

## MOSQUITOES AND OTHER INSECTS KILLED BY AERIAL SPRAYING WITH DDT IN PANAMA

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Aerial spraying with DDT for mosquito and other insect control has aroused much speculation as to its effect on local insect populations. Information of this type is desirable because it is possible that beneficial insects as well as injurious forms may be killed. Biological deserts may be produced by heavy treatments of DDT, and these, of course, will be highly undesirable. In fact, any upset in the balance of nature is liable to produce conditions unfavorable to the general welfare of the plants and animals present. If, for example, insects are eliminated from a large area, young birds may subsequently starve. A wise program of control always considers all factors involved and should not be imposed without regard to the end result.

Undoubtedly in the future large areas will be treated with DDT as a control agent against mosquitoes, flies, forest insects, and other injurious species. This report is one of the first to shed light on the number of species affected by DDT sprays when used over large areas for the control of mosquitoes. Unfortunately, few specimens could be determined as to species, either because they had been damaged or because of lack of knowledge of the Panamanian insect forms.

During airplane-spraying tests in tropical jungles of Panama by the U. S. Navy in December 1944, and by the U. S. Army in January-February 1945, several observations and collections were made of insects affected by DDT mosquito sprays by entomologists<sup>1</sup> working under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Develop-

ment to the Bureau of Entomology and Plant Quarantine.

The Navy tests were made with a Navy TBM airplane equipped with a specially constructed exhaust generator. The droplets produced measured less than 75 microns in diameter. The spray was made of 20 per cent of DDT in Velsicol NR-70 (aromatic petroleum fraction) and was applied at the rate of 0.36 pound of DDT per acre over an area of approximately 1 square mile.

The Army tests were made with a B-25 and a C-47 airplane equipped with a gravity-feed straight-stack or a grid exhaust dispenser designed by Army engineers. The droplets produced were 300 to 150 microns and less in diameter. The following sprays were tested: (1) 5 per cent of DDT in No. 2 fuel oil; (2) 10 per cent of DDT and 20 per cent of polymethylnaphthalene auxiliary solvent (K-237) in No. 2 fuel oil; (3) 5 per cent of DDT and 10 per cent of lubricating oil (S.A.E. 30) in No. 2 fuel oil; and (4) a 5-per-cent DDT aqueous emulsion prepared from a concentrate consisting of 25 per cent of DT, 10 per cent of Triton X-100 (aralkyl polyether alcohol) and 65 per cent of xylene. These sprays were applied at the rate of 0.3 to 0.6 pound of DDT per acre.

Immediately before or after treatment bed sheets (4 by 7 feet) were spread on the ground (fig. 1) under heavy, medium and light jungle canopy. Insects began falling on the sheets about 15 minutes after treatment and continued falling in varying numbers for the next 24 hours. These specimens showed characteristic DDT poisoning.

Casual observations of the insect populations in the jungle indicated no apparent difference in numbers of insects or species before and after treatment. Occasionall

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Fig. 1. Bed sheets were laid on the ground for the collection of insects killed by DDT aerial spraying.

large Lepidoptera and Hymenoptera showing characteristic DDT poisoning were seen on the ground soon after treatment, but no reduction could be observed in the numbers of active insects, other than mosquitoes, from day to day.

Most of the species were represented by only 1 to 5 specimens each; but in the Diptera various species of Calliphoridae, Sarcophagidae, Tylidae, and Culicidae were obtained in much larger numbers. More than 50 individuals were recovered of each of several species and over 200 individuals of one species of mosquito.

The numbers of species<sup>2</sup> by order are listed:

Coleoptera: 53 species, including 12 species of flatheaded borers and 16 species of weevils.

Diptera: 148 species, including 10 species of blowflies.

Hymenoptera: 45 species, including 22 species of ants.

Hemiptera: 26 species.

Lepidoptera: 7 species.

Thysanoptera: 1 species.

Spiders and pseudoscorpions: several species.

<sup>2</sup> All species were identified by specialists of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine.