

# Oviposition response of *Aedes aegypti* (L.) to the presence of conspecific eggs in the field in Trinidad, W.I.

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## ABSTRACT

The oviposition behaviour of *Aedes aegypti* L. was monitored in the field using conventional ovitraps containing paddles with and without other conspecifics eggs in St. Joseph, Trinidad, W.I. Females laid significantly more ( $P < 0.05$ ) eggs in ovitraps containing paddles without eggs (64.6%) than paddles with eggs (36.4%).

Superoviposition was observed in the field, with significantly more ( $P > 0.001$ ) oviposition occurring on paddles bearing less than 25 eggs than others bearing more than 25 eggs. The behavioural sequence leading to egg avoidance and superoviposition is not fully understood. It is suggested that females prefer egg-free substrates but if not available, substrates bearing less than 25 eggs are used in preference to others containing more than 25 eggs. The implications of these results are discussed.

## INTRODUCTION

*Aedes aegypti* (L.) females recognize and avoid oviposition substrates already bearing eggs of their own and those of other conspecifics (Chadee et al. 1990). Such behaviour reduces the possibility of inter- and intra-specific competition and leads to dispersal of females to other containers and to other geographical areas (within its range), where oviposition sites may be available. Thus, the selection of suitable oviposition sites by *Ae. aegypti* is a critical factor in their population dynamics and has important implications for vector control measures like source reduction and focal treatment (Chadee 1988). Recently, Chadee and Corbet (1987) reported that the number of eggs laid during each oviposition instalment was small but with most oviposition occurrences comprising 30 eggs or less.

The egg recognition and avoidance phenomenon among mosquitoes was first recognized under laboratory conditions by Chadee et al. (1990). It has also been demonstrated for other insects [parasitic wasps, *Nemeritis canescens* (Gravenhorst) (Hubbard et al. 1987), cowpea beetles, *Callopobruchus maculatus* (F.) (Ofuya and Agele 1989) and black-flies *Simulium reptans* L. (Coupland 1991)] but has not been reported for field populations.

This investigation was designed to determine whether egg avoidance occurs in the field and whether the density of *Ae.*

*aegypti* eggs at oviposition sites stimulates or deters oviposition in the field.

## MATERIALS AND METHODS

### Study Area

This study was conducted in Trinidad, W.I. at St. Joseph (10° 38'N; 61° 25'W) between 17 March and 9 June 1989, encompassing both the dry and wet seasons, which lasts from December to April (dry season) and May to November (wet season). The study area and the population of *Ae. aegypti* have been described by Chadee and Corbet (1987). The study area had not been treated with insecticides during, or within the preceding 10 weeks of, the observations; and all householders involved gave an assurance that they would not apply insecticides on their properties during the investigation.

### Oviposition

Oviposition of *Ae. aegypti* was monitored using conventional ovitraps (Fay & Eliason 1966) as described by Chadee and Corbet (1990). Each week twenty-four ovitrap paddles containing *Ae. aegypti* eggs laid the previous week were examined under a stereomicroscope (x 40), to find ovitrap paddles bearing <25, 26-50, 51-75, 76-100 and >101 *Ae. aegypti* eggs, the number of eggs counted, and a mark placed under the point at which eggs were positioned. This

mark was used to indicate the amount of water required in each ovitrap to prevent the eggs from being flooded and thus prevent egg hatching. At no time however was there less than 200 ml of water in any ovitrap.

Ovitrap were tied with wire to nails under the eaves of six houses to prevent rainfall increasing the amount of water in each ovitrap. For each exposure, at each of six sites, two ovitraps, one with a paddle bearing eggs (labelled 1A with <25 eggs, 2A with 26-50 eggs, etc.) as described above and the other with an egg free paddle (labelled 1B, 2B, etc.), placed side by side.

Ovitrap were exposed for one week and then collected. At each inspection the paddle (labelled with the site number and letter to indicate whether paddles contained eggs or not) was removed, placed into a plastic bag and taken to the laboratory where all eggs (i.e those on the paddle and those lose in the bag) were counted and examined under a microscope (at x40) for the chorionic pattern reported to be diagnostic for *Ae. aegypti* (Pratt & Kidwell 1969). The number of eggs laid on paddles already bearing eggs was determined by calculating the difference in the number of eggs placed in the field and the number of eggs counted on paddles after a week's exposure. All other paddles were examined and eggs counted and recorded in accordance with Chadee (1988). The results were analysed using a G-test by transforming the data into contingency tables (Sokal & Rohlf, 1980). The act of laying eggs on a substrate which bears eggs laid previously by a con-

specific, whether the same or different individual, was used to define "superoviposition" (see Chadee et al. 1990).

