Graellsia, 78(2): e168
julio-diciembre 2022
ISSN-L: 0367-5041
https://doi.org/10.3989/graellsia.2022.v78.334

WEEVILS (COLEOPTERA, CURCULIONIDAE) ASSOCIATED WITH PISTACHIO TREE (*PISTACIA VERA* L.) CROPS IN CASTILLA – LA MANCHA (CENTRAL SPAIN)

Enrique Fernández-Carrillo[1,*], José Luis Fernández-Carrillo[2], Sara Rodrigo-Gómez[3] & Antonio J. Velázquez-de-Castro[4]

[1] Instituto Regional de Investigación y Desarrollo Agroalimentario y Forestal (IRIAF). Centro de Investigación Agroambiental "El Chaparrillo". Ctra. de Porzuna, s/n. E 13071 Ciudad Real, Spain.
Email: efernandezc@jccm.es – ORCID iD: https://orcid.org/0000-0003-3342-2544

[2] Departamento de Ciencias. Colegio Ntra. Sra. del Prado - Marianistas. Paseo Carlos Eraña 17. 13004 Ciudad Real, Spain.
E-mail: joselfdezc@hotmail.com – ORCID iD: https://orcid.org/0000-0002-8376-7164

[3] Instituto Regional de Investigación y Desarrollo Agroalimentario y Forestal (IRIAF). Centro de Investigación Agroambiental "El Chaparrillo". Ctra. de Porzuna, s/n. E 13071 Ciudad Real, Spain.
E-mail: srodrigog@jccm.es – ORCID iD: https://orcid.org/0000-0002-0611-3466

[4] Museo [UV] Historia Natural. Universitat de Valencia. Calle Doctor Moliner, 50. E-46100 Burjassot, Valencia, Spain.
E-mail: velazquezdecastro@wanadoo.es – ORCID iD: https://orcid.org/0000-0002-5357-4126

[*] Corresponding author: efernandezc@jccm.es

ABSTRACT

This paper presents the results of research carried out in pistachio plantations in the provinces of Ciudad Real, Cuenca and Toledo (Castilla – La Mancha Region), which led to the discovery of eight Curculionidae species from five genera (*Brachyderes, Otiorhynchus, Polydrusus, Sitona* and *Lixus*) of two subfamilies (ENTIMINAE and LIXINAE). *Brachyderes marginellus*, *B. pubescens, Polydrusus subglaber, Otiorhynchus cribricollis* and *Lixus acicularis* have been observed feeding on *P. vera* leaves, and they are recorded for the first time in this host plant. *Polydrusus subglaber* and *Otiorhynchus cribricollis* fed intensively in these leaves and further research on these species is recommended as they may represent important pistachio defoliators in the region. Biological and distributional data of these species are given.

Keywords: Faunistic results, host plant, Curculionoidea, *Polydrusus, Brachyderes, Otiorhynchus*, endemic species, defoliators, *Pistacia*, Castilla-La Mancha.

RESUMEN

Gorgojos (Coleoptera, Curculionidae) asociados al cultivo del pistacho (*Pistacia vera* L.) en Castilla – La Mancha.

Se presentan los resultados de diversos muestreos llevados a cabo sobre parcelas cultivadas de pistachero en diferentes localidades de Castilla – La Mancha, en las provincias de Ciudad Real, Cuenca y Toledo. Se han encontrado un total de 8 especies de Curculionidae, de 5 géneros (*Brachyderes, Otiorhynchus*, *Polydrusus*, *Sitona* y *Lixus*) correspondientes a 2 subfamilias: ENTIMINAE y LIXINAE. *Brachyderes marginellus*, *B. pubescens*, *Polydrusus subglaber, Otiorhynchus cribricollis* y *Lixus acicularis* se han observado alimentándose de hojas de *P. vera* y se citan por primera vez sobre esta planta huésped. *Polydrusus subglaber* y *Otiorhynchus cribricollis* devoran intensamente sus hojas, por lo que se propone seguir investigando estas dos especies como importantes defoliadores de pistacho en la región. Se aportan datos biológicos y corológicos para las especies encontradas.

Palabras clave: Resultados faunísticos, planta huésped, Curculionoidea, *Polydrusus, Brachyderes, Otiorhynchus*, endemismos, defoliadores, *Pistacia*, Castilla – La Mancha.

Recibido/*Received*: 7/10/2021; **Aceptado/*Accepted***: 21/03/2022; **Publicado en línea/*Published online***: 07/09/2022

Cómo citar este artículo/*Citation*: Fernández-Carrillo, E., Fernández-Carrillo, J.L., Rodrigo-Gómez, S. & Velázquez-de-Castro, A.J. 2022. Weevils (Coleoptera, Curculionidae) associated with pistachio tree (*Pistacia vera* L.) crops in Castilla – La Mancha (Central Spain). *Graellsia*, 78(2): e168. https://doi.org/10.3989/graellsia.2022.v78.334

Introduction

Pistachio crops were first introduced into Spain in the 1980s. Since then, the area devoted to the cultivation of pistachios has increased, particularly in recent years, and currently comprises around 55 000 ha (MAPA, 2021a). Spain has led pistachio cultivation in Europe since 2014, followed by Greece and Italy. The majority of the area devoted to this cultivation in Spain is located in the region of Castilla-La Mancha (around 75% of the total national surface area), and is essentially rain fed. Most of this area is concentrated in the province of Ciudad Real, with over 10 000 ha, followed by the provinces of Toledo, Albacete and Cuenca (MAPA, 2021b).

Many pests affect pistachio trees in the zones traditionally devoted to this crop, although its recent introduction and the agri-environmental conditions of Castilla-La Mancha limit their natural enemies in this area. The only defoliator beetle recorded as a pest in this region is the chrysomelid *Labidostomis lusitanica* (Germar, 1824), which can cause substantial damage to young plantations and the fresh green leaves of adult trees (Couceiro *et al.*, 2017; MAPA, 2018; Rodrigo-Gómez *et al.,* 2022).

