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Numerical Taxonomy of Two New Mite Species of the Genus *Caloglyphus* Berlese (Acaridae) from Pakistan

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Abstract. During the mite sampling of the genus *Caloglyphus*, the taxonomical analysis of diagnostic features of the hypopial stage confirmed two new taxa named as *C. agrios* and *C. hadros*. When compared with the already known worldwide species within this genus, these species showed sufficient dissimilarity to be classified as separate taxa. The characteristic features differentiating these new species from the other *Caloglyphus* species are the shapes of gnathosoma, propodosoma, hysterosoma, apodemes, coxal fields, suctorial shield, and chaetotaxy and solenidiotaxy of legs. The present study reports the historical review of the genus, completed with the information on already known species, their description, illustration of main characters, geographical distribution, host range, remarks on the new species, matrixes showing comparisons, and the percentage of similarity along with a key for their identification based on hypopial characters for the species known from Pakistan.

Keywords: new mite species, *Caloglyphus*, mite taxonomy, *Caloglyphus agrios*, *Caloglyphus hadros*, Acaridae, hypopus

Introduction

Mites are the widely distributed tiny arthropods, that can be found in granaries, threshing floors, stacks of hay and straw, dead organic matter, soil, and plant residues. Family Acaridae contains some damage-causing mite species, which are commonly encountered in granaries. The mite-attacked grains lose nutrients and the ability to germinate, due to the mite-feeding on the germ. Crushed bodies of the storage mites cause colouration in flour that reduces the product value. Under normal conditions, these mites develop according to the following pattern: egg, larva, nymph-I, nymph-II, and adult. Some species may produce hypopus under unfavourable conditions. Hypopus is a diapause form that can be carried by rodents or insects to other storing places. This stage offers maximum conservation attributes and provides stable taxonomic characters. Therefore, taxonomy of the stored commodity mites is largely based on the characters of this stage.

The genus *Caloglyphus* has been recorded from many countries of the world and is a key pest among the mite fauna in some of these areas. The present bibliography attempts to compile the world literature on *Caloglyphus,* which is likely to prove a useful tool to researchers involved in all aspects of managing this serious pest. Berlese (1923) first described the genus *Caloglyphus,* designating *Caloglyphus berlesei* Michael, 1903, as its type species. Some species of the genus *Caloglyphus* have been reported from several regions of the world. Zakhvatkin (1941) made a comprehensive review of this genus: described four new species, and redescribed six species with improved descriptions. Nesbitt (1949; 1944), and Samsinak (1966), respectively, added four and one new species to this genus. Mahunka (1979; 1978; 1974; 1973) described five new species. Hughes (1976) made a good addition to the knowledge of this genus. Tseng and Hsieh (1976) redescribed one species with improved description. Samsinak (1980) revised the tribe *Caloglyphini*, reestablished the genus *Caloglyphus* and described one new species. Channabasavanna *et al*. (1981), Rao *et al*. (1982), and Ashfaq and Chaudhri (1983), respectively, added one, one, and four new species. Samsinak (1988) mentioned one new species to the tribe *Caloglyphini*. Zou and Wang (1989), Sevastyanov and Radi (1991), Sher *et al*. (1991), Klimov (1996), and Eraky (1999) added one, three, two, one, and one new species, respectively. Klimov (2000) analyzed acarid mites of the tribe *Caloglyphini* with the narrative of a fresh species. Klimov and Oconnor (2003) published phylogeny, historical ecology and systematics of various mites, together with full descriptions of each taxon, keys and natal informations. Sarwar and Ashfaq (2004) identified and described two new species from Pakistan.

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Materials and Methods

For conducting the present study, representative localities in various ecological zones of Pakistan were surveyed to explore new taxa and distribution range of mites of the genus *Caloglyphus*. All the collected samples of different stored commodities were brought to the laboratory to process them further by employing Berlese's Funnel Method (Berlese, 1923).

Standard and improved techniques were tested and utilized for collection, sorting, storing, mounting and describing the taxa. All the drawings were made on graph paper using an ocular grid. Measurements of body length, width and other body parts were made with the help of an ocular micrometer.

The abbreviations used in figures are: dorsocentral seta 1, 2, 3, 4 (*d1, d2, d3, d4*), internal vertical seta (*vi*), external vertical seta (*ve*), internal scapular seta (*sci*), external scapular seta (*sce*), subscapular seta (*scs*), internal humeral seta (*hi*), external humeral seta (*he*), anterior lateral seta (*la*), posterior lateral seta, 1, 2 (*lp1*, *lp2*), external sacral seta (*sae*), internal sacral seta (*sai*), apodeme 1, 2, 3, 4 (*ap1*, *ap2*, *ap3*, *ap4*), metasternal seta (*mts*), sternum 1, 2 (*st1*, *st2*), ventral humeral seta (*hv*), genital disc 1, 2, 3 (*gdi1*, *gdi2*, *gdi3*), genital seta (*pr*), coxal disc I, II (*di1*, *di2*), seta on femur (*vF*), seta on tarsus (*e*), solenidion on tarsus (*w1*), seta on genu (ó), setae on tibia (*hT*), and milimicron (mμ).

