

Description of Two New Species (Hypopi) of Genus *Acotyledon* Oudemans (Acarina: Acaridae) From Pakistan

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Abstract.- Mites are very important stored grains pests, which cause both qualitative and quantitative losses. They also cause different types of allergenic reactions among the grain handlers and farmers. Acarid mites are found commonly in different areas of Punjab, Pakistan. Genus *Acotyledon* is most common in these areas of Pakistan. A comprehensive survey of different stored grains and stored products from Gujranwala district resulted in discovery of two new species (Hypopi) viz., *Acotyledon kamokiensis* and *A. wazirabadensis*. The types were deposited in the Acarology Research Laboratory, University of Agriculture, Faisalabad.

Key words: Acarid, mites, genus *Acotyledon*, wheat, rice, *Kamokiensis*, *Wazirabadensis*.

INTRODUCTION

Conservation of food grains stock is necessary to ensure continuous supply at stable prices. Majority of the developing countries suffer great losses on account of sub-standard storage facilities for sanitation and heavy mite infestation, which ultimately affects food quality (Johnson and Lyon, 1991). Mites (Acarina: Arachnida) are tiny arthropods which are not easily detected from different types of food commodities and pose great difficulty in their damage detection. Usually the workers are exposed to storage mites which consequently results in many human health problems like acariasis which is mostly the end product of mites ingestion through infected commodity (Li and Wang, 2000), asthma and dermatitis, and allergic diseases (Armentia *et al.*, 1997). They exhibit distinct niches in each type of environment and have assumed unchecked source of trouble for agriculture, forestry and livestock around the globe. The moist conditions along with warm area encourage huge losses to food products.

Acarid mites of genus *Acotyledon* include number of species which infest wide range of stored food stuffs (Ashfaq *et al.*, 1986, 1987, 1990; Chmielewski, 1999). They not only decrease the

germination capacity of grains but they also act as carrier of many fungal and bacterial diseases in humans (Krizkova-Kudlikova *et al.*, 2007; Sinha and Wallace, 1973; Dunn *et al.*, 2008).

Genus *Acotyledon* is most abundant genus occupying the wide range of habitats. It was erected by Oudemans in 1903 and he designated *Acotyledon paradoxa* as its type species. Zachvatkin (1941) synonymized with the *Acotyledon* the genera *Eberhardia* Oudemans, *Cosmoglyphus* Oudemans and *Myrmoglyphus* Vitzthum. He included 16 species in the genus *Acotyledon*. Nesbitt (1945) revised the family Acaridae on the basis of adults, but he did not mention *Acotyledon*. He placed *Cosmoglyphus* as subgenus of *Eberhardia*. Baker and Wharton (1952) synonymized *Acotyledon* with *Eberhardia*. Samsinak (1957) considered *Cosmoglyphus* as subgenus of *Acotyledon* but later in 1960, he described a new species *Acotyledon solenopsidis*. In this paper he did not mention the genus *Cosmoglyphus*. *Acotyledon solenopsidis* is morphologically very close to the type species of the genus *Cosmoglyphus* (*C. krameri*) which shows that he was of the opinion that *Cosmoglyphus* is the synonym of *Acotyledon*. He also agreed to Zachvatkin (1941) considering *Myrmoglyphus* Vitzthum a synonym of *Acotyledon*. Later on, Samsinak re-established the genus *Cosmoglyphus* in 1966. Hughes (1976) placed genera *Acotyledon* and *Cosmoglyphus* in *Caloglyphus* considering it a valid genus. Fain and Philips (1978) described the adults of *Acotyledon paradoxa*. In this paper they also

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described the taxonomic position of this genus and placed *Tyroglyphus agilis* Canestrini, *Eberhardia* (*Cosmoglyphus*) *rhizoglyphoides* Zachvatkin, *Eberhardia* (*Cosmoglyphus*) *pedispinifer* Nesbitt and *Acotyledon sokolovi* Zachvatkin in it. Samsinak (1980) revised the tribe *Caloglyphini*. He erected a new genus *Neoacotyledon* and placed genera *Sancassania* Oudemans, *Caloglyphus* Berlese, *Cosmoglyphus* Oudemans and *Acotyledon* Oudemans. Klimov (2000) proposed new classification for the tribe *Caloglyphini* and he placed 8 genera including *Acotyledon* in this tribe. He also erected a new genus *Mycetosancassania*. Other workers including Womersley (1955), Rupes (1967), Samsinak (1968), Mahunka (1973, 1974, 1978), Sevastianov and Rady (1991) and Eraky (1999) contributed significantly to the fauna of this genus from different parts of the world.

