



Formosan Entomologist

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【Research report】

臺灣蚊蟲種類、寄生微生物及卵不育性之調【研究報告】

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Received: Accepted: Available online: 1985/09/01

Abstract

摘要

自民國七十二年七月至翌年六月間，分別自本省東、南、西、北部各種不同的孳生源採集蚊幼蟲，目的在尋找蚊幼蟲自然感染之寄生蟲或其他病原菌，並檢查家蚊屬蚊卵的不育性，此外也進行參攷標本之收藏。在此期間共採得11屬50種之蚊蟲，其幼蟲、蛹，及成蟲均製成標本。可供日後有關研究鑑定種類之參攷。在所有的孳生源中，以切斷竹筒之水中所得之蚊幼蟲種類最多，我們曾調查熱帶家蚊、雙角家蚊、黃尾家蚊及斑翅家蚊之卵的發育，在75個熱帶家蚊之卵塊中發現一個卵塊疑似不育性的卵塊。在白點斑蚊、海氏家蚊及竹生翠蚊等三種蚊幼蟲體內曾發現微孢子原蟲、原蟲的孢囊內均含8個孢子，屬於Amblyospora屬，此微孢子原蟲對白點斑蚊及海氏家蚊之蚊幼蟲有致死性，將白點斑蚊日微孢子原蟲餵食東鄉斑蚊幼蟲，結果對後無致病性。竹生翠蚊幼蟲感染微孢子原蟲後不會死亡，以第三齡的幼蟲較易發現其感染。在斑翅直蚊發現過一種，直徑約為100微米的纖毛蟲的感染，可能屬於Lambornella，幼蟲感染後會死亡，巨型叢蚊幼蟲發現有體腔真菌之感染，該真菌對此蚊幼蟲有致死性。這些在蚊幼蟲的自然族群所找到的寄生原蟲及體腔真菌，對存在於同一處的其他種類的蚊幼蟲無致病性，故可推論它們均有其特定之寄主。

Key words:

關鍵詞:

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SURVEY OF SPECIES, PARASITIC MICROORGANISMS AND CYTOPLASMIC INCOMPATIBILITY OF MOSQUITOS IN TAIWAN

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From July 1983 to June 1984, field collection of mosquito larvae has been undertaken in our laboratory. Fifty species in eleven genera of mosquitos have been collected. Egg rafts of four species of mosquitos of the genus *Culex* were collected from the field and were examined for embryonic development. Only 1 of 75 collections of *Culex pipiens quinquefasciatus* was suspected to be cytoplasmically incompatible. Thus far we have found microsporidan parasites in three species of mosquitos, *Aedes albolineatus*, *Culex alis* and *Tripteroides bambusa*. Each of these parasites has a pansporoblast with 8 spores and presumably is in the Genus *Amblyospora*. The microsporidans found in the former two species are very virulent, all infected larvae detected died. The infection in *Tripteroides bambusa* is benign, infected larvae develop and survive as well as uninfected larvae. We also have found a ciliate infection, probably a species of *Lambornella* in *Orthopodomyia anopheloides*; all infective larvae died. All of these parasites appear to be highly host specific. Larvae of *Armigeres magnus* infected with *Coelomomyces* have also been collected; all infected larvae died eventually.

INTRODUCTION

Problems presently being experienced in the control mosquitos have given an impetus to search for pathogens and parasites of mosquitos which might be useful for control (Chapman, 1974; Chen and Lien, 1979; Hertlein et al. 1980). In spite of their potential for biological control, the parasites in Taiwan that have been reported are mainly those of J.C. Lien; he reports *Coelomomyces* from 10 species (Laird and Lien, 1980) and a microsporidan from 1 species (Lien, 1978). Three species of gregarines found in 4 species have been described by Lien and Lavine (1980). Cytoplasmic incompatibility which was a means of eradication of mosquitoes has also been considered (Barr, 1966, 1969) since this phenomenon was discovered by Marshall and Staley (1937). So far there are no reports of incompatible egg rafts in the field in Taiwan. Therefore we have examined mosquito larvae collected in various breeding habitats for the presence of parasites, and some egg rafts for incompatible eggs from July 1983 to June 1984. Field-collected specimens of larvae, pupae and adults have been retained for reference purposes.

