HYLEMYA ANTIQUA (MEIGEN)[1]: LONGEVITY AND OVIPOSITION IN THE LABORATORY[2]

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ABSTRACT

In laboratory cultures, some female *Hylemya antiqua* (Meigen) were still alive and ovipositing after 66 days, whereas males usually survived no longer than 50 days. The average lifespan of 12 individually-reared, reproducing females was 48 days. Oviposition began no earlier than 8 days, and on the average, 10.5 days after the females emerged. Heavy oviposition by most females was cyclic, occurring every other day. The mean fecundity/female in 3 cultures was 259.2, 114.5 and 218.4, respectively, but for individually-reared females, it was 491.5. Variations in diet and environment probably lead to poor or inconsistent correlation of laboratory data on longevity and fecundity with actual events in the field. However, these data provide precise guidelines for utilization of *H. antiqua* in laboratory experiments.

INTRODUCTION

In developing a reliable bioassay to examine chemical induction of oviposition by the onion maggot, *Hylemya antiqua* (Meigen) (Vernon *et al.* 1977), an understanding of this insect's basic reproductive behavior was required. In previous observations on the Simon Fraser University *H. antiqua* culture, A. Syed (unpublished data[4]) estimated the longevity of adult flies to be 60-70 days, with females still capable of ovipositing after 2 months. Other studies have been made on *H. antiqua* oviposition and longevity in the laboratory (Perron *et al.* 1953, Allen and Askew 1970) and the field (Perron and Lafrance 1961), but precise data were not collected on a sequential basis for longevity, duration and interval of oviposition, fecundity and oviposition periodicity. These topics were investigated and the results applied to the operation of an oviposition bioassay for *H. antiqua*.

METHODS AND MATERIALS

H. antiqua Culture

Onion maggots used in this study were from a nondiapausing culture maintained at the Simon Fraser University Insectary. Larvae were raised on a diet of carrot powder (30 g), cellulose powder (2 g), 1N HCl (12 ml), methyl paraben (0.025 g), K sorbate (0.025 g), yeast (12 g), water (200 ml), yeast hydrolysate (1.0 g) and Ostoco® multi-vitamins (Charles E. Frosst and Co.) (5 drops). This diet differed from that described by Ticheler (1971) with the addition of yeast hydrolysate (Allen and Askew 1970) and multi-vitamins. Adults were fed on a mixture of sugar (10 parts), skim milk powder (10 parts), soya flour (1 part), yeast hydrolysate (1 part) and Brewer's yeast (1 part) (Ticheler 1971).

Oviposition and Longevity Studies

Mortality and oviposition in 3 adult cultures were recorded daily to assess adult *H. antiqua* longevity and fecundity under laboratory conditions. The cultures were stocked with emergent adults that were allowed to emerge for 3 days after the first females appeared. The day of the first adult female (day 1 of the culture) usually occurred 1-2 days after the first males emerged. Cultures were started in 1975 on June 13 (Culture A), July 1 (Culture B) and July 21 (Culture C), and were maintained at 20-28°C and 30-40% RH. The flies were held in 35 x 60 x 50 cm wooden frame cages with Plexiglas fronts and wire mesh sides and roofs. Oviposition was assessed with 2 onion-baited oviposition chambers per cage (Vernon *et al.* 1977). Freshly prepared chambers were introduced twice weekly, beginning on day 4 of the culture, and filter paper substrates were changed daily. Food and water-soaked vermiculite were supplied to each culture in 9 cm diameter plastic dishes, and replenished as required.