From Pakistan 15 species of this genus have been reported earlier (Ashfaq *et al.*, 1986, 1987, 1990, 1998; Ashfaq and Sarwar, 1999; Ashfaq and Sher, 2002). In the present paper two new species have been described and illustrated thus making a total of 17 species of the genus *Acotyledon* from Pakistan. A comprehensive key has also been included to incorporate the new species.

MATERIALS AND METHODS

A thorough survey of different localities of District Gujranwala was conducted. Different stored grains and stored commodities were collected and brought to Acarology Research Laboratory, University of Agriculture, Faisalabad. These samples were processed through Berlese's Funnel for at least 24 hours. The mites received, were sorted under binocular microscope and hypopi were mounted on the glass slides permanently in Hoyer's medium. These specimens were examined under high power phase contrast microscope and were identified up to the species level with the help of available literature and keys. Sketches of dorsum, venter and legs were prepared with the help of ocular grid. Measurements were done in micrometer with the help of ocular micrometer. Measurement range of 5 paratypes is also given. A comprehensive key is also prepared to include the new species.

RESULTS AND DISCUSSION

The survey resulted in the identification of two new species. A comprehensive key of the known species of the genus *Acotyledon* is prepared which is as under:

Key to Species of Genus *Acotyledon* from Pakistan

1. Sternum 2 (st_2) present 2
- Sternum 2 (st_2) absent 16
2. Gnathosomal fused padipalpi not notched 3
- Gnathosomal fused padipalpi notched 10
3. Propodosomal shield dotted 4
- Propodosomal shield smooth 5
4. Metasternal seta (mts) present
 -*peshawariensis* Ashfaq, Chaudhri and Parvez
 - Metasternal seta (mts) absent*falki* Ashfaq and Sher
5. Apodeme 2 (ap_2) meeting Apodeme 4 (ap_4) 6
- Apodeme 2 (ap_2) not meeting Apodeme 4 (ap_4) 8
6. Metasternal seta (mts) present *wazirabadensis* n.sp.
- Metasternal seta (mts) absent 7
7. Genu III with 1 seta only*lucarus* Ashfaq and Sarwar
- Genu III with 2 seta only
 -*pytho* Ashfaq, Chaudhri and Parvez
8. Dorsum with 3 pairs of visible pores
 -*dolichos* Ashfaq and Sarwar
 - Dorsum without 3 pairs of visible pores 9
9. Suctorial shield pointed posteriorly
 -*thysia* Ashfaq and Sarwar
 - Suctorial shield rounded posteriorly
 -*tariqi* Ashfaq, Sher, Chaudhri and Aslam
10. Gnathosomal fused padipalpi not pear shaped 11
- Gnathosomal fused padipalpi pear shaped 12
11. Propodosomal shield dotted; sternum 2 (st_2) free anteriorly; coxal fields III and IV open
 -*infaustus* Ashfaq, Chaudhri and Parvez
 - Propodosomal shield smooth; sternum 2 (st_2) meeting apodeme 4 (ap_4); coxal fields III and IV closed
 -*thosmos* Ashfaq, Chaudhri and Parvez
12. Coxal fields I-IV not all open 13
- Coxal fields I-IV all open 14
13. Coxal fields III and IV open
 -*ruditas* Ashfaq, Chaudhri and Parvez
 - Coxal fields III and IV closed
 -*hypeir* Ashfaq, Chaudhri and Parvez
14. Seta ve present; tarsi III and IV each with 4 leaf-like setae
 -*stremma* Ashfaq, Chaudhri and Parvez
 - Seta ve absent; tarsi III and IV each with 3 leaf-like setae
15. Gnathosoma 2 segmented; sternum1 (st_1) along with sharp tip *distantis* Ashfaq, Chaudhri and Parvez
- Gnathosoma 1 segmented; sternum1 (st_1) short with blunt tip *bellulus* Ashfaq and Sher
16. Gnathosomal fused padipalpi notched posteriorly; ω_1 more than half the length of tarsi
 -*haripuriensis* Ashfaq, Sher, Chaudhri and Aslam
 - Gnathosomal fused padipalpi not notched posteriorly; ω_1 less than half the length of tarsi *kamokiensis* n.sp.

