

A PRELIMINARY SURVEY OF DOMICILIARY COCKROACHES AND THEIR OOTHECAL PARASITES IN SRI LANKA

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Abstract

A survey of domiciliary cockroaches and their oothecal parasites was carried out in 17 districts. The study was based on empty and live cockroach oothecae collected from dwelling houses. Five species of cockroaches; *Periplaneta americana* (L.) *Neostylopyga rhombifolia* (Stoll) *Periplaneta australasiae* (F.) *Supella longipalpa* (F.) and *Blatella germanica* (L.) were found frequenting houses. Of them, *P. americana* was the most abundant and widely distributed species, while *B. germanica* was the least abundant species. *P. americana* and *N. rhombifolia* were present in all but one district, while *P. australasiae* and *S. longipalpa* were confined to 12 and 08 districts respectively. Mannar district was peculiar in that only one domiciliary species, *N. rhombifolia* was recorded from there. Only two species of oothecal parasites, *Tetrastichus hagenowii* (Ratz.) and *Evania appendigaster* (L.) were encountered during the study. Each of these parasite species was characterized by the size of the emergence hole they made in cockroach oothecae. Thus on the basis of the emergence hole alone it was possible to categorize the empty oothecae as being parasitized. Of the oothecae, those of *P. americana* and *P. australasiae* were parasitized by both species of parasites, while oothecae of *N. rhombifolia* was parasitized by *T. hagenowii* only. Oothecae of *S. longipalpa* and *B. germanica* were not parasitized at all. There appears to be a great paucity in the oothecal parasite fauna of Sri Lanka, compared to India where eight species of hymenopterans are known to parasitize oothecae of domiciliary cockroaches. The possibility of controlling household cockroaches using local and introduced parasites remains to be explored. The shortcomings in this preliminary survey are also reported.

Key words: Domiciliary cockroaches; Oothecal parasites

1. Introduction

More than 3,500 species of cockroaches belonging to about 450 genera are found in the world¹⁴.

Of them 14 species are domiciliary cockroaches. The domiciliary species in particular are of medical importance as household pests and as vectors of various diseases.^{9, 10, 12.}

Parasites belonging to at least six families of hymenopterans have been reported from oothecae of household cockroaches.¹¹

This survey of domiciliary cockroaches and their oothecal parasites was undertaken with a view to use some of the parasites in the biological control of cockroaches and the investigation was based entirely on the oothecae collected during the survey. The cockroach oothecae and their oothecal parasites encountered during the study are reported here.

2. Materials and Methods

During the investigation residential houses in 17 out of the 24 districts were surveyed for cockroach oothecae. Collection of oothecae was done by

selected volunteers (Science Teachers) in all the 17 districts. This method of collecting oothecae had to be restored due to constraints on travel costs and time. The volunteer school teachers in each district were given clear instructions on how to locate and randomly remove cockroach oothecae without damaging. They were instructed to search the kitchens of residential houses and examine all exposed and concealed surfaces for cockroach oothecae, spending about 30 min. at each residence.

They were also provided with data sheets to furnish the following information:-

District, town, address of residence, No. of oothecae collected, collector's name and date of collection. Small consignments of oothecae from these 17 districts were received by post in well packed plastic vials (7.15 x 1.25 cm) plugged with cotton wool.



P. australasiae

Length : 9.5 ± 1.4 mm.
Breadth : 5.4 ± 0.4 m.m.
Thickness : 3.2 ± 0.8 mm.



P. americana

Length : 8.2 ± 1.1 mm.
Breadth : 5.2 ± 0.3 mm.
Thickness : 3.0 ± 0.7 mm.



N. rhombifolia

Length : 10.2 ± 1.3 m.m.
Breadth : 5.2 ± 0.4 m.m.
Thickness : 3.0 ± 0.4 mm.



S. longipalpa

Length : 3.8 ± 1.7 mm.
Breadth : 2.4 ± 0.6 mm.
Thickness : 2.1 ± 0.2 mm.



