

A DESCRIPTION OF TWO NEW SPECIES (HYPOPI) OF THE GENUS *ACOTYLEDON* (ACARIFORMES: ACARIDAE) FROM PAKISTAN

ОПИСАНИЕ ГИПОПУСОВ ДВУХ НОВЫХ ВИДОВ РОДА *ACOTYLEDON* (ACARIFORMES: ACARIDAE) ИЗ ПАКИСТАНА

M. Ashfaq*, M. Sarwar**, A. Parvez*

*Department of Agricultural Entomology, University of Agriculture, Faisalabad, Punjab, 38040 Pakistan

**Plant Protection Services, 26/E.B. Arifwala, Punjab, 57130 Pakistan

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ABSTRACT

Two new species of the genus *Acotyledon* (*A. privus* sp.n. and *A. embio* sp.n.) are collected and described by hypopi from Pakistan. A comprehensive identification key, illustrations of the body parts, phenograms of the similarity matrix of all species of *Acotyledon* known from Pakistan are presented. The data on the geographical distribution are also given.

РЕЗЮМЕ

По гипопусам описаны два новых вида рода *Acotyledon* (*A. privus* sp.n. и *A. embio* sp.n.), собранные в Пакистане. Приведен определительный ключ и фенограмма для всех видов этого рода фауны Пакистана. Приводятся данные по распространению видов.

INTRODUCTION

Mites of the family Acaridae are known worldwide as pests of stored commodities. They contaminate products and affect their nutritive qualities. Their role in the stored grain ecosystem may vary. The mites can be granivorous, herbivorous, fungivorous, scavengers, predators or parasites. Ashfaq and Wahla [1989] found that the positive correlation exists between the mite infestation level of the grains and the germeability. Ashiq [1991] reported that losses in respect of germination of wheat directly correlated to the mite population size.

The genus *Acotyledon* was erected by Oudemans [1903], with *A. paradoxa* as the type species. Zakhvatkin [1941] included 3 new species and 6 already known species in the genus. He provided a key and descriptions for all these species. Mahunka [1961, 1974, 1978] added of 3 new species to this list and redescribed 4 species. Samsinak [1966] added 1 new species in this genus. Ashfaq et al. [1986, 1990] described 10 more new species. Fain and Whitaker [1986] and Sevastyanov and Radi [1991] added 2 new species each, in this genus *Acotyledon*, respectively.

The authors of the present paper discovered 2 new species (hypopi) of this genus in different localities of Pakistan. The comparison of characters, a key, data matrix and ckdogram for these

species and all previously recorded species of this genus in the fauna of Pakistan are presented. All measurements are given in micrometers.

A key to species of the genus *Acotyledon* Oudemans of the fauna of Pakistan by hypopi

1. Gnathosoma notched posteriorly..... 5
Gnathosoma not notched posteriorly..... 2
2. Propodosomal shield smooth..... 3
Propodosomal shield not smooth..... 4
3. Body rounded.....
.....*A. tariqi* Ashfaq, Chaudhri and Sher
Body not rounded.....
.....*A. pytho* Ashfaq Chaudhri and Parvez
4. Sternum 2 (*st2*) and apodeme 5 (*ap5*) present.....
.....*A. peshawariensis* Ashfaq, Chaudhri and Parvez
Sternum 2 (*st2*) and apodeme 5 (*ap5*) absent.....
.....*A. embio*, n.sp.
5. Gnathosoma pear shaped..... 7
Gnathosomal not pear shaped..... 6
6. Propodosomal shield dotted; coxal fields III and IV open; sternum 2 (*st2*) free anteriorly.....
.....*A. infaustus* Ashfaq, Chaudhri and Parvez
Propodosomal shield smooth; coxal fields III and IV closed; sternum 2 (*st2*) meeting apodeme 4 (*ap4*).....
.....*A. thosmos* Ashfaq, Chaudhri and Parvez
7. Sternum 2 (*st2*) present..... 8
Sternum 2 (*st2*) absent.....
.....*A. haripuriensis* Ashfaq, Sher and Chaudhri
8. Coxal fields I-IV open..... 11
Coxal fields I-IV not open..... 9
9. Coxal fields III and IV open; suctorial shield without bifid seta posteriorly..... 10
Coxal fields III and IV closed; suctorial shield with a bifid seta posteriorly.....
.....*A. hypeir* Ashfaq, Chaudhri and Parvez
10. Sternum (*st2*) not meeting genital shield; suctorial shield rounded posteriorly; genu III with 1 seta.....
.....*A. privus*, n.sp.
Sternum 2 (*st2*) meeting genital shield; suctorial shield not rounded posteriorly; genu III with 2 setae.....
.....*A. ruditas* Ashfaq, Chaudhri and Parvez
11. Seta *ve* present; tarsi III and IV each with 4 leaf-like setae.....
.....*A. stremma* Ashfaq, Chaudhri and Parvez

Seta *ve* absent; tarsi III and IV each with 3 leaf-like setae..... *A. distantis* Ashfaq, Chaudhri and Parvez

Acotyledon embio, sp.n.

