

ECTOPARASITIC MITES (ACARINA : OTOPHEIDOMENIDAE) ON SPHINGID MOTHS

BY

V. PRASAD

Department of Entomology, Punjab Agricultural University, Ludhiana (Punjab), India

INTRODUCTION.

There are two kinds of mites that are found on sphingid moths-parasitic and phoretic. The parasitic mites in the recent years have received good attention by some acarologists, especially about the placement of the family. While TREAT (1955) erected Otopheidomenidae for his new mite, *Otopheidomenis zalelesteste* Treat, and KRANTZ and KHOT (1962) accepted this family, CHANT (1965) reduced it to the subfamily level in the family Phytoseidae. However, KRANTZ (1970) and WAINSTEIN (1972) have separated Otopheidomenidae from Phytoseidae because of some outstanding characteristics that are present in the former and absent in the latter.

In past few years the author has described several new species of Otopheidomenid mites from sphingid moths (PRASAD, 1970 a ; 1970 b ; 1972 ; 1973). But none of the papers include the detail studies on geographical or host distribution. Also, no other information, other than the taxonomy, is available in literature about these mites. The present paper includes the results of several years of survey work carried out in Canada, India and U.S.A.

MATERIALS AND METHODS.

A number of Museums and Entomology Departments where sphingid moths were preserved were visited during 1968-1974 (Table 1). The pinned, dry moths were examined under a stereoscopic binocular microscope using a magnification of 100-150 x. All dorsal and ventral areas of the head, thorax, abdomen and wings were examined carefully for the mites. The proboscis was also examined but without uncoiling as they were very fragile. Sometimes, the scales and hairs were removed with a fine needle from the tympanic or metathoracic-abdominal areas as the mites were inside the cavity or the scales. The mites when seen, were collected in vials containing 70 % alcohol with the help of a fine brush. The mites were brought to the head quarter for preparation and study. In all, 6,524 moths distributed over 151 genera and 623 species and subspecies were examined.

The mites in the laboratory were cleared in 10 % Lactic Acid for 24-48 hours on a hot plate or in an incubator at a temperature of 40-45°C. The mites, after clearing, were transferred in 70 % alcohol and were mounted in Hoyer's medium. After the slides were dried on the hot plate or in the incubator for about a week, they were ringed with the nail polish or 'Zut slide ringing compound'. All the mites were identified using a phase contrast microscope.

TABLE I. — Showing the places of survey and the number of sphingid moths examined for the Otopheidomenid mites.

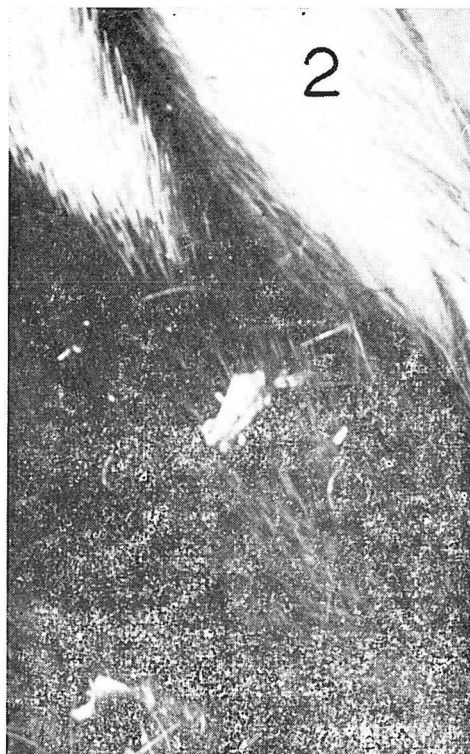
Sr. No.	Places	No. of moths examined	No. of moths Infested
1.	Zoology Museum, University of Michigan, Ann Arbor, Michigan, U.S.A.	635	2
2.	Entomology Museum, Michigan State University, East Lansing, Michigan, U.S.A.	357	4
3.	Field Museum of Natural History, Chicago, Illinois, U.S.A.	1 618	25
4.	Mr. W. Sieker's Collection, Madison, Wisconsin, U.S.A.	2 094	20
5.	Royal Ontario Museum, Toronto, Ontario, Canada.	1 064	6
6.	Government Museum, Madras, Tamil Nadu State, India.	111	9
7.	Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu State, India.	264	2
8.	University of Agricultural Sciences, Hebbal (Bangalore), Karnataka State, India.	144	0
9.	Punjab Agricultural University, Ludhiana, Punjab State, India.	237	0
Total :		6,524	68 *