MATERIALS AND METHODS

Field collections have been undertaken in various breeding places in different parts of Taiwan

island. Collected larvae of mosquitos were taken to the laboratory and abnormal larvae were separated to examine their parasites, we attempted to infect other larvae with isolated parasites. Normal larvae were bred to adults, fourth-instar larval and pupal skins were mounted, and adults were pinned. Egg rafts that we collected were allowed to hatch and the numbers of unhatched eggs and their stages of embryonic development were recorded.

RESULTS AND DISCUSSION

1. Parasites of mosquito larvae

In August 1983 we collected larvae of *Orthopodomyia anopheloides* infected with ciliated protozoans from water in bamboo stumps in Chu Shan Nantou. The ciliates, probably a species of *Lambornella*, were pear-shaped and very large, about 100 μ in length. They were seen in the thorax and head of two larvae of 46 examined. As the infections progressed the ciliates became numerous and could be seen swimming about in the thorax and abdomen. Both infected larvae died and ciliates were seen swimming in the culture medium. Twenty eight apparently uninfected mosquitos from the same collection were exposed to the free swimming ciliates and, of these, three became infected. These larvae also died.

We have found microsporidan parasites in larvae of 3 species of mosquitos in Taiwan: *Aedes albolineatus*, *Culex alis* and *Tripteroides bambusa*. In each case the pansporoblast produced 8 spores suggesting that all of the parasites were in the genus *Amblyospora*. The microsporidan of *Aedes albolineatus* was found in a dead third-instar larva. Since we had no laboratory colony of *Aedes albolineatus*, we fed the spores to larvae of *Aedes togoi* but none became infected. We collected larvae of *Culex alis* from brackish water in rock pools in ChiaLoSui and ChingWahShu Pintung in September 1983, and in these, 8 of 1,449 larvae were infected with the microsporidan. All infected larvae died. Pansporoblasts was about 8 μ in diameter and the spores about 5 μ in length. In November 1983, larvae of *Armigeres magnus* infected with a species of *Coelomomyces* were collected from water in bamboo stumps at PayYun, Taitung. All infected larvae died. All of these parasites appear to be highly host specific. In all cases, infected larvae of one species were found in association with uninfected larvae of other species and other genera.

2. Mosquito fauna

As described by Lien (1978), the occurrence of most mosquitos varies with breeding habitats. In our collections *Aedes albopictus*, *Culex bicornutus* and *Culex p. quinquefasciatus* were the most widely distributed species. The greatest variety of mosquito larvae was found in water of bamboo stumps, probably due to the nutrient food, constant moisture and optimal temperature. All mosquitos collected are shown in Table 1. The breeding habitats associated with these larvae are shown in Table 2. In our collections, larvae of *Culex fuscianus* and *Culex halifaxii* are predatory, as are *Toxorhynchites*. Each larva ate about 80 mosquito larvae throughout the larval stage. These two species are often associated with larvae of other species of *Culex* and may play an important role in controlling the natural population of *Culex* mosquitos.

3. Survey of incompatible egg rafts

The egg rafts we collected include *Culex pipiens quinquefasciatus*, *Culex bicornutus*, *Culex fuscianus* and *Culex neomimulus* either from buckets or from drainages in Paitou, Taipei. Their hatch rate is shown in Table 3. Only one egg raft of *Culex p. quinquefasciatus* is suspected to incompatible, in which about 93% (54/58) of eggs showed evidence of embryonic development, indicating that the embryo died early in development.

Table 1. Specimens of field collection

Genus	No.	Species
<i>Aedes</i>	12	<i>albopictus</i> , <i>aegypti</i> , <i>albolateralis</i> , <i>albolineatus</i> , <i>hatorii formosensis</i> , <i>japonicus</i> , <i>loi</i> , <i>malikuli</i> , <i>perplexus</i> , <i>pulchriventer</i> , <i>togoi</i>
<i>Anopheles</i>	5	<i>balabacensis</i> , <i>fulviatilis</i> , <i>lindesayi</i> , <i>sinensis</i> , <i>indefinitus</i>
<i>Armigeres</i>	4	<i>flavus</i> , <i>magnus</i> , <i>omissus</i> , <i>subalbatus</i>
<i>Culex</i>	17	<i>alis</i> , <i>bicornutus</i> , <i>brevipalpis</i> , <i>fuscanus</i> , <i>hainanensis</i> , <i>halifaxii</i> , <i>hayashii</i> , <i>mimeticus</i> , <i>neomimulus</i> , <i>murrelli</i> , <i>pallithodorax</i> , <i>p. quinquefasciatus</i> , <i>sasai</i> , <i>sitiens</i> , <i>spiculosus tritaeniorhynchus</i> , <i>vishnui</i>
<i>Heizmania</i>	2	<i>macdonaldi</i> , <i>reidi</i>
<i>Malaya</i>	1	<i>genurostris</i>
<i>Mimomyia</i>	1	<i>fusca</i>
<i>Orthopodomyia</i>	1	<i>anopheloides</i>
<i>Toxorhynchites</i>	2	<i>aurifluus</i> , <i>manicatus</i>
<i>Tripteroides</i>	2	<i>aranoides</i> , <i>bambusa</i>
<i>Uranotaenia</i>	3	<i>annandalei</i> , <i>macfarlanei</i> , <i>novobscura</i>