B. germanica

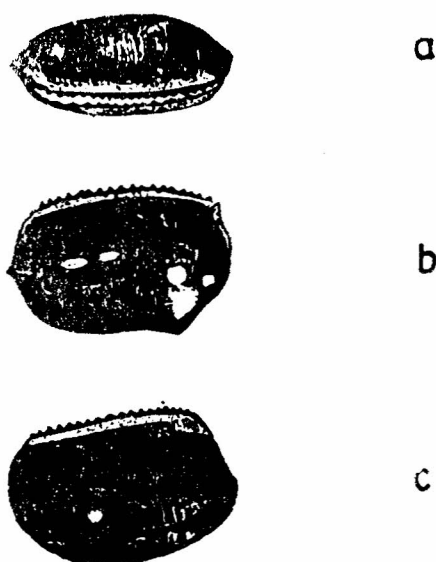
Length : 4.2 ± 1.6 m.m.
Breadth : 3.0 ± 0.5 m.m.
Thickness : 2.7 ± 0.2 mm.

Figure 1.

The size and shape of oothecae of five species of domiciliary cockroaches.

Oothecae received from each district was analysed separately. Based on the differences in the external form of oothecase they were assigned to species. As each cockroach species is characterised by the form of its oothecae this was a convenient method of distinguishing the different species. The shape, size and a description of the oothecae of cockroach species encountered during the study are given in Fig 1.

After assigning oothecae to species, they were further separated into two groups; empty or hatched oothecae with emergence holes *ie.* those from which cockroach nymphs or parasites had emerged, and those apparently healthy and alive or unhatched. Live oothecae were held individually in vials until emergence of parasites or nymphs. The emergents from live oothecae provided a



- a) P. americana emerged
- b) E. appendigaster emerged
- c) T. hagenowii emerged *

Figure 2

Empty oothecae of P. americana showing the three different types of emergent holes

Of a total of 789 oothecae collected from the 17 districts, 20.0% was found to be parasitized by two species of hymenopterans (Table II). They were *Tetrastichus hagenowii* (Ratz) (Hymenoptera: Eulophidae) and *Evania appendigaster* (L.) (Hymenoptera: Evaniidae). Each of these parasites made a characteristic emergence hole during exit from cockroach oothecae in which they developed. Thus, oothecae from which *T. hagenowii* had emerged contained a small emergence hole of diameter. 0.2 mm, while those from which *E. appendigaster* had emerged had a larger hole of diameter. 3.2 mm. Oothecae which had not been parasitized and from which cockroach nymphs emerged had a split along its keel (Fig. 2). Based on the nature of the emergence hole, the empty oothecae collected were categorized as being parasitized (either by *T. hagenowii* or by *E. appendigaster*) or unparasitized.

TABLE II
INCIDENCE OF PARASITISM (%) AMONG COCKROACH
OOTHECAE FROM THE 17 DISTRICTS

Host	<i>P.a</i>		<i>P.au</i>		<i>N.r</i>	
	<i>E.a</i>	<i>T.h</i>	<i>E.a</i>	<i>T.h</i>	<i>E.a</i>	<i>T.h</i>
Amparai	11.11	—	—	—	—	—
Anuradhapura	20.20	—	—	—	—	—
Badulla	—	—	—	—	—	33.33
Batticaloa	11.11	18.52	—	—	—	—
Colombo	25.00	25.00	—	50.00	—	16.66
Galle	23.81	33.33	—	—	—	12.50
Gampaha	18.75	25.00	50.00	—	—	—
Hambantota	—	7.14	—	—	—	—
Jaffna	—	—	—	—	—	8.33
Kalutara	6.67	—	—	—	—	10.00
Kandy	—	—	—	—	—	5.88
Kegalle	11.11	14.81	—	66.66	—	—
Mannar	—	—	—	—	—	—
Matale	—	—	—	—	—	6.45
Matara	11.11	25.00	—	33.33	—	—
Trincomalee	4.16	20.83	—	100.00	—	—
Vanuniya	20.20	25.00	—	33.33	—	—

Of the five species of cockroach oothecae collected, parasites emerged only from oothecae belonging to three species of cockroaches (Table II). Thus, no parasites were recorded from oothecae of *B. germanica* and *S. longipalpa*. Oothecae of *P. americana* and *P. australasiae* were parasitized by both species of parasites, while those of *N. rhombifolia* were parasitized by *T. hagenowii* only. *E. appendigaster* was recorded from 11 of the 17 districts surveyed and *T. hagenowii* from 14 districts. The level of parasitism by each species of parasites seems to vary in the different districts depending on the species of cockroach present (Table II). Incidence of parasitism among *P. americana* oothecae was much higher than those of *P. australasiae* and *N. rhombifolia*.

