



Complementary data on *Graptoppia (Stenoppia) italica* (Acari, Oribatida, Oppiidae) collected from Iran

Fatemeh Ordouni

Department of Plant Protection, College of Agriculture, University of Zabol, Zabol, Iran.

✉ fa.ordouni.sistan@gmail.com

<https://orcid.org/0000-0002-6440-8035>

Sara Ramroodi

Department of Plant Protection, College of Agriculture, University of Zabol, Zabol, Iran.

✉ saramroodi@uoz.ac.ir

<http://orcid.org/0000-0003-3039-2618>

Mohammad Ali Akrami

Department of Plant Protection, School of Agriculture, Shiraz University, Shiraz, Iran.

✉ mohammadali.akrami@gmail.com

<http://orcid.org/0000-0002-7561-9508>

Received:

27 August, 2022

Accepted:

11 September, 2022

Published Online:

08 October, 2022

Subject Editor:

Alihan Katlav

ABSTRACT. The oribatid mite of the family Oppiidae, *Graptoppia (Stenoppia) italica* (Bernini, 1973) (syn.: *Oppia heterotricha* Bernini, 1969) is redescribed based on females collected from soil in Sistan-o Baluchestan (Southeastern Iran) and South Khorasan (Central-Eastern Iran) provinces. Detailed descriptions of the gnathosoma and legs are also provided for the first time. The original description does not reflect the characters of the pubescence of the setae (cilia), characters on the lateral side of the ano-adanal region, as well as the true length of anal and adanal setae. Through the new finding of *Graptoppia italica* in Iran, the number of Oribatids in the family Oppiidae raised to 81 species.

Key words: Oppiid mite, redescription, morphology, systematics, soil, eastern Iran.

Citation: Ordouni, F., Ramroodi, S. & Akrami, M.A. (2022) Complementary data on *Graptoppia (Stenoppia) italica* (Acari, Oribatida, Oppiidae) collected from Iran. *Journal of Insect Biodiversity and Systematics*, 8 (4), 647–655.

INTRODUCTION

The family Oppiidae Sellnick, 1937 (Acari, Acariformes: Oribatida) are the most diverse group of the oribatid mites, comprising 130 genera, 45 subgenera and 1084 described species (Subías, 2022). This family belongs to the superfamily Oppioidea within apterogasterine group, one of the main groups of oribatid mites (Mirzaie & Akrami, 2012). Oppiid mites are generally about 200–600 µm in length and are characterized by the absence of prodorsal lamellae, tutorium, dorsophragma and pleurophragma, absence or presence of costula, diarthric subcapitulum, normal chelicerae, fused epimera III and IV, moniliform and monodactylous legs, 9–12 pairs of notogastral setae and 4–6 pairs of genital setae. They are most diverse in tropical regions, yet a great number of species have been found in temperate zones. Some oppiid species have worldwide distribution. They are common inhabitants of moss, humus, litter and pastures, in both moist and dry conditions and fungi make up a large part of oppid diets with large masses of fungal spores being identified from their gut (Akrami, 2015b). According to the catalogue of Subías (2022), *Graptoppia* comprises three subgenera; *Graptoppia (Graptoppia)* Balogh, 1983, *Graptoppia (Apograptoppia)* Subías & Rodríguez, 1985, *Graptoppia (Stenoppia)* Balogh, 1983, 22 species and one subspecies. *Graptoppia (Stenoppia)* comprises 10 species, distributed in Nigeria, southern Neotropical, West

Corresponding author: Ramroodi, S., E-mail: saramroodi@uoz.ac.ir

Copyright © 2022, Ordouni et al. This is an open access article distributed under the terms of the Creative Commons NonCommercial Attribution License (CC BY NC 4.0), which permits Share - copy and redistribute the material in any medium or format, and Adapt - remix, transform, and build upon the material, under the Attribution-NonCommercial terms.

