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OBSERVATIONS ON HEMISARCOPTES COCCOPHAGUS MEYER
(ASTIGMATA : HEMISARCOPTIDAE), WITH A NEW SYNONYM \(^1\)

BY

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Summary.

*Hemisarcoptes coccophagus* Meyer, a mite predaceous on armoured scale-insects, was sampled both as a predator in colonies of *Parlatoria* spp. and as a "traveller" on the Coccinellid beetle *Chilocorus bipustulatus* (L.). The populations of the mite have a pronounced annual cycle, reaching their peaks in mid-summer. A method for mass-rearing the mite is described. The subgenus *Coleovidia* (Saproglyphidae) is placed in synonymy with *Hemisarcoptes*. It is postulated that additional species of *Hemisarcoptes* may be obtained from *Chilocorus* spp.

The genus *Hemisarcoptes* Lignières, as currently understood, consists of two species, namely *H. malus* (Shimer) and *H. coccophagus* Meyer. Both species are predators of various scale insects (Baker and Wharton, 1952; Meyer, 1962). The better-known of the two, *H. malus*, appears to be a biological-control agent of some significance, as it has been credited with substantially reducing the populations of various Diaspidids. Thus, Smirnoff (1957) records the destruction by this mite of some 75% of a population of *Parlatoria blanchardi* (Targ.) in North Africa. Lord (1947) considers *H. malus* an effective predator of *Lepidosaphes ulmi* L. in Nova Scotia, while Turnbull and Chant (1961) recorded the introduction of *H. malus* into British Columbia to combat scale insects there.

Of particular interest is the mode of dissemination of *H. malus*. It has a hypopal stage, which adheres to Coccinellids of the species *Chilocorus stigma* (Say), the latter being themselves predators of scale insects. The hypopi crawl underneath the elytra of the lady-beetles and are thus transported from one colony of scale insects to another (Barlett and DeBach, 1952).

The other species, *H. coccophagus*, has been investigated to only a small extent.

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Meyer (1962) indicated that it may be an important enemy of the California red scale, Aonidiella aurantii (Mask.), in South Africa, while Gerson (1964) recorded this mite as a predator of Parlatoria pergandii Comstock and P. cinerea Hadden on citrus in Israel. Preliminary observations have shown that the hypopi of this species are phoretic on the Coccinellid Chilocorus bipustulatus (L.) in Israel.

The present paper includes the results of field observations and laboratory experiments obtained since the publication of the aforementioned paper (Gerson, 1964).

Field studies.

Two aspects of the phenology of H. coccophagus were investigated. The one pertains to the predation of the mite on Parlatoria, i.e., the direct effect of the predator on its prey, whereas the other aspect concerns the phoresy of the mite on Chilocorus.

I. Seasonal trends of Hemisarcoptes in Parlatoria colonies on citrus.

Preliminary observations (Gerson, 1964) showed that Hemisarcoptes is most abundant on the trunk and main limbs of citrus trees, where large colonies of Parlatoria spp. are always available. Therefore, the seasonal trends of the mite were studied by collecting small chips of bark from these parts of the trees, at monthly intervals. The sample for each grove consisted of about 30 chips, collected from at least 10 trees. All chips were examined in the laboratory with the aid of a stereoscopic microscope, and a total of 400 live Parlatoria females counted. All scales bearing live stages (including eggs) of Hemisarcoptes were considered as attacked by the predator. In addition to these monthly examinations, various samples were also collected at irregular intervals from other host plants, infested by other scale insects.

The results obtained show that the distribution of the predator along the coastal plain of Israel is rather sporadic. In some groves it could not be found at all, whereas in others it was quite abundant, showing a marked seasonal pattern. Figure 1 represents the results obtained at one grove in the southern part of the coastal plain.

