Acarologia

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Subscriptions: Year 2019 (Volume 59): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2017): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under
the reference ID 1500-024 through the « Investissements d’avenir » programme
(Labex Agro: ANR-10-LABX-0001-01)

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MITES ASSOCIATED WITH THE PASSALUS BEETLE
I. LIFE STAGES AND SEASONAL ABUNDANCE OF
COSMOLAEELAPS PASSALI n. sp. (ACARINA : LAELAPTIDAE)¹ ²

BY

Preston E. Hunter ³ and Karl Mollin ⁴

Several taxonomic papers have been published on mites from passalid beetles (e.g. PEARSE et al 1936; LOMBARDINI 1940, 1951; TRÄGÅRDH 1946, 1951; WOMERSLEY 1957), and the Mesostigmatic mites reported from passalid beetles have been listed by MOLLIN (1962). This paper is one of a series on the Mesostigmatic mites associated with the horned passalus beetle, Popilius disjunctus (Illiger). The work reported here gives the description, seasonal occurrence and life cycle of a new species of Cosmolaelaps associated with Popilius disjunctus in Georgia. More extensive biological studies of this mite will be presented in a separate paper (Mollin and Hunter).

Cosmolaelaps passali n. sp.
(Fig. 1)

Both sexes of this species may be recognized by the lanceolate dorsal plate setae and by the short thick lanceolate ventral body setae. Striations on the genitoventral plate appear to be distinct for the species.

Female. Idiosoma measurements given in Table 1 (all measurements given in Table 1 are the average for 10 individuals). Dorsum. Dorsal plate striations forming distinct scalelike patterns; dorsal plate setae lanceolate, relatively strong, up to 65 μ in length. Ventrum. Sternal plate 170 μ long on the midline, 210 μ at widest point between coxae II and III; 3 pairs of sternal setae, 2 pairs of sternal pores positioned as shown; striations on anterior part forming irregular polygons, posterior with markings near lateral margins only. Presternal plates present.

1. Journal Paper No. 313 of the College Experiment Station of the University of Georgia College of Agriculture Experiment Stations.
2. This study was supported by the National Science Foundation, Grant No. G-13939.
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Fig. 1. — *Cosmolaelaps passali* n. sp. A, ventrum, female; B, female chelicera; C, female dorsum; D, dorsal seta; E, ventrum, male; F, male chelicera.
Mean and standard error for 10 individuals, and range of idiosoma and leg measurements for immature and adult stages of *C. passali*. Measurements are in microns.

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Genito-ventral plate drop-shaped, rounded posteriorly, well separated from anal plate; 258 μ long on midline from posterior margins of sternal plate, 185 μ at greatest width; striations as illustrated; genital setae arise from margins of plate. Metasternal seta arise from integument; pore in integument anterior to base of seta. Peritremal plate extending from middle of coxa IV anteriorly to unite with dorsal plate above coxae I; posterior margin with small irregular projection; small circular striation on surface of plate near medial posterior corner. Anal plate triangular, 110 μ long, 90 μ at greatest width, without striations; posterior anal seta heavier than paired setae; all three setae simple. Ventral body setae short, up to 30 μ long, thick; those nearest genito-ventral plate simple, remaining setae lanceolate, similar to dorsal setae in shape. Legs. Long; legs II slightly heavier than others; all tarsi with claws. Tarsus I with several long slender setae on terminal end of segment, one rodlike, S-shaped seta on dorsal surface; tarsal setae of legs II to IV spine-like. Measurements, including coxae but not claws, given in Table I. 

Male. Idiosoma smaller than female (Table 1). Striae of dorsal plate forming scalelike patterns as in female. Dorsal setae as in female; up to 55 μ long. Ventrum. Presternal area as in female. Holoventral plate 430 μ long on midline, 270 μ wide behind legs IV, and partially surrounding coxae IV posteriorly; short lateral projections between coxae II and III, and III and IV; surface with ten pairs of setae in addition to the three anal setae; location of setae and striations on plate as shown; anterior margin of plate slightly concave, lateral margins thickened at the level of coxae II to IV. Peritremal plate as in female, extending posteriorly to middle of coxae IV. Ventral body setae short, up to 30 μ in length, shaped as in female. Legs. Measurements, including coxae but not claws, given in Table I. Gnathosoma. Chelicerae chelate; movable digit slightly shorter than fixed digit; two sub-terminal teeth on movable digit, three large teeth and 10 to 12 small teeth on fixed digit. Palps with bluntly rounded seta arising from medial surface of genu. Internal posterior rostral setae twice as long as other rostral setae.