Table 2. Breeding habitats associated with mosquitos

Breeding habitat	Genus or species of mosquitos
Bamboo stump	<i>Aedes</i> , <i>Armigeres</i> , <i>Culex</i> , <i>Heizmania</i> , <i>Mimomyia</i> , <i>Orthopodomyia</i> , <i>Toxorhynchites</i> , <i>Tripteroides</i>
Rock pools	
Brackish water	<i>Aedes togoi</i> (northern, eastern), <i>Culex alis</i> (southern), <i>Culex sitiens</i>
Fresh water	<i>Aedes japonicus</i> , <i>Culex pallithodorax</i>
Crab holes	<i>Uranotaenia</i>
Plant leaf axil	<i>Armigeres</i> , <i>Aedes</i> , <i>Malaya</i>
Tree holes	<i>Aedes</i> , <i>Culex bicornutus</i> , <i>Culex brevipalpis</i>
Artificial containers	<i>Aedes albopictus</i> , <i>Culex pipiens</i> , <i>Culex sasai</i>

Table 3. Examination of egg incompitibility in *Culex* mosquitos

Species	No. Egg rafts	Av. egg size	No. egg			Hatch rate
			Hatched	Dead	Infectile	
<i>quinquefasciatus</i>	A. 73	158	11,078	455	143	0.949
	B. 1		72	12	39	0.585
	C. 1		0	54	4	0
<i>bicornutus</i>	2	166	327	3	1	0.988
<i>fuscianus</i>	3	77	214	0	17	0.931
<i>neomimulus</i>	2	238	476	30	2	0.937

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ACKNOWLEDGEMENT

This work is supported by Grant NSC73-0412-B010-01 from National Science Council, R O C.

臺灣蚊蟲種類、寄生微生物及卵不育性之調查

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自民國七十二年七月至翌年六月間，分別自本省東、南、西、北部各種不同的孳生源採集蚊幼蟲，目的在尋找蚊幼蟲自然感染之寄生蟲或其他病原菌，並檢查家蚊屬蚊卵的不育性，此外也進行參攷標本之收藏。在此期間共採得 11 屬 50 種之蚊蟲，其幼蟲、蛹，及成蟲均製成標本。可供日後有關研究鑑定種類之參攷。在所有的孳生源中，以切斷竹筒之水中所得到之蚊幼蟲種類最多，我們曾調查熱帶家蚊、雙角家蚊、黃尾家蚊及斑翅家蚊之卵的發育，在 75 個熱帶家蚊之卵塊中發現一個卵塊疑似不育性的卵塊。在白點斑蚊、海氏家蚊及竹生翠蚊等三種蚊幼蟲體內曾發現微孢子原蟲、原蟲的孢囊內均含 8 個孢子，屬於 *Amblyospora* 屬，此微孢子原蟲對白點斑蚊及海氏家蚊之蚊幼蟲有致死性，將白點斑蚊日微孢子原蟲餵食東鄉斑蚊幼蟲，結果對後無致病性。竹生翠蚊幼蟲感染微孢子原蟲後不會死亡，以第三齡的幼蟲較易發現其感染。在斑翅直蚊發現過一種，直徑約為 100 微米的纖毛蟲的感染，可能屬於 *Lambornella*，幼蟲感染後會死亡，巨形叢蚊幼蟲發現有體腔真菌之感染，該真菌對此蚊幼蟲有致死性。這些在蚊幼蟲的自然族群所找到的寄生原蟲及體腔真菌，對存在於同一處的其他種類的蚊幼蟲無致病性，故可推論它們均有其特定之寄主。