* Percentage of infestation = 1.0 %.

RESULTS AND DISCUSSIONS.

Other than the parasitic Otopheidomenids, the phoretic mites Acarids, Ascids and Erythraeids were also found on the sphingid moths. The oldest collection examined was Bethune Collection (1880-1900) at Royal Ontario Museum, Toronto (Canada) which yielded several Otopheidomenids from *Protoparce rustica* Fab. which was collected in South America (exact location unknown). The Strecker's Collection (1908) at the Field Museum of Natural History, Chicago (U.S.A.) also exhibited many Otopheidomenids on several hosts collected in different parts of the world.

1) *Location of mites* : The mites were found mostly on the dorsal side of abdomen or thorax either posterior to the wing base near the tympanic area (tympanum is absent in Sphingidae) or between the cavity of metathorax and the first abdominal segment (Figs. 3, 4). Some mites were found on the dorsal or ventral side of wings close to the base (Fig. 2), while others were found around eyes, thorax and in the proboscis (Fig. 1). Except tympanic area or metathoracic-abdominal cavity where mites were found in large numbers, the other areas harbored only a few mites. Also, commonly, all the life stages were present on the host. Eggs were found attached with the scales or the hairs.



FIGS. 1 à 4. : 1) *Otopheidomenis pholusis* Prasad — two adults in the coiled proboscis ; 2) *O. pholusis* Prasad — an adult on the wing ; 3) *O. donahuei* Prasad — adults and immatures in the tympanic area ; 4) *O. cocytes* Prasad — cluster of immatures and adults on the dorsal side of metathoracic — 1st abdominal cavity.

The Otopheidomenids live in large colonies. Hundreds of eggs, larvae, nymphs and adults were commonly found on the same host. A few males and females were found in copula. It appears as mating takes place on the host and then the eggs are laid in the tympanic or meta-thoracic-abdominal areas. No eggs were found anywhere on the body except these areas.

Why is the congregation of these mites in tympanic-metathoracic-abdominal area? When there is no tympanum or tympanic cavity in Sphingidae, what is the reason of clustering of these mites in these areas alone than any other part of the body? Why is the egg laying preference only in the tympanic-metathoracic-abdominal areas? These questions can not be answered with certainty at this time. It is known in Noctuidae (Lepidoptera) that the parasitic mites inhabit the tympanic area where they feed and multiply (TREAT, 1954). It is presumed that there is some secretion in the area mentioned above on which these mites feed and reproduce in the same area.

2) *Percentage of infestation* : Out of 6,524 moths examined, only 68 moths, indicating 1.0 % infestation, were found during this study. This infestation rate is very low. It is well established from the works of TREAT (1958) that the infestation rate is much higher in live specimens than the museum preserved specimens. It is possible that many of these mites leave the host while being killed in the insect killing bottles.

The percentage of infestation varies from place to place (Table II) and host to host. Seasonal fluctuation in the rate of infestation is also known (TREAT, 1958).

3) *Geographical Distribution* : Earlier, the mites were reported only from Bolivia, Honduras, India, Panama Canal Zone, Peru and Uganda (PRASAD, 1970 a ; 1970 b ; 1972 ; 1973). From

TABLE II. — Percentage of infestation in sphingid moths of different countries.

