



## Contribution toward the description of a new *Caloglyphus* Berlese mite (Acarina: Acaridae) from collections in Pakistan

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### Abstract

This paper relates to the recognition and description of one novel taxon *Caloglyphus verto* (Hypopus) within the genus *Caloglyphus* Berlese recorded from Pakistan. This species is characterized by possession of a typical gnathosoma in which distal fork is not separated from basal joint. The text comprises interpretations on description of diagnostic characters, morphometric measurements, collection site with ecological data, host material and differentiating remarks of new species from closely related species. Brief details lying on overview of literature of already identified *Caloglyphus* taxa and key covering all the known species in the country are given.

**Key words:** Acarina, Acaridae, *Caloglyphus*, New mite hypopus, Taxonomy, Pakistan

### 1. Introduction

Astigmatic mites family Acaridae are considered to be major pests of stored products. Mites feeding on different stored products cause direct injury; they also cause indirect damages by transmitting fungi and other microorganisms into the stored commodities. Previously the species of *Caloglyphus* were collected from potato tubers, onion bulbs, barley, rice, wheat, flour and chicken feeds (Ostovan and Kamali, 1995). Storage mites frequently cause injury and contamination of crop agro-products, and by allergens and toxins. The *Caloglyphus* often occurred in 4 kinds of "sensitive food ingredients" that include poppy, mustards, lettuce and wheat grain (Stejskal *et al.*, 2002). This may have serious practical consequences since currently the food safety is one of the most important priorities. Taxonomy provides a framework that enables us to undertake studies on the relationships between living things, so that we are better able to understand and assess biodiversity and more efficiently manage it. Therefore, the goal of our study was to review and identify the occurrence of this biotic-hazard in various agricultural products for its integrated pest management development and its implementation.

Genus *Caloglyphus* at this moment has documentation from a lot of countries of the world, but Berlese first proposed and described the genus *Caloglyphus* in 1923 and he selected *Caloglyphus berlesei* Michael, 1903 as its type species for a single species (hypopus). Some species of genus *Caloglyphus* have been reported from several regions of world; Zakhvatkin (1941) prepared a comprehensive review of this genus and depicted 4 new species and re-described 6 species with improved descriptions. Nesbitt (1944 and 1949) and Samsinak (1966) raised 1, 3 and 1 new species to this genus, accordingly. Mahunka (1973, 1974, 1978 and 1979) described 2, 1, 2 and 1 new species, respectively from his area of study. Hughes (1976) prepared an excellent accumulation of knowledge to this genus. Tseng and Hsieh (1976) re-described 1 species with improved drawings. Samsinak (1980) revised the tribe *Caloglyphini*, re-established the genus *Caloglyphus* and illustrated 1 new species. Channabasavanna *et al.*, (1981), Rao *et al.*, (1982) and Ashfaq and Chaudhri (1983) included 1, 1 and 4 new species, correspondingly in this genus. Samsinak (1988) pointed out 1 new species of the tribe *Caloglyphini*. Zou and Wang (1989), Sevastyanov and Radi (1991), Sher *et al.*, (1991), Klimov (1996) and Eraky (1999) supplemented 1, 3, 2, 1 and 1 new species, respectively to this genus. Klimov (2000) reviewed

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acarid mites of the tribe *Caloglyphini* with description of a new species. Oconnor (2003) listed two species of genus *Sancassania* (= *Caloglyphus*) phoretic on other species of arthropods. Klimov and Oconnor (2003) published phylogeny, historical ecology and systematic of some mites including full descriptions of each taxon, keys and biological information. Sarwar and Ashfaq (2004 and 2006), and Sarwar *et al.*, (2005 and 2009) in their studies, recognized and expressed 7 new species reported from this global territory. Current investigations on the occurrence of *Caloglyphus* fauna in the urban environment, has encountered one species that showed sufficient dissimilarity with already existing taxa to be classified it as a separate species.

