

THE EFFECT OF DRYING ON THE VIABILITY OF *Aedes* MOSQUITO EGGS

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The predominating species of *Aedes* mosquitoes found in the lower Columbia River basin lay their eggs in damp, shady locations. The amount and kind of duff found in these places will vary as will the degree of decomposition. This soil is rich in humus. The moisture-absorbing properties are high, and the water is tenaciously held. Even when the soil appears rather dry, it still contains considerable moisture. Undoubtedly some of the eggs are laid in unfavorable locations and some are destroyed during periods of drouth, but the retentiveness of moisture in the duff and the natural resistance of mosquito eggs to drying prevent the destruction of any large number of eggs.

In reporting his studies on the resistance of *Aedes flavescens* Müller eggs to unfavorable conditions, Hearle (1) states that "The eggs are" fairly resistant to superficial dryness over long periods, if dried out slowly and kept in a cool moist place . . . Under natural conditions, soil moisture, even in apparently dry ground, would doubtless be sufficient to prevent eggs from shriveling, and would permit them to remain viable for long periods, probably several years." Mail (2), after holding eggs of several species of *Aedes* (including *A. vexans*) in glass vials without moisture in a cold chamber at 0-10° C. for varying periods up to 20 months, found that some of these eggs would still hatch when they were flooded with water.

The moisture content of field samples containing large numbers of eggs of *A. vexans* (Mg.) and *A. lateralis* (Mg.) taken from topsoil in the lower Columbia River Valley has been determined on two occasions by drying in an oven at 85-90° C. to constant weight. All the samples were from typical breeding areas, and were collected early in the spring, while the soil was still well saturated with

moisture, but before the annual spring flood had covered the river bottom. In three samples taken at Waukeena Falls, Hayden Island, and Sauvies Island between April 6 and 11, 1933, the water content was found to be 39, 34 and 48 per cent. One sample taken at Hayden Island on March 14, 1944 showed 36 per cent of moisture, and another sample taken on the same day on this island, but in a very wet area close to a small pond, showed 46 per cent. The latter contained fewer eggs than the other samples. These data indicate that the average moisture content of the surface layer of soil, which contains the mosquito eggs, is about 40 per cent. None of these samples, except the one last mentioned, appeared excessively wet or fully saturated. The water capacity of any sample depends largely on the amount and kind of duff present, and the degree of decomposition of the vegetable matter.

A large number of soil samples have been handled at the Portland, Oreg., laboratory in the last 14 years. Observation and experience have shown that these humic soil composites are very retentive of moisture, and that viable eggs may be found in very dry soils. Often weeks and months elapse before the moisture content of stored samples drops sufficiently to injure the eggs. Laboratory experiments have shown that the eggs lose their viability rapidly, if they are removed from the soil. In April 1933 several tubs of dirt containing large numbers of mosquito eggs were brought to the laboratory. Of these eggs 63 per cent were *A. vexans* and 37 per cent were *A. lateralis*. This soil contained 48 per cent of moisture. Only a portion of this soil was used, and the tubs remained uncovered in a basement storeroom until the following spring. This storeroom has no windows, is dry, and

has a uniform temperature close to 70° F. In April 1934, when the soil was tested again, it contained 4 per cent of water. When samples of the soil were flooded, numerous larvae were obtained. Most of these larvae were reared to the fourth instar, and a few to pupae and adults. Identification of the larvae showed that 64 per cent of the eggs hatching were *A. vexans* and the remainder *A. lateralis*.

In March 1943 a pail of dirt containing many eggs was collected for laboratory use. About half of this dirt was used, and the remainder stood uncovered in the laboratory until the following August. At this time the dirt was dry and dusty, but 3-quart pans about half full of this dirt when flooded gave 2 to 300 larvae each, as compared with 8 to 1,000 larvae obtained from the fresh soil when it was flooded in March.

A project was outlined in 1944 to determine the relationship between the loss of soil moisture and the decrease in the viability of the mosquito eggs, and also to find out how dry the soil must become before the eggs are destroyed. Topsoil was obtained from Hayden Island (sample containing 36 per cent of water), and the coarser debris and dead leaves were screened out. A moisture determination was made, and duplicate 1-quart samples were flooded. The remainder of the dirt was put in a 5-gallon pail, covered with muslin, and stored in the basement room. At intervals throughout the year the soil was thoroughly mixed and portions of it were removed for moisture determinations and for flooding. Table 1 gives the results of these tests.

It appears evident that the soil moisture had been reduced to the critical point by December 26. At this time a number of the eggs hatched, but when the soil was flooded a month later only nine larvae were found. These tests show that the eggs of these species may survive for long periods in dry soil, but that they are soon desiccated by the depletion of the soil moisture to below 3 per cent. As the moisture content of the soil decreased, the ratio of the larvae of the two species was reversed, and by January 22, 1945, only *A. lateralis* larvae appeared. This indicates that the eggs of *A. lateralis* remain viable longer than do the eggs of *A. vexans*.

Summary

The humic topsoil containing the eggs of *Aedes vexans* (Mg.) and *A. lateralis* (Mg.) has excellent water-absorption properties.

Samples collected in March and April of two different years had an average moisture content of about 40 per cent. This water is tenaciously held, and months of air drying are required to reduce the water content to a point where the viability of the eggs is greatly decreased. However, after the moisture content has been reduced to below 3 per cent, the loss of viability is rapid. The eggs of *A. lateralis* appear to be more resistant to drying than are those of *A. vexans*.

Literature Cited

- (1) Hearle, E. 1929. The life history of *Aedes flavescens* Müller. Roy. Soc. Canada, Proc. and Trans. (ser. 3) 23 (1), sec. 5:85-102.
- (2) Mail, G. A. 1934. The mosquitoes of Montana. Mont. Agr. Expt. Sta. Bul. 288, 72 pp.

TABLE 1. Relationship Between Loss of Soil Moisture and Decrease in Viability of Mosquito Eggs. Each Figure Represents the Average of Two Samples

Date Tested	Moisture	Moisture	Larvae Found	Reduction		in Viable Eggs
	Content of Soil	Loss in Soil		<i>A. vexans</i>	<i>A. lateralis</i>	
	Per Cent	Per Cent	Number	Per Cent	Per Cent	Per Cent
<i>1944</i>						
March 14	36	....	455	72	28	....
May 29	27	25	424	90	10	7
Sept. 16	17	53	339	80	20	25
Dec. 26	3	92	149	44	56	67
<i>1945</i>						
Jan. 22 .....	....	....	9	0	100	98
Feb. 20	2	93	0	0	0	100