S. No.	Countries	No. of moths examined.	No. of moths infested	Percentage infestation
1.	Bolivia	87	6	6.9
2.	Brazil	123	2	1.6
3.	Congo	8	1	12.5
4.	Ecuador	44	1	2.4
5.	Honduras	7	2	28.6
6.	India	756	11	1.5
7.	Indonesia	5	1	20.0
8.	Jamaica	10	1	10.0
9.	Malagasy (Madagascar)	7	2	28.6
10.	Mozambique (Delagoa Bay)	9	2	22.2
11.	Peru	55	5	9.1
12.	Philippines	16	1	6.3
13.	Surinam	6	2	33.3
14.	Venezuela	5	1	20.0
15.	Others **	3 371	30 ***	0.9
Total		4 509	68	—

** Number of moths areawise not recorded or places not known with certainty.

*** Includes infested moths from Guadal Canal -1, Key Islands-1, Ke Island-1, Merica-1, Mexico-2, Orizaba-1, Panama Canal Zone-3, Peru-5, Republic of Central Africa-1, Rio de Janeiro-2, South America-1, Uganda-3, West Irian (Dutch New Guinea)-2, West Malaysia-1, and Yucatan-5,

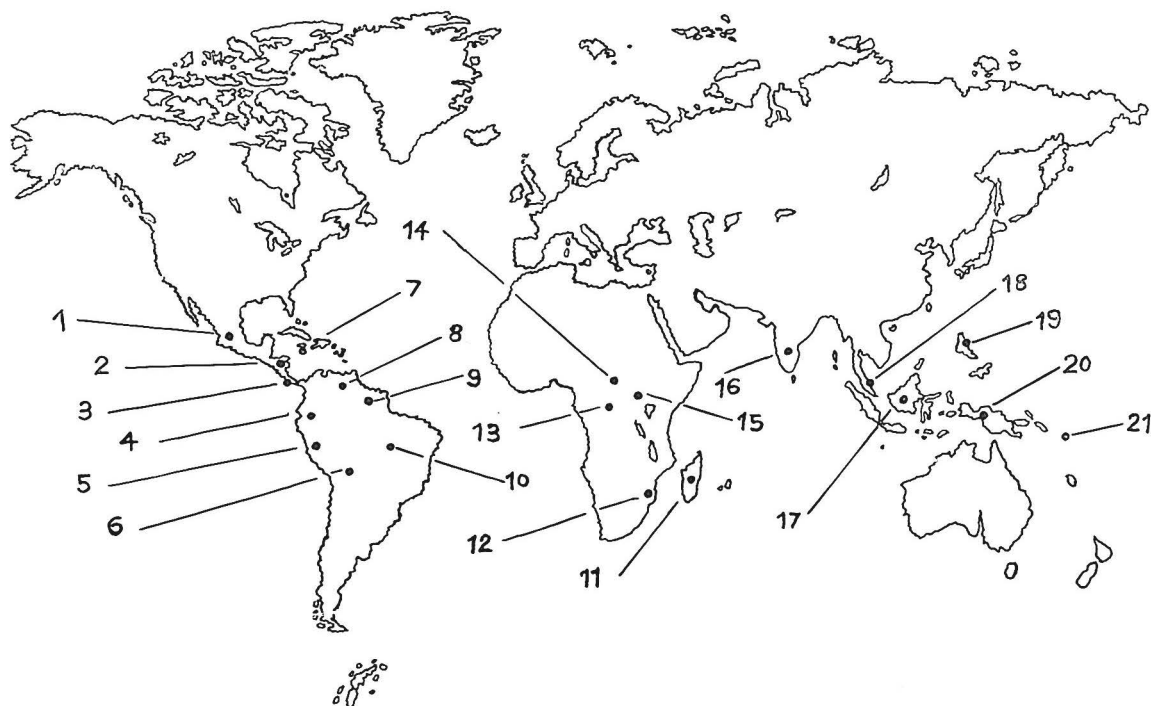


FIG. 5 : Distribution of Otopheidomenid mites on sphingid moths in different parts of the world : 1) Mexico ; 2) Honduras ; 3) Panama Canal Zone ; 4) Ecuador ; 5) Peru ; 6) Bolivia ; 7) Jamaica ; 8) Venezuela ; 9) Surinam ; 10) Brazil ; 11) Malagasy ; 12) Mozambique ; 13) Congo ; 14) Republic of Central Africa ; 15) Uganda ; 16) India ; 17) Indonesia ; 18) Malaysia ; 19) Philippines ; 20) West Irian ; 21) Guadal Canal.