Figs. 1-3.

Hypopus dorsum. The length of the body 300, breadth 238. Propodosomal shield length 78, width 180, dotted, without rostral part; setae *vi* 57, *sci* 10, *sce* 13 and *scs* 20, seta *ve* absent; setae *sci* and *sce* positioned antieriad, forming semi-circular line; *sci-sci* 22, *sce-sce* 77 and *sci-sce* 27. Hysterosomal shield length 223, width 238, dotted; 12 pairs of setae and 3 pairs of visible pores present. Setal measuring: *d1* 9, *d2* 7, *d3* 7, *d4* 7 and *d5* 9; *hi* = *he* = 8; *la* 8, *lp1* = *lp2* 7; *sae* 6, *sai* 40; *d1-d1* 101, *d2-d2* 44, *d3-d3* 43, *d4-d4* 42, *d5-d5* 63, *la-la* 210; *d1-d2* 27, *d2-d3* 30, *d3-d4* 74, and *d4-d5* 64 apart. The anterior margin of hysterosomal shield overlapping the posterior margin of propodosomal shield upto 15, the overlapping area with transverse broken striations (Fig. 1).

Venter. Gnathosoma broad at base, dentate and bifid anteriorly, single segmented, 30 long, 1 pair arista, 33; 2 pairs of small setae (Fig. 3.1). Apodeme 1 (*ap1*) Y-shaped, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) 60 long, free, swollen posteriorly. Apodeme 2 (*ap2*) free and swollen posteriorly. Apodemes 3 (*ap3*) not meeting apodeme 4 (*ap4*) but meeting each other posteriorly, forming a slightly convex line medially. Apodemes 4 (*ap4*) meeting medially, forming an almost straight line. A thin line between apodeme 4 (*ap4*) and apodeme 3 (*ap3*) present. Apodeme 5 (*ap5*) absent.

Sternum 2 (*st2*) absent. Metasternal seta (*mts*) not visible, replaced by a minute pore. Coxal fields I, II and III open, dotted, coxal field IV absent. Area lateral to apodeme 3 (*ap3*) and apodeme 4 (*ap4*) dotted. Sternal shield separated from ventral shield by apodeme 4 (*ap4*) (Fig. 3.2). Ventral shield separated from genital shield. Genital shield as shown in Fig. 2, smooth, 1 pair of paragenital seta (*pr*) situated antero-medially to genital disc (*gdi3*). Genital slit longitudinal, enclosed in a ring, 2 pairs of genital suckers present. Coxal discs *di1* and *di2* present. Seta *hv* simple, 1 pair, 4 μ m long. Suctorial shield 46 μ m long, 49 μ m wide, dotted, anterior margin concave medially, rounded posteriorly, 1 pair anterior and 1 pair anal suckers, both with 2 dots, 2 pairs lateral suckers, upper pair being well-developed, 2 pairs posterior suckers, 1 pair peripheral suckers, lateral suckers situated at the level of anal suckers (Fig. 3.3).

Legs. All of one type, I-IV measuring 84, 79, 54, and 70, respectively (trochanter base to tarsus tip). Setae and solenidia on legs I-IV segments: coxae 0-0-0-0, trochanters 1-1-1-0, femora 1-1-0-0, genua 3-3-0-1, tibiae 3-3-2-2, tarsi 12-9-6-8. Tarsi I and II 26 and 25 long, respectively. Seta *vF* on femora I and II, 45 and 38, respectively, absent on femora III and IV. Seta *e* on tarsi I-IV 40, 22, 22 and 32, respectively. Seta *mG* on genua I and II each lanceolate; *hT* on tibiae I and