Besides P. pergandii and P. cinerea, Hemisarcoptes was also found to attack the following scale insects: (a) Parlatoria oleae (Colvée) on apple and olive trees; (b) Rugsapidiotus lamaricicola (Malenotti) on Tamarix sp. (col. and det. Y. Ben-Dov) and (c) Aonidiella aurantii on citrus trees. The latter record is of special interest, as the predator was initially reported (Meyer 1962), as preying on this Diaspidid. Furthermore, at the site observed, A. aurantii was heavily attacked by H. coccophagus. In a sample of the California red scale collected during November, more than 70% of the live females of the scale were attacked by this predator.
2. The phoresy of *Hemisarcoptes* on *Chilocorus*.

The populations of *Chilocorus bipustulatus* undergo a characteristic annual cycle on citrus in Israel, as shown recently by Rosen and Gerson (1965). These populations reach their peaks at mid-summer, declining towards the fall and starting to build up again in the following spring. For this reason, sampling of *Chilocorus* was possible only during the summer months.

**Table I.** — Extent of phoresy of *Hemisarcoptes* on *Chilocorus*, in orange grove, in the southern coastal plain.

<table>
<thead>
<tr>
<th>Date</th>
<th>Percentage beetles with hypopi</th>
<th>Average no. of hypopi per beetle</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 11</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>April 10</td>
<td>3.3</td>
<td>0.3</td>
</tr>
<tr>
<td>May 11</td>
<td>2.3</td>
<td>0.2</td>
</tr>
<tr>
<td>June 10</td>
<td>30.3</td>
<td>0.7</td>
</tr>
<tr>
<td>July 12</td>
<td>76.0</td>
<td>33.8</td>
</tr>
<tr>
<td>August 10</td>
<td>91.1</td>
<td>34.3</td>
</tr>
</tbody>
</table>
Sampling was done by collecting at least 50 adult beetles off the trunk and main limbs of 10 or more citrus trees per grove. The beetles were examined in the laboratory under a stereoscopic microscope, where the hypopi of *Hemisarcoptes* were recorded. Figure 2 shows an elytron of *C. bipustulatus* with the hypopi in situ. In Figure 3 one such hypopus is shown, enlarged. Table 1 summarizes some representative data from these samplings.

The Table shows that during the spring months there were very few hypopi associated with the beetles, whether averagely or percentage-wise. By July, however, most of the *Chilocorus* population were carrying hypopi, and the average had increased to more than 30 mites per beetle. By August, this association was even more pronounced, but by the next sampling date (September), only very few beetles could be found, most of them heavily laden with hypopi. Only such heavily laden beetles seemed to be affected by the presence of the mites on them, as their movements became rather sluggish. No other effect on *Chilocorus* could be noticed. In one case, up to 202 hypopi were recorded on a single beetle.

**DISCUSSION OF FIELD STUDIES.**

Summer is considered to be the critical season in the build-up of armoured scale insect populations on citrus in Israel (Bodenheimer, 1951). Furthermore, it has been established by monthly observations that during summer the Hymenopterous parasites of *Parlatoria* spp. are rather rare in citrus groves (Gerson, in preparation). The populations of *Hemisarcoptes coccophagus*, as shown above, reach their peaks during this period, thus assuming their relative importance as natural control agents.

A lag of 1-2 months was noticed between the peak in predator activity and the peak in hypopi presence on *Chilocorus*. This suggests that the many hypopi found at the later period on the beetles are the progeny of the abundant June generation.

The synchronization in the comparative abundance of the mite and of *Chilocorus* should equally be noted, as the populations of the latter predator also reach their peak at mid-summer (Rosen and Gerson, 1965).

**THE MASS REARING OF Hemisarcoptes coccophagus.**

The rearing of *Hemisarcoptes malus* in the laboratory apparently presents no difficulties. The mite reproduces well on plant material infested with scale insects, and may even become so abundant as to cause damage to insectary production of Diaspidids, necessitating acaricidal treatments (Sellers and Robinson, 1950).

