

How to Eliminate Mosquitoes From Outdoor Play Areas*

By LINUS C. PALMER

Supt., County Parks & Forestry, Grand Rapids, Mich.

Mosquitoes of various sizes and breeds are found from the frozen regions of the north to the torrid countries of the tropics, some being only a nuisance while others are carriers of some of man's most dreaded diseases.

They can be controlled or entirely eliminated by proper control measures. The success we have had, we owe to the help, advice and encouragement of Professor Ray Hutson and Ex-Professor E. I. McDaniel of the Entomology Department of Michigan State College.

All mosquitoes breed in water and water only. They do not breed in damp grass or shrubbery as is a common supposition of many. The life cycle is fundamentally the same in all groups and the stages of development are practically similar. While there are several varieties in Michigan, the house or domestic mosquito is the most common with the inland-swamp mosquito running a close second.

All mosquitoes hatch from an egg and water is necessary in order to hatch the egg. The familiar mosquito lays her eggs in pools of water, rain barrels, cisterns or any container which will hold water. The eggs are laid in small black masses of from fifty to four hundred each. From the egg comes the larvae commonly called the "wigglers." It feeds on organic matter in the water and gets its air separately by sticking its long tail-like siphon through the upper surface. The larvae remain in that stage from six days to three weeks depending on the temperature, then become pupa. After remaining in this stage from twenty-four to seventy-two hours it emerges as an adult mosquito.

Any control program to be effective must do one or several of the following:

1. Change the level of the water up and down suddenly.
2. Clean vegetation out of drainage ditches.
3. Drain standing water.
4. Treat standing water in such a way that it will be impossible for mosquitoes to breed.
5. Keep fish in garden pools.
6. Do not overplant garden pools with vegetation.
7. Spray to eliminate adults.

The Park and Forestry Department of the County of Kent, Michigan, has been engaged in a mosquito control program for the past twelve years. During that time we have tried all known methods of control, and have used practically all known materials in our control work. The purpose of our mosquito control program was to make our county parks usable by the public from early spring to late fall without being pestered by mosquitoes. This we have succeeded in doing. We have fifteen county parks, all of which has a mosquito problem, some considerably worse than others but none without the pests during the mosquito season which generally runs from sometime in April to October depending on the weather. In several of our parks, the mosquitoes were so bad at times that it was impossible to use them but for a short period during the season.

Best Method of Control

Our first work was trying to control the larvae or "wigglers" mosquitoes just out of the egg. For this work we used copper sulphate to control the growth of algae in stagnant pools. We also used oil to cover the surface of standing water. Later we used paris green and also DDT. Wherever and whenever possible we drained all possible spots where water would accumulate and stand for a period of time. By experimenting with different control measures, all of which were successful to a degree, we determined that our best method of control was to let the mosquitoes emerge as adults—then, spray for their control. Our first work was done using a pyrethrum spray. This method was most satisfactory until the war stopped the importation of pyrethrum, all of which was imported from Japan and the Kenya Peninsula of Africa. After the supply of pyrethrum was stopped, rather than abandon our control work, we used a nicotine spray with excellent results, but with considerable inconvenience to those whose job it was to apply it. During the last stages of the war, DDT was made available and we immediately started to use this material. First, as a liquid spray—then, in dust form—the method we are using at present and plan to continue to use. We use this material for control of both the larvae and adults with near perfect results.

As was said before, our first control

*Address at NGSA Convention, Chicago, Ill., Jan. 31, 1951.

work was controlling larvae. In this we were successful. However, the time element enters prominently into this work as it must be done before the "wrigglers" have a chance to change into the second stage of development, and all breeding places must be watched closely and sprayed either before the eggs are hatched or when the mosquitoes are in the "wriggler" stage. A few days of neglect will give the "wrigglers" a chance to change into the pupa stage, and thence, into adult mosquitoes. For this work we used a drain oil using an emulsifying agent and water, and also kerosene at the rate of one ounce per 15 square feet. Paris green was used as a dust, mixing five pounds of paris green to 100 pounds of carrier and dusting so that the equivalent of $\frac{1}{2}$ pound of paris green was used per acre. This quantity of paris green is not harmful to domestic animals and foliage. All of our dusting was done with hand dusters as the areas covered were rather small.

Results Obtained

While there are many control measures recommended, our best results were obtained by the use of pyrethrum and DDT for adults and a dusting of paris green or DDT for the larvae. In spraying for the control of adults with pyrethrum we used a spray which was prepared as follows:

Pyrethrum — one pound

Summer Oil — one-half gallon

One ounce of this stock solution to one gallon of water. About 25 gallons of the finished spray was used per acre. Our cost for spraying with this material before the last war was approximately \$1.00 per acre. One application remained effective from ten days to two weeks. This work was done with our tree spraying equipment, using a fog nozzle and spraying from the ground up into the air about fifteen feet. The work then as now was done in the early evening or early morning when there was very little wind, allowing for better drift and longer suspension. Where we had a lot of shrubbery, the mosquitoes were driven from their hiding places with nicotine fumigators. After the use of pyrethrum for several years, the war came on and this material was no longer available. Rather than give up our program, we started using a nicotine spray at the strength recommended for aphids. This method was effective but more expensive, and inconvenient for those applying it as the fumes very often made the operators ill.

Our latest, most effective, and incidentally, the cheapest method of control, is by the use of DDT. We started using this material during the last year of the war. We first used it at a strength of $1\frac{1}{2}\%$ but later changed to 3% which we find most effective. For the control of flies, we use it at a strength of 5%. It was first ap-

plied in liquid form with our tree spraying outfit with excellent results but as this equipment was large and heavy, we were unable to get to all places requiring spraying so we later changed our method of application to dusting. We purchased a Root Model 1ZA1 duster which has a hopper capacity of 100 pounds. This model is a portable machine that can be carried and used on a pickup truck with which each park is equipped.

Time of Dusting

The time of dusting is left to the judgment of each caretaker who with the help of one additional man does the work. By using the duster on a pickup truck, all places requiring dusting can be reached without any difficulty. The work requires only two men, one to operate the truck and the other, the duster. We dust 80 acres or more in about three hours. We have found that one machine is sufficient to take care of all of our work. As said before, the work is always done in the early evening or early morning when the mosquitoes seem to be the worst, and also at that time of day there is very little wind so the dust stays suspended for a longer length of time, and also, we get better drift at these times and do a more effective job. The work is done so that if possible, what little wind there is, is on the back of the operator. As to cost, our cost for the past season on a typical 80 acre area was as follows:

1,000 pounds of dust	42.50
Labor (caretaker 5 hrs.) which includes 2 hrs. transporting machine and materials to and from park	6.20
Helper — 3 hrs.	3.72
Equipment rental, truck and duster, gas and oil	2.50

Total cost for 80 acres 54.92

This makes the approximate cost per acre \$0.69.

Three dustings during the season are generally sufficient to do a good control job, but occasionally when we have a warm fall an additional dusting is advisable.

While our biggest and most important job is the control of mosquitoes, when flies become a nuisance we spray or dust for them using the material at a strength of 5%, which we have found very effective.

Our work in the control of mosquitoes and flies has proven that these pests can be controlled using the materials and methods which I have attempted to describe. Where it is not advisable to use DDT due to discrimination against this material or where it is not advisable to use due to danger to fish life, other materials which I have mentioned can be used with very effective results.