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Article

New data on *Cicaditrombium lorestanensis* Noei (Acari: Trombidiidae), *Achaemenothrombium saboorii* Noei (Acari: Achaemenothrombiidae) and the family Neothrombiidae

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ABSTRACT
The members of the genus *Cicaditrombium* Saboori & Lazarboni originally described from Iran, are known as parasites of Hemiptera (Cicadidae) and Lepidoptera (Noctuidae). Larvae of *Cicaditrombium lorestanensis* Noei were collected at South Khorasan Province ectoparasitic on *Chrysolina* sp. (Coleoptera: Chrysomelidae) and *Monosteria* sp. (Hemiptera: Tingidae), which represent the first known hosts for this species. Larvae of *Achaemenothrombium saboorii* were collected at South Khorasan Province, Iran ectoparasitic on Erebidae, Noctuidae, Nymphalidae (Lepidoptera); the family Nymphalidae is recorded as a new host. A hitherto undescribed larva belonging to the family Neothrombiidae was found parasitizing *Rhipicephalus sanguineus.* This is the first record of a member of the family Ixodidae (Acari: Parasitiformes: Ixodida) serving as host for a parasitengone larva. Additional metric and meristic data are provided for *C. lorestanensis* and *A. saboorii.*

KEY WORDS: *Chrysolina*; *incertae sedis*; *Monosteria*; *Rhipicephalus sanguineus*; South Khorasan.

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INTRODUCTION

The genus *Cicaditrombium* Saboori & Lazarboni, 2008 comprises two species including *C. weni* Saboori & Lazarboni, 2008, *incertae sedis*, which was described ectoparasitic on *Chloropsalta ochreata* (Melichar) [syn.: *Cicadatra ochreata* Melichar] (Hemiptera: Cicadidae) from Iran (Saboori and Lazarboni 2008; Felska *et al.* 2018) and was recorded from other regions of Iran as an ectoparasite of moth (Lepidoptera: Noctuidae) (Noei *et al*. 2017). No host association was hitherto known for the second species, *C. lorestanensis* Noei, 2017 (see Noei *et al*. 2017) collected from soil at South Khorasan and Lorestan Provinces.

Achaemenothrombium saboorii was described based on larvae ectoparasitic on Lepidoptera (Crambidae, Erebidae, Geometridae, Noctuidae) and Orthoptera (Tettigoniidae) (Noei and Rabieh 2021).

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Larval Neothrombiidae are known as parasites of Insecta (Coleoptera, Diptera, Microcoryphia, Orthoptera), Arachnida (Opiliones) and Chilopoda (Scolopendromorpha) (Felska *et al.* 2018; Majidi *et al.* 2018; Noei 2020).

In this paper, new host associations of *C. lorestanensis*, *A. saboorii* and one undescribed species of Neothrombiidae are presented; metric and meristic data are supplemented for the described species.

MATERIAL AND METHODS

The specimens (n = 6) of *C. lorestanensis* were extracted directly in Berlese funnel or taken from the hosts collected in Berlese funnel, by removing mites with an insect pin under a stereomicroscope. The specimens of *A. saboorii* (n = 4) were collected based on the method of Noei and Rabieh (2020), each host was put into an individual disposable container to die; then the mites (which detached from the host) were collected under a stereomicroscope. *Rhipicephalus sanguineus* (Latreille) (Acari: Metastigmata: Ixodidae) as a host of one specimen of Neothrombiidae were collected by a sweep net from herbaceous plants. Mites were cleared in lactophenol and mounted on glass microscope slide using Hoyer's medium (Walter and Krantz 2009). The terminology and abbreviations are adapted from Robaux (1974), Southcott (1993), Wohltmann *et al.* (2006), Mąkol (2007) and Saboori *et al.* (2009).