This species was described from a series of 20 females and 20 males taken from laboratory cultures July 9, 1962, Athens, Georgia. Holotype (female), allotype (male), and five paratypes of each sex will be deposited with the U. S. National Museum, Washington, D.C. Three paratypes of each sex deposited with the British Museum (Natural) History, London, England; Bishop Museum, Honolulu, Hawaii; and the Institute of Acarology, Wooster, Ohio. Remaining paratypes in collections of Department of Entomology, University of Georgia, Athens, Georgia.

This species is very similar to C. weeversi (Oudemans) the illustration of which was recently published by Dr. Strandtmann (1963). The new species shows a number of differences from weeversi, e.g., relative size of the dorsal plate, shape.
and markings of the genito-ventral plate, but is most readily separated from *weeversi* by having short, lanceolate ventral body setae compared to the simple setae illustrated for Oudemans species.

Description and duration of immature stages.

The duration and number of life stages was investigated by confining mites and beetles in circular plastic culture dishes 3 inches in diameter and 1 1/2 inches deep. Several small ventilation holes were burned in the dish lid, and the bottom of each dish was covered with sterilized frass and wood material from a passalus beetle tunnel or from beetle cultures. All beetles were cleaned of mites before use. The duration of the immature stages was determined by placing 10 adult mites and a beetle in each of two culture dishes. Each day for 30 days, these mites were moved to new dishes containing a new beetle. Each dish was checked every other day for 18 days after the beetle was removed; and if immature mites were seen some were mounted to determine their developmental stage. From this the average duration of each stage was estimated. The length of the immature stages was also checked by marking the mites using the method of Hunter (1960). Body and leg measurements were made for 10 specimens in the larval and each nymphal stage (see Table 1).

Egg. No more than one mature egg was ever found in the body of females mounted for study. Only a few eggs were found in the culture dishes and no size measurements were made. The eggs seen were whitish in color. In a single observation it took about 20 minutes for the larva to free itself from an egg.

Larva. Body soft, white, oval in shape (Fig. 2); no sclerotization seen. Dorsum. Dorsal surface with six pairs of median setae and seven pairs of setae nearer margin of body; all setae simple and of approximately the same length; integument without markings. Ventrum. Three pairs of sternal setae between coxae I and III; posterior to coxae III three pairs of longer setae plus three pairs of very short setae; all setae simple; tritosternum present; stigmata and peri­treme absent. Legs. All tarsi with claws and caruncle; setae simple, dorsal leg setae shorter than lateral leg setae; tarsus I with a long seta extending well beyond claw, one heavy S-shaped sensory setae; each coxae bearing two setae; relative length and positions of leg setae as shown; pretarsus I appears segmented. Gnathosoma. Two pairs of setae on ventral surface; deutosternal groove not distinctly delineated laterally, deutosternal teeth present; corniculi not well sclerotized; palpal setae simple, chaetotaxy as shown; chelicerae with cone-shaped movable digit, both digits without distinct teeth, fixed digit sclerotized on tip.

The larval period lasted one day with only slight variations in the duration of this stage. Very likely this is a non-feeding stage. The larvae were slow moving and were found well hidden in the deeper frass and beetle fecal material.
Protonymph. Body ovoid (Fig. 2). Dorsum. Two large sclerotized plates; anterior plate about twice size of posterior one, shape of plates as shown; surface of plates with slightly raised, irregular markings, no distinct pattern evident; setal position and number of setae on plates as shown; setae lanceolate, lateral point not as pronounced as in adults or deutonymphs; five pairs of platelets between anterior and posterior plates; 10 pairs of setae arising from integument, four between anterior and posterior plates; six at margins of these plates. Ventrum.

Fig. 2. — Cosmolaelaps passali n. sp. Dorsal-ventral view of immature stages: A, larva; B, protonymph; C, deutonymph; D, dorsal seta, protonymph; E, dorsal seta, deutonymph; F, larva chelicera; G, protonymph chelicera; H, deutonymph chelicera.