To examine longevity, fecundity and oviposition periodicity more closely, individual females were observed from shortly after ecdysis until death. Each of 15 newly emerged females was placed in 13 x 18 x 17 cm wooden cages with Plexiglas fronts and screened backs. From the same culture, 2 males were placed in each cage

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[4]Preliminary report on insect rearing facilities at Simon Fraser University, May 31, 1974.

to ensure mating. They were replaced if lost or dead during the first 2 weeks. The cages were maintained in an environmental chamber at 23°C and 30% RH, with a 16 h light, 8 h dark fluorescent lighting photoperiod. The temperature selected was at the lower range used to maintain *H. antiqua* adults (23-30°C) by Allen and Askew (1970). Food and water were provided for each cage in 4.5 cm diameter plastic dishes. Oviposition chambers (1/cage) were provided from the first day onwards and replaced every 4-5 days. Due to the small cage size, 7 cm diam. plastic petri dishes with filter paper oviposition substrates were used. All cages were thoroughly inspected daily from the beginning of the study for oviposition in and around the oviposition chambers and the food and water dishes.

RESULTS AND DISCUSSION

H. antiqua Longevity

Some females were still alive and ovipositing after 66 days (Figs. 1-6), with males not generally surviving after 50 days. In Culture C, however, (Fig. 5), 2 males lived for 63 days. Absolute longevity was not determined, since the cultures had to be terminated to make room for others. Extrapolations from the mortality graphs suggest that the maximum lifespan of *H. antiqua* females under the conditions of the study is about 70 days.

Of the 17 individually reared females, only 12 were sufficiently long-lived and fecund to be included in the data given in Figs. 7-18. Of those females not included, 3 escaped early in the study, and 1 died after 26 days without oviposition, even though 60 and 45 well developed eggs were present in the right and left ovaries, respectively. Another female, which lived for 53 days, did not begin ovipositing until after 33 days. The average lifespan of the 12 healthy, reproducing females was 48 days, with a range of from 34 (Fig. 9) to 60 days (Fig. 15).

