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, Kamokienis, 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

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 (st2) present ........................................ 2
   - Sternum 2 (st2) absent .................................. 16
2. Gnathosomal fused padipalpi notched .................. 3
   - Gnathosomal fused padipalpi notched ............. 10
3. Propodosomal shield dotted ................................ 4
   - Propodosomal shield smooth .......................... 5
4. Metasternal seta (mts) present ........................... 4
   - Metasternal seta (mts) absent ....................... 6
5. Apodeme 2 (ap2) meeting Apodeme 4 (ap4) ............ 6
   - Apodeme 2 (ap2) not meeting Apodeme 4 (ap4) .... 8
6. Metasternal seta (mts) present ............................. 8
   - Metasternal seta (mts) absent ........................ 13
7. Genu III with 1 seta only .......... lucarus Ashfaq and Sarwar
   - Genu III with 2 seta only ................................ 16
   - .......... pytho Ashfaq, Chaudhri and Parvez
8. Dorsum with 3 pairs of visible pores ...................... dolichos Ashfaq and Sarwar
   - Dorsum without 3 pairs of visible pores .......... 19
9. Suctorial shield pointed posteriorly ....................... 14
   - Suctorial shield rounded posteriorly .............. 23
   - .......... tarigi 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 (st2) free
    anteriorly; coxal fields III and IV open ............
    - .......... infaustus Ashfaq, Chaudhri and Parvez
    - Propodosomal shield smooth; sternum 2 (st2) meeting
      apodeme 4 (ap4); 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 ........................
    - .......... hiper Ashfaq, Chaudhri and Parvez
14. Seta ve present; tarsi III and IV each with 4 leaf-like setae
    - .......... stremma Ashfaq, Chaudhri and Parvez
15. Gnathosoma 2 segmented; sternum1 (st1) along with
    sharp tip .......... distantis Ashfaq, Chaudhri and Parvez
    - Gnathosoma 1 segmented; sternum1 (st1) short with blunt
      tip .......... bellatus Ashfaq and Sher
16. Gnathosomal fused padipalpi notched posteriorly; o8
    more than half the length of tarsi .......... haripuriensis Ashfaq, Sher, Chaudhri and Aslam
   - Gnathosomal fused padipalpi not notched posteriorly; o8
     less than half the length of tarsi .......... kamokinius 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 pedipalpi 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, d1, d2, d3, d4 on hysterosomal shield while seta hi, la, lp1, lp2, sai and sae located off the hysterosomal shield. Setae d1 15 (12-24), d2 15 (10-17), d3 12 (10-12), d4 15 (10-15), hi 12 (7-12), he 17 (17-24), la 10 (10-12), lp7 7 (7-15), lp2 10 (7-12), sae 15 (12), sai 32 (24-27) long; d1-d1 44 (37-54), d2-d2 154 (135-171), d3 - d3 49 (42-76), d4 - d4 69 (61-76), d1-d2 56 (49-59), d2-d1 66 (49-71) and d3 - d4 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 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

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**Fig. 1. Acotyledon kamokiensis** n.sp.; A, dorsal side; B, ventral side; C, gnathosomal pedipalpi with long arista; D, suctorial shield.
paragenital setae (pr) anterior to genital disc (gdi3) 12 (10-12) long. Coxal discs d11 and d12 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, Solenidon ω1 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, Chaudri 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, Chaudri 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 is 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. dt on dorsum is almost 1.5 X longer than dt. The st2 in this species is rod like anteriorly becoming bifid posteriorly and trochanters II and III without setae.
TWO NEW SPECIES OF GENUS ACOTYLEDON

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), dl-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 (apI) 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 (ap 4). 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 doted, genital slit elongated, I pair genital suckers, I pair paragenital setae (pR) anterior to genital disc (gdi3) 10 (10-11) long. Coxal discs dl1 and dl2 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).

Fig. 2. Acotyledon wazirabadensis n.sp; A, dorsal side; B, ventral side; C, gnathosomal pedipalpi with long arista; D, suctorial shield
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 α 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 lancet-like; 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 sectorial shield is without radial striations while in this new species sectorial 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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