Several Curculionidae species are considered pistachio pests. They include *Chaetoptelius vestitus* (Mulsant & Rey, 1861) (Scolytinae), that damages branches and buds in Turkey and Iran (Ghrissi *et al*., 2019; Mehrnejad, 2020), and *Polydrusus davatchii* Hoffmann, 1956 (Hoffmann, 1956; Sadeghi & Zare, 2006), which damages leaves in Central and Southern Iran (Mehrnejad *et al.*, 2017). Two other *Polydrusus* species are potentially harmful, *P. nadaii* Meleshko & Korotyaev, 2005 for Iran's pistachio crops (Velázquez de Castro *et al.*, 2014), and *Polydrusus roseiceps* Pesarini, 1975 in Diyarbakir Province, Turkey (Şimşek & Bolu, 2017). Recently, Açikgöz *et al*. (2022) reported *Strophomorphus sublaevigatus* Desbrochers, 1875 to cause damage on UCB1 pistachio rootstock leaves and bark, in Turkey.

Material and methods

This work has been carried out at several pistachio plantations located in Castilla – La Mancha Region, and specifically in several municipalities in the provinces of Ciudad Real, Cuenca and Toledo (Fig. 1). In order to identify the presence of weevils in pistachio plants

Fig. 1.– Map of Castilla-La Mancha region. Pistachio plantations and monitoring plots (red colour).

Fig. 1.– Mapa de Castilla-La Mancha. Plantaciones de pistachero y parcelas muestreadas (en color rojo).

Table 1.– Characteristics of pistachio crop plots.

Tabla 1.– Características de las parcelas de cultivo de pistacho.

Sampling point	Geographic coordinates	Altitude (m)	Plantation age (years)	Rootstock	Botanical variety	Dry or irrigated land	Weevils detection (yes/no)
Los Navalucillos (Toledo)	39.65888, -4.66194	685	5	*P. terebinthus*	Kerman	Irrigated	Yes
Peralvillo, Miguelturra (Ciudad Real)	39.07703, -3.87204	610	6	*P. terebinthus*	Kerman	Dry	Yes
Peralvillo, Miguelturra (Ciudad Real)	39.07827, -3.87111	611	6	*P. terebinthus*	Kerman	Dry	Yes
Pozuelo de Calatrava (Ciudad Real)	38.86342, -3.8544	610	1	UCB	Ungrafted	Irrigated	Yes
Villamayor de Santiago (Cuenca)	39.6588, -2.88671	818	7	*P. terebinthus*	Kerman	Dry	Yes
Villamayor de Santiago (Cuenca)	39.66199, -2.88557	813	3	*P. terebinthus*	Kerman	Dry	Yes
Cabeza del Palo (Ciudad Real)	38.99714, -3.96307	636	1	*P. terebinthus*	Ungrafted	Irrigated	Yes
Campo de Criptana (Ciudad Real)	39.45143, -3.13903	712	6	*P. terebinthus*	Ungrafted	Dry	No
Chaparrillo (Ciudad Real)	39.004274, -3.962140	623	>10	*P. terebinthus*	Kerman	Irrigated	Yes
Torrenueva (Ciudad Real)	38.61893, -3.39019	745	1	UCB	Ungrafted	Irrigated	No
Valdepeñas (Ciudad Real)	38.78209, -3.29034	762	1	*P. terebinthus*	Ungrafted	Dry	No
Viso de San Juan (Toledo)	39.65858, -4.66139	586	1	*P. terebinthus*	Ungrafted	Irrigated	No

and their still-ungrafted rootstock (*Pistacia terebinthus* or UCB1-*Pistacia integerrima* × *Pistacia atlantica*), 12 young pistachio crop plots were monitored, most of them aged between 1 and 7 years and all of which were of the Kerman variety (Table 1).

Two perpendicular transects were carried out, starting from the center of each plot and using the beating tray sampling method and direct observations on the basis of visible damage (Speight, 2005). Transects were conducted weekly from spring to autumn 2020. All the specimens collected were placed in tubes and transferred to "El Chaparrillo" research center in Ciudad Real Province for their mounting, labeling and subsequent identification. This material was divided between the research Centre's reference collection and some of the authors' private collections.

Results

The sampling attained a total of 328 individuals belonging to eight species and five genera of Curculionidae. The species collected, ranked in order of abundance (individuals and percentage), are: *Polydrusus subglaber* (111 individuals, 34%), *Otiorrinchus cribricollis* (97, 29.6%), *Lixus acicularis* (40, 12.2%), *B. pubescens* (27, 8.2%), *P. pilosulus* (25, 7.6%), *B. marginellus* (12, 3.6%), *Sitona lineatus* (10, 3%), and *S. discoideus* (6, 1,8 %).

ENTIMINAE Schoenherr, 1823

Brachyderes (Brachyderes) pubescens Boheman, 1883.

This species is widely distributed in the Western Mediterranean: the South of France, the Iberian Peninsula, the Balearic Islands and North Africa (Viedma, 1967) and it is also found in Italy (Alonso-Zarazaga *et al.*, 2017).

It has been recorded on several perennial *Quercus,* especially *Quercus ilex* L. (Cardona, 1872; Hoffmann, 1950; Wagner, 1928)*, Q. ilex* subsp. *ballota* (Desf.) Samp. (Compte Sart, 1982), *Pinus* sp. (Cardona, 1872), *Pinus halepensis* Miller (Breit, 1909), and generally in oak and pine trees (Moragues, 1888). It has also been found wintering in oaks in the Moroccan Atlas Mountains, and on *Quercus suber* L., *Quercus pyrenaica* Willd., *Castanea sativa* Miller, or even *Cistus ladanifer* L. in the region of Extremadura in the Iberian Peninsula (Sáez-Bolaño *et al.*, 2010).