RESULTS

Trombidiidae Leach, 1815
Trombidiidae *incertae sedis*
Genus *Cicaditrombium* Saboori and Lazarboni, 2008

Cicaditrombium lorestanensis Noei, 2017

Material examined

One larva (ARS-20210131-1f) was collected ectoparasitic on a chrysomelid beetle, *Chrysolina* sp. (Coleoptera: Chrysomelidae) attached at the hind wing, IRAN: South Khorasan Province, Sarbisheh city, Shavakand region (32° 38' 34" N, 59° 30' 52" E, 6682 m a.s.l.), 5 July 2020, coll. M. Kohansal. One larva (ARS-20210131-1c) was collected attached to the leg of an immature lace bug, *Monosteria* sp. (Hemiptera: Tingidae), same data except Khusf city, Rubayat region (32° 42' 37" N, 59° 16' 37" E, 6617 m a.s.l.), 25 June 2020. Four larvae (ARS-20210131-1a, 1b, 1d, 1e) were collected from soil (off host) sampled under willow (*Salix* sp.) and hawthorn (*Haloxylon* sp.) trees, same data except Khusf city, Rubayat region (32° 42' 37" N, 59° 16' 37" E, 6617 m a.s.l.), 25 June 2020. All six specimens had started to feed and were engorged. Two larvae (ARS-20210131-1a–1b) are deposited in the Acarological Collection, Jalal Afshar Zoological Museum (JAZM), Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran, two specimens (ARS-20210131-1c–1d) are deposited in the Acarological Collection, Acarological Society of Iran, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran and two specimens (ARS-20210131-1e–1f) in the collection of the Department of Plant Protection, College of Agriculture, University of Zabol, Iran (DPPZ).

Remarks

Cicaditrombium lorestanensis was described based on only three specimens collected off host from soil samples, one specimen from Lorestan Province (West of Iran) and two specimens from South Khorasan Province (East of Iran). During present study, additional specimens were collected

in South Khorasan Province (Rubayat and Shavakand region) from soil samples or ectoparasitic on *Chrysolina* sp. (Coleoptera: Chrysomelidae) and *Monosteria* sp. (Hemiptera: Tingidae). Due to the presence of some specimens of *Chrysolina* sp. in the containers with material extracted in Berlese funnels, it is possible that some of the engorged larvae left their hosts during extraction. The specimens collected in this study are congruent with respect to the leg setal formula [one specimen (ARS-20210131-1a) abnormally with three setae on femur II on left side] and measurements (Table 1) with *C. lorestanensis* given by Noei *et al*. (2017). The soil samples were taken from under willow (*Salix* sp.) and hawthorn (*Haloxylon* sp.) trees, on which the hosts of these mites seem to feed.

Table 1. Metric data for *Cicaditrombium lorestanensis* Noei, 2017 from South Khorasan Province (present study) and from the previous study (Noei *et al.* 2017).

