



Cold fogger treatment killed up to 99 percent of native adult and caged test mosquitoes. Only small amounts of the aerosol moved out of the treatment area.

Cold fogging for mosquito control

Norman B. Akesson

Aerosols consisting of small airborne drops less than 60 microns in diameter (25,400 microns = 1 inch) have been used in California mosquito control for nearly 40 years. The early machines of the 1940s were converted military smoke-screen generators or even simpler devices that merely introduced a controlled flow of an oil base insecticide liquid into the engine exhaust of an aircraft or ground vehicle. These "smokers" were remarkably successful, but they produced a wasteful wide range of drop sizes, from the irritating and ineffective smoke of 0.1 to 1 micron size at one end to drops of 50 to 100 microns at the top end. The larger drops tend to deposit rather than remain airborne as required for most effective control of adult mosquitoes.

In the mid 1950s, U.S. Department of Agriculture researchers, borrowing from aircraft jet engine developments at that time, introduced cold fog aerosol machines which produced a narrower band of drop sizes (about 5 to 50 microns in diameter). These machines were introduced into Cal-

ifornia in the late 1950s and quickly became a widely accepted and highly effective way to knock down adult mosquitoes rapidly. Although source reduction and large area treatments by aircraft continued, the low cost and relatively simple ground-operated cold foggers became a highly effective means of protecting small towns and larger cities against adult mosquitoes.

The first California cold foggers were put together by the ingenious mechanics and managers of several California mosquito abatement districts after observing Alameda Naval Air Station thermal generator conversions at work. University engineers helped to upgrade the design of the machines and to develop application and operational information on flow rates, energy input, and drop size to improve their effectiveness.

The basic function of the machines is to produce an aerosol fog with a volume median diameter of 25 to 30 microns. Its drop size range also is much narrower than that of the older thermal aerosols; hence, it

is more effective for adult mosquito control. A blower or rotary compression furnishes air at 300 to 400 cubic feet per minute at 4 to 6 pounds per square inch pressure. The atomizer (vortical or twin-fluid) converts this energy and produces an aerosol at a fluid atomization rate of 10 to 20 fluid ounces per minute.

Research on the energy requirement of the vortical device compared with other commercial twin-fluid types indicates that several of the latter provide equally effective atomization. The air requirements for the high-pressure types are 100 to 150 pounds per square inch pressure at 8 to 10 cubic feet per minute for 15 to 25 fluid ounces per minute to produce the desired drop size. Such a compressor can be driven by the vehicle engine, which reduces the overall noise level and total machine cost.

Identifying and using suitable weather conditions, coupled with the proper adjustment of the machine, constitute relatively simple but inflexible limitations on aerosol use. Operationally, an aerosol must be released either upwind from the treatment site or in successive swaths while proceeding upwind. Highly stable atmospheric conditions with a temperature inversion (overhead air warmer than the air near the ground) are essential. A low but positive air motion helps to distribute the aerosol. This normally occurs during early evening and may hold during the night and into early morning, or until the rising sun warms the air and causes vertical turbulence.

Morning and evening applications were equally effective in studies. An aerosol applied in the morning dissipates more rapidly than an evening treatment, minimizing its contact with nontarget organisms.

Research has helped to identify the permissible weather range for aerosol applications to specific terrain. Studies have been conducted in open agricultural areas, a wooded valley, and in small villages with shade tree canopy. Limited evaluations have been made of aerosol application effects on mosquitoes and other insects. Basic research objectives are to maximize the effectiveness of aerosols by more precise applications, confining them to treatment sites, and to minimize annoyance caused by treatments by reducing machine noise and the dispersal of irritating, smoke-like drops. Aerosols continue to be valuable tools in overall mosquito control but are most useful as an adjunct to other methods in an integrated mosquito management program.

Norman B. Akesson is Professor of Agricultural Engineering, University of California, Davis, CA 95616.