

Effects of mating or association of the sexes on longevity in *Culex pipiens quinquefasciatus* Say*

Chong Yoon Joo, MD; Doo Hyun Baik, MD; Jong Bong Kim

Department of Parasitology, Keimyung University
School of Medicine, Taegu, Korea

＝國文抄録＝

熱帶 집모기에 있어서 性關係가 壽命에 미치는 影響

朱鍾潤・白斗鉉・金種鳳

啓明大學校 醫科大學 寄生蟲學教室

만크로프트 絲狀蟲의 主要媒介蚊인 熱帶 집모기에 있어서 암컷과 수컷의 性關係가 壽命에 미치는 影響을 알아보기 위해 1983年 3월부터 10월까지 3回 反復實驗으로 調査하였다.

수컷의 平均壽命은 交尾를 하지 않은 group이 交尾를 한 group보다 길었는데 반하여 암컷의 壽命은 交尾한 group이 交尾하지 않은 group보다 길었다.

一週일에 한번씩 새로운 수컷을 注入한 암컷 group에서의 平均壽命은 交尾하지 않은 group보다 짧았다. 産卵한 group의 암컷 壽命은 産卵하지 않은 group보다 平均壽命이 5.0~20.0% 減少하였다.

以上の 結果로 미루어보아 熱帶 집모기의 平均壽命은 암컷과 수컷의 性關係의 期間에 比例하여 짧아진다는 것을 알았다.

Introduction

Since Deevey's first report on the life table for natural population of animals in 1947, many investigators have made studies on the construction, description and analysis of age specific life tables for insects and other arthropods of medical importance.

Hamilton(1948) made a list of 70 species ranging from invertebrates to human beings, and reported that in 80.0 per cent of these the lifespan of the female was longer than that of the male. His list includes a number of insect

species and in the majority of these the male was listed as shorter lived than the female.

A study of Liles and Delong (1960) found that presumably mated female *Aedes aegypti* outlived virgin females by approximately 17.0 per cent when fed a non-egg-producing sucrose diet. Conversely, virgin males outlived mated males by about 30.0 per cent.

Subsequently, observations on the shorter lifespan of male mosquitoes have been presented by Wattal et al. (1961), Meillon et al. (1967), Walter and Hacker(1974), Reddy(1976), Gomez et al. (1977), Suleman and Reisen(1979) and Yasuno and Razagopalan(1977).

*The results of this study were presented at the 25th annual meeting of the Korean Society for Parasitology in 1983.

In general, female mosquitoes outlive males, but this varies enormously, depending upon many factors.

The purpose of this study was to estimate the effects of mating and/or male-female association on the lifespan of adult *Cx. p. quinquefasciatus*, i.e., whether the males or females live longer together or separately, and the effects of egg production on longevity of the male mosquitoes.

Materials and Methods

The laboratory colonies used in this study were originally obtained from Thithishima which had been reared continuously in the laboratory of Medical Entomology, The National Institute of Health, Japan for 15 years.

The colonies of *Cx. p. quinquefasciatus* were provided to our laboratory by courtesy of Dr. Y. Wada in September of 1982, and maintained for 25 generations as of September in 1984 under our laboratory conditions.

The colonies were maintained by allowing adult females to engorge on a laboratory mouse fixed between two layers of softwire screen once a week.

The egg raft were deposited by females about 4 days later in the container of water. The approximately 300 first larvae which hatched these eggs were placed in an enamel rearing pan containing 1.5 liter of distilled water.

The crushed powders of laboratory mouse pellets were provided as a food for larvae.

When pupae appeared in about a week they were collected with a pipette every day, and transferred individually to small test tubes, and then the numbers of emerging males and females counted daily.

The size of cages were used to minimize any effects of cage size or population density on the results obtained. This measured 30×30×30Cm.

The effects of mating and/or male-female association and egg productions on the longe-

vity of adult *Cx. p. quinquefasciatus* were tested by comparing six groups of male and female.

All experiments were replicated three times and performed in an insectary in which the temperature was maintained between 24°C and 26°C and relative humidity was regulated between 75 per cent and 85 per cent.

A 16L: 8D photoperiod was established with five 40 watt fluorescent lights, and with 1.0 hour simulated dusk and dawn.

Adults were continuously offered 5.0 per cent sucrose solution in flask with cotton wads and changed to new solutions every 5 days.

Each morning all dead individuals were removed and their sex determined and recorded.

The standard one way analysis of variance was used to interpret the results.

Results and discussion

Cx. p. quinquefasciatus Say is a cosmotropically distributed domestic mosquito which has been incriminated in the transmission of West Nile virus and found naturally infected with *Wuchereria bancrofti* in China, Japan and south-eastern Asia.