Character	1a	1b	1c	1d	1e	1f	Range	Noei *et al.* (2017); n = 3
IL	1080	1375	650	780	1200	580	580–1375	267–305
IW	750	780	380	440	660	350	350–780	135–157
SD	123	112	120	120	115	125	112–125	119
W	82	77	-	80	85	82	77–85	83–90
AW	62	60	-	60	58	60	58–62	60–65
PW	70	67	-	70	65	67	65–70	70–74
AA	40	36	-	40	40	42	36–42	42–44
SB	47	45	-	46	45	47	45–47	47–52
ASB	80	76	80	82	75	87	75–87	76–78
PSB	43	40	40	37	40	40	37–43	41–43
MA	47	42	41	40	40	45	40–47	40–45
AP	30	27	27	30	27	27	27–30	29–33
AL	16	15	15	15	15	15	15–16	18–19
PL	50	50	47	45	46	50	45–50	49–50
AM	28	25	30	27	30	30	25–30	25–33
S	52	> 45	62	57	57	60	45–62	55–60
LSS	57	60	-	60	57	62	57–62	62
HS	30	30	-	35	34	37	30–37	34–36
SL	50	50	60	52	52	50	50–60	46–56
SS	18	18	-	18	17	20	17–20	18–20
DS Min.	35	35	37	35	35	35	35–37	30–38
DS Max.	50	50	47	45	50	47	45–50	42–53
PDS Min. (h_1)	38	37	40	37	40	42	37–42	30–43
PDS Max. (h_2)	57	50	55	57	52	55	50–57	49–65
1a	25	22	27	30	27	22	22–30	>15–27
1b	22	27	22	27	27	22	22–27	20–30
2a	> 15	> 15	20	> 15	> 12	> 12	12–20	>15–>16
2b	15	20	17	> 17	> 12	17	12–20	>17–21
3a	> 12	17	15	15	15	17	12–17	12–17
3b	> 15	> 15	20	> 17	> 15	> 17	15–20	>16–>20
cs	3	3	3	3	3	3	3	3
bs	12	12	15	15	15	12	12–15	9–11
Cx I	62	55	57	60	52	52	52–62	52–61
Tr I	42	42	40	42	42	40	40–42	35–40
Fe I	55	55	52	55	50	55	50–55	52–56
Ge I	30	28	27	30	27	30	27–30	27–32
Ti I	47	45	44	47	45	47	44–47	42–49
Ta I (L)	72	75	75	75	70	75	70–75	70–76
Ta I (H)	17	17	17	17	17	17	17	17–18
Leg I	308	300	295	309	286	299	286–309	278–314
Cx II	55	52	52	50	52	57	50–57	55–58
Tr II	42	40	40	40	40	42	40–42	35–36

Table 1. Continued.

Character	1a	1b	1c	1d	1e	1f	Range	Noei *et al.* (2017); n = 3
Fe II	52	47	50	50	47	50	47–52	50
Ge II	25	26	26	27	25	27	25–27	26–28
Ti II	42	40	40	41	40	42	40–42	41–43
Ta II (L)	65	61	65	65	62	65	61–65	61–65
Ta II (H)	17	17	17	17	17	17	17	16–17
Leg II	281	266	273	273	266	283	266–283	264–280
Cx III	50	46	47	49	47	48	46–50	47–54
Tr III	47	42	45	42	42	45	42–47	37–41
Fe III	57	52	55	52	50	55	50–57	50–52
Ge III	27	27	26	26	27	29	26–29	27–30
Ti III	50	46	47	50	47	52	46–52	50–52
Ta III (L)	71	70	72	70	67	70	67–72	60–69
Ta III (H)	15	15	15	15	15	15	15	14–15
Leg III	302	283	292	289	280	299	280–302	271–297
IP	891	849	860	871	832	881	832–891	813–891

Achaemenothrombiidae Saboori, Wohltmann and Hakimitabar, 2010
Genus *Achaemenothrombium* Saboori, Wohltmann and Hakimitabar, 2010

Achaemenothrombium saboorii Noei, 2021

Material examined

One larva (ARS-20210131-2a) was collected ectoparasitic on *Dichagyris leucomelas* Brandt (Lepidoptera: Noctuidae), IRAN: South Khorasan Province, Darmiyan city, Dorokhsh region (33° 08' 22" N, 59° 42' 54" E, 6345 m a.s.l.), 24 July 2020, coll. M. Kohansal; one larva (ARS-20210131-2d) – the same data except for *Hyponephele lupina* (O. Costa) (Lepidoptera: Nymphalidae); one larva (ARS-20210131-2c) – the same data except for *Drasteria saisani* (Staudinger) (Lepidoptera: Erebidae) and one larva (ARS-20210131-2b) – the same data except on an unidentified moth (Lepidoptera: Noctuidae). All four specimens had started to feed and were engorged. Two specimens (ARS-20210131-2a–2b) are deposited in the Acarological Collection, Acarological Society of Iran, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran and two specimens (ARS-20210131-2c–2d) - in the collection of the Department of Plant Protection, College of Agriculture, University of Zabol, Iran (DPPZ).