The similarity between species based the presence or absence of 25 characters quoted from the entire body was expressed (Table 1). A complete comparison of the presently reported new species (including differences and similarities), with eight other species of the genus was also furnished (Table 2). Numerical classification was performed using resemblance function and average linkage clustering strategy by following the techniques devised by Sokal and Sneath (1963) and phenetic relationships with the species already reported in the literature were examined to help build a background for the genus *Caloglyphus*.

Results and Discussion

1. *Caloglyphus agrios*, new species, hypopus (Fig. 1): description

Dorsum. Body 300 mμ long, 243 mμ wide, divided into propodosomal and hysterosomal shields. Propodosomal shield with rostral projection antero-medially, 90 mμ long, 215 mμ wide, dotted medially, broken striations antero-laterally; setae *vi*, *ve*, *sci*, *sce* and *scs* each 1 pair, simple, *scs* broad medially, setae respectively measuring 25 mμ, minute (very small), 6 mμ, 18 mμ and 25 mμ in length; *sci-sci* 36 mμ, *sce-sce* 85 mμ and *sci-sce* 25 mμ apart; setae *sci* and *sce* forming semi-circular line. Hysterosomal shield 233 mμ long, 243 mμ wide, smooth medially, lateral margins of hysterosomal shield turn towards venter, encircled by transverse, broken striations anteriorly, longitudinal, broken striations latero-posteriorly, a row of transverse striations latero-posteriorly. Hysterosomal shield with 11 pairs of setae, simple, 3 pairs of visible pores. Setae *d1 = d2 = d3 = d4* = 8 mμ; *hi* 5 mμ, *he* 6 mμ; *la* 6 mμ; *lp1 = lp2* = 5 mμ; *sae* 25 mμ; *sai* 8 mμ long; *d1-d1* 72 mμ, *d2 - d2* 55 mμ, *d3 - d3* 66 mμ, *d4 - d4* 68 mμ; *d1 - d2* 37 mμ, *d2 - d3* 68 mμ, *d3 - d4* 53 mμ, and *la - la* 155 mμ apart. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin by 23 mμ with transverse, broken striations (Fig. 1a).

Venter. Gnathosoma fused pedipalpi, 2-segmented, with parallel lateral margins, straight at base, 32 mμ long (basal segment 21 mμ, distal segment 11 mμ), arista 1 pair, 35 mμ long, bifurcated anteriorly, 2 pairs of small setae. Apodeme 1 (*ap1*) Y-shaped, continuing with sternum 1 (*st1*). Sternum 1 (*st1*) free, 41 mμ long; apodeme 2 (*ap2*) free; apodeme 3 (*ap3*) free; apodeme 4 (*ap4*) not meeting medially, making broad rounded tip. Sternum 2 (*st2*) double-lined, 24 mμ long, meeting apodeme 4 (*ap4*) and apodeme 5 (*ap5*). Metasternal seta (*mts*) 1 pair, simple, 7 mμ long, each seta in encircled area of apodeme 4 (*ap4*) and apodeme 5 (*ap5*). Seta *hv* 1 pair, 10 mμ long. Coxal fields I and II open, III and IV closed. Ventral shield separated from genital shield. Genital shield dotted, genital slit elongated with 2 pairs of genital suckers and a pair of genital seta (*pr*) messed to genital disc (*gdi3*). Coxal discs (*di1* and *di2*) present, conoids. Genital disc (*gdi3*) kidney-shaped, without radial striations. Suctorial shield 66 mμ long, 78 mμ wide, dotted, concave antero-medially, rounded posteriorly; posteriorly and laterally with broad sclerotized piece with bifurcated, pointed ends; anterior suckers 1 pair, rounded with radial striations. Anal suckers 1 pair, rounded, anal suckers equal to anterior suckers. One pair of lateral and 1 pair of posterior suckers,

