

Longevity and Developmental Studies of *Aedes aegypti*

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OBJECTIVE : To determine the seasonal longevity and developmental rates of *Aedes aegypti*.

BACKGROUND : Previous population dynamics studies of *Aedes aegypti* in Bangkok did not reveal a significant relationship between the survival rate of this mosquito and the seasonal variation in prevalence of human dengue virus infections (1). Recent observations suggest that the prevalence of dengue virus infections during the rainy season may be related to environmental factors occurring during the preceding cool season (2). Since the development time and survival of *Ae. aegypti* are markedly influenced by temperature (3, 4), field and laboratory investigations on temperature and humidity were initiated to reconsider this aspect of the population dynamics of *aegypti* in Bangkok.

METHODS : *Aedes aegypti* longevity and developmental studies were conducted in a house located in the Din Daeng study area and in environmental chambers in the Department of Medical Entomology, AFRIMS. Hereafter the house will be referred to as the field house. *Aedes aegypti* larvae were collected from 14 houses in the Din Daeng study area (5) during the latter part of December, 1978, and again during the latter part of May, 1979, to provide mosquitoes for studies during the cool and hot seasons, respectively. Larvae were reared in the field house and adults were allowed to feed on hamsters to provide F₁ eggs. Eggs were hatched and 200 larvae were transferred to each of 3 plastic trays (20 cm x 26 cm x 4.5 cm) that contained 1000 ml of water. In addition, 200 larvae were placed in each of 4 ceramic water (ong) jars (28 l.) that contained 12 l. of water. Before adding water to the 4 ong jars, each jar was washed thoroughly and scoured with a steel brush to eliminate any extraneous *aegypti* eggs. Water came from a large ong jar used by a family for storing tap water for every day use.

Aedes aegypti found in the water source jar were removed from the water before it was added to the experimental water containers. A thin layer of sediment settled out of the water in each experimental container. Sediment was also observed in ong jars in houses throughout the Din Daeng study area and in larval pans in the 7th floor insectary of the main AFRIMS laboratory. Apparently, the sediment comes from the tap water, and it probably serves as a food source for *aegypti* larvae. Beside testing the survival of 200 larvae each in 2 test ong jars with this water (without added food), one gram of ground mouse chow was placed in each of the 3 trays and the 2 remaining ong jars containing larvae.

Each day the water temperature was recorded and the containers were checked for pupae. Pupae were removed daily, counted and transferred to water in screened paper cups for retaining emerging adults.

The longevity studies were initiated with newly emerged F_1 generation *aegypti*. Males and engorged and unengorged females were transferred to paper cups, 10 per cup and placed on the floor along the walls of each room of the field house. Cotton saturated with a 5% sucrose solution was provided continuously to mosquitoes. An oviposition substrate was provided for some of the engorged mosquitoes. The number of surviving mosquitoes was recorded daily. A hygrothermograph was used for recording temperature and humidity.

Aedes aegypti eggs from the same mosquitoes that provided eggs for the studies in the field house were used as a source of mosquitoes for laboratory studies. In addition, *aegypti* from 3 different laboratory colonies were employed. The latter mosquitoes were included for comparative data on the rate of development and to study the effects of temperature on the isoenzyme profile of the different strains as reported elsewhere in the annual report. Eggs were hatched and 200 larvae each were placed in plastic trays, each containing 1000 ml of water. One gram of ground mouse chow was added to each tray.

Larvae were placed in environmental chambers that were maintained at approximately 20° and 35°C. Selection of temperature was based on extreme minimum and maximum temperatures that occur in Bangkok. Daily records were maintained for temperatures, the number of pupae and the number of adults that emerged for each strain as described for the Din Daeng field house studies.

RESULTS : The development and longevity of immature *aegypti* reared in the Din Daeng field house during the winter season are summarized in Table I. The development of first stage larvae to adults in ong jars with food was rapid, with 50% of males and 50% of females emerging within 6.4 to 6.9 days. In the jars with food, the survival rate from first stage larva to adult was high, 0.92 and 0.85 for each of 2 replicates of 200 larvae. In contrast, the time required for emergence of 50% of adults from larvae reared in one ong jar without food, ranged from 15 to 18.1 days for males and females, respectively. Also, the survival (0.56) of immatures was much lower than that of larvae reared in jars supplemented with food. Developmental studies of 200 *Ae aegypti* larvae in the other ong jar not supplemented with food were aborted due to predation by *Toxorhynchites splendens* larvae.