Africa, Japan, western Mediterranean, Germany, Vietnam, Chile, South Africa and Sumatra. The main diagnostic characteristics of *Graptoppia* (*Stenoppia*) were summarized by Balogh (1983), Subías and Balogh (1989), and Balogh and Balogh (1992). An identification key to species of *Graptoppia* (*Stenoppia*) was presented by Ermilov and Frolov (2021). Members of the genus *Graptoppia* (*Stenoppia*) can be easily distinguished by the presence of well-developed costulae and transcostula, sensillus fusiform, short and unilaterally ciliate; rounded or tridentate rostrum, lamellar setae closer to interlamellar setae than to rostral setae, rostral setae far from each other, lyrifissure *iad* in adanal position, adanal setae *ad*₁ in postanal and *ad*₃ in preanal positions.

The genus *Graptoppia* (*Stenoppia*) belonging to the subfamily Multioppiinae Balogh, 1983 was proposed by Balogh (1983) with *Oppia heterotricha* Bernini, 1969 as the type species (now it is *Oppia italica* Bernini, 1973). Bernini was forced to change the name of *O. heterotricha* from Ravenna in 1973, because at the same time the same name was also used by Balogh and Mahunka (1969) for a South American entity. He proposed *O. italica* (Bernini, 1973) for the specimens collected from Ravenna. The same species was found in other localities, in Italy and Spain and redescribed (Subías & Arillo, 1991) from Portuguese. Both original (Bernini, 1973) and subsequent (Subías & Arillo, 1991) re-descriptions are suffering from an inadequate emphasis on the critical diagnostic characters, i.e. pubescence of the setae (cilia) and measurements. Our recent surveys in the Southeastern and Central-Eastern parts of Iran during 2018–2021 (Sistan-o Baluchestan and South Khorasan provinces) led to the collection of the oribatid mites in soil samples. Among them we found specimens run to *Graptoppia italica*, which herein redescribed and illustrated. A comparison of the Iranian specimens with the original description (intraspecific variabilities), was made and additional diagnostic characters are also provided.

MATERIAL AND METHODS

Soil samples were collected from Sistan-o Baluchestan province (Zahak county) and South Khorasan province (Birjand county) during 2018–2021. Each sample contained about two kilograms of soil taken from the surface to a depth of 15 cm. Mites in soil samples were extracted through Berlese-Tullgren funnels set to jars with 75% ethanol. Subsequently, mite individuals were removed, cleared in lactophenol fluid and permanently mounted on microscope slides using Hoyer's medium. The slides were placed in an oven at 45°C for two weeks. The mites were examined under an Olympus BX41 phase contrast microscope. Figures were made using a drawing tube attached to the microscope. The examined material and data on their locality and habitat are given in the 'material examined' section. Only adults (female) were collected. Body length was measured from the tip of the rostrum to the posterior edge of the notogaster, and body width refers to the maximum width of the notogaster in dorsal aspect. All body measurements are presented in micrometres (µm). The length of some setae is given in parenthesis. Morphological terminology and abbreviations used in this paper follow Ermilov and Frolov (2021). Five specimens are deposited in the Collection of the Department of Plant Protection, College of Agriculture, University of Zabol, Iran, and one is deposited in the Acarological collection of the Department of Plant Protection, School of Agriculture, Shiraz University, Iran.

RESULTS

Taxonomic hierarchy

Phylum Arthropoda von Siebold, 1848

Order Sarcoptiformes Reuter, 1909

Suborder Oribatida Dugès, 1834

Family Oppiidae Sellnick, 1937

Subfamily Multioppiinae Balogh, 1983

Genus *Graptoppia* Balogh, 1983

Subgenus *Stenoppia* Balogh, 1983

Graptoppia (Stenoppia) italica (Bernini, 1973)

Oppia heterotricha Bernini, 1969, 51:1–3, Holotype & Paratype. – Bernini Collection, Italy, Ravenna (Preoccupied - Balogh, 1983).