## 2. Materials and methods

For contributions to the knowledge of exploring and describing species of the genus *Caloglyphus*, samples for mites' collection were taken from places which were scarcely or not sampled properly earlier in the areas of Punjab province. Samples consisting of trees bark, leaf litter, stored fruits and grains were collected to allow a wide range of representations of the stored products and mites species found in these commodities. The *Caloglyphus* were extracted from substrates using a modified Berlese funnel apparatus and then individually removed with a brush under a stereomicroscope, in the laboratory. All specimens were slide-mounted for identification using Hoyer's medium. Drawings of different body parts were made with the help of an ocular grid. All measurements were given in micrometers ( $\mu\text{m}$ ).

A chronological analysis of the genus, description and illustration of main body characters and resemblance remarks for the new species are given by studying earlier literature. The terms of body parts and idiosomal chaetotaxy follow Griffiths *et al.*, (1990); and terms of leg chaetotaxy and solenidiotaxy follow Griffiths (1970).

### Diagnosis of genus *Caloglyphus* Berlese

Dorsal shield smooth or scantily dotted. Gnathosoma considerably longer than wide at its base, two segmented segments clearly separated. Sternum 1 (*st1*) and apodeme 2 (*ap2*) not reaching posterior end and not united with each other. Coxal suckers 2 pairs, well developed/ completely reduced or replaced by fairly long seta. Coxal field III generally shut. Genital shield separated from/ not separated from ventral shield. Suctorial shield well developed, lateral suckers anterior to posterior suckers but at same level of anal suckers, shield separated from posterior body end by small distance, considerably smaller than shield length. Tarsi III and IV short, stout. Seta *e* not more than one-half of leg II, and I enlarged distally. Apex of genu I with 1 seta only. Seta *ba* of tarsi I and II tapering anteriorly. Claws normal, much smaller than tarsi.

## 3. Description of Hypopus

### *Caloglyphus verto* sp. nov.

**DORSUM:** Body 278  $\mu\text{m}$  long, 208  $\mu\text{m}$  wide, divided into propodosomal and hysterosomal shields. Propodosomal shield with rostral projection antero-medially, 90  $\mu\text{m}$  long, 190  $\mu\text{m}$  wide, dotted all around; setae *vi*, *ve*, *sci*, *sce* and *scs*, each 1 pair, simple, measuring 38  $\mu\text{m}$ , 6  $\mu\text{m}$ , 5  $\mu\text{m}$ , 9  $\mu\text{m}$  and 19  $\mu\text{m}$  in length, respectively; setae *sci*, *scs* and *sce* forming circular line; *sci-sci* 38  $\mu\text{m}$ , *sce-sce* 88  $\mu\text{m}$  and *sci-sce* 29  $\mu\text{m}$  apart. Hysterosomal shield 213  $\mu\text{m}$  long, 208  $\mu\text{m}$  wide, dotted, anterior and lateral margins with dots and broken striations, lateral margins turn toward the ventral side, 11 pairs setae, 2 pairs visible pores. Setae *d1* = *d2* = *d3* = *d4* = 6  $\mu\text{m}$ ; *hi* 10  $\mu\text{m}$ , *he* 6  $\mu\text{m}$ ; *la* 7  $\mu\text{m}$ , *lp1* = *lp2* = 8  $\mu\text{m}$ ; *sai* 14  $\mu\text{m}$ , *sae* 8  $\mu\text{m}$  long; *d1 - d1* 70  $\mu\text{m}$ , *d2 - d2* 45  $\mu\text{m}$ , *d3 - d3* 50  $\mu\text{m}$ , *d4 - d4* 57  $\mu\text{m}$ ; *d1 - d2* 40  $\mu\text{m}$ , *d2 - d3* 62  $\mu\text{m}$ , *d3 - d4* 38  $\mu\text{m}$  and *la - la* 160  $\mu\text{m}$  apart. Hysterosomal shield anterior margin overlapping propodosomal shield posterior margin upto 25  $\mu\text{m}$ , overlapping area with dots and transverse, broken striations (Figure 1).