Remarks

Achaemenothrombium saboorii was described based on larvae ectoparasitic on *Drasteria cailino* (Lefèbvre), *D. flexuosa* (Ménétriés), *D. saisani* (Staudinger) (Lepidoptera: Erebidae), *Gnopharmia colchidaria* (Lederer) (Lepidoptera: Geometridae), *Stiphrometasia monialis* (Erschoff) (Lepidoptera: Crambidae), *Bryophila moeonis* (Lederer) (Lepidoptera: Noctuidae) and *Platycleis intermedia* (Audinet-Serville) (Orthoptera: Tettigoniidae) (Noei and Rabieh 2021). *Achaemenothrombium saboorii* is recorded for the second time from South Khorasan Province, Iran ectoparasitic on *Dichagyris leucomelas* Brandt (Lepidoptera: Noctuidae), *Drasteria saisani* (Staudinger) (Lepidoptera: Erebidae) and *Hyponephele lupina* (O. Costa) (Lepidoptera: Nymphalidae). *Dichagyris leucomelas* and *H. lupine* are recorded as new hosts for *A. saboorii*.

The leg setal formula and measurements are given in Tables 2 and 3, respectively. The specimens collected in the present study fit the data on *A. saboorii* given by Noei and Rabieh (2021) based on Table 2 and 3.

Table 2. Leg chaetotaxy of *Achaemenothrombium saboorii* Noei, 2021 in the present paper and from the previous study (Noei and Rabieh 2021 = A).

Character	2a	2b	2c	2d	A; n = 26
Ta I	4ω, 1ε, 14/12ζ, 69/67n	5ω, 1ε, 14/12ζ, 55/60n	4ω, 1ε, 8/11ζ, 60/58	4ω, 1ε, 12/13ζ, 61/64n	4–6ω, 1ε, 9–16ζ, 50–66n
Ti I	6φ, 1κ, 19/17n	6φ, 1κ, 19/16n	6/7φ, 1κ, 15/16n	7/6φ, 1κ, 20/21n	4–8φ, 1κ, 16–23n
Ge I	3σ, 1κ, 7n	3σ, 1κ, 8/7n	3σ, 1κ, 6n	4/2σ, 1κ, 9/10n	3σ*, 1κ, 5–10n
Fe I	9n	10/9n	9n	9n	7–11n
Tr I	1n	1n	1n	1n	1n
Cx I	2n	2n	2n	2n	2n
Ta II	3ω, 1ε, 1ζ, 37n	4/3ω, 1ε, 1ζ, 35/38n	3ω, 1ε, 1ζ, 38/39n	3ω, 1ε, 1ζ, 38/37n	3ω**, 1ε, 1ζ, 31–42n
Ti II	3φ, 15/14n	3φ, 18/16n	3φ, 17/15n	3φ, 18/17n	3φ***, 12–21n
Ge II	1/2σ, 1κ, 7/6n	1σ, 1κ, 6n	1σ, 1κ, 7/6n	1σ, 1κ, 7/8n	1σ[4]*, 1κ, 5–8n
Fe II	9/8n	9n	8n	8n	7–10n
Tr II	1n	1n	1n	1n	1n
Cx II	2n	2n	1/2n	2n	2–3[5]*n
Ta III	35n	33/34n	34n	37/34n	29–39n
Ti III	18n	17/18n	17/18n	19/20n	13–22n
Ge III	1σ, 7n	1σ, 7n	1σ, 6/7n	2/1σ, 8n	1σ[6]*, 5–8n
Fe III	8n	8n	10/8n	8/9n	8–10n
Tr III	1n	1n	1n	1n	1n
Cx III	2n	1/2n	2/1n	2n	2n

* 4σ on one side of symmetry axis in four specimens, 2σ on one side of symmetry axis in one specimen; ** 4ω on one side of symmetry axis in one specimen; *** 4φ on one side of symmetry axis in six specimens, 5φ on one side of symmetry axis in one specimen; [4]* 2σ on one side of symmetry axis in four specimens; [5]* 17 specimens with two setae on coxa II, six specimens with three setae, 3/2 in two specimens and 2/4 in one specimen; [6]* 2σ on one side of symmetry axis in three specimens, one specimen without solenidion on one side of symmetry axis.