Acotyledon kamokiensis, new species (Fig. 1)*Hypopus**Diagnosis*

The main diagnostic characters of this species are as follows; body oval shaped with dark brown colour. Gnathosomal padipalpi straight posteriorly. Propodosomal shield separated from hysterosomal shield with strongly striated area. *Sai* 2X longer than *Sae*. 3 visible pores are located on dorsum.

Dorsum

Body oval shape, 274 (245-294) long, 225 (186-255) wide; divided into propodosomal and hysterosomal shields. Propodosomal shield 27 (15-29) long, 159 (157-176) wide provided with a small rostrum antero-medially, dotted; setae *vi*, *sci*, *sce*, 22 (22-27), 24 (20-24) and 34 (17-32) long respectively, seta *ve* absent, *sci-sci* 27 (12-15), *sce-sce* 110 (86-110) and *sci-sce* 42 (37-47) apart. Setae *sci* and *sce* in semi-circular line. Hysterosomal shield 220 (191-230) long, 171 (159-233) wide, dotted; 3 pair visible pore. Setae simple, seta *he*, *d*₁, *d*₂, *d*₃, *d*₄ on hysterosomal shield while seta *hi*, *la*, *lp*₁, *lp*₂, *sai* and *sae* located off the hysterosomal shield. Setae *d*₁ 15 (12-24), *d*₂ 15 (10-17), *d*₃ 12 (10-12), *d*₄ 15 (10-15), *hi* 12 (7-12), *he* 17 (17-24), *la* 10 (10-12), *lp*₁ 7 (7-15), *lp*₂ 10 (7-12), *sae* 15 (12), *sai* 32 (24-27) long; *d*₁-*d*₁ 44 (37-54), *d*₂-*d*₂ 154 (135-171), *d*₃ - *d*₃ 49 (42-76), *d*₄ - *d*₄ 69 (61-76), *d*₁-*d*₂ 56 (49-59), *d*₂- *d*₃ 66 (49-71) and *d*₃ - *d*₄ 73 (54-76) apart. Hysterosomal shield anterior margin separated from propodosomal shield (Fig. 1A).

Venter

Gnathosomal fused pedipalpi I segmented, 27 (24-27) long, parallel laterally, rounded posteriorly, 1 pair arista, 44 (39-49) long, 2 pairs small setae (Fig. 1C). Apodeme I (*ap* 1) 20 (12-20) long, V-shaped continuing with sternum I (*st* 1). Sternum I (*st* 1) free, pointed, 37 (37-47) long. Apodeme 2 (*ap* 2) not meeting apodeme 4 (*ap* 4). Apodeme 3 (*ap* 3) meeting apodeme 4 (*ap* 4). Apodeme 4 (*ap* 4) meeting medially making a semi-circular line. Sternum 2 (*st* 2) absent. Apodeme 5 (*ap* 5) converging medially meeting apodeme 4 (*ap* 4). Metasternal seta (*mts*) 15 (10-15). Coxal fields I, II and IV open, III closed and dotted. Area lateral to