In Castilla – La Mancha, it has previously been captured in Ciudad Real Province, in the municipality of Alcoba (Cabañeros National Park), on *Quercus faginea* Lam., *Q. ilex* subsp. *ballota*, *Q. pyrenaica* and *Betula alba* L. (Fernández-Carrillo, 2013). In this study, it has been found on *Pistacia vera* in the municipality of Villamayor de Santiago (Cuenca) (Fig. 2A), and again in Ciudad Real, in May and June. This is, to the best of the authors' knowledge, the first record of this species feeding on *Pistacia vera.*

Brachyderes (Gastraspis) marginellus Graells, 1858

This endemic species has been recorded in Southern Portugal and in some provinces from Central and Southern Spain (Alonso-Zarazaga, 2018).

Previously recorded from Ciudad Real Province by Viedma (1967), it has been also found in Alcoba, (Cabañeros National Park environment), on *Q. ilex* subsp. *ballota* (Fernández-Carrillo, 2013). It has also been recorded on *Arbutus* sp. (Gurrea Sanz *et al.*, 1989), *Cistus* sp. (Uhagón, 1887), *C. monspeliensis* L. and *C. ladanifer* (Sáez-Bolaño *et al.*, 2010), and on *Q. ilex* subsp. *ballota* (Compte Sart, 1982; Viedma, 1967).

In this study, *B. marginellus* was found on cultivated *Pistacia vera* in the municipality of Los Navalucillos (Toledo Province), in June and July (Fig. 2B–C). This is the first record of this species feeding on cultivated pistachio trees, although wild *Pistacia* species could be possible host plants for this beetle, since *P. terebinthus* L. and *P. lentiscus* L. can be found in the same distribution area.

Otiorhynchus (Arammichnus) cribricollis Gyllenhal, 1834

This is a ubiquitous, invasive, thermophilic species that is native to the Eastern Mediterranean (Alonso-Zarazaga, 2013). It is broadly distributed throughout Albania, France, Hungary, Italy, Portugal, North Africa and Spain, and has colonized the United States, Australia and New Zealand (Di Marco & Osella, 2001). Despite being widely distributed in Spain, it had not previously been recorded in Ciudad Real Province (Alonso-Zarazaga, 2018).

Otiorhynchus cribicollis is parthenogenetic and its larvae thrive in the roots of *Artemisia gallica* Willd., *Medicago sativa* L. and other annual herbaceous plants (Hoffmann, 1963). The adults show a strong preference for members of the Oleaceae family (*Ligustrum, Siringa, Phillyrea* and *Olea*), although they also attack dozens of wild and cultivated plants (*Citrus, Eucalyptus, Prunus, Pyracantha, Pyrus, Rosa, Vitis,* etc.) (Di Marco & Osella, 2001).

In Spain, *O. cribicollis* has been described as a secondary pest in olive trees, although it can cause severe damage locally, especially in young trees in late spring (Alvarado *et al.*, 1998). Despite its polyphagy, it is the first record on *Pistacia.* Specimens were found on *P. vera* in the municipality of Ciudad Real (Fig. 2D), in September, and had devoured the leaves (Fig. 3A) to such an extent that the plot owner sprayed it using the pyrethroid insecticide lambda-cihalotrin.

Polydrusus (Eurodrusus) pilosulus Chevrolat, 1865

This species is endemic to the Iberian Peninsula, where it has been recorded haphazardly but extensively