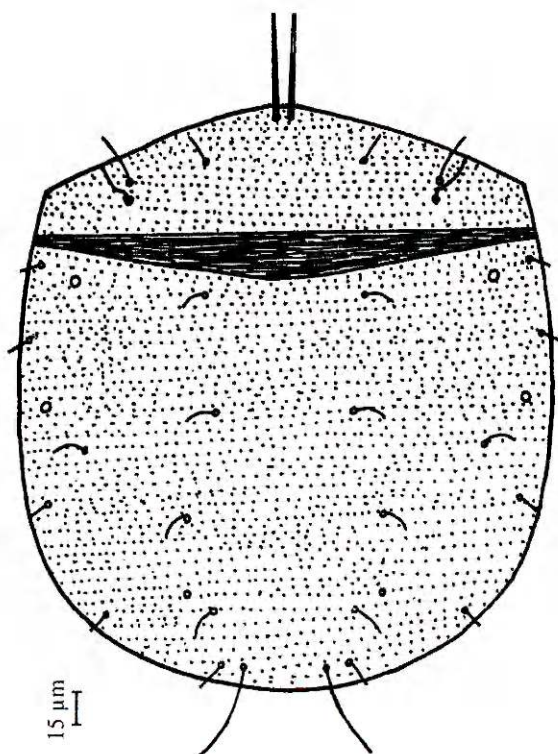


Fig. 1. *Acotyledon embio*, dorsal view.
Рис. 1. *Acotyledon embio*, дорсально.

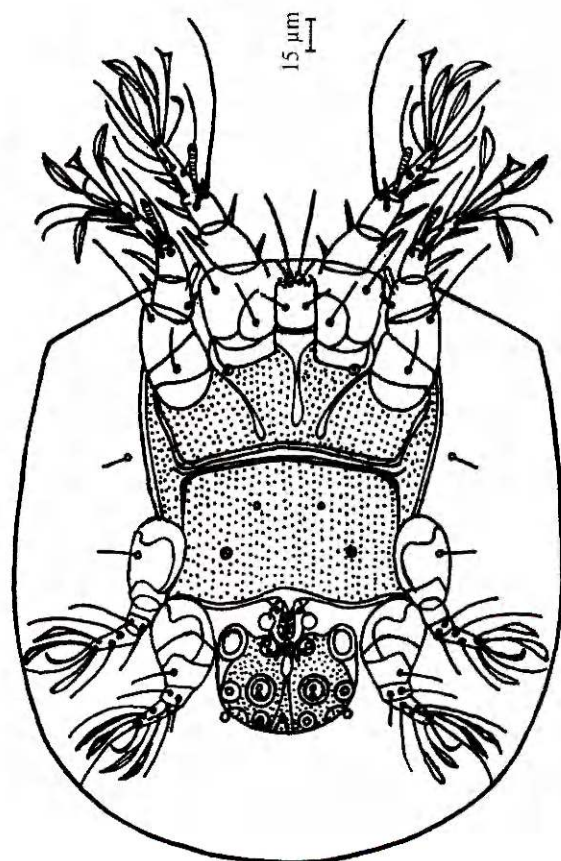


Fig. 2. *Acotyledon embio*, ventral view.
Рис. 2. *Acotyledon embio*, вентрально.

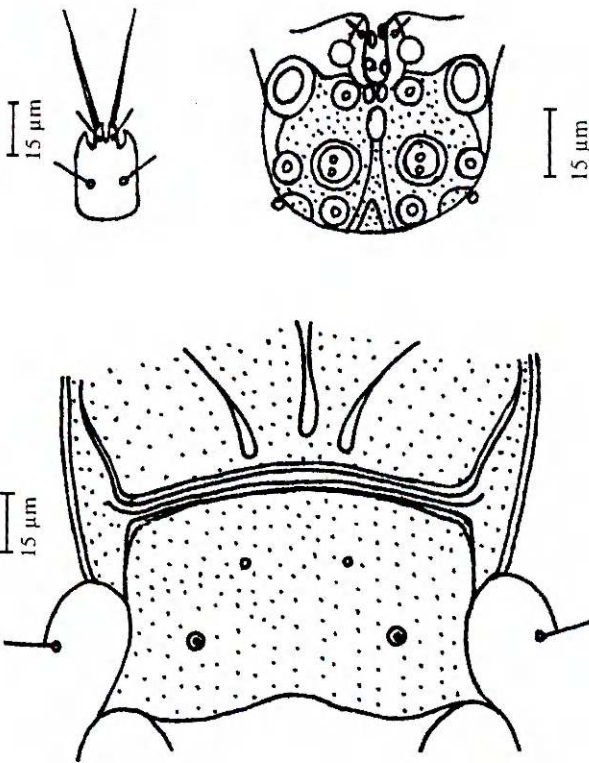


Fig. 3. *Acotyledon embio*, 1 – gnathosoma, 2 – ventral shields, 3 – suctorial shield.

Рис. 3. *Acotyledon embio*, 1 – гнатосома, 2 – вентральные щитки, 3 – присасывательный диск.

II each lanceolate, 12, 11, 21, and 17, respectively. Seta σ , on genua I and II, a spine 11, a solenidion 10, respectively. Dorsal seta ϕ on tibiae I and II 70 and 47, respectively. Tarsi I and II each bearing solenidion ω , 21 and 19, respectively. Seta *ba* on tarsus I 39. Tarsi I–IV provided with 3 leaf-like setae, 1 – spoon-shaped; 3 leaf-like + 1 spoon-shaped; 3 leaf-like; 4 leaf-like setae, respectively (Fig. 2).

