A FEASIBILITY STUDY ON THE UTILIZATION OF MONOMOLECULAR FILMS FOR MOSQUITO ABATEMENT

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It has long been common knowledge that a film of petroleum oil over the surface of mosquito breeding water would kill the larvae, presumably by suffocation, but the effects of many other types of surface film have not been sufficiently investigated. During a study of the use of chemical films to reduce evaporation losses of water from open storage reservoirs (Meinke and Waldrip, 1964), it was suggested that such films might also be useful in mosquito control. Results of the tests carried out using three normal fatty alcohols for the control of mosquito development are reported here.

METHODS AND MATERIALS. Two laboratory experiments were carried out using a combined total of 660 larvae and pupae. The tests were run in Turtox entomological breeding chambers and rectangular polypropylene containers measuring 5 inches deep with a surface area of 72 square inches. Beakers (500 ml.) were substituted for the finger bowls in the breeding chambers.

Larvae and pupae of *Culex quinquefasciatus* were collected and placed in the containers with some of the same water from which they were collected along with food in the form of alfalfa pellets, a culture rich in microinvertebrates, and infusoria tablets containing wheat germ, agar-agar, yeast and other nutrients. Small pieces of cork were placed in each container to provide the imago with something to grasp after emergence. All tests were conducted in the laboratory at about 25° C. Three long-chain fatty alcohols, (n-octanol, n-hexadecanol and dodecanol [lauryl alcohol]) were tested for their larviciding capability by applying a measured quantity to the water surface.

RESULTS AND DISCUSSION. The n-octanol proved to be unsatisfactory because of the volatility and solubility which did not allow it to produce a stable film on the surface.

With hexadecanol, the larvae were observed apparently feeding on the fine solid particles which floated on the surface. Larval development was rapid and appeared normal; therefore the hexadecanol also was discarded.

With the third alcohol (lauryl), both larvae and pupae decreased in all but one sample. Treatment consisted of application of 1 drop (approximately 17 mg) of the material to the water surfaces of test containers.

One experiment using lauryl alcohol[1] began with 141 larvae and 199 pupae. Many of the larvae had reached maturity

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[1] The lauryl alcohol used in these experiments was furnished by Rohm and Haas Company and goes by the trade name of Dytol L-79.

when the experiment started and pupated shortly after treatment. This was evident in one sample since there was an increase in the number of pupae during the first 24 hours.

This experiment showed a definite reduction in living larvae. There were 36 live larvae at the end of 24 hours and a disappearance of all live larvae after 48 hours. A reduction of pupae also was evident, and at the termination of the experiment, (48 hours) there were 65 dead mosquitoes. There were 21 live pupae which remained at the end of 48 hours. These were kept under observation. They developed into adults which became entangled in the surface film while emerging and died. Thus, there was a 100 percent mortality.

One additional laboratory experiment using lauryl alcohol was carried out. The results of this experiment substantiated the findings of the previous study. In this experiment there was a total of 4 live larvae at the 24-hour count from a beginning sum of 70 larvae. Two of the beginning four pupae developed into mosquitoes which became entrapped in the surface while emerging and died. Mortality estimations were not made at 48 hours, but 72-hour observations showed that all organisms were dead. The four live larvae probably died between 24 and 48 hours as those observed in previous experiments. This study, like the previous study, resulted in a 100 percent mortality.

Several other laboratory and field observations were carried out. In these observations there were indications that the large larvae and immature pupae were killed first. The pupae which were about to give rise to the adult did so; however, the adults were wetted by the film while emerging and drowned.

After the larvae had penetrated the film, a number of times it was noted that they would try to clean their respiratory siphon with their mouth parts. A few hours later the treated water surface would no longer support the larvae. The larvae continued to attempt to penetrate and attach to the surface and respire. After numerous unsuccessful attempts they fatigued, sank to the bottom and died from anoxia. The results of MacFie (1917) are similar to the findings in this experiment. He showed that the larvae of certain species were unable to live if they were deprived access to the water surface.

The ability of the larvae to suspend from the surface has been discussed by Klein, Tate and Vincent (1935). They point out that the perispiracular glands in the larvae of certain genera of mosquitoes secrete an oily substance which produces the hydrofuge property of the spiracle opening. This secretion can be wetted by oils which are able to enter the spiracles, and it can be dissolved by ether.

The experiments with the lauryl alcohol seem to substantiate these earlier findings. The monomolecular film of alcohol appears to bring about a wetting action on the spiracle, thus reducing the hydrofuge property of the spiracle openings. This wetting action prevents the larvae from being supported by the surface, and death ensues from asphyxiation. There may be some plugging or coating of the respiratory tract which contributes to the cause of death. This appears to be more likely in the pupae than the larvae. The cause of death is speculative at this point, but it appears to be caused by a physical phenomenon rather than a toxic effect.

The wetting effect was also observed on adults alighting on a lauryl alcohol treated surface. The adult begins to sink into the water surface shortly after alighting. If it remains on the treated surface a few seconds it will sink to the point where its wings or abdomen become wetted, and then it becomes entrapped in the water and drowns.

These pilot studies have stimulated additional thought on the use of non-toxic, biodegradable monomolecular films as mosquito control agents. These films would not be incompatible with antipollution programs, and because of the almost negligible toxicity of lauryl alcohol we believe that waters thus treated can be utilized for agriculture, recreation and for drinking by both humans and animals.

SUMMARY. Three long-chain normal alcohols were studied to determine their effectiveness in controlling the development of the mosquito. Lauryl alcohol, a 12 carbon, colorless, biodegradable alcohol which is liquid at room temperature and essentially non-toxic, manifested definite capabilities as a mosquito abatement agent. The laboratory studies showed that larvae and pupae are unable to survive in water treated with lauryl alcohol. Emergents become entrapped in the film and die, and adults which alight on the treated surface become wetted and drown.

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