Table 3. Metric data of *Achaemenothrombium saboorii* Noei, 2021 in the present study and from the previous study (Noei and Rabieh 2021 = A).

Character	2a	2b	2c	2d	Range	A; n = 26
IL	840	980	690	650	650–980	610–1200
IW	440	610	370	320	320–610	330–760
LN	59	61	45	57	45–61	38–65
MA	137	135	135	137	135–137	105–140
AW	180	182	180	165	165–182	167–192
PW	164	153	157	155	153–164	155–177
SB	135	132	127	122	122–135	115–140
MSA	161	157	150	160	150–161	138–162
ASB	220	220	195	217	195–220	172–220
PSB	82	82	77	75	75–82	67–85
L	302	302	272	292	272–302	250–305
W	205	205	200	190	190–205	182–210
AP	88	85	76	77	76–88	67–92

Table 3. Continued.

Character	2a	2b	2c	2d	Range	A; n = 26
SA	36	37	36	35	35–37	32–42
SP	60	60	55	50	50–60	43–60
AM	75	75	62	70	62–75	60–75
AL	52	46	42	47	42–52	40–52
PL	60	55	52	57	52–60	47–62
AMB = AA	102	107	87	91	87–107	70–102
S	110	107	100	110	100–110	92–117
PLN 1	57	62	55	62	55–62	41–57
HS 1	110	112	92	111	92–112	77–107
LSS 1	187	187	192	182	182–192	157–212
SS 1	85	77	99	107	77–107	75–132
SL 1	87	72	75	82	72–87	70–90
PLN 2	17	20	17	17	17–20	11–20
HS 2	55	62	47	52	47–62	37–62
LSS 2	97	90	78	87	78–97	72–105
SS 2	52	51	47	54	47–54	42–65
SL 2	82	72	75	75	72–82	62–80
DS min.	52	45	42	42	42–52	40–57
DS Max.	75	67	72	72	67–75	62–85
***h*$_1$**	80	77	75	87	75–87	70–87
***h*$_2$**	97	95	82	97	82–97	87–117
GL	152	152	152	150	150–152	82–145
1a	70	70	67	71	67–71	55–75
1b	57	70	70	67	57–70	50–67
2a	72	62	65	75	62–75	52–70
***2b*$_1$**	45	45	32	47	32–47	27–63
3a	65	55	52	57	52–65	45–62
***3b*$_1$**	65	55	54	60	54–65	40–67
***3b*$_2$**	57	> 40	53	55	> 40–57	45–62
cs	9	9	9	11	9–11	8–10
bs	25	32	> 27	35	25–35	20–40
Ta I (L)	245	250	235	250	235–250	217–247
Ta I (H)	32	32	30	32	30–32	27–40
Ti I	137	142	127	145	127–145	122–142
Ge I	85	87	82	86	82–87	77–92
Fe I	187	187	170	187	170–187	170–195
Tr I	90	87	80	85	80–90	75–90
Cx I	107	117	117	110	107–117	105–120
Leg I	851	870	811	863	811–870	790–871
Ta II (L)	187	187	180	190	180–190	167–197
Ta II (H)	30	30	27	30	27–30	27–32
Ti II	132	140	127	137	127–140	116–137
Ge II	77	77	75	75	75–77	70–82
FeII	170	172	157	175	157–175	157–180
Tr II	90	90	82	92	82–92	80–95
Cx II	125	125	117	122	117–125	110–130
Leg II	781	791	738	791	738–791	722–802
Ta III (L)	187	197	187	195	187–197	172–200
Ta III (H)	27	27	25	27	25–27	22–30
Ti III	162	170	160	175	160–175	137–172
Ge III	85	87	82	86	82–87	75–87
Fe III	187	195	176	200	176–200	167–200
Tr III	110	106	97	105	97–110	87–112
Cx III	132	145	130	132	130–145	122–140
Leg III	863	900	832	893	832–900	789–903
IP	2495	2561	2381	2547	2381–2561	2301–2576