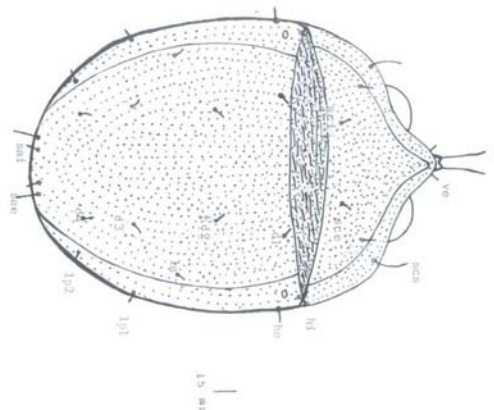


Figure 1. Dorsal side

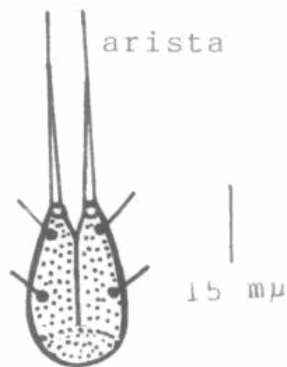


Figure 3 Gnathosoma

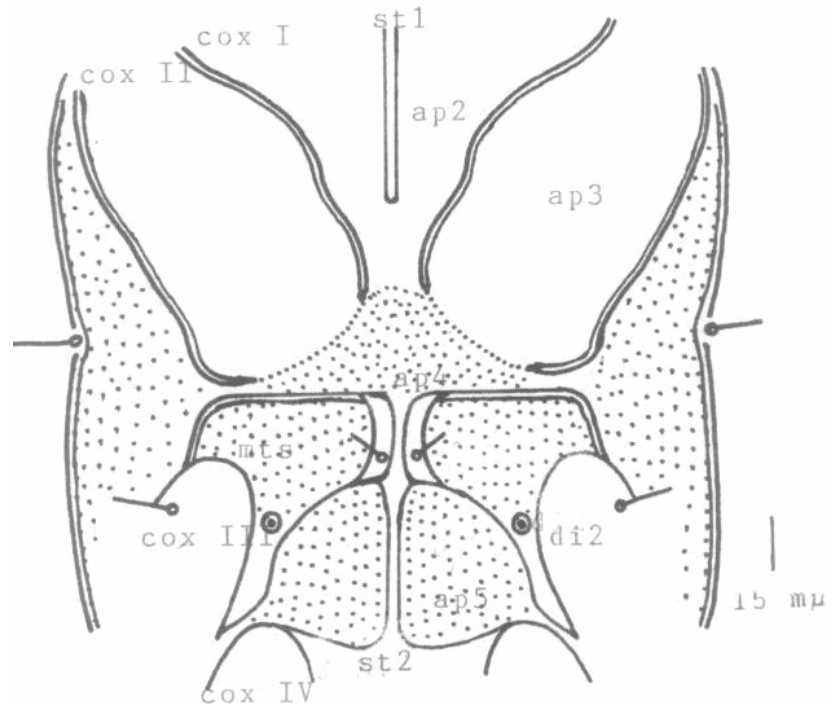


Figure 4. Coxal fields

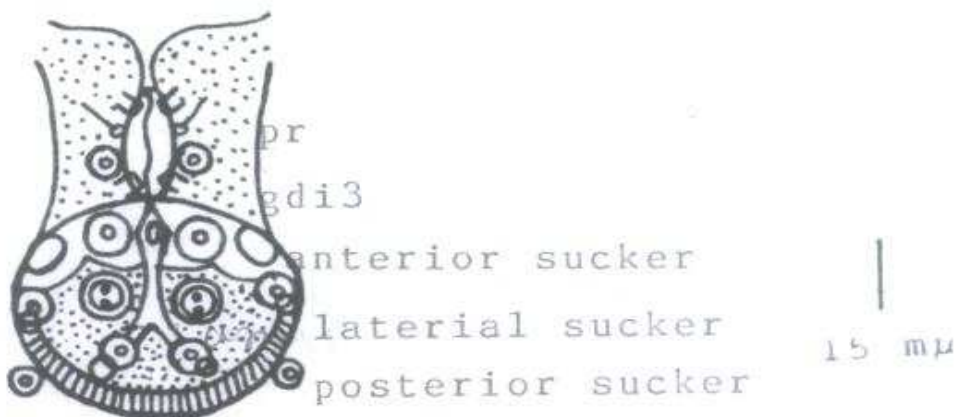


Figure 5. Suctorial shield

**LEGS:** Strong and stout, I-IV measuring 108  $\mu\text{m}$ , 95  $\mu\text{m}$ , 80  $\mu\text{m}$  and 70  $\mu\text{m}$  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 3-3-1-1, tibiae 3-3-2-2, tarsi 12-9-8-7. Tarsi I and II 40  $\mu\text{m}$  and 34  $\mu\text{m}$  long, respectively. Seta *vF* on femora I and II 34  $\mu\text{m}$  and 36  $\mu\text{m}$  long, respectively, absent on femora III and IV. Seta *e* on tarsi I-IV measuring 40  $\mu\text{m}$ , 28  $\mu\text{m}$ , 25  $\mu\text{m}$  and 20  $\mu\text{m}$  in length, respectively. Seta *mG* on genua I and II spine-like; *hT* on tibiae I and II lancet-like, 14  $\mu\text{m}$ , 12  $\mu\text{m}$ , 23  $\mu\text{m}$  and 19  $\mu\text{m}$  long, respectively. Seta *ó* on genua I and II, a simple seta and a spine, 15  $\mu\text{m}$  and 6  $\mu\text{m}$  long, respectively. Tarsi III and IV short and stout. Seta *ö* on tibiae I and II 85  $\mu\text{m}$  and 32  $\mu\text{m}$  long, respectively. Seta *ba* on tarsus I 23  $\mu\text{m}$  long. Tarsi I-IV provided with 1 spoon-shaped + 2 leaf-like; 1 spoon-shaped + 2 leaf-like; 3 leaf-like + 1 lancet-like; 3 leaf-like + 1 lancet-like setae, respectively. Seta *d* on leg IV tarsus 33  $\mu\text{m}$  long (Figure 2).

**TYPE:** Holotype, hypopus, collected from Multan (latitude 30-12 N, longitude 71-28 E, altitude 221 m, and mean annual temperature and rainfall 26.50 °C and 168 mm, respectively) from leaf litter on 25.12.1994 (Sarwar) and deposited in Acarology Research Laboratory, Department of Agricultural Entomology, University of Agriculture, Faisalabad.