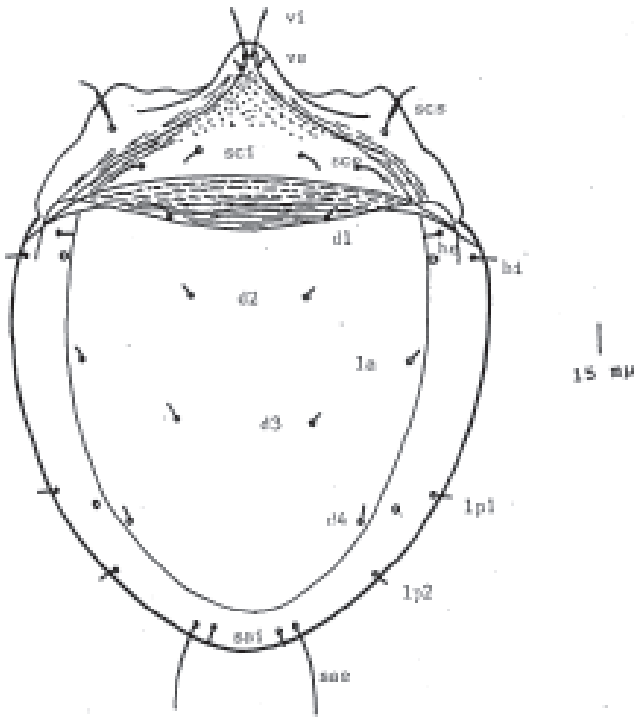

Fig. 1a. Dorsal side of *Caloglyphus agrios*, hypopus, new species.

cooids; 1 pair of clear areas and 1 pair of dotted areas, representing the vestigial suckers towards periphery, 1 pair of suckers below the suctorial shield. Suctorial shield separated towards periphery, 1 pair of suckers below the suctorial shield. Suctorial shield separated from posterior body end by 27 mμ, a distance smaller than suctorial shield length (Fig. 1b).

Legs. Strong and stout, I-IV, respectively, measuring 125 mμ, 110 mμ, 93 mμ, and 93 mμ in length (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 12-9-7-7. Tarsi I and II, 46 mμ and 36 mμ long, respectively. Seta *vF* on femora I and II, 37 mμ and 54 mμ long, respectively, absent on femora III and IV. Seta *e* on tarsi I-IV, measuring 28 mμ, 19 mμ, 18 mμ and 18 mμ in length, respectively. Seta *mG* on genua I and II; *hT* on tibiae I and II, each lancet-like, measuring 14 mμ, 10 mμ, 28 mμ and 12 mμ in length, respectively. Seta ó on genu I, a simple seta, on genu II, a solenidion, 30 mμ and 17 mμ long, respectively. Tarsi I and II, each with a solenidion, *w1* 26 mμ and 28 mμ long, respectively. Tarsi I and II 46 mμ and 36 mμ long, respectively, while III and IV short and stout. Dorsal seta ö on tibiae I and II, 68 mμ and 41 mμ long, respectively. Seta *ba* 25 mμ long. Tarsi I-IV provided with setae: 5 leaf-like + 1 spoon-shaped; 4 leaf-like + 1 spoon-shaped; 3 leaf-like + 1 club-shaped; 3 leaf-like + 1 club-shaped, respectively. Seta *d* on leg IV, tarsus 66 mμ long (Fig. 1b).

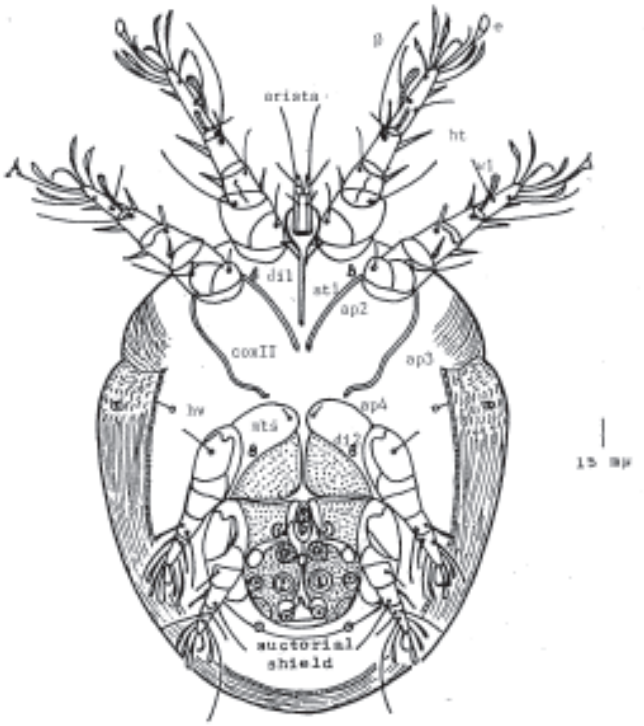

Fig. 1b. Ventral side of *Caloglyphus agrios*, hypopus, new species.