The number of residential houses sampled during the survey and the total number of randomly selected oothecae by the volunteers in the different districts varied greatly. This variability in sample size (n) was minimized to a certain degree by considering the relative abundance of the different cockroach species and % parasitism.

4. Discussion

Of the domiciliary species of cockroaches which deposit their oothecae (oviparous) only five species were found during the survey. Records at the National Museum, Sri Lanka, however, lists seven species of cockroaches as household pests of Sri Lanka (Table III). As to why two of the species listed by them were not encountered during the survey cannot be explained. Perhaps, these two species of cockroaches are found less abundantly and the oothecae may be deposited in inaccessible places. However, due to the small number of oothecae received from certain districts, no definite conclusion can be drawn about the species present particularly in these districts of Sri Lanka, from this preliminary survey.

TABLE III
THE DOMICILIARY COCKROACHES REPORTED FROM
SRI LANKA* AND INDIA**

Sri Lanka	India
<i>Blattella germanica</i> (L)	<i>Blattella germanica</i> (L)
<i>Blatta orientalis</i> (L)	<i>Neostylophyga rhombifolia</i> (Stoll)
<i>Neostylophyga rhombifolia</i> (Stoll)	<i>Periplaneta americana</i> (L)
<i>Periplaneta americana</i> (L)	<i>Periplaneta australasiae</i> (L.)
<i>Periplaneta brunnea</i> (Burmister)	<i>Periplaneta brunnea</i> (Burmister)
<i>Supella longipalpa</i> (F.)	<i>Supella longipalpa</i> (F)

* Records at the National Museum, Sri Lanka

** Narasimham & Sankaran (1976)

P. americana. which has a world wide distribution was the most abundant species in Sri Lanka, being absent only from the Mannar district. Much of the Mannar district lies in a small island 22.5 km from the mainland. The sample of oothecae was received from this small island and perhaps due to its isolation is inhabited by the wingless *N. rhombifolia* which has completely displaced *P. americana*.

The two species of parasites recorded during the survey were parasitic on three of the cockroach species only. Exposure of oothecae of the five domiciliary species of cockroaches to the two parasites, under laboratory conditions gave similar results⁶, thus confirming the findings of this survey.

The oothecal parasite, *Tetrastichus asthenogmus* (Waterson) had been described from Sri Lanka, by Waterson¹⁵. However, later work¹¹ has indicated this to be a misidentification of a poorly developed specimen of *T. hagenowii*. Six species of domiciliary cockroaches (Table III) and eight species of oothecal parasites have been reported from India⁷. Their work reports the following six parasite species in addition to *T. hagenowii* and *E. appendigaster*. They are (1) *T. asthenogmus* (Waterston) (2) *Evania* sp. near *antennalis* Westw. (3) *Anastacus* sp (Hymenoptera: Eupelmidae), (4) *Comperia mercaeti* (Compere) (Hymenoptera: Encyrtidae), (4) *Comperia mercti* (Compere) (Hymenoptera: Encyrtidae), (5) *Anastatus tenuipes* Bolivar (Hymenoptera: Eupelmidae) and (6) *Tetrastichus* sp. nov. (miser group). Species (3) and (6) have been subsequently described by Z. Boucek of the C.I.E. London⁷. As to why none of the above parasites occur in Sri Lanka inspite of the fact that their hosts are well represented here, remains to be investigated.

Unlike in *S. longipalpa* absence of oothecal parasites in *B. germanica* is understandable, due to its habit of depositing its oothecae only when the nymphs are about to emerge. But according to Cameron² the parasite *Brachygaster minutes* (OL) (Hymenoptera: Evaniidae) has been recorded from *S. supellictilum*, which is recently known as *S. longipalpa*⁴. This parasite has not been reported from Sri Lanka, but *C. mercti* has been reported from the Indian continent⁷ as being specific to *S. longipalpa* (F.). With regard to *N. rhombifolia*, although *F. appendigaster* has been reported as a parasite of this species by Swezey¹³, Roth & Willis¹¹ considers this to be erroneous. Moreover, the latter authors have even failed to parasitize *N. rhombifolia* oothecae with *T. hagenowii*, in the laboratory. Contrary to these records, oothecae of *N. rhombifolia* collected during this survey were found to be parasitized by *T. hagenowii* (parasitism level ranged from 6.5-33.3%). Furthermore, laboratory studies⁶ confirmed that *N. rhombifolia* is a host of *T. hagenowii* but not of *E. appendigaster*.