Oppia italica Bernini, 1973, 3(1):421. (replacement name by Bernini, 1973)

Graptoppia (Stenoppia) italica Bernini, 1973. (new combination by Balogh, 1983)

Material examined. Four specimens: Zahak county, Chah-Nimeh recreational, Sistan-o Baluchestan province, southeastern Iran, soil under berry tree (*Morus* sp.), 30°50'39"N, 61°43'07"E, 483 m a.s.l., 11-V-2018; one specimen: Zabol county, Campus of the University of Zabol, Sistan-o Baluchestan province (Southeastern Iran) soil under tamarisk (*Tamarix* sp.), 31°02'26"N, 61°32'07"E, 475 m a.s.l., 22-VI-2021, coll.: F. Ordouni; one specimen: Birjand county, Waterfall Chahardeh village, South Khorasan province (Central-Eastern Iran), the soil under waterfall, 32°48'35"N, 59°14'26"E, 1686 m a.s.l., 7-V-2020, coll.: M. Kohansal.

Diagnosis. Body size: 196–285 (length) × 92–184 (width). Rostrum rounded and not incised, costulae and transcostula present, well-developed, basal part of costulae not developed. Rostral, lamellar, interlamellar and exobothridial setae setiform with 3, 2, 2, and 1 cilia respectively. Rostral setae slightly thicker and longer than lamellar and interlamellar setae. Bothridial setae fusiform with long ten branches. Interbothridial region with two pairs of clear muscle sigillae. Interbothridial tubercles absent. Longitudinal rows, comprising four pairs of muscle sigillae, present in front of the bothridia, nine pairs long, setiform with one branch notogastral setae, one pair (*c*) of minute, needle form without branch setae. Epimeral and anogenital setae thin and setiform and epimeral border IV semi-oval. Long lyrifissures *ia*, *im*, *iad*, *ad*₁ and *ad*₂ setae thicker and longer than other ano-adanal setae, *ad*₁ setae with one branch and the others smooth, solenidion φ of tibia I very long, whip-like.

Complementary description (Figs 1–8)

Measurements. Body length: 196–285; notogaster width: 92–184 (n=6).