Material examined. Holotype, hypopus, type material was collected from Jhelum, Pakistan, from groundnut (*Arachis hypogea* L.) on 19.9.1994 (Sarwar) and deposited in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan.

Comparative notes. After going through the key, and keeping in view the other species described so far, this new species was found to be closely related to *C. trigonellum* Sher, Ashfaq and Parvez, however, the following characters separated the two.

a. Hysterosomal shield dotted in *C. trigonellum,* but smooth in the new species (*C. agrios*).
b. Gnathosoma not parallels laterally in *C. trigonellum,* but parallel in the new species.
c. Sternum 1 (*st1*) bifid posteriorly in *C. trigonellum,* but not bifid in the new species.
d. Apodemes 4 (*ap4*) meeting medially in *C. trigonellum,* but not meeting in the new species.
e. Paragenital seta (*pr*) antero-medial to genital disc (*gdi3*) in *C. trigonellum,* but messed in the new species.

This new species is also comparable with *C. tshernyshevi* Zakhvatkin on the basis of the following points.

a. Basal joint of gnathosoma twice as long as wide in *C. tshernyshevi,* but not so in the new species (*C. agrios*).
b. Propodosomal shield 4-times shorter than hysterosomal shield in *C. tshernyshevi,* but 3-times shorter in the new species.
c. Leg I tarsus with 4 leaf-like setae in *C. tshernyshevi,* but with 5 leaf-like setae in the new species.
d. The coxal, genital, posterior and lateral suckers are less fleshy in *C. tshemyshevi,* but not so in the new species.
e. The external seta of genu I is thin and hair-like in *C. tshernyshevi,* but not so in the new species.

2. *Caloglyphus hadros*, new species, hypopus (Fig. 2): description

Dorsum. Body 283 mμ long, 218 mμ wide, divided into propodosomal and hysterosomal shields. Propodosomal shield with rostral projection antero-medially, 78 mμ long, 196 mμ wide, antero-lateral parts with broken striations, dotted medially; setae *vi*, *ve*, *sci*, *sce* and *scs*, each 1 pair, simple, measuring 21 mμ, 6 mμ, 10 mμ, 19 mμ and 28 mμ in length, respectively; *sci-sci* 33 mμ, *sce-sce* 85 mμ and *sci-sce* 25 mμ apart; setae *sci* and *sce* forming a semi-circular line. Hysterosomal shield 228 mμ long, 218 mμ wide, smooth, dotted and striated antero-laterally, a row of minute striations latero-posteriorly. Hysterosomal shield lateral margins turn towards the venter. Hysterosomal shield with 11 pairs of setae, simple, 3 pairs of visible pores. Setae *d1* = *d2* = *d3* = *d4* = 4 mμ; *hi* 7 mμ,

he 6 mμ; *la* 5 mμ, *lp1* = *lp2* = 8 mμ; *sae* 32 mμ, *sai* 10 mμ long; *d1-d1* 66 mμ, *d2 - d2* 45 mμ, *d3 - d3* 62 mμ, *d4 - d4* 58 mμ; *d1 - d2* 34 mμ, *d2 - d3* 63 mμ, *d3 - d4* 55 mμ, and *la - la* 138 mμ apart. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin by 23 mμ, with transverse, broken straitions and dots (Fig. 2a).

Venter. Gnathosoma fused pedipalpi, parallel lateral margins, broad and notched posteriorly, bifurcated anteriorly, 2-segmented, 29 mμ long (basal part 17 mμ, distal part 12 mμ), 1 pair of arista, 33 mμ long, 2 paris of small setae. Apodeme 1 (*ap1*) Y-shaped, continuing with sternum 1 (*st1*), sclerotized. Sternum 1 (*st1*) free, 43 mμ long. Apodeme 2 (*ap2*) free, curved at tip. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*). Apodemes 4 (*ap4*) not meeting medially. Apodeme 5 (*ap5*) and apodeme 4 (*ap4*) meeting anteriorly making broad, rounded tip, not meeting with the same structure from other side. Sternum 2 (*st2*) double-lined, 35 mμ long. Metasternal seta (*mts*) 1 pair, 6 mμ long, each seta in encircled area of apodeme 4 (*ap4*) and apodeme 5 (*ap5*). Seta *hv* 8 mμ long, 1 pair. Coxal fields I and II open, III and IV closed; I, II and III smooth, IV dotted. Ventral shield separated from genital shield. Genital shield, as shown in Fig. 2b, dotted, genital slit elongated with 2 pairs of genital suckers and 1 pair of paragenital seta (*pr*), messed to genital disc (*gdi3*). Coxal discs *di1* and *di2* present; *di1* and *di2* conoids. Genital disc (*gdi3*) kidney-shaped. Suctorial shield 60 mμ long, 70 mμ wide, dotted, anterior margin concave medially, rounded posteriorly, a sclerotized pointed bifurcated piece arising from latero-posterior margin on either side. Anterior suckers 1 pair, rounded; anal suckers 1 pair, rounded without radial striations, 2 dots in between; anal suckers equal to anterior suckers, 1 pair lateral and 1 pair of posterior conoids; 2 pairs of peripheral suckers; 1 pair of suckers below suctorial shield. Suctorial shield separated from posterior end of the body by 30 mμ, a distance smaller than suctorial shield length (Fig. 2b).

