EFFECT OF COMPLETE DARKNESS ON THE DEVELOPMENT OF THE MOSQUITO *CULISETA INCIDENS* (THOMSON) (DIPTERA: CULICIDAE) [1]

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INTRODUCTION. It was demonstrated that the common nonautogenous *Culex pipiens* L. and the autogenous strains of *Culex pipiens, Culex quinquefasciatus* Say, *Aedes aegypti* (L.), *Aedes geniculatus* (Oliver) and *Anopheles plumbeus* Step. can develop in the absence of light, and that the larvae show marked negative phototropism (Jobling, 1937; Callot, 1965). The larvae of *C. incidens* were found to be unable to survive in a completely dark condition (Frost *et al.*, 1936). Brennan and Harwood (1953) described the importance of alternating periods of light and darkness in rearing *Culex tarsalis* Coquillett. Omardeen (1957) made an interesting study on the behavior of larvae and pupae of *Aedes aegypti* in light gradients. He found that "second- and third-instar larvae show no marked preference for any light intensity," but that fourth-instar larvae tend to "aggregate in the darkest region of the trough, and this negative photo-reaction is very pronounced in the pupae."

Love and Whelchel (1955) reported that pupation of *Aedes triseriatus* (Say) was retarded as the natural photoperiod became shorter in the winter months. The larvae, however, when stimulated by longer periods, of light (at moderate temperature) pupated readily. Adult females exposed to 15 hours of light in midwinter laid eggs that produced progeny which developed and pupated in the complete absence of light. Larvae collected in midsummer also developed and pupated in complete darkness. Love and Whelchel concluded: "shortening the photoperiod in the fall provides the stimulus which results in the production of a characteristic winter type of ova. Only larvae hatched from these ova are affected by variations in the photoperiods."

The purpose of my experiment was to determine the effect of complete darkness on the rearing of larvae of *C. incidens*.

MATERIALS AND METHODS. Fifteen first instar larvae (24 hours old and exposed to light for less than 24 hours) were placed in each of 12 enamel pans (6" x 8" dimensions) filled with 500 milliliters of distilled water. Six of these were placed in completely dark cabinets while the remaining six were kept under normal laboratory illumination. There was no appreciable temperature difference between the light and dark areas.

Two hundred mg. of bread crumbs and 20 mg. of brewer's yeast were supplied to the larvae in each pan at intervals of 3 days. Observation was made daily for both the "control" group and "dark condition" group. While observations of the latter were being made, light sources were cut off except for a flashlight covered with a red filter that was used for the examination. All pupae from the dark condition group were placed in the cabinets, whereas the ones from the control pupae were kept under normal laboratory conditions. The adults that emerged from both the "control" and the "dark" group were transferred to gallon jars and kept there until they died. All dead mosquitoes were placed in a desiccator and dehydrated for 10 days before being weighed on an analytical balance.

There was no aeration of the water in larval pans; however, the scum-like pellicle which formed on the water surface was removed daily by dragging strips of paper toweling over the surface.

RESULTS AND DISCUSSION. The results of this experiment are summarized in Table 1. There were no significant differences between the "control" group and the "dark" group with reference to: (1) length of time from first larval instar to first pupation, (2) percent of pupation, (3) percent of adult emergence, (4) sex ratio, and (5) the dry weight of adult mosquitoes.

The effect of complete darkness on the development of larvae of the mosquito *C. incidens* was first observed by Frost *et al.* (1936). Since then, no similar study has been reported in the literature. It seems, however, that Frost's conclusion that this species could not develop to adulthood in complete darkness was based on improperly designed experimentation. It is not clear whether the "complete darkness" referred to by these workers means the absence of light throughout the larval developmental period *without any interruption*, or with occasional but brief interruptions of darkness (when food was added or when the larvae were examined).

TABLE 1.—Effect of complete darkness on the development of the mosquito *Culiseta incidens*.

Condition	Control	Dark
Days from 1st instar to 1st pupation	Ave. 9	9
Percent pupation	96	87.3
Sex ratio diff.	no	no
Percent adult emergence	91.7	78
Dry wt. per mosquito (mg.)		
Males	.68	.70
Females	1.19	1.18

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The results obtained in the present experiment, however, showed that darkness did not have any inhibitory effect on the development of the *C. incidens* larvae. Statistical analyses indicated that there was no significant difference in effect between larvae reared in the dark and those "controls" which were reared in normal laboratory illumination. This obviously does not agree with the conclusions of Frost and her associates. The present writer believes that the inhibitory effect of darkness which was theorized by these workers might, in fact, have been the result of other factors, such as a deficiency of food, a disturbing formation of pellicle, or other environmental features.

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FEATURES AND BENEFITS OF BULK FLIT MLO HANDLING [1]

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Virginia does not support any mosquito control research; therefore, it is essential that we attend the American Mosquito Control Association's meetings and other meetings to keep up with the latest developments. For several years, we heard about the virtues of Flit MLO as a mosquito larvicide, and we decided that we should determine if its use was suitable to conditions in Virginia.

In 1967, we obtained a drum of Flit MLO and tested it under varying conditions in several types of mosquito breeding places. It was found that Flit MLO, as claimed, did a good job of killing mosquito larvae and, at the recommended rates, it did not kill fish nor burn vegetation. There appeared to be one problem which resulted from one of its main assets. Would it be possible to train men to apply the reduced rates recommended? If they applied Flit MLO at the rates at which they generally applied fuel oil, the cost would be exorbitant.

The following year, one crew was given Flit MLO to use for the entire season. This exercise not only proved that a good job of killing mosquito larvae could be done, but also proved that men could be trained with the proper equipment to make application at the recommended rates. Hence, it was concluded that Flit MLO was a good larvicide and could be applied properly. Now it was time to investigate the cost.

When purchased in drum lots, the cost was high; but if bulk delivery could be taken, the cost per gallon could be reduced. Table 1 shows the comparative costs of drum vs. bulk. These figures are based on 10,000 gallons per year usage.

Another item of cost to be considered is that of drum handling. Table 2 shows these figures.

By adding the saving on bulk buying and the saving in drum handling, it can be seen that there is a total saving of $2,854 on 10,000 gallons. Hence, it was determined that by purchasing Flit MLO in bulk, a substantial saving could be realized. Now, how much would it cost to provide bulk storage?

[1] Presented at the 28th Annual Meeting of the American Mosquito Control Association, Miami Beach, April 23–26, 1972.