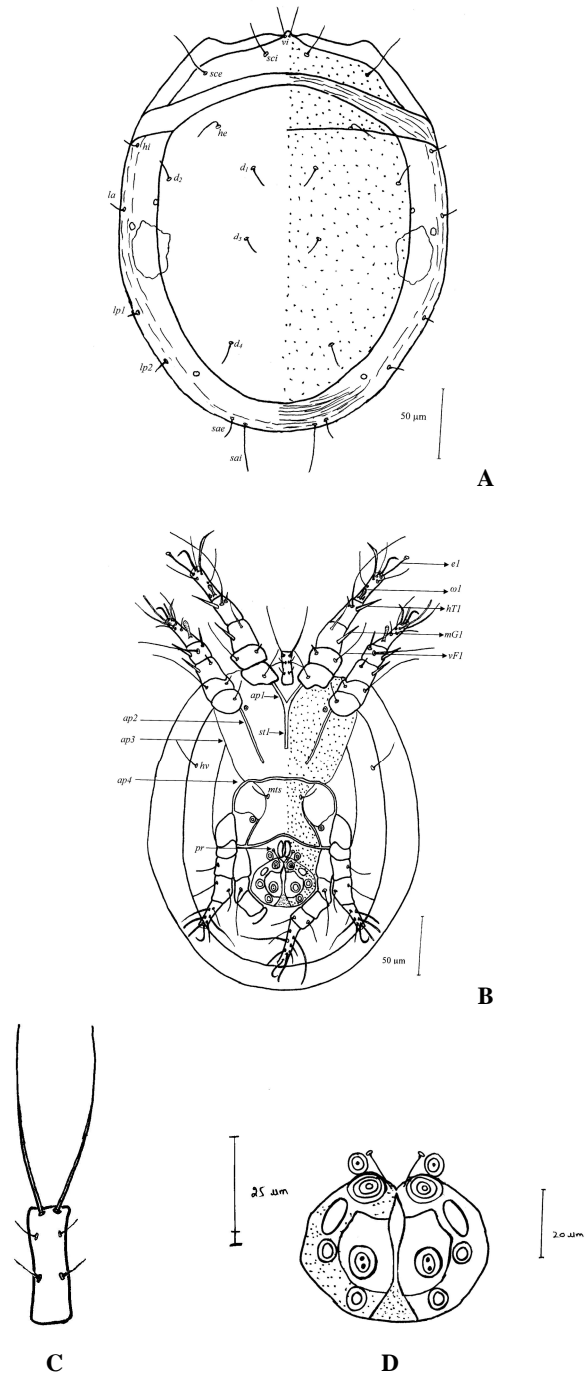


Fig. 1. *Acotyledon kamokiensis* n.sp.; A, dorsal side; B, ventral side; C, gnathosomal padipalpi with long arista; D, suctorial shield.

apodeme 3 (*ap* 3) and apodeme 4 (*ap* 4) not dotted. Seta *hv* I pair 29 (15-24) long. Genital shield dotted, genital slit elongated, genital suckers absent, I pair

paragenital setae (*pr*) anterior to genital disc (*gdi3*) 12 (10-12) long. Coxal discs *di1* and *di2* present. Suctorial shield concave antero-medially, rounded posteriorly, 42 (47-49) long, 54 (49-56) wide (Fig. 1D), I pair anterior suckers, I pair anal suckers, 2 pairs each of lateral and posterior suckers, lateral suckers little bit anterior to anal suckers (Fig. 1B).

Legs

All of one type, I - IV measuring 116 (98-115), 96 (91-103), 98 (83-105) and 103 (86-110) in length respectively (Trochanter base to tarsus tip). Setae and solenidia on legs I - IV segments: Coxae 0-0-0-0, trochanters 1-1-0-0, femora 1-2-0-1, genua 1-2-1-0, tibiae 2-3-2-2, tarsi 6-6-6-6. Tarsi I-IV 31 (37-42) - 29 (29-37) - 24 (24-32) - 40 (24-42) long respectively. Seta *vF* on femora I, II and IV 39 (24-47), 51 (34-42) and 39 (24-32) long respectively, absent on femur III. Seta *e* on tarsi I 27 (24-39) long, absent on femora II, III and IV. Seta *mG* on genua I and II 22 (17-24) and 20 (20-24) long, *hT* on tibiae I and II 24 (17-27) and 20 (20-24) long respectively. Setae σ on Genu I 22 (10-27) long, Solenidion ω_1 on tarsi I and II 12 (15-20) and 15 (15-20) long respectively. Setae ϕ on tibia I and II 73 (44-76) and 49 (39-59) long respectively. Tarsi I-IV provided with I cup-shaped + 1 leaf-like + 3 lancet like; 2 lancetlike; 3 lancet like; 3 lancet-like setae respectively (Fig. 1B).

Type

Holotype hypopus was collected from Grain Market Kamokey (Gujranwala) from Wheat (*Triticum aestivum*) grains on 15-04-2010 and deposited in the Department of Agri. Entomology, University of Agriculture, Faisalabad.

Etymology

The species name is described on the basis of locality (Kamokey) from which this species was collected.

Remarks

This new species is very close to already known species *Acotyledon haripuriensis* Ashfaq, Sher, Chaudhri and Aslam, but this new species differs from *A. haripuriensis* due to the following

characters:

1. *A. haripuriensis* has 2 pairs of visible pores on dorsum while this new species has 3 pairs of visible pores on dorsum.
2. In *A. haripuriensis* the hysterosomal shield overlapping the propodosomal shield while in this new species the hysterosomal shield is separated from propodosomal shield.
3. *A. haripuriensis* has notched gnathosomal padipalpi posteriorly while in this new species it is straight posteriorly.
4. In *A. haripuriensis* *mts* is present at tip of open coxal field III while in this new species coxal field III is closed and *mts* is present over it.
5. In *A. haripuriensis* area lateral to *ap3* and *ap4* is dotted while in this new species area lateral to *ap3* and *ap4* is smooth.