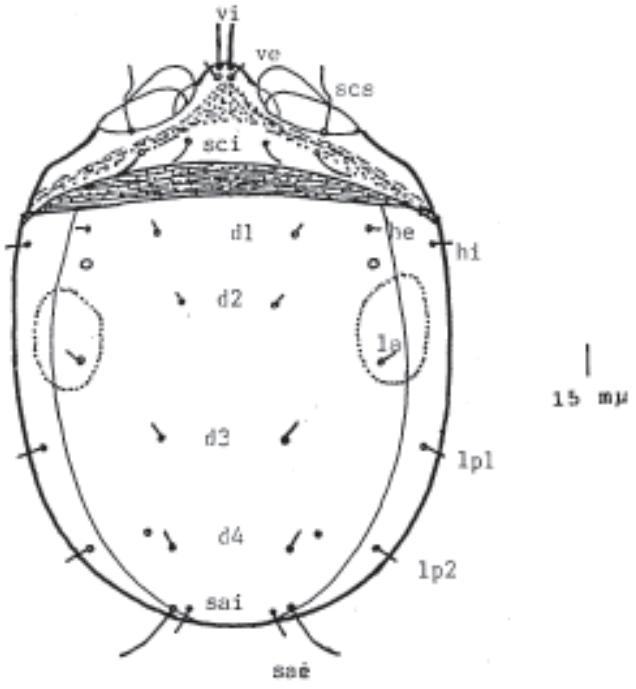

Fig. 2a. Dorsal side of *Caloglyphus hadros*, hypopus, new species.

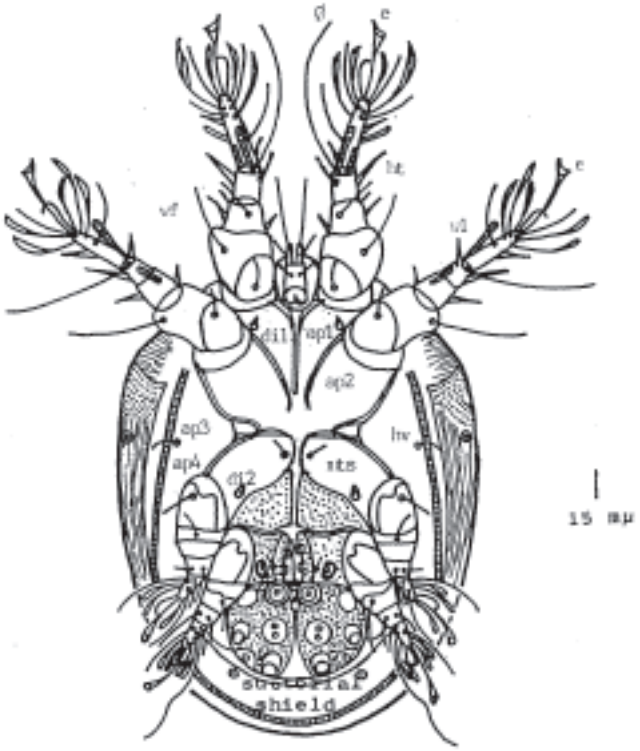

Fig. 2b. Ventral side of *Caloglyphus hadros*, hypopus, new species.

Legs. Strong and stout, I-IV measuring 118 mμ, 105 mμ, 80 mμ and 80 mμ 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 1-1-1-0, genua 4-3-0-1, tibiae 3-3-2-2, tarsi 14-10-7-8. Tarsi I and II 45 mμ and 35 mμ long, respectively. Seta *vF* of femora I, II and III 32 mμ, 40 mμ and 25 mμ long, respectively, absent on femur IV. Seta *e* on tarsi I-IV measuring 25 mμ, 20 mμ, 15 mμ, and 15 mμ in length, respectively. Seta *mG* on genua I and II spine-like; *hT* on tibiae I and II, each lancet-like, 12 mμ, 10 mμ, 17 mμ and 14 mμ long, respectively. Seta ó on genu I, a simple seta, 29 mμ long, on genu II 14 mμ long, a solenidion. Tarsi I and II, each with a solenidion *w1* 25 mμ and 27 mμ long, respectively. Tarsi III and IV short and stout. Seta ö on tibiae I and II 70 mμ and 38 mμ long, respectively. Seta *ba,* on tarsus, I 26 mμ long. Tarsi I-IV provided with setae: 1 spoon-shaped + 4 leaf-like; 1 spoon-shaped + 5 leaf-like; 1 spoon-shaped + 3 leaf-like; 1 spoon-