Type material. Holotype (hypopus), collected from maize (*Zea mays* L.). Rawalpindi, 14.08.94 (Sarwar), and deposited in the collections of the Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad.

DIFFERENTIAL DIAFNOSIS

This new species shows highest similarity with *Acotyledon haripuriensis* Ashfaq, Sher and Chaudhri from which it can be differentiated on the basis of the following characters: 1. Gnathosoma notched posteriorly in *A.haripuriensis* but not notched in this new species. 2. Metasternal seta (*mts*) present in *A.haripuriensis* but absent in this new species. 3. Apodeme 5 (*ap5*) present in *A.haripuriensis* but absent in this new species. 4. A club-shaped seta present on tarsus II in *A.haripuriensis* but absent in this new species.

The new species is discernible from *A.tshernyshevi* Zachv. on account of the following characters: 1. Dorsum smooth in *A.tshernyshevi* but dotted in the new species. 2. Gnathosoma notched

posteriorly in *A.tshernyshevi* but not notched in this new species. 3. Metasternal seta (*mts*) present in *A.tshernyshevi* but absent in this new species. 4. Apodeme 5 (*ap5*) present in *A.tshernyshevi* but absent in this new species.

Acotyledon privus, sp.n.

Figs. 4–6.

Hypopus dorsum. The length of the body 253, breadth 218, divided into propodosomal and hysterosomal shields. Propodosomal shield length 45, width 178, dotted, provided with well defined rostrum antero-medially; setae *vi*, *ve*, *sci*, *sce*, and *scs* simple measuring 25, minute, 20, 22 and 25, respectively; *sci–sci* 5, *sce–sce* 86, and *sci–sce* 42; *sci* and *sce* forming semi-circular line (Fig.4). Hysterosomal shield 205, 218, dotted with longitudinal and zig-zag striations latero-posteriorly; 11 pairs setae and 3 pairs visible pores. Setae measuring: *d1* = *d2* = *d3* = *d4* = 19; *hi* = *he* = 15; *la* 15, *lp1* = *lp2* = 14; *sae* 13, *sai* 21; *d1–d1* 55, *d2–d2* 46; *d3–d3* 65, *d4–d4* 52; *d1–d2* 34, *d2–d3* 60, *d3–d4* 55 and *la–la* 101. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin upto 30, the overlapping area with dots (Fig.4).

Venter. Gnathosoma pear-shaped, broad and notched at base, length 25, arista 1 pair, each on anterior bifurcated part, 45; 2 pairs small setae (Fig.6.1). Apodeme 1 (*ap1*) Y-shaped, sclerotized piece, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) free, 56. Apodeme 2 (*ap2*) meeting apodeme 4 (*ap4*), bifid posteriorly. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*). Apodemes 4 (*ap4*) meeting medially. Apodeme 4 (*ap4*) and apodeme 3 (*ap3*) 6 and 4 broad, respectively. Sternum 2 (*st2*) bifid anteriorly, meeting apodeme 4 (*ap4*), sclerotized piece, 38, free, a thin membranous line continuing upto genital shield. Apodeme 5 (*ap5*) broad at base, pointed at anterior end but not meeting apodeme 4 (*ap4*) and sternum 2 (*st2*), metasternal seta (*mts*) present at tip. Coxal field II closed, dotted, I, III and IV open, dotted (Fig.6.2). Area lateral to apodeme 3 (*ap3*) and apodeme 4 (*ap4*) dotted. Seta *hv* 1 pair, 15. Genital shield as shown in Fig.5, dotted; genital slit elongated with 2 pairs genital suckers and 1 pair paragenital seta (*pr*) anterior to genital disc (*gdi3*). Coxal discs *di1* and *di2* present. Suctorial shield length 33, width 41, concave antero-medially, rounded posteriorly, dotted, anterior suckers 1 pair, anal suckers 1 pair, rounded with 2 dots, 2 pairs lateral and 2 pairs posterior suckers, lateral suckers at same level as anal suckers (Fig.6.3).

Legs. All of one type, I–IV measuring 95, 85, 70 and 75 in length, respectively (trochanter base to tarsus tip). Setae and solenidia on legs I–IV segments: coxae 0–0–0–0, trochanters 1–1–1–0, femora 1–1–0–0, genua 3–4–1–1, tibiae 3–3–1–1, tarsi 12–9–8–8. Tarsi I and II each 24. Seta *vF* on femora I and II 32 and 25, respectively, absent

on femora III and IV. Seta *e* on tarsi I–IV measuring 27, 14, 27, and 20, respectively. Seta *mG* on genua I and II each lancet-like; *hT* on tibiae I and II each lancet-like 26, 16, 28, and 25, respectively. Seta σ , a spine on genu I, a solenidion on genu II, 15 and 7, respectively. Tarsi I and II with a solenidion ω 1 20 and 17, respectively. Dorsal seta ϕ on tibiae I and II 5 and 38, respectively. Seta *ba* on tarsus I 33. Tarsi I–IV provided with 2 leaf-like + 1 spoon-shaped; 3 leaf-like + 1 spoon-shaped; 4 leaf-like + 1 lanceolate; 3 leaf-like + 1 lanceolate setae, respectively (Fig.5).