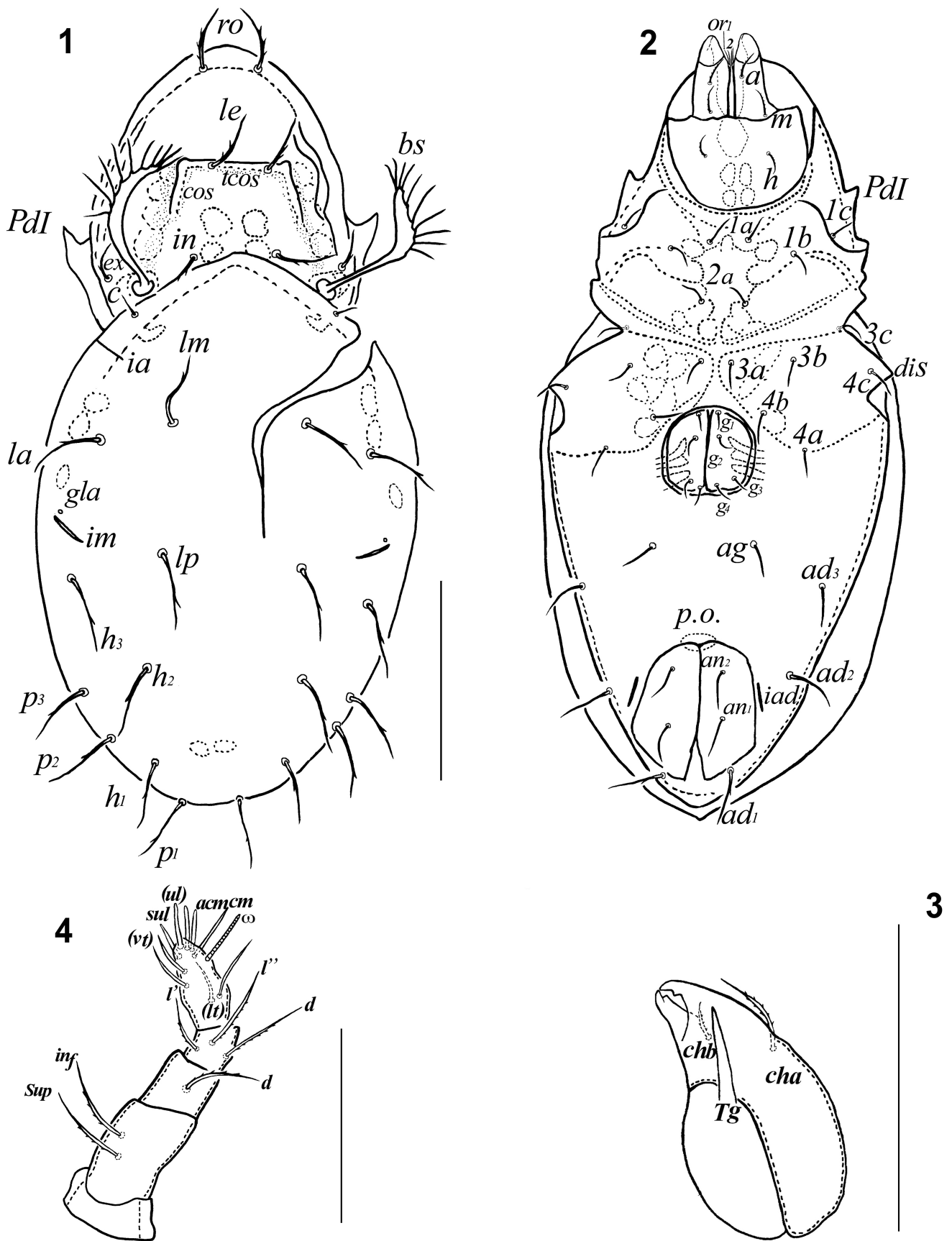
Integument (Figs 1). Body colour light brownish. Body surface smooth but transcostular regions densely microgranulate.

Prodorsum (Figs 1). Prodorsum with rostrum rounded, undivided, costulae and transcostula. Lamella and translamella well-developed, basal part not developed. Rostral setae (*ro*, 19–21) setiform, with 3 cilia, lamellar (*le*, 10–15) and interlamellar (*in*, 10–13) setae setiform, slightly thinner than rostral setae, each with 2 cilia; rostral setae far from each other, longer than their mutual distance, *le* subequal to their mutual distance (*le-le*), interlamellar setae shorter than their mutual distance. Setae *le* nearer to setae *in* than to setae *ro*, originating on transcostula line. Exobothridial setae (*ex*, 9–15) setiform, thin with one cilium and inserted anterolateral to funnel-shaped bothridia. Bothridial setae (*bs*, 30) fusiform and unilaterally ciliate with long 10 branches to make the heads of the branches converge towards each other. Two pairs of interbothridial and four pairs of muscle sigillae present in front of the bothridia. Relative distances: (*ex-ex*) > (*in-in*) > (*le-le*) = (*ro-ro*).

Notogaster (Figs 1). Smooth with 10 pairs of setae developed. Setae *c* needle-form and much shorter than the others, directed laterally, other setae long, setiform with one short branch towards the apex (12–17). Opisthotal gland openings and notogastral lyrifissures *ia*, *im* well visible; *ip*, *ih* and *ips* not observed. Circumgastric scissure and circumgastric sigillar band visible.