shaped + 4 leaf-like; 1 spoon-shaped + 5 leaf-like; 1 spoon-shaped + 3 leaf-like; 1 spoon-shaped + 4 leaf-like, respectively. Seta *d* on leg IV, tarsus 50 mμ long (Fig. 2b).

Material examined. Holotype, hypopus, type material was collected from Mirpur, Azad Jamu and Kashmir (Pakistan), from gram (*Cicer arientinum* L.) on 15.10.1994 (Sarwar) and deposited in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad, Pakistan.

Comparative notes. The following points differentiate this new species from *C. agrios*, another new species described above.

a. Gnathosoma not notched in *C. agrios,* but notched posteriorly in this new species (*C. hadros*).
b. Apodeme 3 (*ap3*) not meeting apodeme 4 (*ap4*) in *C. agrios,* but meeting in this new species.
c. Tarsi I-IV with 5-4-3-3 leaf-like setae, respectively, in *C. agrios,* but with 4-5-3-4 leaf-like setae, respectively, in this new species.
d. Seta *vF* on femur III absent in *C. agrios,* but present in this new species.

In its characteristics, this new species is also nearer to *C. merisma* Ashfaq and Chaudhri, but the following characters differ in the two species.

a. Setae *sci* and *sce* of equal size in *C. merisma,* but not equal in the new species (*C. hadros*).
b. Coxal field III open in *C. merisma,* but closed in the new species.
c. Apodemes 4 (*ap4*) meeting medially in *C. merisma,* but not meeting in the new species.
d. Genital disc (*dgi3*) simple in *C. merisma,* but kidney-shaped in the new species.
e. Suctorial shield anal suckers not equal to anterior suckers in *C. merisma,* but equal in size in the new species.
f. Seta *e* on tarsi III and IV lancet-like in *C. merisma,* but spoon-shaped in the new species.

Key to Pakistan species of the genus *Caloglyphus* (Hypopodes)

1. Sternum 2 (*st2*) present 2
   Sternum 2 (*st2*) absent 8
2. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*) 6
   Apodeme 3 (*ap3*) not meeting apodeme 4 (*ap4*) 3
3. Palposoma lateral, margins parallel 4
   Palposoma lateral, margins not parallel 5
4. Sternum 1 (*st1*) bifid posteriorly;
   paragenital seta (*pr*) bifid
   C. multaniensis Ashfaq and Chaudhri
   Sternum 1 (*st1*) not bifid posteriorly;
   paragenital seta (*pr*) not bifid
   C. agrios nov. sp.
5. Setae *sci* and *sce* forming straight line;
   coxal discs (*di1*, *di2*) not conoids
   C. opacatus Ashfaq and Chaudhri
   Setae *sci* and *sce* not forming straight line;
   coxal discs (*di1*, *di2*) conoids
   C. trigonellum Sher, Ashfaq and Parvez
6. Gnathosoma notched posteriorly 7
   Gnathosoma not notched posteriorly
   C. faisalabadiensis Sher, Ashfaq and Parvez
7. Setae *sci* and *sce* of equal size;
   apodemes 4 (*ap4*) meeting medially
   C. merisma Ashfaq and Chaudhri
   Setae *sci* and *sce* not of equal size;
   apodemes 4 (*ap4*) not meeting medially
   C. hadros nov. sp.
8. Palposoma extended beyond the body;
   apodemes 4 (*ap4*), meeting medially
   C. morosus Ashfaq and Chaudhri
   Palposoma not extended beyond the body;
   apodemes 4 (*ap4*), not meeting medially 9
9. Coxal field III open;
   genital disc (*dgi3*) and suctorial shield with radial striations
   C. clemens Sarwar and Ashfaq
   Coxal field III closed;
   genital disc; (*dgi3*) and suctorial shield without radial striations
   C. cingentis Sarwar and Ashfaq

Surveys of the genus *Caloglyphus* undertaken previously in Pakistan represented 8 species. Currently, two new species have been collected and described. The new species herein reported are ninth and tenth of this genus reported from Pakistan and Azad Kashmir. A comparison of characters of the ten species is presented in Table 1, and the matrix of the percentage of similarities between these species is shown in Table 2. The phenogram (Fig. 3) identifies two subdivisions having sister groups, showing different relationships at different levels of linkages with one another. A brief discussion pertaining to the 10 species reported from Pakistan follows below.