The biological studies for various species of mosquito have been carried out extensively many investigators.

As a result, a considerable amount of field data and some laboratory data can be found related to the biology, migratory habits, mating, dynamics of total population, and host-seeking behaviour of many species of mosquitoes.

A study of Weidhaas et al.(1971) reported information about the dynamics of a population of *Cx. p. quinquefasciatus*. Also, Walter and Hacker(1974) studied the variation in life table characteristics among three geographic strains of *Cx. p. quinquefasciatus*.

Additional observations on lifespan of *Cx. p. quinquefasciatus* were presented by Reddy

Table 1. Effect of mating or association and/or egg deposit on female lifespan of *Culex pipiens quinquefasciatus* (1983)

Group	Average days lived			
	1	2	3	Average
Virgin females	38.15	58.24	64.64	50.09
Females with equal number of males until male died	37.65	64.57	60.54	50.31
Females with equal number of males until male died (on blood meal)	40.47	51.63	—	43.48
Females with multiple groups of males	29.04	42.77	33.59	35.34
Females with multiple groups of males (on blood meal)	34.40	39.82	39.53	37.80
Females with 1/2 of No. of males	37.76	46.14	—	41.91

(1976), Gomez et al. (1977), Suleman and Reisen (1979), and others.

In the present study the effects of mating or association and/or egg deposit on female lifespan of *Cx. p. quinquefasciatus* were tested by comparing six groups and listed in Table 1.

In the group of females associated with equal number of males, the average lifespan of females was longer than that of virgin females, whereas the repeated addition of young males to a group of females shortened the average lifespan of mated females or females associated with males, compared with virgin females.

The exact cause of the shorter lifespan of females with males added on every one week is not known, but there are several factors possibly related to being "bothered" excessively, and the physiological conditions.

Liles (1965) in the study on effect of mating or association of the sexes on longevity in *Aedes* species reported that the mating or association proved of benefit even if the time was as short as one day, but the addition of new males every two week proved detrimental.

Similar results have been obtained by Liles and Delong (1960), and Suleman and Reisen (1979).

In the groups of females given the opportunities of a blood meal every one week, the egg production of the mated females were directly correlated with decreased longevity, but in mated female lifespan when young males were added every one week there was not a

decrease.

The results in this study are in agreement with previous finding (Liles and Delong, 1960: and Liles, 1965).

A study of Liles and Delong(1960) mentioned the fact that the mated females lived about as long as the unmated ones, in spite of greater egg production, indicating a probable benefit from the males or "male effect".

The data shown in Table 2 present the effects of mating or association of the sexes and/or egg production on lifespan of two-week old virgin females with males of different ages.

Of the six groups, two groups indicated a lifespan decrease. They were the groups in which the two-week old virgin females were mated or associated with young males.

These data indicate that the addition of young males to a group of older females must be similar in order to result in a decrease in female lifespan.

In the study of the longevity and productivity of adult male and female mosquitoes, Liles(1965) studied the effects of mating or association of the sexes on longevity in *Ae. aegypti* (L.). It was found that up to about two weeks of age, association or mating with males of similar age increased the life span over that of virgin females even if the mating or association period was as brief as one hour.

In this study of two-week old virgin females with 13—14 days old males, the average lifespan of females was longer than with the virgin females.

Table 2. Effect of mating or association of the sexes and/or egg deposit on lifespan of two week old virgin females with males of different ages (1983)

Group	Average days lived			
	1	2	3	Average
Virgin females	36.74	41.43	44.24	40.66
Two week old virgin females with 13—14day old males until male died	31.41	52.06	—	41.17
Two week old virgin females with 13—14day old males until male died (on blood meal)	40.37	39.38	42.83	40.48
Two week old virgin females with young males until male died	31.20	29.57	38.96	32.28
Two week old virgin females with young males until male died (on blood meal)	35.87	—	—	35.87
Two week old virgin females with young males for one day	38.86	42.65	36.64	39.92

Table 3. Lifespan of males confined with different numbers of females various lengths of time in large cages (1983)

Group	Average bays lived			
	1	2	3	Average
Virgin males	65.92	63.28	70.88	66.70
Males with equal number of females	27.18	30.08	44.33	33.89
Males with 2X No. of females	33.14	34.36	32.90	33.60
Males with 1/2 X No. of females	34.89	—	—	34.89
6-day-old virgin males with 6-day-old females until death	24.73	23.69	30.49	26.21
6-day-old virgin males with 6-day-old females for one day	32.16	30.46	27.92	30.11
9-day-old virgin males with 9-day-old females for two days	29.48	29.89	—	29.69
9-day-old virgin males with 9-day-old females until death	26.46	28.27	—	27.30

The results of the present study are similar to those reported by Liles(1965).

