Progress of Biological Studies on Primary Reproductives in *Cryptotermes domesticus* (Isoptera: Kalotermitidae)

by

Zhen-You Huang[1]*, Xing Qian[1], Jun-Hong Zhong[1], Chuan-Guo Xia[1]

& Jian Hu[2, 3]

ABSTRACT

Cryptotermes domesticus (Haviland) is a serious pest causing wood damage. It is one of the most important termite species in China. This paper is intended to summarize the progress of biological studies on the life cycle of primary reproductives, the ecological factor's influence on swarming, and on new colony development and behavioral features.

Key words: *Cryptotermes domesticus*， Primary reproductives, Biological study

INTRODUCTION

Cryptotermes domesticus Haviland (Isoptera: Kalotermitidae) is a species of termite known to cause severe damage to wood and wood products worldwide (Termite research laboratory of Guangdong entomological institute 1979, Edwardo & Mill 1986, Ping & Xiu 1997). It originated in India and Malaysia (Gay 1969, Huang *et al.* 1989, Li 2002). Now it has spread into Sri Lanka, Indonesia, Taiwan, Thailand, Singapore, Japan, Finland, Panama, Samoa, the Solomon Islands, New Britain, the Society Islands, Fiji, Australia, Guma and southern provinces of China such as Guangdong, Guangxi, Hainan, and Yunnan by importing wood and wood products. In Zhanjiang, Guangdong Provinces, P. R. China, it has caused much damage to wood and wood products (Gay 1969, Huang *et al.* 1989, Zhu *et al.* 1994, Li 2002).

C. domesticus is easily spread and difficult to control. In order to prohibit the spreading of *C. domesticus,* our group studied the biology of primary

[1]Guangdong Entomological Institute, Guangzhou 510260, China

[2] South China Botanical Garden, The Chinese Academy of Sciences, Guangzhou 510650， China

[3] Graduate University of Chinese Academy of Sciences, Beijing 100049, China

* Author for correspondence, E-mail： Huangzyoo2@163 .com

Natural Science Foundation of Guangdong Province (No. 010085)

reproductives in *C. domesticus* in Guangzhou for many years.

PROGRESS OF BIOLOGICAL STUDIES ON PRIMARY REPRODUCTIVES IN C. DOMESTICUS

The life cycle and development of primary reproductives in *C. domesticus*.

C. domesticus was reared using *Pinus massoniana lamb*, *Pinus spp.*, *Pseudotsuga menziesis*, *Cyclobalanopsis spp.*, and *Schima spp.* A life cycle from a couple of primary reproductives establishing a new colony to reproduce the new primary reproductives was investigated (Huang *et al.* 2005).

The results indicate that finishing a life cycle at indoor temperatures required seven years in Guangzhou and six or seven years in Zhanjiang; but at a constant temperature of 27℃ and relative humidity of 80%,the cycle can be completed in two or three years (Huang *et al.* 2005).

The swarm period of primary reproductives in *C. domesticus*.

The swarm period of primary reproductives in *C. domesticus* was longer than other species and occurred yearly from the middle of April to late August in Guangzhou based on three years of observation (Huang *et al.* 2004a). The first day of the swarm period was the 15th of April and the last day was the 16th of September (n=60). The swarm period was about 55-80 days and the peak occurred from May to July (Table 1). The swarm time was generally 18:30-19:30, with the peak at 19:00-19:30, when 66.66% of primary reproductives were swarming at this time (Huang *et al.* 2004a).

Influence of temperature, relative humidity and atmospheric pressure on swarming of primary reproductives in *C. domesticus*.

The relationship between the swarming of primary reproductives in *C. domesticus* and temperature, relative humidity and atmospheric pressure was observed for three years in the laboratory (Huang *et al.* 2004b). The results indicated that the swarming of primary reproductives occurs over a broad range of temperatures, relative humidity and atmospheric pressure, where the range of temperature, relative humidity and atmospheric pressure are 25-30℃, 70%-90% and 999-1006mhPa, respectively. At temperatures of 27-30℃, the swarming times are increased, with the largest swarming times occurring at 28-29℃, representing about 47.49% of the total swarming

Table 1. Number of swarmimg days of primary reproductives in three years.