This new species can also be compared with already known species *Acotyledon distantis* Ashfaq, Chaudhri and Parvez but this new species differs from *A. distantis* due to following characters:

1. In *A. distantis* propodosomal shield is smooth while in this new species propodosomal shield is dotted.
2. In *A. distantis* 4 pairs of visible pores are present on dorsum while in this new species 3 pairs of visible pores are present on dorsum.
3. In *A. distantis* the hysterosomal shield is overlapping propodosomal shield while in this new species the hysterosomal shield is separated from propodosomal shield.
4. In *A. distantis* gnathosomal fused padipalpi are pear shaped, broad and notched at base while in this new species it is not notched and of same width.
5. In *A. distantis* *st2* is bifurcated anteriorly while in this new species *st2* is absent.

Acotyledon wazirabadensis, new species (Fig. 2)

Hypopus

Diagnosis

The main features of this species are: body rounded dark brown in colour. d_4 on dorsum is almost 1.5 X longer than d_1 . The *st2* in this species is rod like anteriorly becoming bifid posteriorly and trochanters II and III without setae.

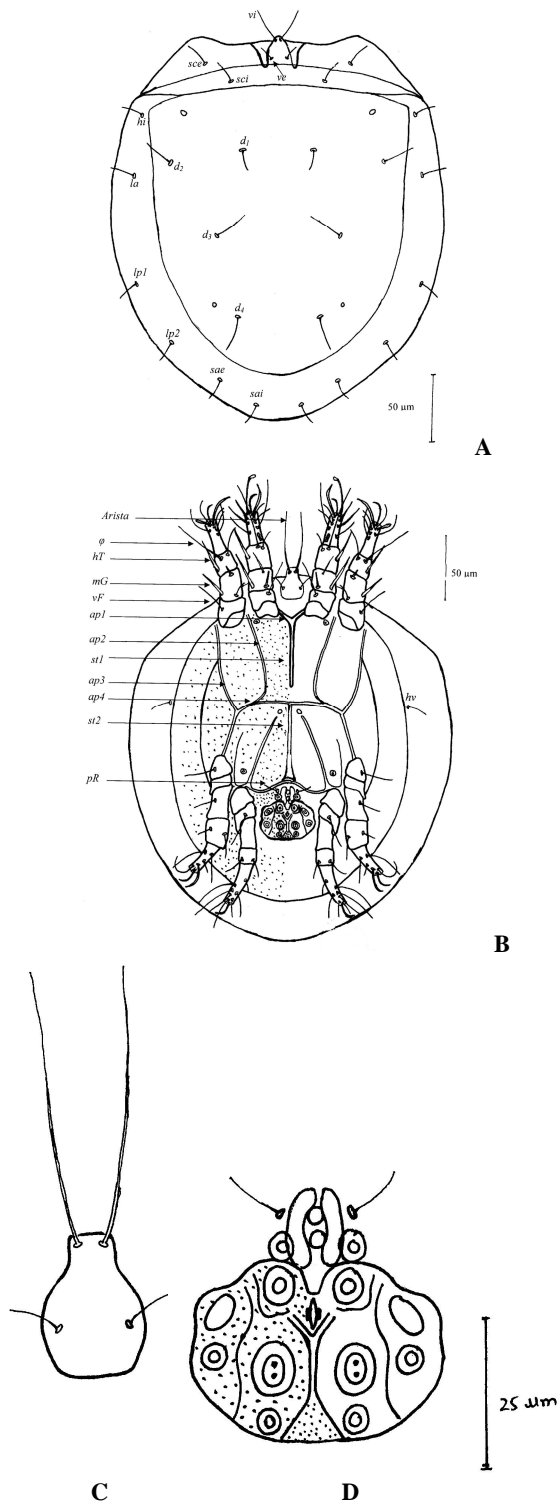


Fig. 2. *Acotyledon wazirabadensis* n.sp.; A, dorsal side; B, ventral side; C, gnathosomal padipalpi with long arista; D, suckorial shield