Gnathosoma (Figs 2–4). Subcapitulum shorter than wide. Three pairs of subcapitular setae (*a*, *m*, *h*) setiform, slightly barbed, *h* shorter than *m* and *a*. Two pairs of adoral setae (*or*₁, *or*₂) setiform, thin, smooth. Palps with typical setation 0-2-1-3-9(+1 ω). Chelicerae with two setiform, barbed and ciliated setae, *cha* longer than *chb*. Trägårdh's organ (*Tg*) of chelicerae narrowly triangular.

Epimeral regions (Fig. 2). With a number of round muscle sigillae. Epimeral setal formula 3-1-3-3. Setae setiform, thin, short, epimers III and IV fused and epimeral I and II narrower than epimers III and IV, epimeral border IV distinct, semi-oval. Discidia triangular, rounded distally.



Figures 1–4. *Graptoppia (Stenoppia) italica* (Bernini, 1973), adult female. **1.** General habitus, dorsal view (gnathosoma and legs not shown); **2.** General habitus, ventral view; **3.** Chelicera; **4.** Palp. Scale bar 50 µm.

Anogenital region (Fig. 2). Genital plates (21–30 × 20–40) with four pairs of genital (g_1 – g_4) and one pair of aggenital (ag) plates, two pairs of anal (an_1 , an_2) and three pairs of adanal setae (ad_1 – ad_3) setiform and thin; both genital and aggenital plates smaller than anal plates (30–51×30–52). Adanal setae longer than anal setae. Three pairs of well-developed genital papillae present. Long lyrifissures iad located close and parallel to anal plates, setae ad_1 in postanal and setae ad_3 in preanal position. Setae ad_1 and ad_2 thicker and longer than other ano-adanal setae. Setae ad_1 with one branch and ad_2 smooth.

Legs (Figs 5–8). All legs monodactylous, claws slender and smooth. Porose areas on femora and trochanters III and IV not observed. Formulas of leg setation and solenidia: I (1-5-2-4-20) [1-2-2], II (1-5-2-4-16) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]. Homology of setae and solenidia listed in Table 1. Famulus of tarsi I erect, blunt-ended, inserted posterior to solenidion ω_1 . Solenidion φ_1 of tibia I very long, whip-like. Solenidia ω_1 on tarsus I, ω_1 and ω_2 on tarsus II and φ on tibia II, III and IV and σ on genu III bacilliform, Solenidia ω_2 on tarsus I, φ_2 on tibia I, σ on genua I and II, slightly thickened, slightly blunt-ended.

Distribution. Western Mediterranean, Germany, Vietnam (Subías, 2022) and Iran (present study).

Remarks. Iranian specimens of this species differ from Italian, Spanish and Portuguese specimens (Bernini, 1969; Subías & Arillo, 1991) by having lamellar, interlamellar, exobothridial and notogaster setae with 2, 2, 1 and 1 branch respectively, adanal setae longer than anal setae, longer lyrifissures ia , im and iad , setae ad_1 and ad_2 thicker and longer than other ano-adanal setae and setae ad_1 with one branch.

DISCUSSION

The oribatid fauna of Iran is represented by 86 families, 191 genera and 380 species (Akrami, 2015a). Considering the new findings of *Graptoppia* (*Stenoppia*) *italica* in Iran, the number of Oribatids in the family Opiidae raised to 81 species. There was controversy on the number of cilia on setae made it difficult to use these characters for diagnosis. While the general differences were considered as the intraspecific variabilities, we believe both original (Bernini, 1973) and the subsequent redescription (Subías & Arillo, 1991) were made under small magnification, so that, the true pubescence of the setae is unclear. Furthermore, the original description does not reflect the characters of the lateral side of the ano-adanal region, as well as the anal adanal setae, so their true length was unclear. The lengths of fissures are not an appropriate character for separating the species of *Graptoppia* (*Stenoppia*), but the position of the adanal lyrifissure is widely accepted.

Table 1. Leg setation and solenidia of adult *Graptoppia* (*Stenoppia*) *italica* (Bernini, 1973).