In addition to the two parasites encountered during the survey, a wasp *Ampulex compressa* (F.) (Hymenoptera: Sphecidae) which attacks and oviposits into the adults and late nymphal stages was found to parasitize three of the

domiciliary species of cockroaches namely, *P. americana*, *P. australasiae* and *N. rhombifolia*⁸. *A. compressa* along with the other oothecal parasites have been used in the control of cockroaches in some Pacific islands^{5, 16}, and in Bombay, India¹.

The low level of parasitism recorded particularly for *P. americana*, the most dominant and abundant species of domiciliary cockroaches in Sri Lanka, suggests that more promising parasites not represented in Sri Lanka would be worth introducing. Basic information on the biology, host specificity and efficiency of the three local parasites, *T. hagenowii*, *E. appendigaster*, and *A. compressa* are already available with us^{3, 5, 8}. This information may be used in selecting additional species, specially those occurring in India⁷, for introduction.

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References

1. Amonkar, S. V., Vijayalakshmi, L. V. & Rhakkar, G. V. (1974) Control of American Cockroach *Periplaneta americana* (L) by its egg parasite *Tetrastichus hagenowii* (Ratz.): a field trial. Symposium on biological approach to problems in medicine, industry and agriculture, Bhabha Atomic Research Centre, Bombay 228 - 223.
2. Cameron, E. (1955) on the parasites and predators of the cockroach I. *Tetrastichus hagenowii*. Bull. ent. Res. 46: 137 - 147.
3. Gamalath, P. (1980) Investigation of the biology and life history of *Tetrastichus hagenowii* (Ratz), the egg parasite of the American cockroach *Periplaneta americana* (L). M.Sc. Thesis, University of Sri Jayewardenepura, Sri Lanka, 184 pp.
4. Gurney, A. B. (1970) On the scientific name of the brown banded Cockroach, *Supella longipalpa* (Fabricius) (Dictyoptera, Blattaria, Batteilidae), U.S. Dept. Agr. Coop. Econ. Ins. Rep., 20, 752-754.
5. Hoyt., C. P. (1957) Parasites and predators introduced into the pacific islands for the biological control of insects and other pests. South Pacific Commission Tech. Paper. No. 101.
6. Kumarasinghe, N. C. (1984) The biology and behaviour of *Evania appendigaster* (L). (Hymenoptera: Evanidae), an oothecal parasite of *Periplaneta americana* (L). M.Sc. Thesis, University of Sri Jayewardenepura, Sri Lanka, 300 pp.
7. Narasimham, A. U. & Sankaran, T. (1979) Domiciliary cockroaches and their oothecal parasites India Entomophage 24: 273-279.

8. Perera O. P. & Edirisinghe, J. P., (1985) Household cockroaches parasitized by *Ampulex compressa* Fabr. in Sri Lanka. (Abstract) Proc. 41st SLAAS Annual Sessions, Part I: 72-73.
9. Roth, L. M. & Willis, E. R. (1954) The reproduction of cockroaches. Smithson. Misc. Coll. 122 (12)
10. Roth, L. M. & Willis E. R. (1957) The Medical & Veterinary Importance of Cockroaches, Smithson. Misc. Coll. 134, 147 pp.
11. Roth, L. M. & Willis E. R. (1960) The Biotic Association of Cockroaches, Smithson, Misc. Coll. 141. 470 pp.
12. Steinhouse, E. A. (1963) Insect pathology. Vol. 1-3, Academic Press, London.
13. Swezy, O. H. (1929) Proc. Hawaii ent... Sec. 7: 282-292
14. Truman, L. C. (1961) Pest Control technology 6 Prude University, Lafayette, Indiana.
15. Waterson, J. (1915) New species of Chalcidoidea from Ceylon. Bull. ent. Res. 5, 325-342
16. Zimmerman . C. (1948) Insects of Hawaii. Vol. 2. Apterygota to Thysanoptera, inclusive. Honolulu. 475 pp.