of this host (Delobel and Sadeghi, 2013). The known regions for the distribution of *Spermophagus canus* are central Asia, Kazakhstan, China, Tadjikistan, Pakistan and Iran (Borowiec, 1987, 1991 and Anton, 1998).

Two new hosts of the families Apiaceae and Fabaceae are reported for *Caryedon mesra* in this study. This insect was previously reported only from Palestine (Johnson *et al.*, 2004; Lobl & Smetana, 2010,) and its only known host was *Ferula communis* L. of the family Apiaceae (Johnson *et al.*, 2004). The hosts of the genus *Caryedon* are in three subfamilies, Mimosoideae, Caesalpinioideae, and Papilionoideae of the family Leguminosae (Silvain *et al.*, 1998). The fact that it feeds in seeds belonging to two different families indicates that it is a polyphagous insect.

Acknowledgments

The authors appreciate the financial support of the Research Institute of Forests and Rangelands and University of Tehran. They wish to thank Dr. L. Borowiec, Dr. G. Kergoat and Mr. Z. György for their helps and guidance.

References

- Alvarez, N., Romero Napoles, J., Anton, K. W., Benrey, B. & Hossaert-McKey, M. (2006) Phylogenetic relationships in the Neotropical Bruchid genus *Acanthoscelides* (Bruchinae, Bruchidae, Coleoptera). *Journal of Blackwell verlag* 44 (1), 63-74.
- Anton, K. W., Halperin, J. & Calderon, M. (1997) An annotated list of the Bruchidae (Coleoptera) of Israel and adjacent areas. *Israel Journal of Entomology* 32, 59-96.
- Anton, K. W. (1998) Results of the Czechoslovak-Iranian Entomological expeditions to Iran 1970, 1973 and 1977 Coleoptera: Bruchidae. *Casopis Narodniho Musea. Rada Prirodovedna* 167 (1-4), 73-90.
- Anton, K. W. & Delobel, A. (2003) African species of the *Bruchidius centromaculatus* group with "eyed" female pygidium (Coleoptera: Bruchidae: Bruchinae). *Genus* 14 (2), 159-190.
- Arora G. L. (1977) Taxonomy of the Bruchidae (Coleoptera) of Northwest India Part I. Adults. *Oriental Insect Supplement* 7, 1-132.
- Bernays, E. A. and Chapman, R. F. (1994) *Host-Plant selection by phytophagous insects*. Chapman & Hall, New York. 312 pages.

- Borowiec, L.** (1985) The status of *Bruchus tragacanthae* OLIVIER (Coleoptera, Bruchidae). *Polskie Pismo Entomologiczne* 55, 245-249.
- Borowiec, L.** (1987) The seed-beetles (Coleoptera, Bruchidae) from the Middle East. *Polskie Pismo Entomologiczne* 57, 601-616.
- Borowiec, L.** (1991) Revision of the genus *spermophagus* Schoenherr (Coleoptera: Bruchidae: Amblycerinae). *Genus* 3-64.
- Decelle, J., & Lodos, N.** (1989) Contribution to the study of Legume Weevils of Turkey (Coleoptera: Bruchidae). *Bulletin et annales de la Société royale d'entomologie de Belgique* 125, 163-212.
- Delobel, A.** (2004) Les types de *Bruchidius* décrits par Emile Blanchard (Coleoptera, Bruchidae). *Revue Française d'Entomologie (N. S.)* 26 (4), 165-173.
- Delobel, A., Anton, K. W. & Kergoat, G.** (2004) New data on European *Astragalus*-feeding *Bruchidius*, with the description of a new species from Southern Italy (Coleoptera: Bruchidae: Bruchinae). *Genus* 15 (2), 173-185.
- Derbel, S., Noumi, Z., Anton, K. W. & Chaieb, M.** (2007) Life cycle of the coleopter *Bruchidius raddianae* and the seed predation of the *Acacia tortilis* Subsp. *raddiana* in Tunisia. *C. R. Biologies* 330, 49-54.
- Delobel, A., Sadeghi, S. E.** (2013) Remarks on the *Spermophagus rufipes* species group, with the description of a new species from Iran (Coleoptera: Chrysomelidae: Bruchinae: Amblycerinae). *Genus* 24 (3-4), 309-314.
- Delobel, A., Sadeghi, S. E.** (2014) Two new *Bruchus* species from the Iranian highlands, with biological data (Chrysomelidae: Bruchinae). *Genus* 25 (3), 433-440.
- Johnson, C. D.** (1970) *Biosystematics of the Arizona, California, and Oregon species of the seed beetle genus Acanthoscelides Schilsky (Coleoptera: Bruchidae)*. Vol. 59, 116pp. University of California Publications in Entomology.
- Johnson C. D., Southgate B. J. & Delobel A.,** (2004) A revision of the Caryedontini (Coleoptera: Bruchidae: Pachymerinae) of Africa and the Middle East. *Memoirs of the American Entomological Society, Zoological Record* 44 (140), 1-120.
- Kergoat, G. J., Alvarez, N., Hossaert-Mckey, M., Faure, N. & Silvain, J. F.** (2005a) Parallels in the evolution of the two largest new and old world seed-beetle genera (Coleoptera, Bruchidae). *Molecular Ecology* 14, 4003-4021.
- Kergoat, J., Delobel, A., Fédière, G., Le Rü, B. & Silvain, J. F.** (2005b) Both host-plant phylogeny and chemistry have shaped the African seed-beetle radiation. *Journal of Molecular Phylogenetics and Evolution* 35, 602-611.
- Kergoat, J., Silvain, J. F., Delobel, A., Tuda, M. & Anton, K. W.** (2007) Defining the limits of taxonomic conservatism in host-plant use for phytophagous insects: Molecular systematics and evolution of host-plant associations in the seed-beetle genus *Bruchus* Linnaeus (Coleoptera: Chrysomelidae: Bruchinae). *Molecular Phylogenetics and Evolution* 43, 251-269.
- Kingsolver, J. M.** (2004) *Handbook of the Bruchidae of the United States and Canada (Insecta, Coleoptera)*. 340 pp. U. S. Department of Agriculture.
- Lobl, I. & Smetana, A.** (2010) *Catalogue of Palaearctic Coleoptera*. Vol. 6, 507 pp. Apollo Books.
- Ranjbar, M. & Karamian, R.** (2003) Some remarks on the genus *Astragalus* sect. *Incani* in Iran. *Botanical Journal of the Linnean Society* 143, 443-447.
- Silvain, J. F. & Delobel, A.** (1998). Phylogeny of West African Caryedon (Coleoptera: Bruchidae): Congruence between Molecular and Morphological Data. *Molecular Phylogenetics and Evolution* 9 (3), 533-541.
- Stojanova, A.** (2010) Seed beetle *Bruchidius terrenus* (Sharp) (Coleoptera: Chrysomelidae: Bruchinae)-New invasive species to the Bulgarian fauna. *Biotechnol. & Biotechnol Equipment* 24 (2), 646-647.

Received: 13 May 2015

Accepted: 24 February 2016