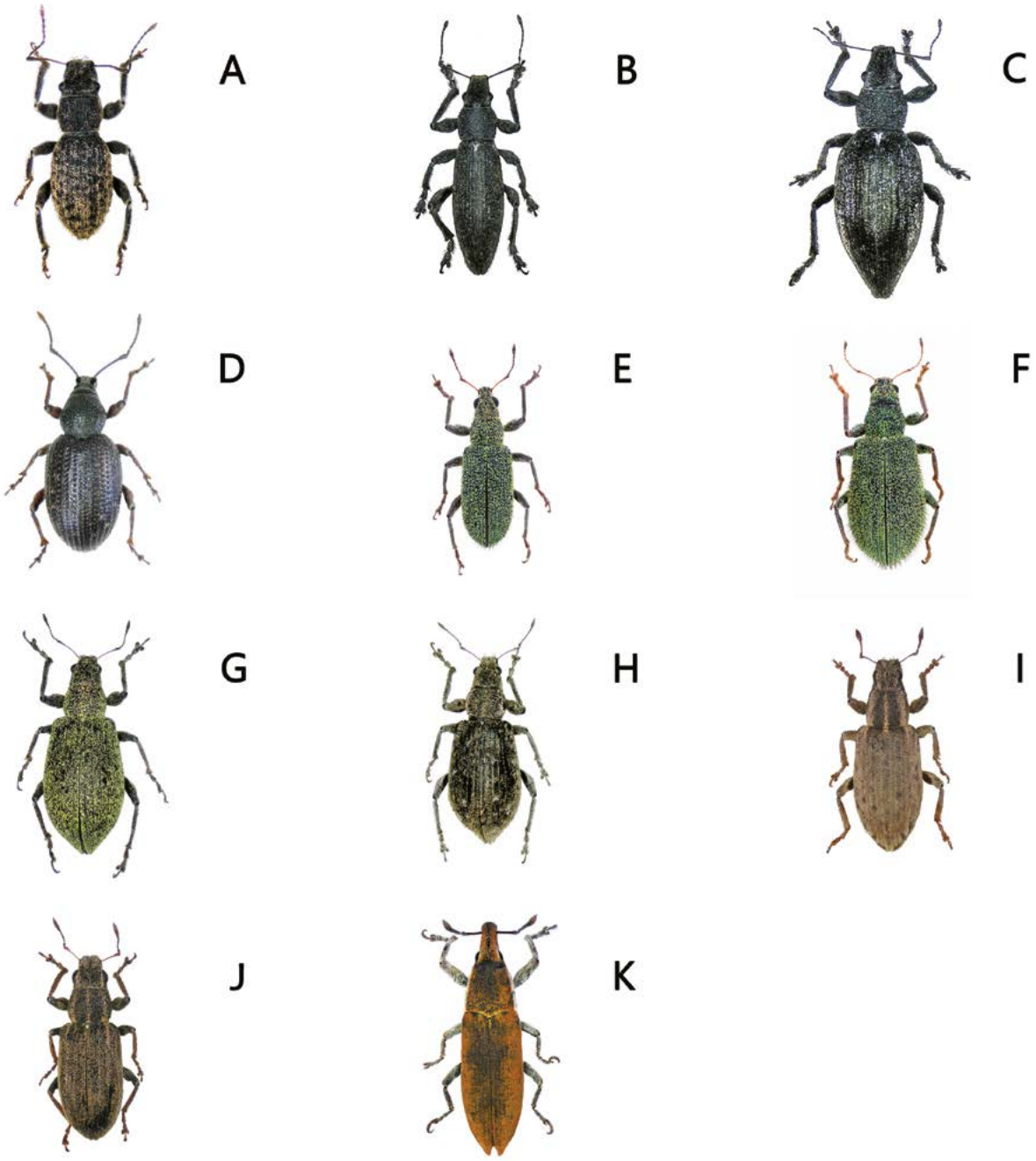

Fig. 2.– Habitus of weevil species found on pistachio trees. (A) *Brachyderes pubescens*, (B) *Brachyderes marginellus*, male, (C) *Brachyderes marginellus*, female, (D) *Otiorhynchus cribricollis*, (E) *Polydrusus pilosulus*, male, (F) *Polydrusus pilosulus*, female, (G) *Polydrusus subglaber*, female, green form, (H) *Polydrusus subglaber*, female, brown form, (I) *Sitona discoideus*, (J) *Sitona lineatus*, (K) *Lixus acicularis.*

Fig. 2.– Habitus de las diferentes especies de curculiónidos encontradas en pistacheros. (A) *Brachyderes pubescens*, (B) *Brachyderes marginellus*, macho, (C) *Brachyderes marginellus*, hembra, (D) *Otiorhynchus cribricollis*, (E) *Polydrusus pilosulus*, macho, (F) *Polydrusus pilosulus*, hembra, (G) *Polydrusus subglaber*, hembra, forma verde, (H) *Polydrusus subglaber*, hembra, forma marrón, (I) *Sitona discoideus*, (J) *Sitona lineatus*, (K) *Lixus acicularis.*

(Gurrea & Sanz, 2000). In Castilla – La Mancha, *P. pilosulus* has been recorded in the provinces of Albacete (Gurrea Sanz *et al.*, 1989) and Ciudad Real (Iglesias, 1922).

It has been recorded on *Q. pyrenaica* (Sanz & Gurrea, 1995) and *Populus* sp. trees (Ceballos & Dafauce, 1960; Silva *et al.*, 1968). It has also been recorded on *Acer monspessulanum* L., *Cistus ladanifer*, *C. salviifolius* L., *Erica scoparia* L., *Phillyrea angustifolia* L., *Q. faginea, Q. ilex* subsp. *ballota, Q. pyrenaica*, *Q. suber* and *P. lentiscus* in Alcoba (Ciudad Real Province), both in the Cabañeros National Park and in its surrounding areas (Fernández-Carrillo, 2013).