Month	1997		2002		2003	
	swarming days	Ratio (%)	swarming days	Ratio (%)	swarming days	Ratio (%)
Apr.	6	7.4	5	9.09	1	1.49
May	21	25.92	14	24.45	21	31.34
Jun.	18	22.22	14	25.45	17	25.37
Jul.	24	29.62	12	21.81	16	23.88
Aug.	10	12.34	9	16.36	12	17.91
Sep.	1	1.23	1	1.81	0	0
Oct.	0	0	0	0	0	0
Nov.	1	1.23	0	0	0	0

times. At a relative humidity of 70%-85%, the swarming times are similarly increased, with the longest swarm times at 75%-80%, representing about 34.77% of the total. Swarming times also increased at atmospheric pressures between 1003-1005mhPa, with the longest times occurring at 1004-1005mPa, representing about 35.58% of the total swarming times (Fig 1, Fig 2).

Formation and development of new colonies in *C. domesticus*.

At indoor temperatures in June & July every year in Guangzhou, the female (n=40) started to produce eggs at 7-16 days (average: 11.33 ± 2.32 days) with the eggs hatching after 46-71 days (average: 55.13 ± 6.42 days). The numbers of offspring are 3-8 individuals in one year (n=15), 10-16 individuals in a two year old new colony (n=20), 12-35 individuals in a three year old colony (n=5), and 23-57 individual offspring plus1-3 individual soldiers in a four year old colony (n=11). The time for sexual maturation of a new colony is seven years (n=6), when 36-115 individual offspring and 1-4 individual soldiers are in a colony (Qian *et al.* 2005a).

At a constant temperature of 27°C & a relative humidity of 80%, the female (n=30) started to produce eggs at 8-18 days (average: 11.6 ± 2.66 days), with the eggs hatching after 50-73 days(average: 57.8 ± 5.79 days). The numbers of offspring are 6-10 individuals in a one year old colony (n=15), and 16-34 individual offspring with 1-2 individual soldiers in a two year old colony (n=16). The time for sexual maturation of a new colony is 2-3 years (n=12), with 18~40 individual offspring and 1-2 individual soldiers in a colony (Qian *et al.* 2005a).

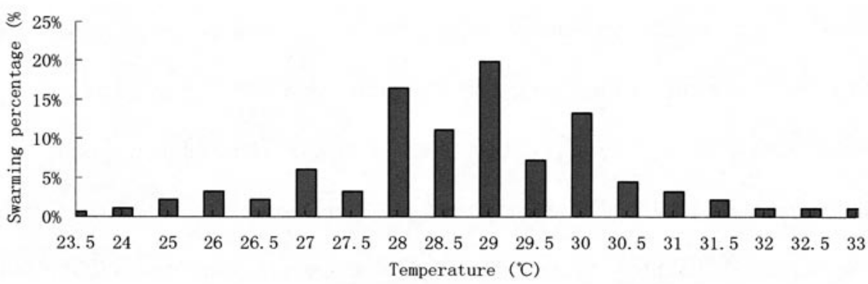

Fig. 1 Influence of temperature on the swarming of primary reproductives.

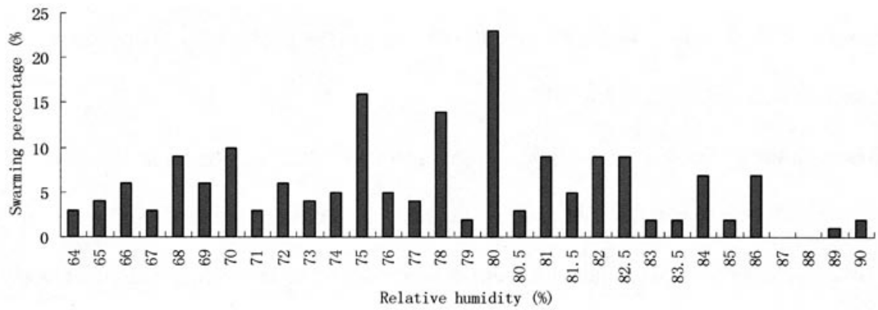

Fig. 2 Influence of relative humidity on the swarming of primary reproductives.

Behavioral features of primary reproductives in *C. domesticus*.

Behavioral features of primary reproductives

Primary reproductives during swarming have phototaxis.

Male & female primary reproductives have no obvious tandem behavior.

Primary reproductives which have lost their wings search and go deep into concealed locations.

Primary reproductives tend to close the mouths of holes after entry to guard against disturbance by external factors.

Primary reproductives move, eat, excrete and reproduce in holes.

Primary reproductives push out excrement from holes after colony formation.