Sternal plate weakly sclerotized, somewhat pointed posteriorly; bearing three pairs of setae, two pairs of pores; some sclerotization in presternal area; tritosternum well developed; four pairs of setae arising from integument between sternal and anal plate; anal plate round, bearing three setae; stigmata present, peritreme short not extending forward of coxa III. Legs. Long in relation to body; tarsi II-IV with some spinelike setae, tarsus I with slender setae; all tarsi with claws and caruncle, caruncle extends into a setalike lateral distal element; pretarsus I appears segmented. Gnathosoma. Corniculi well sclerotized; deutosternal groove delineated laterally; deutosternal teeth present; four pairs setae on ventral surface, relative lengths as shown; palps with heavy, medial seta on
genu, trochanter with one ventral seta, other setae as shown; chelicera chelate, movable digit with two teeth, fixed digit with two large and five to six smaller teeth; short spinelike pilus dentilis on side of fixed digit; tectum serrated.

The protonymphal stage lasted an average of five days. These mites moved quite rapidly and stayed well hidden in the deeper and especially in the damp frass material but at a level just above where the larvae were found. They came to the surface only when disturbed, and at such times immediately burrowed back into the frass material, possibly as a response to light.

Deutonymph. Body shape as shown (Fig. 2). Dorsum. Dorsal plate well sclerotized, incised above coxae IV; median surface of plate marked by ridges forming no distinct pattern, around margin of plate striae more regular and similar to that of adult; dorsal plate setae similar to those of adult, setae on anterior half of plate slightly longer than posterior ones; chaetotaxy of dorsal plate as shown; one pair of setae similar to dorsal plate setae arising from integument above coxa IV; posteriorly numerous short lanceolate setae arise from integument, these setae similar in size and appearance to ventral body setae. Anterior end of peritremal plate and peritreme visible dorsally above coxa I. Ventrum. Presternal plates present, sternal plate bearing four pairs of setae, three pairs of pores, a fourth pore in integument behind plate; plate with striations on posterior part; five pairs of small platelets in integument behind sternal plate and posterior of coxae IV; four pairs of simple setae, and 14 pairs of short lanceolate setae arising from integument. Anal plate oval, bearing three setae. Legs. Chaetotaxy as shown; pretarsus I appears segmented. Gnathosoma. Ventral setae as shown; tectum serrated; palpus with blunt seta on medial surface of genu, trochanter with 2 ventral setae, other palpal setae as shown. Chelicerae similar to protonymph, well sclerotized.

This stage showed the greatest range in size, the females being considerably larger than the males. The largest female deutonymphs in many cases were larger than mature adult males. The deutonymph stage lasts from nine to 12 days with an average of 11 days, making an overall average of 17 days for these mites to go through the larval and nymphal stages. The deutonymphs were fast moving mites and were often seen running about on the surface of the frass and fecal material.

Host Association and Seasonal Abundance.

Information on the seasonal abundance of this mite on the passalus beetle was obtained by collecting beetles over a 20 month period from decaying hardwood logs near Bishop, Georgia. Collections were started in June, 1961, and were made monthly except for a three month period from July to September in 1962. In collections made during the first year all beetles were placed in a single container with wood material from beetle tunnels. After the first year, beetles were placed in individual containers when collected. In all cases the beetles were brought
into the laboratory and examined immediately for mites. The number and position of attachment of \textit{C. passali} mites was recorded for each beetle.

Only adult mites were found on the passalus beetles. The sex ratio of the mites found on the beetles was taken only for a four month period from March through June, 1962. During that period 186 mites were taken from 160 beetles and of these mites only three were males.

The mites attached to a beetle by their chelicerae, predominately to the setae in front of legs I, by grasping a seta about one third of its length above the base. Normally, disturbing would not cause the mite to release its hold on a seta, but if forced to do so, the mite would usually quickly grasp the same seta or a new seta at the same level. While attached to a seta the mite moves its palpi about very actively. The front legs, which are not used for supporting the body, are also moved about but not as actively or as systematically as the palpi.