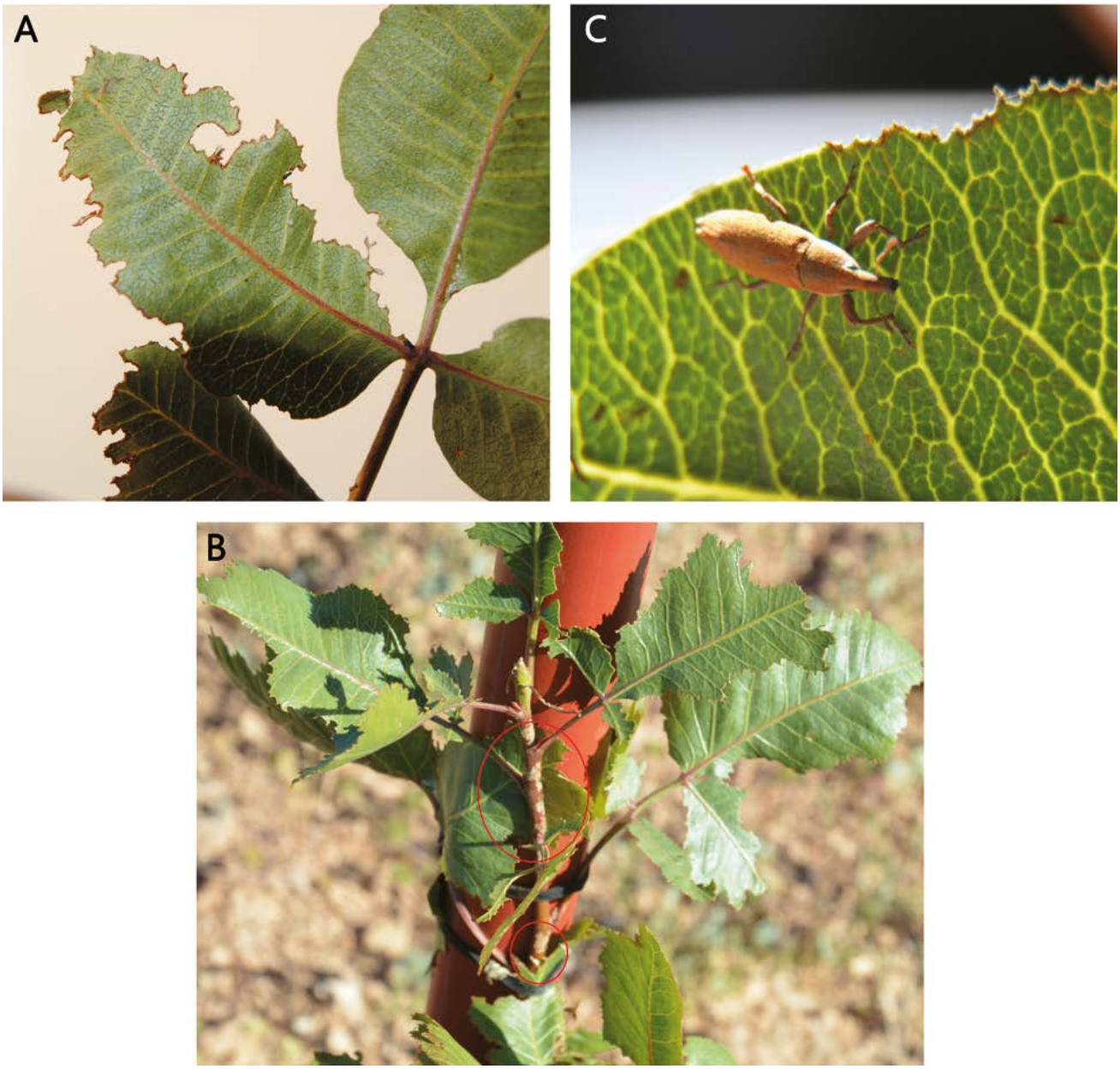

Fig. 3.– Damage to pistachio trees caused by (A) *Otiorhynchus cribricollis*, (B) *Polydrusus subglaber*, damage to leaves and bark, (C) *Lixus acicularis*

Fig. 3.– Daños en plantaciones de pistacheros causados por (A) *Otiorhynchus cribricollis*, (B) *Polydrusus subglaber*, daños en hojas y corteza, (C) *Lixus acicularis.*

In the present study, we encountered *P. pilosulus* on *P. vera* in the municipalities of Ciudad Real (Fig. 2E–F) and Pozuelo de Calatrava in Ciudad Real Province, as well as in Villamayor de Santiago in Cuenca Province from April to the end of June.

Polydrusus (Eurodrusus) subglaber Desbrochers des Loges, 1870

This is another native Iberian species, first described from Sierra Nevada, and distributed throughout the southern half of the Iberian Peninsula. Gurrea & Sanz (2000) summarized the Iberian records from the Spanish provinces of Albacete, Almería, Granada, Jaén and Málaga, and from the Portuguese province of Beira Litoral. Alonso-Zarazaga (2013) reported a similar distribution, in Sierra Nevada and other Baetic and Penibaetic-System mountains. This author also indicates that *P. subglaber* attacks *Q. ilex* subsp. *ballota*. In Extremadura, it has, together with other Curculionidae species, caused damage to the fruit and leaves of plum and peach trees on the Plains of the River Guadiana during spring (CADRMAE-Ex, 2015).

This study provides new evidence on the food plant of this species in Villamayor de Santiago, Cuenca, where a large number of specimens were

found devouring the leaves and even the bark of the tree trunks and young branches of *Pistacia vera* (Fig. 3B). This is the first record of *P. subglaber* on *P. vera*, where it was causing significant damage. Numerous clutches of eggs were found on the lower side of the leaves throughout May. The majority of the individuals observed and trapped from May to the end of June corresponded to the description of *P. variegatus* Desbrochers, 1870, which is currently synonymous with *P. subglaber* (Alonso-Zarazaga, 2013; Alonso-Zarazaga *et al.*, 2017). Unlike the typical greenish-scale appearance usually observed (Fig. 2G), the *variegatus* form is brown with some light checkerboard-like spots (Fig. 2H). Only a small number of the individuals had the typical appearance.

Sitona discoideus Gyllenhal, 1834

Sitona species attack herbaceous or shrub legume crops. *Sitona discoideus* is an Euro-Mediterranean species introduced into Oceania and America (Río *et al.* 2019). It is common and widely distributed throughout the Iberian Peninsula (Velázquez de Castro, 1997), where it attacks *Medicago* and *Trifolium* (Velázquez de Castro *et al.* 2007).

Only two specimens have been recorded on the plots surveyed in this work, in May and June, both on *P. vera* in the municipalities of Ciudad Real and Pozuelo de Calatrava (Ciudad Real) (Fig. 2I). Their presence in pistachio crops is probably due to the use of these plants as a shelter.

Sitona lineatus (Linnaeus, 1758)

Sitona lineatus is widely distributed in the Holarctic Region and Australia (CABI, 2019). It is the most commonly found species of *Sitona* and is broadly distributed throughout the Iberian Peninsula (Velázquez de Castro, 1997). It feeds on legumes in Trifolieae and Vicieae tribes (Velázquez de Castro *et al.* 2007).

Some specimens were collected in June on *P. vera* on plots in the municipality of Ciudad Real (Fig. 2J). As in the case of *S. discoideus,* this crop is probably used as a shelter by *S. lineatus*.

LIXINAE Schoenherr, 1823
Lixus (Ortholixus) acicularis Germar, 1823

This taxon is distributed in the west Palaearctic region (Alonso-Zarazaga *et al.*, 2017). It thrives on *Dittrichia viscosa* (L.) Greuter (Asteraceae) (Hoffmann, 1954), although it has been recorded on other genera such as *Crepis* (mentioned as *Barkhausia*), *Hedypnois* (Hoffmann, 1954), and *Senecio* (Compte Sart, 1982).