The results presented in Table 1 and Table 2 indicate that the average lifespan of mated females on blood meals was reduced 5.0 per cent to 20.0 per cent below that of mated females receiving sucrose only.

It has been known that the mated females of mosquitoes, particularly where egg productivity is high, show a shortened lifespan usually dependant upon the rate and extend of egg production, and apparently related rather directly to the nutritional drain caused by the process.

The effects of the different age of the male at time of mating or association the various length of time with females, the presence of different numbers of females on male lifespan are shown in Table 3.

The average lifespan of unmated males was longer than that of virgin females when the sexes were reared separately on 5.0 per cent sucrose solution.

The unmated males lived significantly longer alone than when caged with females, but virgin females lived longer when with males than when alone.

These results are similar to those reported by Liles and Delong (1960), Liles (1965), Suleman and Reisen (1979), and others.

The shorter lifespan of mated males in *Cx. p. quinquefasciatus* may be, in part, related to the rate and extent of mating. The physiological activity associated with the process, such as increasing flying, as well as the drain of nutrient reserves for sperm production may account for the earlier deaths (Liles, 1965).

In the group of the males with equal number

of females, they had more than 50.0 per cent shorter lifespan than virgin males. This was higher than usually recorded when insects are placed together earlier in adult life (Liles, 1965).

The results presented in Table 3 indicate that although the average lifespan of unmated males is longer than that of virgin females, the male lifespan is shortened apparently in proportion to length of time in association with females.

Summary

A study of the effects of mating or association of the sexes on longevity in *Culex pipiens quinquefasciatus* Say has been conducted during the period from March to October in 1983.

The unmated males lived significantly longer alone than when caged with females but virgin females lived longer when with males than when alone.

The repeated addition of young males to a group of females shortened the average lifespan of mated females or females associated with males, compared with virgin females.

The average lifespan of mated females on blood meals was reduced 5.0 per cent to 20.0 per cent below that of mated females receiving sucrose only.

It is concluded that although the average lifespan is shortened apparently in proportion to length of time in association with females.

Literature cited

- Deevey ES: Life tables for natural populations of animals. *Quart Rev Biol* 1947 ; 22 : 283—314
- Gomez C, JE Rabinovich, CE Machado-Allison: Population analysis of *Culex pipiens fatigans* Wied. (Diptera:Culicidae) under laboratory conditions. *J Med Entomol* 1977 ; 13 : 453—463
- Hamilton JB: The role of testicular secretions as indicated by the effects of castration in man and by studies of pathological conditions and the short lifespan associated with male-ness. *Recent Progr Hormone Res* 1948 ; 3 : 257—322
- Liles JN, DM DeLong: The longevity and productivity of adult male and female *Aedes aegypti* when reared separately and together on three different diets. *Ann Entomol Soc Am* 1960 ; 53 : 277—280
- Liles JN: Effects of mating or association of the sexes on longevity in *Aedes aegypti*(L.). *Mosquito News* 1965 ; 25 : 434—439
- De Meillon, BA Sebastian, ZH Khan: The duration of egg, larval and pupal stages of *Culex pipiens fatigans* in Rangoon, Burma. *Bull WHO* 1967 ; 36 : 7—14
- Reddy SR: Laboratory studies on the development, survival and life table of *Culex fatigans* and *Anopheles stephensi*. *Proc Indian Acad Sci (Sect. B)* 1976 ; 84 : 117—123
- Suleman M, WK Reisen: *Culex quinquefasciatus* Say: Life table characteristics of adults reared from wild-caught pupae from north west frontier Province, Pakistan. *Mosquito News* 1979 ; 39 : 756—762
- Walter NM, CS Hacker: Variation in life table characteristics among three geographic strains of *Culex pipiens quinquefasciatus*. *J Med Entomol* 1974 ; 11 : 541—550
- Wattal BL, NL Kalra, KMS Bedi: Studies on culicine mosquitoes. 2. Laboratory studies on the longevity of adult *Culex fatigans* Wiedemann, 1828. *Indian J Mal* 1961 ; 15 : 321—337
- Weidhaas DE, RS Ratterson, CS Lofgren, HR Ford: Bionomics of a population of *Culex pipiens quinquefasciatus* Say. *Mosquito News* 1971 ; 31 : 177—182.
- Yasuno M, PK Rajagopalan: Population estimation of *Culex fatigans* in Delhi villages. *J Com Dis* 1977 ; 9 : 172—183