Leg	Tr	Fe	Ge	Ti	Ta
I	v'	d , (l), bv'' , v''	(l), σ	(l), (v), φ_1 , φ_2	(ft), (tc), (it), (p), (u), (a), s , (pv), v' , (pl), l'' , ε , ω_1 , ω_2
II	v'	d , (l), bv'' , v''	(l), σ	(l), (v), φ	(ft), (tc), (it), (p), (u), (a), s , (pv), l'' , ω_1 , ω_2
III	l' , v'	d , l' , ev'	l' , σ	l' , (v), φ	(ft), (tc), (it), (p), (u), (a), s , (pv)
IV	v'	d , ev'	d , l'	l' , (v), φ	ft'' , (tc), (p), (u), (a), s , (pv)

Note: Tr, Fe, Ge, Ti, Ta – leg trochanter, femur, genu, tibia, tarsus, respectively. Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus). Single prime (') marks setae on anterior and double prime (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution in the paper as follows: F.O.: Sample collection, Initial identification; S.R.: Preparing the description and line drawings; M.A.A.: Confirmation of the identifications. All authors read and approved the final version of the manuscript.

FUNDING

This research received no specific grant from any funding agencies.

AVAILABILITY OF DATA AND MATERIAL

Not applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

ACKNOWLEDGMENTS

This study (as a part of PhD thesis of the senior author) was partly supported by the University of Zabol, Iran and partly by Shiraz University, Shiraz, Iran that is greatly appreciated.

REFERENCES

- Akrami, M.A. (2015a) An annotated checklist of oribatid mites (Acari: Oribatida) of Iran. *Zootaxa*, 3963 (4), 451–501. <https://doi.org/10.11646/zootaxa.3963.4.1>
- Akrami, M.A. (2015b) New records of species of the genera *Corynoppia*, *Ramusella* and *Rhinoppia* (Oribatida: Oppiidae) from Iran, with a key for Iranian oppiid mite species. *Journal of Crop Protection*, 4 (3), 301–311.
- Balogh, J. & Balogh, P. (1992) *The Oribatid Mites Genera of the World*. Volume 1. Hungarian National Museum Press, Budapest. 263 p.
- Balogh, J. & Mahunka, S. (1969) The scientific results of the Hungarian soil zoological expeditions to South America. 10. Acari: Oribatids, collected by the second expedition. I. *Acta Zoologica Academiae Scientiarum Hungaricae*, 15 (1–2), 1–21.
- Balogh, J. (1983) A partial revision of the Oppiidae Grandjean, 1954 (Acari: Oribatei). *Acta Zoologica Academiae Scientiarum Hungaricae*, 29 (1–3), 1–79.
- Bernini, F. (1969) Notulae Oribatologicae I. Contributo alla conoscenza degli Oribatei (Acarida) della Pinetadei S. Vitale (Ravenna). *Redia*, 51, 329–375.
- Bernini, F. (1973) Notulae Oribatologicae. VII. Gli Oribatei (Acarida) dell'isolotto di Basiluzzo (Isole Eolie), 3, 355–480. <https://doi.org/10.21426/B63110608>
- Dugès, A.L. (1834) Recherches sur l'ordre des Acariens I–III. *Annales des Sciences Naturelles, Zoologie*, 2 (2), 18–63.
- Ermilov, S.G. & Frolov, A.V. (2021) New data on oribatid mites (Acari, Oribatida) phoretic on passalid beetles (Coleoptera, Passalidae) from the Afrotropical and Oriental regions, with descriptions of three new species from Congo, Gabon and Ghana. *Systematic and Applied Acarology*, 26 (4), 769–787. <https://doi.org/10.11158/saa.26.4.8>
- Mirzaie, M. & Akrami, M.A. (2012) New records of the family Oppiidae (Acari: Sarcoptiformes: Oribatida) for the fauna of Iran. *Persian Journal of Acarology*, 1 (2), 101–108.
- Reuter, E. (1909) Zur Morphologie und Ontogenie der acariden mit besonderer Berücksichtigung von *Pendiculopsis graminum* (E. Reut.). *Acta Societatis Scientiarum Fennicae*, 36 (4), 1–287. <https://doi.org/10.5962/bhl.title.4705>