It has additionally been found in Cabañeros National Park in the municipality of Alcoba, Ciudad Real Province, on *Erica scoparia* L. and *Cistus ladanifer* (Fernández Carrillo, 2013).

In the sampling described here, it has been found, from the end of June to August, in the municipalities of Ciudad Real, Los Navalucillos (Figs. 2K, 3C), and Villamayor de Santiago (Ciudad Real, Toledo and Cuenca Provinces, respectively), again, for the first time on *P. vera.*

Discussion

Of the eight species discussed in this work, *Brachyderes marginellus*, *B. pubescens* and *Lixus acicularis* have been observed feeding on *P. vera* leaves, yet causing little damage without having a significant injurious effect on the plant. However, *Otiorhynchus cribricollis* and *Polydrusus subglaber* damaged the plants to such an extent that plant development was affected, and plant protection products were required or treatment was planned for the next season, respectively.

With regard to the remaining species, the low numbers detected of specimens of *Polydrusus pilosulus, Sitona discoideus* and *S. lineatus* indicate that their presence on *P. vera* is likely accidental.

Although Castilla – La Mancha's pistachio crops are considered essentially pest-free, our results show that two of the afore mentioned species do behave as significant defoliators, at least in their adult stage. However, the *O. cribricollis* specimens were close to irrigated alfalfa and olive tree crops, both of which are host plants, which could have been a predisposing factor for the occurrence of attacks. Moreover, *P. subglaber* specimens have been found feeding on *Q. ilex,* as previously reported, and it is, therefore, likely that this species has gradually started moving to pistachio crops and feeding on them.

As the contributions of Sadeghi & Zare (2006) made clear, most harmful arthropods associated with wild pistachio plants in Iranian forests are commonly found on cultivated trees. In this way, the enormous growth in the cultivation area in Castilla – La Mancha, together with the use of new agronomical techniques to maximize production, such as irrigation or hybrid rootstocks, might lead to the progressive emergence of new pests or the expansion of those already existing, as had previously occurred in California, which was once considered to be virtually pest-free (Daane *et al.*, 2005). Another example can be found in Iran, where the population density and colonization areas for *P. davatchii* have increased during the last decade (Mehrnejad, 2020).

As evidenced by the Official Registry for Phytosanitary Products of the Spanish Ministry of Agriculture, Fisheries and Food (MAPA, 2022), there is currently a serious shortage of authorized active substances to treat pistachio crops. It is also worth noting that a large proportion of the area devoted to pistachio cultivation in Spain is farmed organically

(currently 44%), thus making it the crop with the greatest share of this differentiated-quality production program (MAPA, 2021c). Farmers are consequently confronting significant risks that may rapidly increase over the next few years, and they will have little leeway to respond.

Further research into the identification of potential pistachio defoliators, their natural dispersion conditions and factors affecting population dynamics are, therefore, required. Research into their possible natural enemies is also desirable in order to control their populations if needed.

Acknowledgements

Thanks to Estrella Díaz Torres and Antonio García Olmedo (finca El Zauceral), Leyre García-Salmones Martínez, Javier E. Vivar Toledo, Eugenio Algaba Moreno, Francisco José Juan Simón, Manuel Escribano Rubio-Quintanilla and Jorge Iglesias Cantero. Thanks are also due to all people at El Chaparrillo (IRIAF) for their support during the study. The present study was co-funded by EAFRD (European Agricultural Fund for Rural Development), Ministerio de Agricultura, Pesca y Alimentación (MAPA) and Junta de Comunidades de Castilla-La Mancha (JCCM), through an innovation pilot project in plant health area, promoted by 16.2.2 operation under Rural Development Programme of Castilla-La Mancha, for 2014-2020 period.

References

Açikgöz, M., Aslan M. M. & Erbey, M., 2022. A new pest in the pistachio orchards of Turkey: *Strophomorphus sublaevigatus* Desbrochers, 1875 (Coleoptera: Curculionidae). *Munis Entomology & Zoology*, 17(1): 443-447.

Alonso-Zarazaga, M.A., 2013. Los Gorgojos (Coleoptera: Curculionoidea). In: Ruano F., Tierno de Figueroa M., Tinaut A. (Eds.) *Los insectos de Sierra Nevada. 200 años de historia*. Vol. 2. Asociación Española de Entomología: 146-192.

Alonso-Zarazaga, M.A., 2018. Elenco sistemático de los Curculionoidea (Coleoptera) de la Península Ibérica e Islas Baleares. *Boletín de la Sociedad Entomológica Aragonesa (S.E.A.)* 63: 3-44.

Alonso-Zarazaga, M.A., Barrios, H., Borovec, R., Bouchard, P., Caldara, R., Colonnelli, E., Gültekin, L., Hlaváč, P., Korotyaev, P., Lyal, C.H.C., Machado, A., Meregalli, M., Pierotti, H., Ren, L., Sánchez-Ruiz, M., Sforzi, A., Silfverberg, H., Skuhrovec, J., Trýzna, M., Velázquez de Castro, A.J. & Yunakov, N.N., 2017. Cooperative Catalogue of Palaeartic Coleoptera Curculionoidea. Monografías electrónicas S. E. A. *Sociedad Entomológica Aragonesa, S. E. A.*, vol. 8. Zaragoza (Spain). 729 pp. Available from http://sea-entomologia.org/monoelec.html [accesses 24 Aug. 2021].

Alvarado, M., Serrano, J.M., González, M.I. & De La Rosa, A., 1998. Contribución al conocimiento y control de *Otiorrhynchus cribricollis* Gyll. (Coleoptera: Curculionidae) Plaga del olivo. *Boletín de sanidad vegetal. Plagas* 24: 715-726.