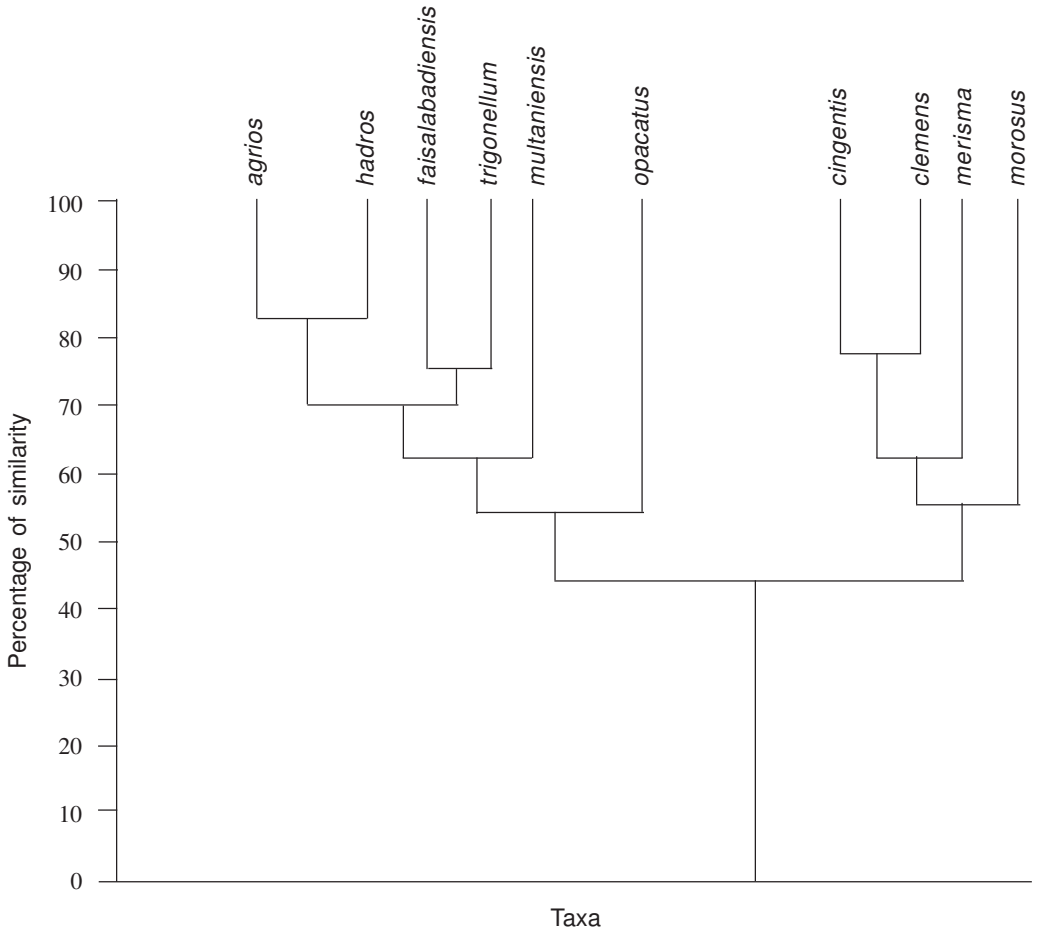

Fig. 3. Phenogram of species of the mite genus *Caloglyphus* Berlese (Acaridae).

The present expression, in the first cluster, shows the highest shared phenetic affinity of 92% between the new species *agrios* and *hadros*, which are linked in a pair-like format. Both the species have been collected from adjoining sub-mountaineous areas of similar ecological habitats. The second pair in this cluster depicts an affinity of 80% between the species *faisalabadiensis* and *trigonellum*, as these two species are common to the same habitat, having identical hosts. The affinity of these species could thus be attributed to be due to the same ecological zones that they occupy. These two pairs are linked to each other at 76% level of the phenetic affinity. The species *multaniensis* and *opacatus* show an affinity of 68% and 60.5%, respectively, with the groups of *agrios-hadros*, and *faisalabadiensis-trigonellum* species, thus completing the cluster. Since these species are associated with diverse ecological zones, their affinity among themselves may be due to the sharing of common genetic characters, rather than ecological relatedness. So, the characters used for the separation of species within the genus appear to be of consistent occurrence.