- Sellnick, M. (1937) Die Gattung Trizetes Berlese und ihre Stellung im System der Oribatei (Acar.). *Zoologischer Anzeiger*, 120, 76–79.
- Subías, L.S. & Arillo, A. (1991) Los Opiidae Grandjean, 1951 (Acari. Oribatida) de Madeira. *Vieraea: Folia Scientiarum Biologiarum Canariensium*, 20, 39–52.
- Subías, L.S. & Balogh, P. (1989) Identification keys to the genera of Opiidae Grandjean, 1951 (Acari: Oribatei). *Acta Zoologica Hungarica*, 35 (3–4), 355–412.
- Subías, L.S. & Rodriguezzi, P. (1985) Opiidae (Acari, Oribatida) de los sabinares (*Juniperus thurifera*) de España III. *Graptoppia* a. str. Balogh. *Cuadernos de Investigación Biológica, Bilbao*, 8, 69–76.
- Subías, L.S. (2022) Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes, Oribatida) del mundo (1758–2002). *Graellsia*, 60 (Extra), 3–305. <https://doi.org/10.3989/graellsia.2004.v60.iExtra.218> [Update available from: http://bba.bioucm.es/cont/docs/RO_1.pdf]
- von Siebold, C.T. (1848). Lehrbuch der vergleichenden Anatomie der Wirbellosen Thiere. Erster Theil. In: von Siebold, C.T. & Stannius, H. (eds.) *Lehrbuch der Vergleichenden Anatomie*, Verlag von Veit & Comp., Berlin, pp. 1–679. <https://doi.org/10.5962/bhl.title.118645>

اطلاعات تکمیلی گونه‌ی *Graptoppia (Stenoppia) italica* (Acari, Oribatida, Oppiidae) جمع‌آوری شده از ایران

فاطمه اردونی^۱، سارا رامروودی^{۱*} و محمدعلی اکرمی^۲

۱ گروه گیاهپزشکی، دانشکده کشاورزی، دانشگاه زابل، ایران
۲ بخش گیاهپزشکی، دانشکده کشاورزی، دانشگاه شیراز، ایران.

* پست الکترونیک نویسنده مسئول مکاتبه: sararamroodi@uoz.ac.ir

ا تاریخ دریافت: ۰۵ شهریور ۱۴۰۱ | تاریخ پذیرش: ۲۰ شهریور ۱۴۰۱ | تاریخ انتشار: ۱۶ مهر ۱۴۰۱ |

چکیده: کنه‌ی اریباتید (*Graptoppia (Stenoppia) italica* (Bernini, 1973) syn.:) متعلق به خانواده‌ی Oppiidae، بر اساس نمونه کنه‌های جنس ماده جدا شده از خاک در استان‌های سیستان و بلوچستان (جنوب شرق ایران) و خراسان جنوبی (شرق میانی ایران) بازتوصیف شد. هم‌چنین نخستین توصیف دقیق از گناتوزوما و پاهای این گونه نیز ارائه شد. توصیف اصلی این گونه فاقد جزئیات کافی در مورد تاژک‌های روی موها، خصوصیات ناحیه جانبی ano-adanal و هم‌چنین طول واقعی موهای anal و adanal است. با ثبت حضور گونه *Graptoppia italica* تعداد کنه‌های اریباتید خانواده Opiidae در ایران به ۸۱ گونه رسید.

واژگان کلیدی: کنه آپیده، بازتوصیف، شکل‌شناسی، سیستماتیک، خاک، شرق ایران