Dorsum

Body almost rounded, 274 (225-274) long, 235 (186-235) wide; divided into propodosomal and hysterosomal shields. Propodosomal shield 22 (10-24) long, 196 (135-191) wide provided with a small rostrum antero-medially, setae *vi*, *ve*, *sci*, *sce*, 24 (12-27), 12 (10-24), 17 (12-24) and 17 (20-27) long respectively. *sci-sci* 66 (34-74), *sce-sce* 103 (59-93) and *sci-sce* 22 (24-39) apart. Setae *sci* and *sce* not in semi-circular line. Hysterosomal shield 208 (162-203) long, 174 (135-176) wide. Setae *d₁*, *d₂*, *d₃* and *d₄* on hysterosomal shield while setae *hi*, *la*, *lp₁*, *lp₂*, *sai* and *sae* off the hysterosomal shield. 2 pair visible pores. Setae simple, *d₁* 15 (22-24), *d₂* 22 (15-24), *d₃* 24 (15-20), *d₄* 24 (15-29), *hi* 15 (7-15), *la* 17 (7-17), *lp₁* 15 (10-15), *lp₂* 15 (10-15), *sae* 15 (12-17), *sai* 15 (15-22) long; *d₁-d₁* 49 (32-44), *d₂-d₂* 149 (113-145), *d₃-d₃* 86 (39-74), *d₄-d₄* 59 (47-59), *d₁-d₂* 51 (44-54), *d₂-d₃* 61 (49-66) and *d₃-d₄* 59 (39-59) apart. Hysterosomal shield anterior margin overlapping propodosomal shield and overlapping area smooth (Fig. 2A).

Venter

Gnathosomal fused pedipalpi, I segmented, 24 (20-29) long, broad at base, rounded posteriorly, I pair arista, 47 (37-47) long, 1 pairs small setae (Fig. 2C). Apodeme I (*ap1*) 12 (7-12) long, V-shaped continuing with sternum I (*st1*). Sternum I (*st1*) free, pointed, 49 (39-51) long. Apodeme 2 (*ap2*) meeting apodeme 4 (*ap4*). Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*). Apodeme 4 (*ap4*) meeting medially making a semi-circular line. Sternum 2 (*st2*) meeting apodeme 4 (*ap4*) anteriorly, free posteriorly, 61 (49-61) long. Apodeme 5 (*ap5*) converging medially not meeting apodeme 4 (*ap4*). Metasternal seta (*mts*) absent. Coxal fields I, III and IV open, II closed, dotted. Area lateral to apodeme 3 (*ap3*) and apodeme 4 (*ap4*) dotted. Seta *hv* I pair 15 (12-17) long. Genital shield dotted, genital slit elongated, 1 pair genital suckers, I pair paragenital setae (*pR*) anterior to genital disc (*gdi3*) 10 (10-11) long. Coxal discs *di1* and *di2* present. Suctorial shield concave antero-medially, rounded posteriorly, 29 (27-34) long, 42 (37-44) wide (Fig. 2D), I pair anterior suckers, I pair anal suckers, 2 pairs each of lateral and posterior suckers, lateral suckers at the same level as anal suckers (Fig. 2B).

Legs

All of one type, I - IV measuring 81 (74-88), 83 (69-83), 91 (66-93) and 91 (69-91) in length respectively (Trochanter base to tarsus tip). Setae and solenidia on legs I - IV segments: Coxae 0-0-0-0, trochanters 0-0-1-0, femora 1-1-0-1, genu 2-3-1-0, tibiae 2-2-2-2, tarsi 8-7-5-7. Tarsi I-IV 24 (24-27) -27 (20-27) -24 (20-32) -34 (24-37) long respectively. Seta *vF* on femora I and II 27 (22-37) and 24 (24-27) long respectively, absent on femur III. Seta *e* on tarsi I 29 (24-27) long, absent on tarsi II, III and IV. Seta *mG* on genua I and II 29 (17-27) and 20 (15-17) long respectively, *hT* on tibiae I and II 24 (22-24), 24 (17-24) long respectively. Setae σ on Genu I 12 (7-10) long, Solenidion ω_1 on tarsi I 7 (10-15) long, Setae ϕ on tibia I and II 49 (37-56) and 39 (27-37) long respectively. Tarsi I - IV provided with I cup-shaped + 1 leaf-like + 2 lancet like; 1 lancetlike; 2 lancet-like; 3 leaf-like + 5 simple setae respectively (Fig. 2B).