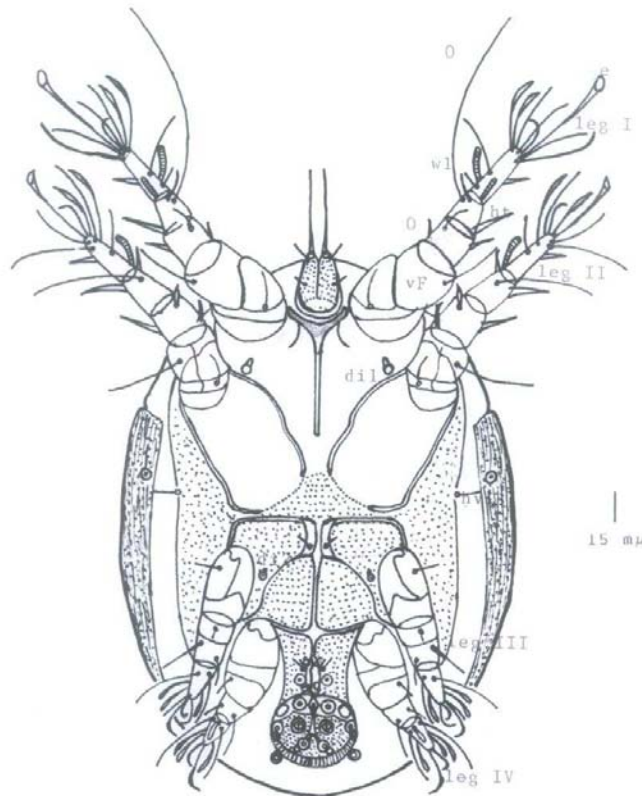


Figure 2. Ventral side

**REMARKS:** This new species closely resembles to that of *Caloglyphus trigonellum* Sher, Ashfaq and Parvez but differs from it due to the following characters:

1. Gnathosomal distal fork separated from basal joint in *C. trigonellum* but not separated in this new species.
2. Sternum 1 (*st1*) bifid posteriorly in *C. trigonellum* but not bifid in this new species.
3. Genital disc (*gdi3*) kidney-shaped in *C. trigonellum* but rounded in this new species.
4. Suctorial shield without radial striations in *C. trigonellum* but with striations posteriorly in this new species.
5. Tarsi I and II each with 5 leaf-like setae in *C. trigonellum* but each with 2 leaf-like setae in this new species.
6. Apodemes 4 (*ap4*) meeting medially in *C. trigonellum* but not meeting in this new species.

#### 4. Conclusions

Most systematic work previously published on the mites of genus *Caloglyphus* associated with different stored commodities in Pakistan is represented by 13 species, at this instance; the present authors have collected and described 1 new species. With continuing studies and descriptions of additional new species, the fauna of the country will ultimately become completely known. As is common with other acaroids species that are generalist foragers, *Caloglyphus* is a genus of agricultural importance worldwide and they show a wide range of peculiar morphological characteristics. They might occur in much more pervasive localities to utilize many diverse hosts. However, host records of genus *Caloglyphus* are not yet sufficiently extensive to exhibit any clear phylogenetic signal.

The earlier described *C. agrios* and *C. hadros* species have been collected from adjoining sub-mountainous areas of similar ecological niche; their similarity could thus be attributed to their similar ecological habitats. The species *C. faisalabadiensis* and *C. trigonellum* are the commoners of the same habitat, having the identical hosts, thus it is revealed that resemblance of these species could be attributed to the same ecological zones they occupy. Whereas, the species *C. multaniensis*, *C. kenos*, new species *C. verto* and *C. opacatus* are the dwellers of arid plains, their affinity could thus be attributed to the similar ecological niche they inhabit. Species *C. cingentis*, *C. clemens*, *C. merisma*, *C. morosus*, *C. bradys* and *C. austerus* are the dwellers of varied ecological regions from hilly areas to coastal lands, as such, the affinities depicted by these species with one another could not be an attribute of ecology. Perhaps rather it is due to sharing of stable characters at generic level. It is noteworthy from the data that species of this genus have a wide range of distribution in four provinces of Pakistan and Azad Kashmir because they have been collected from discrete, diverse ecological habitats like hills, sub-mountainous areas, arid plains and coastal areas which indicates that species have an ability to adopt diverse ecological habitats; and hence can be presumed to have a wider genetic plasticity. The

ability of these species to adapt to diverse ecological habitats and yet sharing numerous characters reflects the occurrence of stable generic characters at this level and their adaptive amplitude to varying ecological zones. The characters used for the separation of species of this genus appear to be of consistent occurrence. It is hypothesized that in view of the discernable heterogeneity of the taxa, as the number of species described in this genus increase, it may be possible to split the genus into more sub-genera.