Breit, J., 1909. Eine Koleopterologische Sammelreise auf Mallorka. Systematisches Verzeichnis der auf Mallorka gesammelten Koleopterenarten. *Verhandlungen Zoologisch-Botanischen Gesellschaft in Wien*, 59: 72-94.

CABI, 2019. *Sitona lineatus* (pea leaf weevil). In: *Invasive Species Compendium*. Wallingford, UK: CAB International. Available from www.cabi.org/isc [accessed 24 Aug. 2021].

CADRMAE-Ex [Consejería de Agricultura, Desarrollo Rural, Medio Ambiente y Energía, Gobierno de Extremadura], 2015. Boletín fitosanitario de avisos e informaciones, nº 8. Estación de avisos agrícolas. Available from http://www.juntaex.es/filescms/con03/uploaded_files/SectoresTematicos/Agricultura/SanidadVegetal/Boletinfitosanitario/2015/Boletin_n8_2015.pdf [accessed 24 Aug. 2021].

Cardona, F., 1872. *Catálogo metódico de los coleópteros de Menorca*. Tip. Fábregues. Mahón. 120 pp.

Ceballos, G., & Dafauce, C., 1960. Principales plagas de los chopos en España. *Montes,* 16: 327-342.

Compte Sart, A., 1982. Coleópteros del monte de El Pardo y la Casa de Campo (Madrid). 1. Superfamilia Curculionoidea. *Eos*, *Revista Española de Entomología,* 57 (1-4): 17-67.

Couceiro López, J.F., Guerrero Villaseñor, J., Gijón López, M.C., Moriana Elvira, A., Pérez López, D. & Rodríguez de Francisco, M., 2017. *El cultivo del pistacho.* Ed. Mundiprensa. Madrid, 772 pp.

Daane, K., Yokota, G., Krugner, R., Steffan, S., da Silva, P., Beede, R., Bentley, W. & Weinberger, G., 2005. Large bugs damage pistachio nuts most severely during midseason. *California Agriculture,* 59 (2): 95-102. https://doi.org/10.3733/ca.v059n02p95

Di Marco, C. & Osella, G., 2001: Gli *Otiorhynchus* Germar, 1824 ed i generi adesso strettamente affini: *Dodecastichus* Stierlin, 1861, *Limatogaster* Apfelbeck, 1899 dell'Appennino abruzense-molisano (Coleoptera, Curculionidae). *Memorie del Museo Civico di Storia Naturale di Verona (II Serie). Sezione Scienze della Vita*, 15: 1-117.

Fernández-Carrillo, J.L., 2013. *Fauna de coleópteros fitófagos del Parque Nacional de Cabañeros (Ciudad Real), con especial atención a la superfamilia Curculionidea.* PhD thesis. Universidad de Castilla - La Mancha, Spain. https://ruidera.uclm.es/xmlui/handle/10578/3964

Ghrissi, I., Braham M., Said, I., & Ayberk, H., 2019. Ecological study of pistachio barkbeetle, *Chaetoptelius vestitus* (Muls & Rey, 1861) (Coleoptera: Curculionidae). *Fresenius Environmental Bulletin*, 28 (3): 1971-1977.

Gurrea, M.P. & Sanz, M.J., 2000. *Endemismos de Curculionoidea (Coleoptera) de la Península Ibérica, Islas Baleares y Canarias*. Universidad Autónoma de Madrid. 384 pp.

Gurrea Sanz, M.P., Sanz Benito, M.J., de los Mozos Pascual, M., Martín Cano, J. & Munguira, M.L., 1989. Contribución al conocimiento de la fauna

coleopterológica de la provincia de Albacete: Curculionoidea de la Sierra de Alcaraz. *Actas IX Bienal de la Real Sociedad Española de Historia Natural*. Madrid (Spain), p: 156-165.

Hoffman, A., 1950. Coléoptères Curculionides (Premiére Partie). *Faune de France,* 52: 1-486. Féderation Française des Societés de Sciences Naturelles. Paris.

Hoffmann, A., 1954. Coléoptères Curculionides (Deuxième Partie). *Faune de France*, 59: 487-1208. Féderation Française des Societés de Sciences Naturelles. Paris [1955].

Hoffmann, A., 1956. Curculionides nouveaux rapportés par la mission G. Remaudière en Iran. *Revue de Pathologie Végétale et d'Entomologie Agricole de France* **35**: 341-249.

Hoffmann, A., 1963. Phytofagoidea. Sous-Famille des Otiorhynchinae. Les *Otiorhynchus*. In A. S. Balachowky (Ed.) *Entomologie appliqué à l'Agriculture. Traité. I. Coléoptères Phytophagoidea (Chrysomelidae, Curculionidae, Attelabidae, Scolytidae et Platipodidae)*. Deuxième volume, p. 878-1391. Masson et Cie. Paris.

Iglesias, L., 1922. Enumeración de los Curculiónidos de la Península Ibérica. *Boletín de la Real Academia de Ciencias Exactas, Físicas y Naturales*, 18: 1-117. [Reedición: 1988. Área de Ciencias Biolóxicas. Seminario de Estudos Galegos. Facsimilar Ediciós do Castro, A Coruña].

MAPA [Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente], 2018. *Guía de Gestión Integrada de Plagas para el cultivo del Pistacho*. Madrid. 59-61.

MAPA [Ministerio de Agricultura, Pesca y Alimentación], 2021a. *Encuesta sobre superficies y rendimientos (ESYRCE)*. Available from https://www.mapa.gob.es/es/estadistica/temas/estadisticas-agrarias/comentariosespana2021_tcm30-584074.pdf [accessed 31 Jan. 2022].