Type

Holotype hypopus was collected from Godowns in Wazirabad from Rice (*Oryza sativa*) on 06-07-2010 and deposited in the Department of Agri. Entomology, University of Agriculture, Faisalabad.

Etymology

This species name is described on the basis of locality (Wazirabad) from which this species was collected.

Remarks

This new species is very close to already known species *Acotyledon falki* Ashfaq and Sher, but this new species can be separated from *A. falki* due to following features:

1. *A. falki* has 1 pair of visible pores on dorsum while this new species has 2 pairs of visible pores on dorsum.
2. In *A. falki* the overlapping area of hysterosomal and propodosomal shields is dotted while in this new species the overlapping area is smooth.
3. In *A. falki* setae on trochanters I and II are present while in this new species no seta is present on trochanter I and II.

4. In *A. falki* total 3 and 2 setae are present on genu I and III respectively while in this new species total 2 and 1 setae are present on genu I and III respectively.
5. In *A. falki* suctorial shield is without radial striations while in this new species suctorial shield is with radial striations.

This new species can also be compared with already known species *Acotyledon pytho* Ashfaq, Chaudhri and Parvez but this new species can be separated from *A. pytho* due to following features:

1. In *A. pytho* 3 pairs of visible pores are present on dorsum while in this new species 2 pairs of visible pores are present on dorsum.
2. In *A. pytho* rostrum is well defined while in this new species rostrum is not well defined.
3. In *A. pytho* overlapping area of hysterosomal and propodosomal shields is dotted while in this new species this overlapping area is smooth.
4. In *A. pytho mts* is present while in this new species *mts* is absent.
5. In *A. pytho* genital slit is longitudinal enclosed in a ring while in this new species genital slit is open.
6. In *A. pytho* tarsi IV has prominently long setae over it while in this new species only moderate or short setae are present over tarsi IV.

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REFERENCES

- ARMENTIA, A., MARTINEZ, A., CASTRODEZA, R., MARTINEZ, J., JIMENO, A., MENDEZ, J. AND STOLLE, R., 1997. Occupational allergic disease in cereal workers by stored grain pests. *J. Asthma.*, **34**: 369-378.
- ASHFAQ, M., CHAUDHARI, W.M. AND PARVEZ, A., 1986. Taxonomic studies on hypopi of the genus *Acotyledon* Oudemans (Acarina: Acaridae) from Pakistan. *Pak. Entomol.*, **8**: 1-28.
- ASHFAQ, M. AND SARWAR, M., 1999. Three new hypopi of