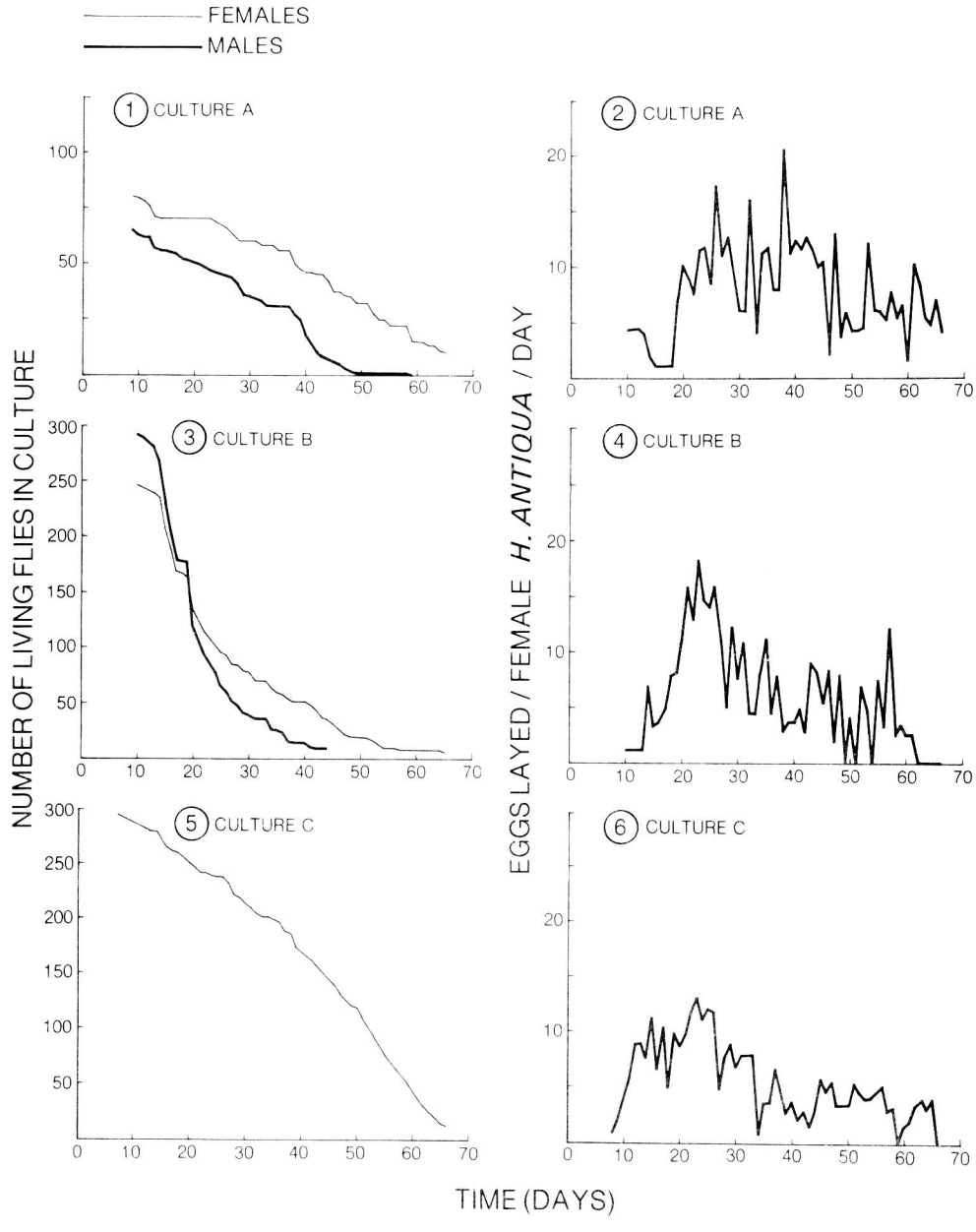
These data corroborate laboratory observations by A. Syed (unpublished data[4]) that *H. antiqua*, when reared on the diet described above, live for 60-70 days. When reared on a different artificial diet, male and female *H. antiqua* life expectancies ranged from 8-41 days ($\bar{X}$= 24.8) and 9-85 days ($\bar{X}$ = 36.5), respectively (Allen and Askew 1970). In another study, females lived as long as 139 days in the laboratory, and males for 70 days when reared on onion (Perron *et al.* 1953). Under field conditions, the mean longevity of females during 3 successively hotter seasons (3 generations/season) was, respectively, 84.6, 58.3 and 53.3 days (Perron and Lafrance 1961). Mean male longevity was less than 2/3 that of the females. From these studies, it appears that diet and temperature can influence *H. antiqua* longevity, and thus total fecundity, under field and laboratory conditions. These factors should, therefore, be considered important in producing and maintaining adult insects with comparable vigor for bioassay purposes.

H. antiqua Oviposition

Oviposition was observed no earlier than 8 days after female emergence in the 3 culture cages (Figs. 2, 4, 6). It began after 5 days and was maximal after 12 days in the study by Allen and Askew (1970). In Cultures A and C, oviposition continued as long as the females lived (66 days), whereas in Culture B, oviposition ceased after 62 days even though 8 females still remained. For the 12 individually reared females, egg laying began, on the average, 10.5 days after emergence (Figs. 7-18), with a range of from 8 (Fig. 18) to 13 days (Fig. 11). In many cases, oviposition continued until just before death, with one female laying 13 eggs the day before dying at 60 days (Fig. 17). In 2 instances, egg laying ceased 8 and 10 days before death at ages 41 and 45 days, respectively (Figs. 7, 10). If such post-reproductive individuals were to remain alive in field populations, they should be taken into account in population dynamics studies and in assessment of the reproductive potential of pest populations.

In Figs. 4, 6 and 7-18, egg production/female was generally highest between days 10 and 30, after which oviposition decreased and became irregular. Culture A (Fig. 2) was exceptional, maintaining a high rate of oviposition for 20-45 days. Individuals in this culture were much less crowded than flies in Cultures B and C, and may have benefited from lower levels of competition for food, water and oviposition sites.