The second cluster is a combination of four species in which the phenetic affinity of 88% is clearly evident between the *cingentis-clemens* pair, which are the dwellers of varied ecological areas. To this pair, species *merisma* and *morosus* join at 66% and 59% levels of phenetic affinities, respectively. All the species of this second cluster, though the dwellers of discrete localities, show affinity among themselves and their affinity may be due to the consistent characters and instincts which embody the genus. This infers that similarity could be an attribute of genetics. This second cluster is bridged to the first cluster at 59% level of shared affinity, thus forming one of the largest phenogram in the present study from heterogeneous habitats.

Conclusion

The specimens accommodated in the genus *Caloglyphus* have a wide range of distribution in Pakistan, as they have been collected from discrete and diverse ecological habitats. This indicates that the species have an ability to adapt to diverse ecological habitats, and can thus be presumed to have a wider

Table 1. Comparison of characters among the species of the mite genus *Caloglyphus* Berlese (Acaridae)

Characters	*multani-ensis*	*opacatus*	*merisma*	*morosus*	*faisalaba-diensis*	*trigonel-lum*	*cingentis*	*clemens*	*agrios*	*hadros*
Propodosomal setae (*sci, sce*) of equal size	-	-	+	-	-	-	-	-	-	-
Propodosomal setae (*sci, sce*) forming a straight line	-	+	-	-	-	-	-	-	-	-
Propodosomal setae (*sci, sce*) posterior in position	+	+	-	-	+	+	-	-	-	-
Hysterosomal shield, dotted	+	-	-	-	+	-	-	-	+	+
Gnathosoma parallel, laterally	-	-	+	-	-	-	-	-	-	+
Gnathosoma notched, posteriorly	+	+	-	-	+	+	-	-	-	-
Gnathosoma distal fork, separated from basal joint	-	-	-	+	-	-	+	+	-	-
Gnathosoma with 2 pairs of small setae	+	+	-	-	-	+	-	-	+	-
Sternum 1 (*st1*) bifid, posteriorly	-	-	+	+	-	+	-	-	-	-
Sternum 2 (*st2*) absent	+	+	+	-	+	+	+	+	+	+
Apodeme 3 (*ap3*) not meeting apodemes 4 (*ap4*)	+	-	+	-	-	+	+	+	+	+
Apodemes 4 (*ap4*) meeting medially	+	+	-	-	+	+	-	-	+	+
Coxal field III, shut	+	-	-	-	-	-	-	+	-	-
Ventral shield separated from genital shield	-	+	-	+	+	+	-	-	-	-
Coxal discs (*di1, di2*), conoids	+	-	-	-	-	-	-	-	-	-
Genital disc (*gdi3*), kidney-shaped	+	+	-	+	+	+	+	+	+	+
Genital disc (*gdi3*), with radial striations all around	+	-	-	-	+	+	-	-	+	+
Paragenital seta (*pr*), anteromedial to disc (*gdi3*)	+	-	+	-	+	+	+	+	+	+
Paragenital seta (*pr*) bifid	+	-	-	+	-	-	-	-	-	-
Suctorial shield rounded posteriorly	+	+	-	-	-	-	+	+	-	-
Suctorial shield anal suckers equal to anterior suckers	+	+	+	+	+	+	+	+	+	+
Suctorial shield with lateral and posterior conoids	+	+	+	+	+	+	+	-	+	+
Seta ó on genu II, a solenidion	+	+	+	+	+	+	+	-	+	+
Leg I tarsus with 2 leaf-like setae	+	-	+	-	+	+	+	+	+	+
Leg II tarsus with 3 leaf-like setae	-	-	-	+	-	+	+	+	+	+

Table 2. Matrix showing percentage of similarity among the species of the mite genus *Caloglyphus* Berlese (Acaride)

Species	*multaniensis*	*opacatus*	*merisma*	*morosus*	*faisalabadiensis*	*trigonellum*	*cingentis*	*clemens*	*agrios*	*hadros*
multaniensis	xx									
opacatus	60	xx								
merisma	44	44	xx							
morosus	32	56	56	xx						
faisalabadiensis	68	72	56	52	xx					
trigonellum	68	68	56	60	80	xx				
cingentis	56	56	72	68	60	64	xx			
clemens	52	44	60	56	48	52	88	xx		
agrios	72	56	64	52	76	80	76	64	xx	
hadros	64	48	72	52	76	72	76	64	92	xx

genetic plasticity. Probably, more species of the genus *Caloglyphus* have to be included from other geographical locations of Pakistan with more characters taken to make the picture of phenogram more meaningful. Finally, more work is still needed before the species relationships can be considered stable, certainly with the hope that the inter-relationships between different genera in particular and that between families of Acari in general would provide a basis for future phylogenetic work by the addition of further characters and taxa, which would gain worldwide acceptance by both the cladistics and classifiers.

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