This information acquired on species identification and taxonomic sequence about *Caloglyphus* mites is desirable to properly assist in their management. Knowledge of the natural host associations is also supportive to provide baseline data prior to any operation put into practice to control a pest species; such baseline data will allow the recognition of precise host. Finally, knowledge of the natural geographic range of each species is also necessary in order to avoid introduction of potential pest mites into new areas. In order to complete the survey of different taxa, it is proposed to visit several of the collection sites to examine the fauna that were not previously surveyed. Finally, the accumulated taxonomic information could be used at a later date to conduct phylogenetic and evolution analyses of the taxa.

### Key to Pakistan species of genus *Caloglyphus* Berlese (Hypopus)

1. Sternum 2 (*st2*) present .....2
- Sternum 2 (*st2*) absent .....12
2. Apodeme 2 (*ap2*) meeting apodeme 3 (*ap3*) .....*C. austerus*, Sarwar *et al.* (2009)
- Apodeme 2 (*ap2*) not meeting apodeme 3 (*ap3*) .....3
3. Apodeme 3 (*ap3*) meeting apodeme 4 (*ap4*) ..... 8
- Apodeme 3 (*ap3*) not meeting apodeme 4 (*ap4*).....4
4. Gnathosomal lateral margins parallel.....5
- Gnathosomal lateral margins not parallel.....6
5. Sternum 1 (*st1*) bifid posteriorly; paragenital seta (*pr*) bifid.....*C. multaniensis*, Ashfaq and Chaudhri (1983)
- Sternum 1 (*st1*) not bifid posteriorly; paragenital seta (*pr*) not bifid.....*C. agrios*, Sarwar *et al.* (2005)
6. Setae *sci* and *sce* forming straight line; coxal discs (*di1*, *di2*) not conoids.....*C. opacatus*, Ashfaq and Chaudhri (1983)
- Setae *sci* and *sce* not forming straight line; coxal discs (*di1*, *di2*) conoids.....7
7. Apodeme 4 (*ap4*) not meeting medially; paragenital seta (*pr*) antero-medial to genital disc (*gdi3*); gnathosomal distal fork not separated from basal joint.....*C. verto*, n. sp.
- Apodeme 4 (*ap4*) meeting medially; paragenital seta (*pr*) meso to genital disc (*gdi3*); gnathosomal distal fork separated from basal joint.....*trigonellum* Sher *et al.* (1991)
8. Gnathosoma notched posteriorly..... 9
- Gnathosoma not notched posteriorly..... 10
9. Setae *sci* and *sce* of equal size; apodemes 4 (*ap4*) meeting medially.....*C. merisma*, Ashfaq and Chaudhri (1983)
- Setae *sci* and *sce* not of equal size; apodemes 4 (*ap4*) not meeting medially.....*C. hadros*, Sarwar *et al.* (2005)
10. Gnathosomal distal fork separated from basal joint; genital disc (*gdi3*) kidney-shaped.....11
- Gnathosomal distal fork not separated from basal joint; genital disc (*gdi3*) not kidney-shape.....*C. kenos*, Sarwar and Ashfaq (2006)
11. Hysterosomal shield smooth; sternum 1 (*st1*) not bifid posteriorly; coxal discs (*di1*, *di2*) conoids .....*C. bradys*, Sarwar *et al.* (2009)
- Hysterosomal shield dotted; sternum 1 (*st1*) bifid posteriorly; coxal discs (*di1*, *di2*) not conoids .....*C. faisalabadiensis*, Sher *et al.* (1991)
12. Gnathosoma extended beyond the body; apodemes 4 (*ap4*) meeting medially.....*C. morosus*, Ashfaq and Chaudhri (1983)
- Gnathosoma not extended beyond the body; apodemes 4 (*ap4*) not meeting medially.....13
13. Coxal field III open; genital disc (*gdi3*) and suctorial shield with radial striations.....*C. clemens*, Sarwar and Ashfaq (2004)
- Coxal field III closed; genital disc (*gdi3*) and suctorial shield without radial striation.....*C. cingentis*, Sarwar and Ashfaq (2004).

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