- the genus *Acotyledon* Oudemans (Acarina: Acaridae) from Pakistan. *Pak. Entomol.*, **21**: 3-14.
- ASHFAQ, M., SARWAR, M. AND PARVEZ, A., 1998. A description of two new species (hypopi) of the genus *Acotyledon* (Acariformes: Acaridae) from Pakistan. *Acarina*, **6**: 51-57.
- ASHFAQ, M. AND SHER, F., 2002. Description of two new species (hypopi) of genus *Acotyledon* Oudemans (Acarina: Acaridae) from Pakistan. *Pak. J. agric. Sci.*, **39**: 38-46.
- ASHFAQ, M., SHER, F. AND CHAUDHARI, W.M., 1990. Two new (hypopi) species of genus *Acotyledon* Oudemans (Acarina: Acaridae) from Pakistan. *Pakistan J. Zool.*, **22**: 181-192.
- ASHFAQ, M., SHER, F. CHAUDHARI, W.M. AND ASLAM, M., 1987. Two new (hypopi) species of genus *Acotyledon* Oudemans (Acarina: Acaridae) from Pakistan. *Pak. Entomol.*, **9**: 31-40.
- BAKER, E.W. AND WHARTON, G.W., 1952. *An introduction to Acarology*. The MacMillan Company, New York. pp. 465.
- CHMIELEWSKI, W., 1999. Acceptance of buckwheat grain as a food by *Tyrophagus putrescentiae* (Schr.) (Acari: Acaridae). *Fagopyrum*, **16**: 95-97.
- DUNN, J.A., THIND, B.B., DANKS, C. AND CHAMBERS, J., 2008. Rapid method for the detection of storage mites in cereals: feasibility of an ELISA based approach. *Bull. entomol. Res.*, **98**: 207-213.
- ERAKY, S.A., 1999. Five new hypopial nymphs (Acari, Acaridae, Histostomatidae) described from different habitats. *Folia Ent. Hung.*, **60**: 45-56.
- FAIN, A. AND PHILIPS, J.R., 1978. Astigmatic mites from nests of birds of prey in the U.S.A. IV. Description of the life cycle of *Acotyledon paradoxa* Oudemans, 1903. *Zool. Meded.*, **53**: 29-39.
- HUGHES, A.M., 1976. *The mites of stored food and houses*. Tech. Bull. No. 9. Ministry of Agriculture Fisheries and Food, London. pp. 400.
- JOHNSON, W.T. AND LYON, H.H., 1991. *Insects that feed on trees and shrubs*. 2nd ed., rev. Comstock Publishing Associates. 560pp.
- KLIMOV, P.B., 2000. A review of acarid mites of the tribe *Caloglyphini* (Acaridae, Acariformes) with description of a new genus and species from Siberia and Russian Far East. *Vestnik Zool.*, **34**: 27-35.
- KRIZKOVA-KUDLIKOVA, I., STEJSKAL, V. AND HUBERT, J., 2007. Comparison of detection methods for *Acarus siro* (Acari: Acaridida: Acarididae) contamination in grain. *J. econ. Ent.*, **100**: 1928-1937.
- LI, C.P. AND WANG, J., 2000. Intestinal acariasis in Anhui Province. *World J. Gastroenterol.*, **6**: 597-600.
- MAHUNKA, S., 1973. Auf insekten lebende Milben (Acari: Acarida: Tarsonemida) aus Afrika II. *Acta Zool. Hung.*, **19**: 289-337.
- MAHUNKA, S., 1974. Auf insekten lebende Milben (Acari: Acarida: Tarsonemida) aus Afrika III. *Acta Zool. Hung.*, **20**: 137-154.
- MAHUNKA, S., 1978. Schizoglyphidae fam. n. and new taxa of Acaridae and Anotoidae (Acari: Acarida). *Acta. Zool. Hung.*, **24**: 107-131.
- NESBITT, H.H.J., 1945. A revision of the family Acaridae (Tyroglyphidae) order Acari, based on comparative morphological studies. *Canad. J. Res., D.*, **23**: 139-188.
- OUDEMANS, A.C., 1903. Notes on Acari. *Tijdschr Ent.*, **45**: 147
- RUPES, M.A., 1967. Contribution on the genus *Acotyledon* Oudemans, 1903 (Acarina, Acaridae), with description of two new species: *A. calcis* sp. n. and *A. samsinaki* sp. n. *Vest. esk. Spol. Zool.*, **31**: 250-259.
- SAMSINAK, k., 1968. A new acaridoid mite *Acotyledon palaeorhizae* n. sp. *Pacific Insects*, **10**: 271-273.
- SAMSINAK, K., 1957. *Acotyledon tetramorii* n.sp. Eine neue myrmecophile Tyroglyphidae (Acari). *Acta Soc. Ent. Cechosl.*, **54**: 396-399.
- SAMSINAK, K., 1966. Die Neuerrichtung der Gattung *Cosmoglyphus* Oudemans, 1932, gleichzeitigein Beitragzum Problem der "Copra Itch". *Zool. Anz.*, **176**: 27-42.
- SAMSINAK, K., 1968. A new acaridoid mite *Acotyledon palaeorhizae* n. sp. *Pacific Insects*, **10**: 271-273.
- SAMSINAK, K., 1980. *Caloglyphus rodriguezii* sp. n., with taxonomic remarks on the tribe *Caloglyphini* (Acari: Acaridae). *Mitt. Zool. Mus. Berlin.*, **56**: 201-206.
- SEVASTYANOV, V.D. AND RADY, G., 1991. New species of entomophilous mites family Acaridae (Sarcoptiformes) of Lower Egypt fauna. *Zool. Z.*, **70**: 133-139.
- SINHA, R.N. AND WALLACE, H.A.H., 1973. Population dynamics of stored-product mites. *Oecologia*, **12**: 315-327.
- WOMERSLEY, H., 1955. The acarine fauna of muttonbirds' nests on a Bass Strait island. *Aust. J. Zool.*, **3**: 412-38.
- ZAKHVATKIN, A.A., 1941. Fauna of USSR Arachnoidea VI (1) Tyroglyphoidea (Acari). *Zool. Inst. Acad. Sci. USSR, New Ser. No. 28*. English Translation 1959, Rateliffe, A., Hughes, A. M., Amer. Inst. Biol. Sci., 573 pp.

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