Type material. Holotype, hypopus, collected from maize (*Zea mays* L.), Abbottabad, 14.08.1994 (Sarwar) and deposited in the collections of the Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad.

DIFFERENTIAL DIAFNOSIS

This new species has clustering with *Acotyledon ruditas* Ashfaq, Chaudhri and Parvez but differs from the latter by the following features: 1. Seta *ve* absent in *A.ruditas* but present in this new species. 2. Sternum (*st2*) meeting genital shield in *A.ruditas* but not meeting in this new species. 3. Paragenital seta (*pr*) situated mesiad to genital disc (*gdi3*) in *A.ruditas* but anteriorad in this new species. 4. Suctorial shield narrows posteriorly in *A.ruditas* but broadly rounded in this new species. 5. Genu III

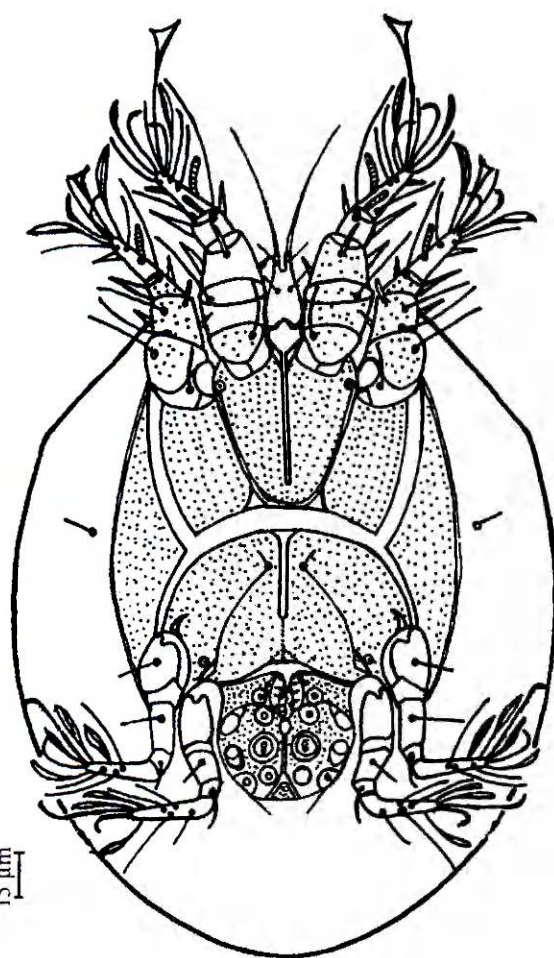


Fig. 5. *Acotyledon privus*, ventral view.

Рис. 5. *Acotyledon privus*, вентрально.

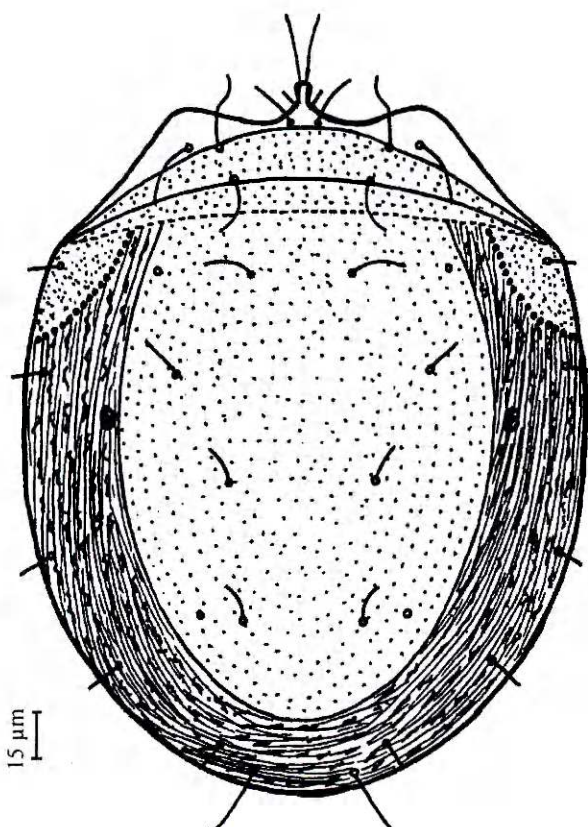


Fig. 4. *Acotyledon privus*, dorsal view.