Neothrombiidae Feider, 1955

Material examined

One larva (ARS-20210131-3a) was collected ectoparasitic on *Rhipicephalus sanguineus* (Latreille) (Acari: Metastigmata: Ixodidae), IRAN: South Khorasan Province, Sarbisheh city, Doroh region (33° 10' 55" N, 60° 24' 36" E, 3457 m a.s.l.), 3 July 2020, coll. M. Kohansal. The specimen is deposited in the Acarological Collection, Jalal Afshar Zoological Museum (JAZM), Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran,

Remarks

The families Acrididae, Gryllidae, Gryllotalpidae, Rhaphidophoridae, Tetrigidae (Insecta: Orthoptera); Dolichopodidae, Ephydridae, Hybotidae (Insecta: Diptera); Silphidae, Tenebrionidae (Insecta: Coleoptera); Machilidae (Insecta: Microcoryphia); Monoscutidae (Arachnida: Opiliones) and Scolopendridae (Chilopoda: Scolopendromorpha) were recorded as host of larval Neothrombiidae (Felska *et al.* 2018; Majidi *et al.* 2018). In this study, *Rhipicephalus sanguineus* (Latreille) (Acari: Metastigmata: Ixodidae) is recorded as a new host for the family Neothrombiidae. The collected engorged specimen was attached to the leg tarsus I of its host and probably belongs to a new genus of Neothrombiidae. Additional samplings in order to collect more specimens are planned before a formal description will be published.

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داده‌های جدید در مورد گونه‌های *Cicaditrombium lorestanensis* (Acari: Trombidiidae) و *Achaemenothrombium saboorii* (Acari: Achaemenothrombiidae) و خانوادهٔ Neothrombiidae

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چکیده

افراد جنس *Cicaditrombium* Saboori and Lazarboni از ایران توصیف شدند و به عنوان انگل راسته‌های ناجوربالان (خانواده Cicadidae) و بالپولکداران (خانواده Noctuidae) شناخته می‌شوند. لاروهای گونه *Cicaditrombium lorestanensis* Noei از استان خراسان جنوبی به صورت انگل بیرونی روی *Chrysolina* (Coleoptera: Chrysomelidae) و *Monosteria* sp. (Hemiptera: Tingidae) جمع‌آوری شدند، که این میزبان‌ها برای این گونه جدید هستند. لاروهای گونه *Achaemenothrombium saboorii* از ایران، استان خراسان جنوبی به صورت انگل بیرونی روی بالپولکداران خانواده‌های Erebidae، Noctuidae و Nymphalidae جمع‌آوری شد و خانوادهٔ Nymphalidae به عنوان میزبان جدید برای این گونه گزارش می‌شود. یک لارو تاکنون توصیف نشدهٔ متعلق به خانوادهٔ Neothrombiidae به عنوان انگل گونه *Rhipicephalus sanguineus* یافت شد. این نخستین گزارش از افراد خانوادهٔ Ixodidae (Acari: Parasitiformes: Ixodida) است که به عنوان میزبان لارو کنه‌های پارازیتنگونا عمل می‌کند. داده‌های متریک و مریستیک اضافی، برای گونه‌های *C. lorestanensis* و *A. saboorii* ارایه می‌شوند.

واژگان کلیدی: *Chrysolina*؛ *incertae sedis*؛ *Monosteria*؛ *Rhipicephalus sanguineus*؛ خراسان جنوبی.

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