Figures 1 and 2 shows the pattern of development and of emergence of immatures reared with and without food added to the ong jars. The prolonged period and sporadic pattern of emergence of *aegypti* reared in the jar not supplemented with food is consistent with data for emerging adults trapped during population density studies reported elsewhere in this report. This suggests that the availability of food is an important determinant of the rate of development and productivity of *aegypti* in the ong jars in the Din Daeng study area. The rate of development of immature *aegypti* reared in trays was approximately one day longer and longevity was slightly lower than that for mosquitoes reared in the ong jars supplemented with food. These differences may have resulted from crowding in the different volumes of water in trays as compared to jars.

The results of longevity studies for adult *aegypti* during the cool and hot seasons are presented in Table 2. Mean longevity was longer for both male and female mosquitoes during the cool season. The greatest difference was observed for engorged and unengorged female *aegypti* that were not provided an oviposition substrate. Engorged mosquitoes of both the cool and hot seasons exhibited strikingly higher longevity than the other females. In addition, the range of longevity for the former mosquitoes was longer than the other females. Mean longevity of males was approximately the same for both seasons. Although mean longevity for males was lower than that of most groups of females, the range of longevity of males was comparable to that of females.

A marked difference was noted in the rate of development and longevity of *aegypti* reared at different temperatures in the laboratory (Table 3). The time required for the emergence of 50% of adults of different strains of mosquitoes was approximately 3 times longer for mosquitoes reared at 20°C. Only the slight variation was observed in the development rates among the different strains reared at 20°C, with the Din Daeng strains requiring the longest period of time. Survival rates from first stage larvae to adults were also lower for mosquitoes reared at the lower temperature. The development and survival rates of mosquitoes reared at the higher temperature were somewhat similar to those observed for mosquitoes reared in the Din Daeng field house at 30°C, except for the groups reared in the ong jar that was not supplemental with food. The results for the latter were similar to those for mosquitoes reared at the lower temperature in the laboratory. Additional studies will be conducted to further define the seasonal development and survival of *Ae. aegypti*.

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Table 1. The rate of development of F₁ generation *Aedes aegypti* in the Din Daeng Field House during the cool season, 23 January - 3 March, 1979.¹

Mosquitoes ²	No. of 1st stage larvae	Time to Pupation (50%) ³	Time to Emergence (50%) ³		Period Egg to Last Adult (days)	% Survival to Adult
			Males	Females		
DDFH (ong jar-food)	200	4.7	6.4	6.8	21	92
DDFH (ong jar-food)	200	4.7	6.6	6.9	18	85
DDFH (ong jar-no food)	200	14.6	15.0	18.1	44	56
DDFH (Tray-food)	200	5.9	9.0	8.0	12	85
DDFH (Tray-food)	200	5.5	7.5	7.7	Not determined	71
DDFH (Tray-food)	200	6.0	7.7	8.0	14	75
DDFH (Tray-food)	200	5.6	7.6	7.8	Not determined	77

¹ Temperature mean and range for the room was 30°C (24-33°C), and the temperature mean and range for the water was 26.6 (24-28°C)

² *Aedes aegypti* were reared from eggs of females that originated from larvae collected in the Din Daeng study area during December and January 1978 and 1979.

³ Days past hatching of eggs that 50% of mosquitoes had pupated or emerged.

Table 2. Survival of F₁ generation *Aedes aegypti* in the Din Daeng field house during the cool and hot seasons.¹

Sex/condition ²	Season	Number of Mosquitoes	Survival (Days)	
			Mean	Range
♀♀ (engorged)	cool	90	17.5	2-25
♀♀ (engorged)	hot	150	8.0	2-21
♀♀ (engorged) ⁴	cool	30	27.0	7-39
♀♀ (engorged) ⁴	hot	30	23.0	1-30
♀♀ (unengorged)	cool	60	17.5	2-25
♀♀ (unengorged)	hot	60	12.5	2-26
♂♂	cool	40	7.8	1-30
♂♂	hot	40	6.5	1-23

¹ Cool season: Mean maximum and minimum temperatures were 32.2° and 27.8°C, respectively, range-maximum 30.6°-33.3°C, minimum 23.8°-32.2°C; and the mean maximum and minimum humidities were 97% and 68% respectively, range-maximum 80%-100%, minimum 46%-80%.

Hot season: Mean maximum and minimum were 33.3° and 28.9°C, respectively, range-maximum 30.6°-35°C, minimum 26.6°-30.6°C; and the mean maximum and minimum humidities were 92% and 67%, respectively, range-maximum 76%-100%, minimum 56%-89%.

² Sugar water provided to all mosquitoes.

³ Age to which 50% of mosquitoes survived.

⁴ Oviposition substrate provided.

Table 3. The rate of development of different strains of *Aedes aegypti* at different temperatures in the laboratory, AFRIMS, 11 January - 23 January 1979.