The mites showed no preference for direction orientation on the beetle, the position of the setae and the crowding of other mites apparently being the primary orienting factors. Because the mites, grasp the lower part of a seta, they usually

\begin{table}[h]
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\caption{Collection data of \textit{C. passali} taken from passalus beetles.}
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Date   & Total no. beetles & Total no. mites & No. beetles with mites & $\bar{x}$ no. mites/beetle & $\bar{x}$ no. mites/beetle \\
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1961   &                &                &                      &                        &                        \\
June... & 40             & 39             & 24                    & 1.60                    & 0.37                    \\
July... & 40             & 10             & 7                     & 1.30                    & 0.25                    \\
Aug.....& 40             & 6              & 5                     & 1.20                    & 0.15                    \\
Sept.... & 40             & 4              & 3                     & 1.30                    & 0.10                    \\
Oct......& 40             & 13             & 9                     & 1.40                    & 0.32                    \\
Nov......& 40             & 91             & 26                    & 3.50                    & 2.27                    \\
Dec......& 40             & 17             & 10                    & 1.70                    & 0.42                    \\
1962   &                &                &                      &                        &                        \\
Jan......& 40             & 110            & 28                    & 3.80                    & 2.75                    \\
Feb..... & 40             & 156            & 36                    & 4.30                    & 3.90                    \\
Mar......& 40             & 91             & 32                    & 2.80                    & 2.27                    \\
Apr......& 40             & 86             & 23                    & 3.70                    & 2.15                    \\
May......& 40             & 3              & 2                     & 1.50                    & 0.07                    \\
June.....& 40             & 6              & 5                     & 1.20                    & 0.15                    \\
Oct...... & 53             & 6              & 6                     & 1.00                    & 0.11                    \\
Nov...... & 35             & 23             & 12                    & 1.92                    & 0.66                    \\
Dec...... & 79             & 26             & 20                    & 1.30                    & 0.37                    \\
1963   &                &                &                      &                        &                        \\
Jan...... & 98             & 16             & 14                    & 1.14                    & 0.16                    \\
Feb..... & 100            & 264            & 93                    & 2.84                    & 2.64                    \\
Mar..... & 40             & 167            & 35                    & 4.77                    & 4.17                    \\
Apr...... & 74             & 13             & 9                     & 1.44                    & 0.20                    \\
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had the posterior end of the body raised, especially when crowded, so that they were somewhat perpendicular to the beetle.

For the 20 months that collections were made, 999 beetles were collected (Table 2). From these beetles, 1,149 C. passali mites were taken making an average of 1.15 mites per beetle. Approximately 40% of the beetles—399—had C. passali mites attached and those beetles which had mites attached averaged 2.88 mites per beetle. The most mites were found on beetles taken during the colder months of the year, the highest mite counts for a consecutive three month period being from January to March. During this time 66% of the beetles collected had mites with an average of 2.25 mites per beetle. The fewest mites were found on beetles collected in midsummer and early fall, and for the three month period in which the fewest mites were found on beetles, only 13% of the beetles had mites and these averaged 0.16 mites per beetle.

When all of the collection data were considered, there was a highly significant (P < .01) positive correlation between the average number of mites per beetle and the percent of beetles with mites indicating that the mites were not evenly distributed among the beetles collected. A test for homogeneity in a distribution of the binomial form was carried out to determine if the percent of beetles with mites was random in our collections. The chi-square value obtained in this test was highly significant (P = .001) indicating that the mites were not randomly distributed among the beetles collected.

We have very little factual information for the possible reason(s) for the lack of randomness of the mites on the beetles. It was noted that tenneral beetles normally had fewer mites and this was particularly evident in cases where young beetles were found in tunnels with fully colored beetles. The collection method for the first year could have been a contributing factor; however, the percent of beetles with mites was not significantly different during the last part of the collection period when the beetles were confined in individual containers. Attached mites do not readily leave the beetle which would also tend to rule out the collecting method as an important factor.

The most logical explanation for the lack of randomness of the mites on the beetles would be a preference for one beetle over another due to some physiological factor such as might be associated with age, sex or other conditions of the beetle. Another important factor could have been availability of the beetles to the mites. Mites may have had little chance to encounter beetles in the more extreme areas of the tunnel system or in isolated tunnels.

**Summary**

The male, female, and immature stages of *Cosmolaelaps passali* n. sp. are described and illustrated. This mite has been taken only in association with the horned passalus beetle, *Popilius disjunctus* (Illiger). The female mite is common
on the beetle, attaching by the chelicerae to setae just in front of legs I. The male mite is only rarely found on the beetle, and the immature stages have never been taken on the beetle. The immature stages live in frass in and near the beetle tunnels.

Records taken for monthly collections over a 20 month period showed that approximately 40% of the 999 passalus beetles collected had C. passali mites attached and those beetles with mites averaged 2.88 mites per beetle. The fewest mites were found on beetles collected in midsummer and early fall; the most mites were found on beetles taken during the colder months of the year. Statistical treatment of the data showed that the mites were not randomly distributed among the beetles collected.

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