Table II it is apparent that Otopheidomenids are found on sphingid moths in a number of countries like Bolivia, Brazil, Congo, Ecuador, Honduras, India, Indonesia, Jamaica, Malagasy, Mozambique, Peru, Philippines, Surinam, Venezuela etc. All these countries are located close to equator between 30°N and 30°S (Fig. 5). It is interesting to note that these mites are completely absent from other countries even though some of these belong in the above altitude (Table III). From this data it is evident that the Otopheidomenids prefer the tropical condition. It is presumed that further studies will reveal the presence of these mites in other tropical countries.

TABLE III. — Number of moths examined from different places of the world in which infestation of moths was not found.

S. No.	Places	No. of moths examined
1.	Algeria	3
2.	Argentina	12
3.	Asia	2
4.	Asia Minor	4
5.	Australia	50
6.	Bermuda	2
7.	Canada	125
8.	Capsian Sea	2
9.	Central America	5

S.No.	Places	No. of moths examined
10.	Chile	4
11.	China	13
12.	Costa Rica	14
13.	Cuba	27
14.	Egypt	8
15.	England	5
16.	Europe	67
17.	French Guiana	2
18.	Galapagos Islands	6
19.	Germany	70
20.	Guatemala	4
21.	Hongkong	2
22.	Hungary	2
23.	Iraq	18
24.	Italy	7
25.	Japan	66
26.	Korea	20
27.	New Guinea	17
28.	Nicaragua	27
29.	Panama	11
30.	Sahara	3
31.	Solomon Islands	1
32.	Spain	3
33.	Syria	2
34.	Tahiti	1
35.	Taiwan	367
36.	Uruguay	2
37.	U.S.A.	1 334
38.	U.S.S.R.	5
Total		2 313

4) *Host range* : From Table III it is clear that the Otopheidomenids parasitise a large number of hosts. Out of 151 genera and 623 species and subspecies studied, 30 genera and 47 species and subspecies were found infested with Otopheidomenids. More than one species were found parasitized in same genus of the moths. Also, same moth species present in two or more areas were found parasitized by the Otopheidomenids. At this time it is not known if a single moth is used by a single or multiple Otopheidomenid species.

Most commonly, unilateral infestation of the tympanic area was found. However, in a few cases, both left and right tympanic areas were found infested by these mites.

TABLE IV. — Different genera, species and subspecies of sphingid moths found infested by Otophidomenids in different areas of the world.