Though nothing was known as regards methods for the rearing of *H. coccophagus*, it seemed reasonable to assume that this species will also thrive under condition optimal for its congener. Rearing experiments were thus carried out, using as hosts
Diaspidid scale insects kept under conditions of high humidities. The scale insect used was *Hemiberlesia lataniae* (Sig.), reared on potato tubers. High humidities were obtained by using a saturated solution of ammonium sulphate, which maintains a relative humidity of about 80% in the ambient atmosphere (Winston and Bates, 1960). Half-litre glass jars, filled to about a third of capacity with the saturated solution, were used as rearing chambers. A potato tuber was introduced into each jar, and supported above the solution by fine muslin. The jars were hermetically sealed with polyethylene bags. The latter, as well as the muslin, were held fast by rubber bands.

Rearings were initiated by the placing on the tubers of hypopi-rich elytra that had been removed from field-collected *Chilocorus* beetles. Tritonymphs of the mite were observed within a few days, and after 4-8 weeks large colonies developed. This method proved to be preferable to that of placing individual post-hypopod stages of *Hemisarcoptes* on the tubers, as by using hypopi-rich elytra many dozens of mites could develop simultaneously. One such colony, inhabiting a single tuber, survived for eight months. Whenever the Diaspidids began to die out, followed by

Fig. 2. — An elytron of *Chilocorus bipustulatus* (L.) with the hypopi of *Hemisarcoptes coccophagus* Meyer _in situ_.

Fig. 3. — A hypopus of *Hemisarcoptes coccophagus* Meyer.
their predators, subcultures were started by transferring a few mites to other *Hemiberlesia* infested tubers.

*Hemisarcoptes* nymphs and adults, when obtained from citrus bark infested by *Parlatoria* spp., showed a pinkish-red hue. During the laboratory rearings it was often observed that the mites were yellowish. This change in colour corresponds to the colour of the body fluids of the scale-insect prey. The body fluids of *Parlatoria* spp. on citrus are lilac-coloured, whereas those of *Hemiberlesia* are yellow.

In the laboratory, *H. coccophagus* reproduced also upon feeding on *Lepidosaphes beckii* (Newm.) or *Chrysomphalus aonidum* (L.).

**A new synonym for *Hemisarcoptes*.**

As both species of *Hemisarcoptes* were found to be associated with *Chilocorus* spp., a review of the pertinent literature was made in order to obtain additional data on *Chilocorus*-associated mites. This review revealed that hypopi of *Vidia (Coleovidia) cooremani* Thomas (Astigmata: Saproglyphidae) are known to be associated with *Chilocorus cacti* (L.) in Texas (Thomas, 1961). An examination of Thomas’ figures together with his description of the attachment of the hypopi to the inner lining of the elytra of *C. cacti*, suggests that *Coleovidia cooremani* should more properly belong to the genus *Hemisarcoptes*.

Dr. Edward W. Baker, of the United States Department of Agriculture, kindly agreed to examine hypopi obtained from *C. bipustulatus*. He has compared these mites with the type material of *Coleovidia cooremani*, concluding that the two generic names should indeed be regarded as synonyms (E. W. Baker, personal communication, 1965). Consequently, *Coleovidia* is to be considered a junior synonym of *Hemisarcoptes* and transferred from the Saproglyphidae to the Hemisarcoptidae. Nothing is yet known as to the other stages of *Hemisarcoptes cooremani*.

**Concluding remarks.**

The data presented show that *H. coccophagus*, like *H. malus*, is a biological control agent of some importance. Its close association, in the field, with another such agent *C. bipustulatus*, suggests a method by which the mite may be broadcast in the citrus groves. Since techniques for the mass-rearing of *Chilocorus* are already in use in this country (Nadel and Biron, 1964), it is hereby proposed that *Hemisarcoptes* should also be mass-reared, but under separate conditions, and the two predators brought into contact at the appropriate period. *Chilocorus* may then be distributed in the groves. The same method may also apply to other Coccinellids.

Finally, it should be pointed out that all three species of *Hemisarcoptes*, namely *malus, coccophagus* and *cooremani*, were found to be phoretic on various species of *Chilocorus*. Hence, the examination of additional species of *Chilocorus* seems
warranted, as other species of Hemisarcoptes, a promising biological-control agent, may thus be obtained.

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