Рис. 4. *Acotyledon privus*, дорсально.

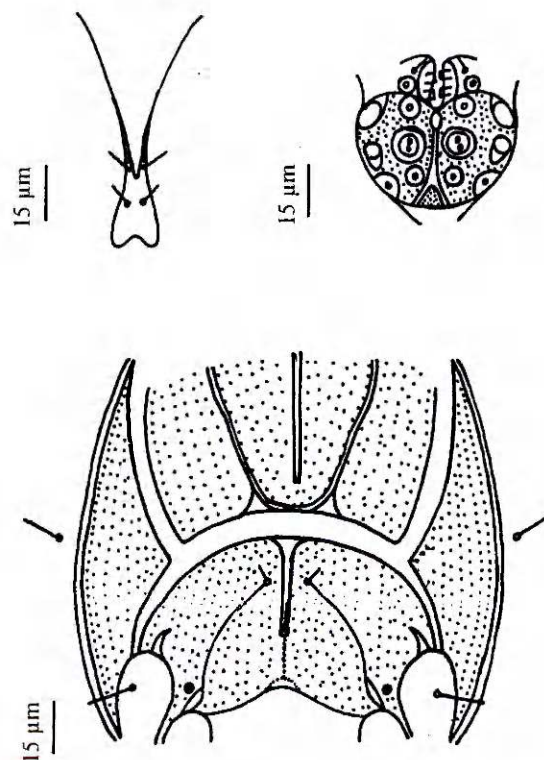


Fig. 6. *Acotyledon privus*, 1 – gnathosoma, 2 – ventral shields, 3 – suctorial shield.

Рис. 6. *Acotyledon privus*, 1 – гнатосома, 2 – вентральные щитки, 3 – присасывательный диск.

with 2 setae in *A.ruditas* but with 1 seta in this new species. 6. Tarsi III and IV with 3 and 4 leaf-like setae, respectively in *A.ruditas* but with 4 and 3 leaf-like setae, respectively in this new species.

This new species is very close to *Acotyledon peshawariensis* Ashfaq, Chaudhri and Parvez but both species can be differentiated on the basis of the following character states: 1. Seta *ve* absent in *A.peshawariensis* but present in this new species. 2. Gnathosoma not notched in *A.peshawariensis* but notched in this new species. 3. Sternum 2 (*st2*) not bifid anteriorly in *A.peshawariensis* but bifid in this new species. 4. Tarsus I with 3 leaf-like setae in *A.peshawariensis* but with 2 leaf-like setae in this new species. This new species shares many morphological characters with *Acotyledon volgini* Zakhvatkin but following character states differentiate the new species from the latter: 1. Body surface smooth in *A.volgini* but dotted in this new species. 2. Gnathosoma not notched in *A.volgini* but notched posteriorly in this new species. 3. Sternum 2 (*st2*) free anteriorly in *A.volgini* but meeting apodeme 4 (*ap4*) anteriorly in this new species. 4. Metasternal seta (*mts*) not prominent in *A.volgini* but prominent in this new species. 5. Tarsi I and IV with 4 and 5 leaf-like setae, respectively in *A.volgini* but 2 and 3 leaf-like setae, respectively, in this new species.

DISCUSSION

The genus *Acotyledon* has the world-wide distribution. It is also widely distributed in Pakistan, and until recently included 10 known species. 2 more new species were added to the list by the present authors. The phenogram (Fig.7) being a result of comparison of characters reflected in Table 1 and analysis of the similarity matrix (Table 2) shows the presence of some major clusters presenting different levels of linkage between species of the genus *Acotyledon*.

The first cluster depicts an affinity of 80% between *A.distantis* and *A.haripuriensis*. *A.embio* joins this pair at 74% similarity level. The former two species are restricted in their distribution by plains, and the latter is confined to submountainous areas. The species of this cluster are a characteristic of spatially limited microhabitats, yet the high level of affinity could be an attribute of the genetic phenomenon. This cluster is linked to the second cluster at 76% affinity level.