Oviposition by *H. antiqua* in the laboratory was cyclic (Figs. 7-18). Following its onset, heavy oviposition generally occurred once every 2 days as shown (Figs. 7, 10, 12, 14, 15, 16, 18) although some females were able to oviposit heavily for 2 or 3 consecutive days (Figs. 7, 8, 12). This distinctive oviposition rhythm deteriorated somewhat as the flies aged, and oviposition occurred less frequently. In one case (Fig. 17), after 36 days oviposition occurred only once every 3 days with a gradual reduction in brood size. The average maximum daily production for the 12 flies was 52 eggs (range, 40-81). The average fecundity/female in Cultures A, B and C were, respectively, 259.2, 114.5 and 218.4 eggs, whereas for the individually reared females fecundity was 491.5 eggs/female (range 319-841). Under laboratory conditions, Perron *et al.* (1953) found females to lay up to 706 eggs. Allen and Askew (1970), obtained an average oviposition rate of 343 eggs/female. *H. antiqua* oviposition in the field was considerably lower (Perron and Lafrance 1961), ranging in a 3 year study from 57.8 to 24.3 eggs/female. Laboratory studies on adult fecundity, therefore, do not directly apply to field populations which en-

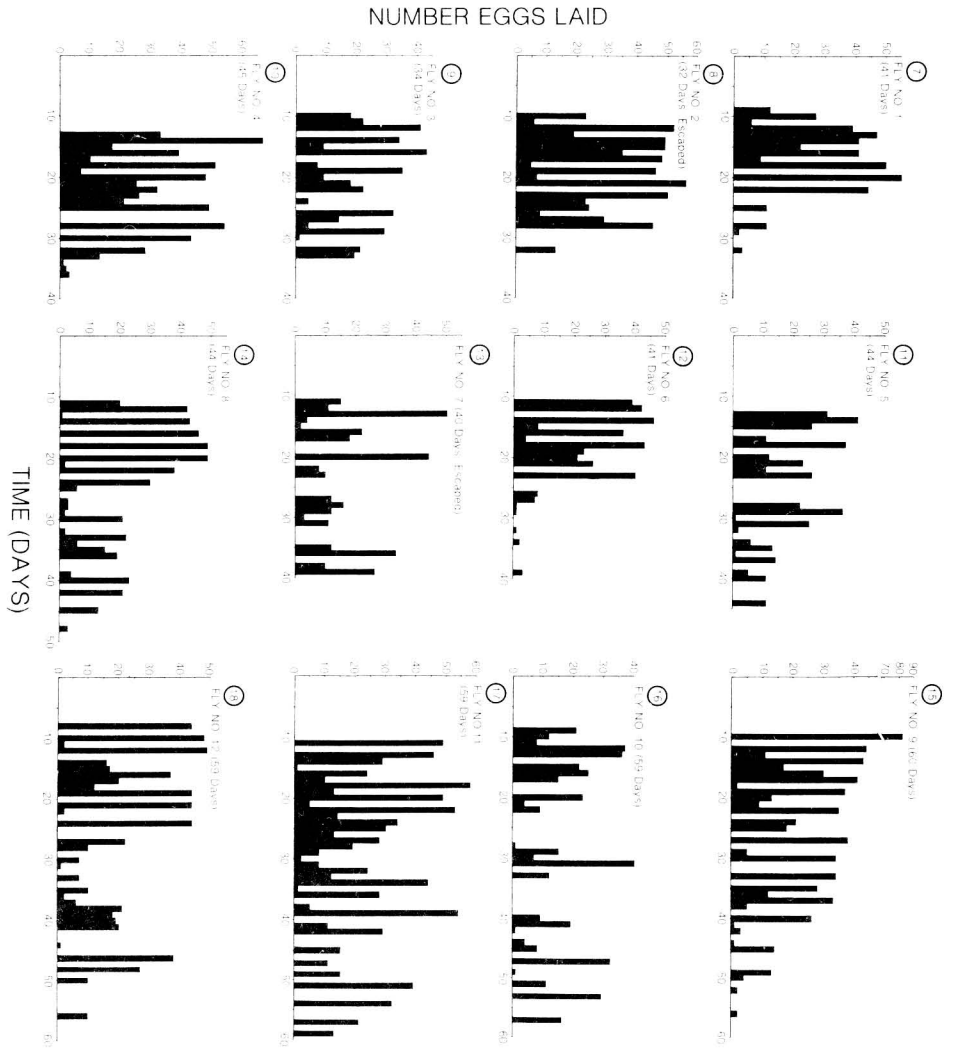


Figs. 1-6. Mortality and oviposition in 3 laboratory-reared cultures of Hylemya antiqua.

counter variability in diet and environmental conditions.

CONCLUSIONS

The data reported herein were used in the development of a bioassay designed to screen the response of *H. antiqua* females to oviposition-inducing kairomones (Vernon *et al.* 1977, Pierce *et al.* 1978). Properly reared and nourished *H. antiqua* adults are ready for oviposition studies between the ages of 10 and 15 days. Fairly consistent oviposition can be expected



Figs. 7-18. Longevity (in parentheses) and fecundity of 12 individually reared **Hylemya antiqua** females maintained in 13 x 18 x 17 cm cages under controlled environmental conditions.

from healthy cultures for at least 30 days after the onset of oviposition. Since a 48 h oviposition rhythm is in evidence, females should be deprived of host odor stimuli for at least a 24 h period before presenting the test stimuli. This procedure would ensure that flies are in oviposition readiness. The duration of an experiment could be 1 or 3 days, since oviposition would be expected on these days, but not on the 2nd or 4th days. Since most of the bioassays involve highly volatile chemicals, and a finite chemical release system, experiments of longer duration than 3 days would not be practical, nor would they be necessary to establish the activity of candidate stimuli. Ten to 15 females/replicate would be adequate, since healthy individuals can each be expected to lay about 40 eggs on the first and third days, given the proper stimuli.