MAPA [Ministerio de Agricultura, Pesca y Alimentación], 2021b. *Anuario Estadística 2020*. Available from https://www.mapa.gob.es/es/estadistica/temas/publicaciones/anuario-de-estadistica/2020/default.aspx?parte=3&capitulo=07&grupo=10 [accessed 31 Jan. 2022].

MAPA [Ministerio de Agricultura y Pesca, Alimentación], 2021c. *Producción Ecológica: Estadísticas 2020*. Available from https://www.mapa.gob.es/es/alimentacion/temas/produccion-eco/estadisticas_pe_2020_tcm30-564465.pdf [accessed 31 Jan. 2022].

MAPA [Ministerio de Agricultura, Pesca y Alimentación], 2022. *Registro de productos fitosanitarios*. Available from https://www.mapa.gob.es/es/agricultura/temas/sanidad-vegetal/productos-fitosanitarios/registro/menu.asp [accessed 31 Jan. 2022].

Mehrnejad, M.R., 2020. Arthropod pests of pistachios, their natural enemies and management. *Plant Protection Science*, 56(4): 231-260. https://doi.org/10.17221/63/2019-PPS

Mehrnejad, M.R., Meleshko, J.Y. & Korotyaev, B.A., 2017. Morphological description and observations on the biology of *Polydrusus davatchii* (Coleoptera: Curculionidae: Entiminae). A pest of pistachio trees in Iran. *Biologia*, 72 (9): 1067-1014. https://doi.org/10.1515/biolog-2017-0116

Moragues F., 1888. Coleópteros de Mallorca. *Anales de la Sociedad Española de Historia Natural*, 18: 11-34.

Río Del, M.G., Lanteri, A., Gittins López, C., Rivero, V., González, D. & López Armengol, M.F., 2019. First record of the exotic pest *Sitona discoideus* Gyllenhal, 1834 (Coleoptera: Curculionidae) in Argentina. *Revista de la Sociedad Entomológica Argentina*, 78 (2): 30-33. https://doi.org/10.25085/rsea.780205

Rodrigo-Gómez, S., Gil-Tapetado, D., García-Gila, J., Blasco-Aróstegui, J. & Polidori, C., 2022. The leaf beetle *Labidostomis lusitanica* (Coleoptera: Chrysomelidae) as an Iberian pistachio pest: projecting risky areas. *Pest Management Science*, 78 (1): 217-229. https://doi.org/10.1002/ps.6624

Sadeghi, H. & Zare, M., 2006. The injurious arthropods of wild pistachio trees (*Pistacia vera*: Anacardiaceae) in northeastern Iran. *Caspian Journal of Environmental Sciences*, 4 (1): 83-87.

Sáez-Bolaño, J.A., Blanco Villero, J.M., Sánchez Ruiz, M. & Alonso-Zarazaga, M.A., 2010. Los Curculionidae de la Sierra de Tudía (Badajoz, Extremadura, España). I. El género *Brachyderes* Schoenherr, 1823. *Boletín de la Sociedad Entomológica Aragonesa (SEA*), 46: 541-545.

Sanz, M.J. & Gurrea, M.P., 1995. Curculionoidea de la Sierra de Guadarrama (Sistema Central Ibérico) (Coleoptera). In: Comité Editorial (Eds.) *Avances en Entomología Ibérica.* Museo Nacional de Ciencias Naturales (CSIC) y Universidad Autónoma de Madrid: 279-300.

Silva, F.A., Nogueira, C.D.S. & Ferreira, F.J.C., 1968. Entomofauna das salicáceas (*Populus* spp. e *Salix* spp.): 1 Lista (Insetos). *Estudos e Divulgaçao Técnica, Grupo C, Seçao Entomologia Florestal*, Ministerio da Agricultura e Pescas. Lisboa. 20 pp.

Şimşek, A, & Bolu, H., 2017. Determination of the harmful insect fauna in pistachio (*Pistacia vera* L.) orchards in Diyarbakir Province. *Dicle Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 6 (2): 43-58.

Speight, M.R., 2005. Sampling insects from trees: shoots, stems, and trunks. In: Leather, S. R. (eds.). *Insect Sampling in Forest Ecosystems*. Blackwell, London; 77-115. https://doi.org/10.1002/9780470750513.ch5

Uhagón, S., 1887. Coleópteros de Badajoz. Tercera parte. *Anales de la Sociedad Española de Historia Natural*, 16, Memorias (2): 373-384.

Velázquez de Castro, A. J., 1997. *Estudio morfológico y taxonómico del género Sitona Germar, 1817 (Coleoptera, Curculionidae)*. PhD thesis. Universidad Complutense de Madrid, Spain. Available from https://eprints.ucm.es/id/eprint/4193/ [accessed [accessed 31 Jan. 2022].

Velázquez de Castro, A. J., Alonso Zarazaga, M.A. & Outerelo, M., 2007. Systematics of Sitonini (Coleoptera, Curculionidae: Entiminae), with a hypothesis on the evolution of feeding habits. *Systematic Entomology*, 32: 312-331. https://doi.org/10.1111/j.1365-3113.2006.00368.x

Velázquez de Castro, A.J., Gharalli, B. & Korotyaev, B.A., 2014. *Polydrusus nadaii* Meleshko & Korotyaev, a new

possible new pest for Pistachio trees in Iran (Coleoptera, Curculionidae, Entiminae). *Bulletin de la Société Entomologique de France*, 119 (3): 315-318. https://doi.org/10.3406/bsef.2014.2447

Viedma, M.G., 1967. Revisión del género *Brachyderes* Schönherr, con especial referencia al estudio de su edeago y a su distribución geográfica dentro de la Península Ibérica (Col. Curculionidae). *Eos*, *Revista Española de Entomología,* 42 (3-4): 575-596.

Wagner, H., 1928. Eine Sammelreise nach Zentral-Spanien (Sommer 1925). *Coleopterologische Centralblatt*, 3 (3-4): 150-153.