The second cluster shows the shared phenetic affinity of 80% between *A.peshawariensis* and *A.privus* linked in a pair-like format. First and second clusters are linked at 67% level of shared affinity. *A.infaustus* joins the union of first and second clusters at 56.8% level of shared affinity. In the second cluster, *A.peshawariensis* and *A.privus* are dwellers of hilly

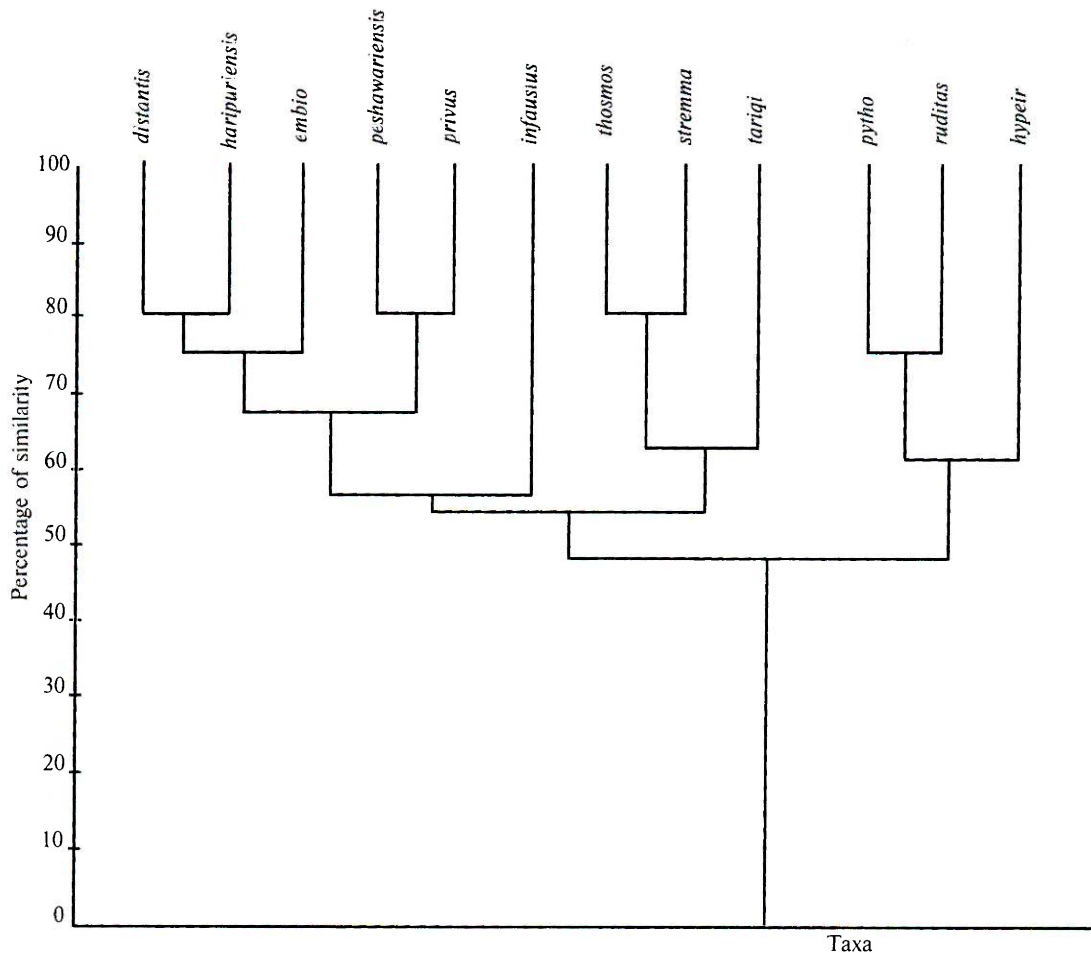


Fig.7. Phenogram of species of the genus *Acotyledon* Oudemans

Рис.7. Фенограмма пакистанских видов рода *Acotyledon* Oudemans

Table 1.
 Characters of Pakistan species of the genus *Acotyledon* Oudemans
 Таблица 1.
 Матрица признаков пакистанских видов рода *Acotyledon* Oudemans