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NORTHERLY RANGE EXTENSION FOR *CRAMPTONOMYIA SPENCERI* ALEXANDER (DIPTERA: PACHYNEURIDAE)

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Cramptonomyia spenceri Alexander is a distinctive nematocerous fly of the Pacific coast, discovered by Professor G. J. Spencer at Vancouver on 30 March 1930 (Alexander, 1931; Jacob, 1937; Vockeroth, 1974). It is the only described Nearctic and Canadian species of the family Pachineuridae (McAlpine *et al.*, 1979). The fly is especially prevalent in red alder *(Alnus rubra)* woods where the larva tunnels under the bark of rotten alder logs (Vockeroth, 1974). Vockeroth lists all the known localities for *Cramptonomyia spenceri.* These range from Wallace Bridge and Castle Rock, Oregon north to Hope and Mount Seymour, British Columbia.

On 26 March 1979, one of us (RJC) collected a male *Cramptonomyia* at Kaien Station, Kaien Island, 5 km south of Prince Rupert, British Columbia. This is approximately 700 km northwest of the previous most northerly locality for the species. At 1200 h, males were common among the drift logs and shrubbery along the railway tracks parallelling the shoreline of the sea. Stands of red alder grew 20 m away from the collection site. The weather was warm and sunny; the temperature was about 12°C. No adults were observed at the same location on 16 April 1979.

On 10 March 1979, one male, and on 31 March 1979, 21 males and two females were collected in a pure stand of young red alders at the University of British Columbia in Vancouver. Eggs (see Vockeroth, 1974) were found on rotting alder logs on the latter date; in one case the egg density was 1 per 2 cm^2. On 18 April 1979 no adults were seen at the same location. Vockeroth (1974) also noted a disappearance of adults from this Vancouver locality in the first half of April, 1973.

Although the Prince Rupert record represents a considerable northerly extension of the known range of *Cramptonomyia spenceri*, the above observations suggest there is little difference in its period of activity at the two latitudes.

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