Strains	Temperature	No. of Larvae	Time to Pupation (days) (50%)	Time to emergence (days) (50%)		Period (days) Egg to last adult	% survival to adult
				Males	Females		
Colony #1 ¹	19.8 (19-20)	200	12.1	16.0	15.2	28	51
Colony #1	34.7 (30-38)	200	3.5	5.0	5.5	18	80
Colony #3 ²	19.8 (19-20)	200	12.0	15.0	17.3	29	65
Colony #3	34.7 (30-38)	200	5.0	6.0	7.3	16	92
Colony #4 ³	19.8 (19-20)	200	11.3	14.8	17.5	21	58
Colony #4	34.7 (30-38)	200	3.7	4.9	5.9	15	78
DDFH ⁴	19.8 (19-20)	200	13.1	16.7	18.0	36	46
DDFH	34.7 (30-38)	200	5.0	6.5	6.6	12	88

¹ Colony established during 1968 from unknown specimens collected at Koh Samui.

² Colony established during 1977 from larvae collected in Bangkok, Thailand, F-19 generation.

³ Colony established during 1977 from 2 adults ($\sigma^7 + \text{Q}$) collected in Bangkok, F-10 generation.

⁴ Colony established during 1979 from larvae collected in Din Daeng, Bangkok, Thailand, F-1 generation.

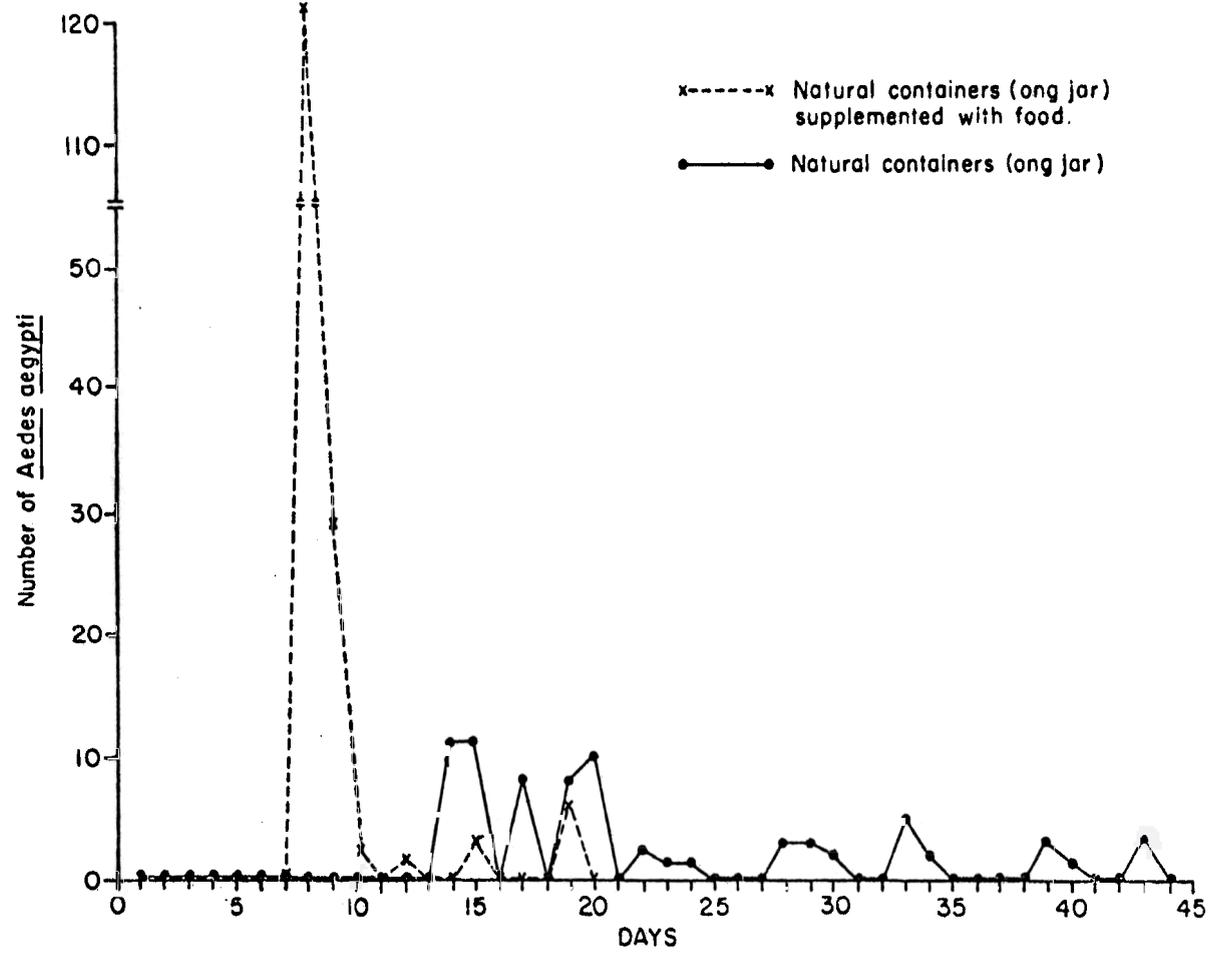


Figure 2 Dailey emergence of *aedes aegypti* that developed from larvae reared in a natural container and in a natural container supplemented with food.