Primary reproductives spread easily after colony formation (Huang *et al.* 2003).

Signs of *C. domesticus* infestation in wood and wood products.

0.3~1.5 mm circular holes (open or closed) appear in the surface of the wood and wood products.

Fine, sand-shaped and densely formed excretions appear around the outsideof holes (Huang *et al*. 2003).

Influences of different species of wood on new colonies of *C. domesticus*.

62 species of wood from Southeast Asia were collected and acted as the food of *C. domesticus*. Alates of *C. domesticus* were transferred to the wood and allowed to pair naturally. After pairing, the termites entered and developed new colonies inside the wood. Influences of different species of woods on the termite's feeding and the new colony's development were investigated (Qian *et al*. 2005b). The results indicated that *C. domesticus* has broad tastes and can feed on most species of wood despite large differences in taxonomy, with the exception of *Eusideroxylon zwageri*. All wood tested had no influence on the alate's pairing and were caved by new couples. Dissecting the colonies after pairing for 3 months, we found that females and males survived and offspring grew normally in most species of wood except *Artocarpus* sp. A, *Artocarpus* sp. B, *Cinnamomun* sp., *Eusideroxylon zwageri, Kokoona* sp., *Madhuca* sp., *Pentace* sp., *Polyalthian* sp., *Pometia* sp., *Tectona grandis,* and *Terminalia* sp. (Qian *et al*. 2005b) (Table 2)

CONCLUSIONS

We recognized the regular activity of primary reproductives in *C. domesticus* and the relationship between colonies and ecological factors, and searched out the weak stages to control the termites based on our studies on swarming, formation, development, reproduction, feeding habits and life cycle of primary reproductives in *C. domesticus* for many years. Hopefully this knowledge will help to reduce the damage done by this termite to wood and wood products, offer assistance for effective control of this termite's reproduction and spread, and facilitate termite biology research development in wood.

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Table 2: Influences of different species of wood on new colonies of *C. domesticus.*

Species of wood	Inspected colonies*	Infested (%)	Species of wood	Inspected colonies*	Infested (%)
Dacrydium sp.	4	75	*Garcinia* sp	3	100
Podocarpus imbricatus	5	100	*Pentace* sp.	—	—
Polyalthia sp.	—	—	*Heritiera* sp.	5	100
Beilschmiedia sp.	4	75	*Durio* sp.	4	100
Cinnamomum sp.	—	—	*Drypetes* sp.	4	100
Eusideroxylon zwageri	—	—	*Endospermum* sp.	4	100
Litsea sp.	5	100	*Parkia* sp.	4	50
Myristica sp.	5	100	*Pithecellobium* sp.	5	100
Xanthophyllum sp.	5	100	*Cynometra* sp.	5	100
Duabanga sp.	4	75	*Dialium* sp.	5	100
Aquilaria sp.	5	60	*Intsia palembanica*	5	100
Hydnocarpus sp.	5	100	*Koompassia excelsa*	4	100
Octomeles sumatrana	4	50	*Koompassia malaccensis*	4	100
Schima sp.	5	100	*Sindora* sp.	4	100
Dipterocarous sp.	5	100	*Lithocarpus* sp.	4	100
Dryobalanops sp.	5	100	*Artocarpus* sp.	—	—
Hopea sp.	5	100	*Artocarpus* sp.	—	—
Hopea sp.	4	75	*Kokoona* sp.	—	—
Shorea sp.	4	50	*Santiria* sp.	5	100
Shorea sp.	4	75	*Amoora* sp.	5	100
Shorea sp.	4	75	*Pometia* sp.	—	—
Shorea sp.	3	66	*Gluta sp.* or *Melanochyla* sp.	5	100
Shorea sp.	4	50	*Mangifera* sp.	5	100
Syzygium sp.	4	100	*Parishia* sp.	4	100
Dactylocladus stenostachys	5	100	*Swintonia* sp.	4	100
Paratocarpus sp.	5	100	*Diospyros.*sp.	4	100
Kerminalia sp.	—	—	*Madhuca* sp.	—	—
Combretocarpus rotundatus	4	100	*Palaquium sp.*	4	50
Pellacalyx sp.	4	100	*Pouteria sp.*	5	100
Cratoxylum sp.	4	100	*Anthocephalus chinensis*	5	100
Calophyllum sp.	5	100	*Tectona grandis*	—	—

*count includes live colonies only

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