## RESULTS

The 60 egg-free ovitrap paddles collected a total of 2,190 *Ae. aegypti* eggs (63.4%) whereas from the other 60 ovitrap paddles containing eggs, a total of 1,265 eggs (36.6%) was collected. The results from Table 1 show no significant differences in the number of oviposition occurrences on paddles exposed with and without eggs ( $G=1.08$ ). However, when the number of eggs laid on ovitrap paddles exposed with eggs and without eggs (Table 2) were compared using a G-test, the results suggested that significantly more eggs were observed in ovitraps with egg-free paddles than those exposed with eggs ( $G=4.0$  d.f. 1;  $P < 0.05$ ). Thus, females appeared to avoid laying in ovitraps already containing eggs laid by other conspecifics.

Data from Tables 1 and 2 also suggest that superoviposition occurred in the field. However, the number of eggs on ovitrap paddles measured the degree of superoviposition which took place. Gravid females landing on paddles bearing less than 25 eggs, oviposited significantly ( $G=274.1$ , d.f.4,  $P > .001$ ) more eggs than those landing on paddles bearing more than 25 eggs (Table 2). A total of 1317 eggs was already present on paddles and the number of eggs laid during superoviposition bouts being 1416 *Ae. aegypti* eggs (see Table 2).

Table 1. Number of oviposition occurrences on ovitrap paddles exposed with and without *Ae. aegypti* eggs in the field (1989).

Date	Occurrence of oviposition on paddles			
	N	with eggs	N	without eggs
17 March	6	0	6	2
1 April	6	1	6	2
7 April	6	2	6	2
14 April	6	1	6	1
21 April	6	4	6	3
28 April	6	3	6	4
5 May	6	2	6	2
12 May	6	3	6	3
19 May	6	2	6	3
2 June	6	3	6	5
Total	60	21	60	27

$G=1.08$ ; d.f.9; NS

Table 2. Showing occurrence and number of eggs laid when superoviposition occurred in the field in Trinidad (1988).

Eggs (range)	No. of paddles with eggs exposed	Oviposition occurrences	Paddles with		Difference	%
			Eggs	Superoviposition		
< 25	21	11	152	853	701	82.2
26-50	19	5	189	348	159	46.0
51-75	13	4	324	794	470	59.1
76-100	5	1	430	516	86	16.7
> 100	2	0	222	222	0	0
	60	21	1317	2733	1416	51.8

$g=274.1$ ; d.f.4;  $P>.001$

### DISCUSSION

In the present field study, the egg avoidance and superoviposition behaviour of *Ae. aegypti* was very similar to that observed under laboratory conditions (Chadee et al. 1990). Chadee et al. (1990) suggested that such discrimination of "own" and "other" females eggs was remarkable since the *Ae. aegypti* strain used in the laboratory study belonged to an African (Gambia) inbred laboratory population. However, the present data suggest similar behavioural patterns of avoidance under field conditions, although, the population of *Ae. aegypti* in Trinidad is domestic in habit and probably genetically heterogeneous (Wallis et al. 1984).

The present data indicated that superoviposition may be dependent on numerous factors. One factor identified, so far, involves the number of eggs present on the oviposition substrate (see Tables 1 and 2), thus suggesting a dose-response reversal effect (Dethier 1947), similar to that detected in *Ae. aegypti* for host seeking and blood feeding (Muller 1988) and oviposition (Benzon & Apperson 1988). However, the avoidance of superoviposition reduces crowding of aquatic growth stages which can reduce size, and therefore fecundity, of females, and retard growth (Moore & Fisher 1969; Mulla 1979), thus increasing time dependent mortality e.g. predation and drought.

During the present study superoviposition occurred despite the availability of suitable sites in nature but more eggs were laid on paddles bearing less than 25 eggs than those containing more than 25 eggs. It is noteworthy that the behavioural sequence leading to egg avoidance and superoviposi-

tion is also not yet clear. As a first step, Chadee et al. (1990) assumed that a female decides whether or not to oviposit by comparing whether the oviposition substrate has eggs or not; if the present substrate has no eggs she lays. Alternatively, females could be responding to a chemical marker/pheromone of egg origin or the density of eggs on the substrate (present study), but where each increase in egg density results in a lower probability of acceptance of substrate for further oviposition.

Lastly, the number of eggs laid for each installment (Chadee and Corbet 1987) is similar to the number found on paddles (under 30 eggs) prior to superoviposition in the field (Table 1). Thus, the present results suggest that superoviposition may be a forerunner to avoidance of oviposition substrates (already bearing eggs) by gravid *Ae. aegypti*. That is, each oviposition substrate can accommodate two oviposition installments after which it is avoided by gravid females. Consequently, the avoidance of oviposition substrates bearing eggs may result in an increase in temporal and spatial dispersal of adults and eggs, thereby increasing time-dependent mortality among females which are not first to lay in preferred sites.

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