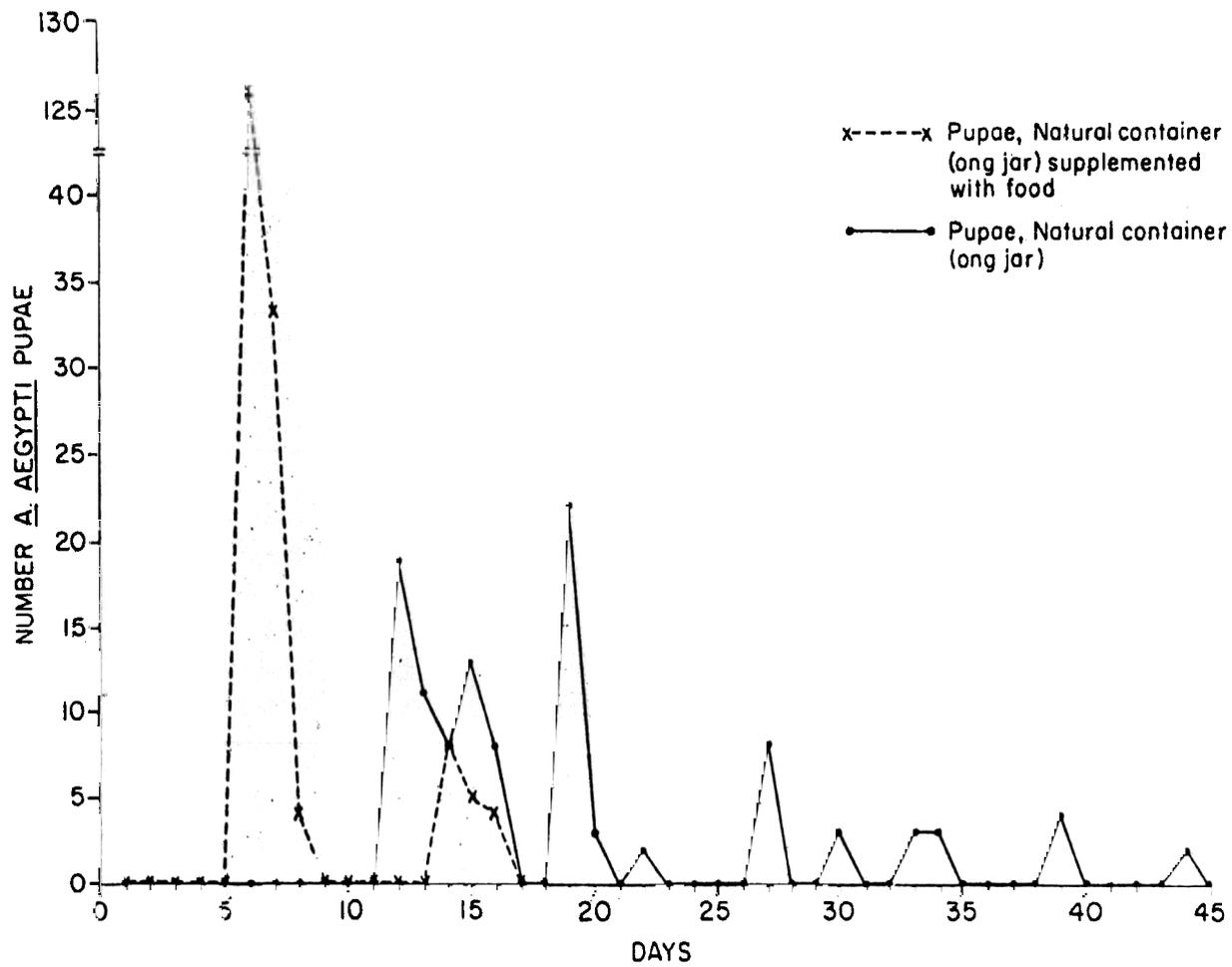


Figure 1. Daily pupation of *aedes aegypti* larvae that were reared in a natural container and in a natural container supplemented with food.