Characters	1	2	3	4	5	6	7	8	9	10	11	12
1 Body almost rounded	-	+	-	-	-	-	-	+	-	-	+	-
2 Setae absent	+	-	+	-	+	+	+	+	-	+	+	+
3 Hysterosomal shield with 3 pairs visible pores	+	-	-	+	+	+	+	+	+	+	-	-
4 Seta <i>sae</i> longer than <i>sai</i>	-	-	-	-	+	-	-	-	-	-	-	-
5 Rostrum well defined	+	+	+	-	+	-	+	+	+	-	-	+
6 Gnathosoma notched posteriorly	+	+	+	+	-	+	-	+	+	-	-	+
7 Gnathosoma with 3 pairs small setae	-	+	-	-	-	-	-	-	-	-	-	-
8 Sternum 2 (<i>st2</i>) meeting apodeme 4 (<i>ap4</i>)	+	-	+	+	+	+	+	+	+	-	+	-
9 Sternum 2 (<i>st2</i>) bifid posteriorly	+	-	-	-	-	+	-	-	-	-	+	-
10 Sternum 2 (<i>st2</i>) meeting genital shield	+	+	-	+	-	+	-	+	-	-	-	-
11 Apodeme 2 (<i>ap2</i>) meeting apodeme 4 (<i>ap4</i>)	-	-	-	-	+	+	+	+	+	-	-	-
12 All coxal fields open	-	+	+	+	-	-	-	-	-	+	-	+
13 Coxal field II closed	-	-	-	-	+	+	+	+	+	-	-	-
14 A bifid setae near posterior margin of suctorial shield	-	-	-	-	-	+	-	-	-	-	-	-
15 Suctorial shield broadly rounded posteriorly	+	+	+	+	-	+	+	-	+	+	+	+
16 Suctorial shield lateral suckers anterior to anal suckers	-	-	-	-	-	+	-	-	-	-	-	-
17 Genital slit enclosed in aring	+	-	-	+	+	+	-	+	+	+	-	+
18 Paragenital seta (<i>pr</i>) anterior to genital disc (<i>gd3</i>)	+	+	-	+	-	-	+	-	+	-	+	+
19 Metasternal seta (<i>mts</i>) prominent	-	+	+	-	+	+	+	+	+	-	-	+
20 Genu III with 2 setae	-	-	+	+	+	+	-	+	-	-	+	-
21 Tarsus I with 12 setae	-	+	+	-	+	+	+	-	+	+	+	+
22 Tarsus II with club-shaped seta	-	+	-	-	-	-	-	-	-	-	-	+
23 Tarsus III with 3 leaf-like setae	-	-	+	-	-	+	+	+	-	+	-	+
24 Tarsus III with 8 setae	+	-	-	+	+	-	-	+	+	-	+	-
25 Tarsus IV with 4 leaf-like setae	+	+	-	+	+	-	-	+	-	+	-	-

areas, and *A. infaustus* is limited in its distribution by the plains of Pakistan. The affinity between these species can be high because of sharing the common genetic characters, especially taking into account the fact that the species occupy different ecological zones.

The third cluster is a combination of three species in which the phenetic affinity of 80% revealed between *A. thosmos* — *A. stemma* pair, both from discrete localities of plains and coastal areas. *A. tariqi* is linked to this pair at 62% affinity, being

restricted in its distribution to coastal areas. This infers that the similarity once again could be an attribute of genetics. The third cluster is bridged to the first and second clusters at 56.44% level of shared affinity.

The cluster IV is joined to clusters I to III at 51.17% level of shared affinity. The fourth cluster shows the shared phenetic affinity of 76% between the species *A. pytho* and *A. ruditus*, the species *A. hyper* joins this pair at 60% affinity level. In this cluster

Table 2.
Matrix showing percentage of similarity in Pakistan species of the genus *Acotyledon* Oudemans
Таблица 2.
Матрица процентного сходства пакистанских видов рода *Acotyledon* Oudemans

	1	2	3	4	5	6	7	8	9	10	11	12
1 <i>thosmos</i>	XX											
2 <i>infaustus</i>	52	XX										
3 <i>distantis</i>	52	60	XX									
4 <i>stremma</i>	80	56	56	XX								
5 <i>pytho</i>	56	32	56	52	XX							
6 <i>hypeir</i>	52	28	60	48	56	XX						
7 <i>peshawariensis</i>	56	48	72	44	68	64	XX					
8 <i>ruditas</i>	64	40	56	60	76	64	60	XX				
9 <i>privus</i>	68	52	60	64	72	60	80	64	XX			
10 <i>embio</i>	60	52	68	64	56	52	64	48	52	XX		
11 <i>tariqi</i>	64	48	64	60	52	48	60	44	56	56	XX	
12 <i>hariपुरiensis</i>	56	72	80	52	44	48	68	44	64	72	56	XX

A.pytho and *A.ruditas* are inhabitants of coastal areas and plains, whilst *A.hypeir* restricted in its distribution to the plains of Pakistan. Since these species are dwellers of different ecological zones, the affinity among them may be a result of sharing the common genetic characters rather than ecological relatedness. The data on the distribution of these species also help to ascertain that such species as *A.pytho* and *A.ruditas*, both possessing similar morphologies and occupying similar and variable habitats, have the relatively high genetic plasticity. So, the characters used for the differentiation of species within the genus appear to be of consistent occurrence.

It is interesting to note that the high affinity between the species from different ecological zones does not reflect the ecological characteristics of their habitats, and consequently is an attribute of the common generic characters. Therefore, it is possible to say that the relationships between these species do not necessarily imply the similar ecological conditions of their habitats. The ability of few species which were collected from more than one locality and yet sharing numerous characters, reflects the occurrence of stable generic characters at this level and their adaptive amplitude to varying ecological zones. Hence, it can be presumed that they have a wide range of genetic plasticity.

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