	Genera	Species & subspecies (countries or area)
1.	<i>Acherontia</i>	<i>lachesis</i> (Philippines).
2.	<i>Acosmeryx</i>	<i>anceus</i> (Dutch New Guinea).
3.	<i>Amplifypterus</i>	<i>gannascus</i> (Panama Canal Zone).
4.	<i>Antinephele</i>	<i>achlora</i> (Uganda).
5.	<i>Batocnema</i>	<i>cocquerehi</i> (Madagascar)
6.	<i>Bhomis</i>	<i>necki</i> (Dutch New Guinea)
7.	<i>Campsogene</i>	<i>panopos</i> (Indonesia)
		<i>panopos celebensis</i> (Malaysia).
8.	<i>Chaerocampa</i>	<i>capensis</i> (Delagoa Bay).
		<i>celerio</i> (Delagoa Bay and India).
		<i>nessus</i> (Ke Island).
9.	<i>Cocytius</i>	<i>cluentius</i> (Jamaica).
		<i>duponchal</i> (Peru).
10.	<i>Coelonia</i>	<i>fulvinotata</i> (Republic of Central Africa).
11.	<i>Deliephila</i>	<i>hypothous</i> (Key Island).
12.	<i>Dilophonata</i>	<i>ella</i> (Yucatan).
13.	<i>Erinnyis</i>	<i>ello</i> (Yucatan).
		<i>lassauxi merianae</i> (Mexico).
		<i>obscura</i> (Peru).
14.	<i>Herse</i>	<i>cingulata</i> (Merica).
15.	<i>Hippotion</i>	<i>aporodes</i> (Uganda).
16.	<i>Isognathus</i>	<i>rimosa inclitus</i> (Yucatan).
17.	<i>Macroglossa</i>	<i>ceculus</i> (Brazil).
18.	<i>Nephele</i>	<i>hespera</i> (India).
19.	<i>Pachylia</i>	<i>darceta</i> (Panama Canal Zone and Peru).
		<i>resumens</i> (Panama Canal Zone).
20.	<i>Panogena</i>	<i>iasmini</i> (Madagascar).
21.	<i>Philampelus</i>	<i>anchemolus</i> (Mexico).
		<i>satellita</i> (Surinam).
22.	<i>Pholus</i>	<i>anchemolis</i> (Bolivia).
		<i>labrusciae</i> (Peru).
		<i>obliquus</i> (Bolivia).
		sp. (Honduras).
23.	<i>Phlegethontius</i>	<i>diffisa tropicalis</i> (Bolivia).
		<i>lichaena</i> (Peru).
		<i>rustica</i> (Ecuador, Orizaba and Peru).
24.	<i>Protoparce</i>	<i>convolvuli</i> (India).
		<i>rustica</i> (S. America).
25.	<i>Pseudosphinx</i>	<i>tetrio</i> (Bolivia & Venezuela).
26.	<i>Sphinx</i>	<i>aurigutta</i> (Bolivia).
		<i>duponchelli</i> (Surinam).
		<i>istar</i> (Guadal Canal).
		<i>rustica</i> (Rio de Janeiro).
27.	<i>Theretra</i>	<i>clotho</i> (India).
28.	<i>Triptogon</i>	<i>lugubris</i> (Honduras).
29.	<i>Xylophanes</i>	<i>docilis</i> (Brazil).
		<i>maculator</i> (Peru).
30.	<i>Zonilia</i>	<i>viridescans</i> (Congo).

CONCLUSION.

How do these mites get hold of the uninfested host? Is there any trail that is followed by other mites or only one female mite starts the colony? Do more than one species use a single host? Only the future studies would answer these questions. It is known in the case of *Dicrocheles phalaenodectes* Treat that the mites follow the chemical trail and infest the uninfested host on the plant when the moths visit the flowers for feeding.

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ABSTRACT.

The Otopheidomenids (Acarina : Otopheidomenidae) were found to parasitize 30 genera and 47 species and subspecies of sphingid moths (Lepidoptera) in various countries located between the latitude of 30°N and 30°S. The percentage of infestation in the museum preserved moths was found to be 1.0 %. However, the percentage of infestation was found to be 28.6 % in the moths of Malagasy and Honduras and 33.3 % in the moths of Surinam. All the life stages were found on the same host mostly in the tympanic area or metathoracic-Ist abdominal cavity.

RÉSUMÉ.

Les Otopheidomenidae parasitent 30 genres et 47 espèces ou sous-espèces de Sphingididae (Lépidoptères) dans diverses régions situées entre les parallèles 30° N et 30° Sud. Le pourcentage d'infestation sur les papillons en collections dans les musées est de 1 %. Toutefois, le pourcentage d'infestation est de 28,6 % pour les papillons de Madagascar et du Honduras et de 33,3 % pour les papillons du Surinam. Toutes les stases sont récoltées sur le même hôte, principalement dans la zone du tympan ou dans la première cavité abdominale métathoracique.

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