AEDES AEGYPTI REARED FROM DRY ARTIFICIAL HABITATS DURING DROUGHT IN PUERTO RICO IN 1974

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ABSTRACT. *Aedes aegypti* larvae were reared from 27 of 114 dry cement flower vases sampled in a cemetery over a period of 6 months during the 1974 drought in San Juan, Puerto Rico. In laboratory experiments dry sand and dry sugar when placed in cages containing 150 to 300 adults yielded some larvae.

The recent finding that dengue is endemic in dry southern Puerto Rico (Lee and Moore 1973), poses research problems on the ecology, behavior, and control of *Aedes aegypti* during dry periods. If the eggs survive dryness in the field as they do in the laboratory (Fox 1974), control measures should include not only breeding sites with water but also the dry habitats. Elsewhere various workers have studied dry tree-hole material (Cooling 1924; Dunn 1926; Foote and Cook 1959; Rao et al. 1970), but in the Western Hemisphere dry natural and artificial habitats have been neglected.

The purpose of this research was to ascertain (a) in the field the degree that dry cement flower vases yield *Aedes aegypti* larvae, and (b) in the laboratory whether freshly discharged eggs get into dry habitats.

MATERIALS AND METHODS. The field work was done in the "Cementerio San José," which is in the Villa Palmeras, Santurce section of the city of San Juan, Puerto Rico. Here there are hundreds of tombs, each adorned with 2 or more cement flower vases measuring about 31 by 20 cm. When there is abundant rainfall all the vases have rain water and 85% of them are infested with *Aedes aegypti* larvae (Table 1). But March to August, 1974 was a period of severe drought and nearly all vases remained dry. Each week I collected material from different vases by scraping the bottom and sides, and placed this débris which consisted mostly of dry sand, dry leaves, and bits of cement in cardboard containers. In the laboratory I flooded the samples with distilled water and observed them daily for larvae, keeping the cardboard containers covered.

The National Weather Service Office at the San Juan International Airport, about 3 miles away, reported the following data for the period March through August, 1974: Total rainfall, 15.57 inches (departure from normal, —15.44); average minimum to average maximum temperature, 73.4° F to 89.3° F; relative humidity average % at 2:00 p.m., 53 to 60, at 8:00 a.m., 61 to 70. I recorded the air temperature and relative humidity weekly at 9:30 a.m.; the temperature varied from 81° F to 90° F, and the RH from 46% to 66%.

To find out whether *Aedes aegypti* eggs could get into dry habitats, I used about 150 caged adults of the Arecibo, Puerto Rico laboratory strain, and fed them on a guinea pig for 1 hour 3 times a week. In the cage I placed 2 finger bowls lined with paper towel strips; 1 contained 2 tablespoons of dry sugar, the other 2 tablespoons of dry sand; no water was present. In further experiments I added to the cage 3 bowls containing water, larvae, and pupae in addition to the bowl with dry sugar and the bowl with dry sand. Another series of experiments involved 3 bowls of dry sand and 3 bowls of water with larvae in a cage containing 300 adults. The temperature of the cage was about 77° F and the relative humidity varied from 54% to 60%. After 1 week I removed the dry bowls, flooded them with distilled water and observed them

Table 1. *Aedes aegypti* larvae from cement vases containing water in San Juan, Puerto Rico during a period of abundant rainfall.

Month (1973)	No. of samples	No. samples infected	No. of larvae	Rainfall (inches)[1]
March	11	8	88	4.66
April	24	14	195	8.48
May	34	32	981	0.48
June	14	14	458	4.71
July	6	6	325	2.44
August	13	13	648	7.00
Total	102	87	2,695	27.77

[1] San Juan International Airport (3 miles east).

for larvae daily for a week or more, keeping them covered.

RESULTS. *Aedes aegypti* was the only species of mosquito reared from the dry cement vases in the cemetery. Each month of drought the dry samples yielded larvae, and for the whole 6-month period about 24% of the 114 dry cement vases sampled were positive with a total of 232 larvae (Table 2). During the laboratory experiments, specimens rested often on the papers of the bowls of sugar or sand, sometimes on the sugar or sand itself, and occasionally they were *in copula*. Larvae were obtained from both the dry sugar and the dry sand and more occurred when other bowls containing water were present in the cage (Table 3). In the series of experiments involving 3 bowls of dry sand and 3 bowls of water in a cage, a total of 12 bowls (4 replicates) of dry sand yielded a total of 7 larvae with 3 bowls infested.

Table 2. *Aedes aegypti* larvae from dry cement vases in San Juan, Puerto Rico, during drought.

Month (1974)	No. of samples	No. samples infected	No. of larvae	Rainfall (inches)[1]
March	17	4	4	1.92
April	18	5	69	1.20
May	26	1	7	2.42
June	11	4	6	2.34
July	18	3	35	1.12
August	24	11	111	6.57
Total	114	27	232	15.57

[1] San Juan International Airport (3 miles east).

Table 3. Discharge of eggs by caged *Aedes aegypti* in bowls of dry sugar and dry sand as shown by rearing larvae from them[1]

Replicate	Number of larvae	
	Sugar	Sand
1	2	3
2	0	11
3	0	1
4	2	0
5	0	1

[1] In replicates 1 and 2 other bowls containing water were in the cage; in replicates 3, 4 and 5 no other bowls containing water were in the cage.

DISCUSSION. Since many dry artificial habitats may be infested during drought, *Aedes aegypti* programs should include: (1) obtaining the "Dry habitat index" (the percentage of dry habitats which yield larvae); (2) spraying dry habitats, if necessary; and (3) research to find insecticides effective in both dry and wet habitats.

Under certain laboratory conditions freshly discharged eggs do get into dry habitats. We can only speculate on whether or not this occurs in nature. I believe that under stress from climate and through the inheritance of behavioral characteristics a strain could survive which would oviposit in dry breeding sites.

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