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Proc. NE Mosq. Control Assoc., 9th Ann. Mtg.
Feb. 19, 1963. Waltham, Mass.

PASA RACHA-7-00 Res,
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PROCEEDINGS OF N. M. C. A.

INSECTICIDE RESISTANCE IN MOSQUITOES

Richard W. Fay^{1/}

B/CS #42

Failure of mosquito control operations may arise from (1) deterioration of the insecticidal formulation, (2) inadequate application techniques, (3) inadequate knowledge of the ecology of the species concerned, (4) resistance of the mosquitoes to the chemical utilized. In the latter case, resistance to the insecticide may occur through (a) conversion by enzyme action to a non-toxic compound, (b) storage of the toxicant in a non-sensitive tissue, or (c) non-absorption of the toxicant at a sensitive site of action.

At present 99 species of insects of medical importance have been reported in over 100 countries of the world as being resistant to one or more commonly used insecticides. Among the mosquitoes in the U.S.A., 14 species have shown resistant populations in certain areas. They are as follows: Aedes aegypti to DDT, dieldrin, and BHC; Ae. dorsalis to the same insecticides and toxaphene; Ae. nigromaculis to DDT, Dieldrin, BHC, chlordane, heptachlor, Korlan, Malathion, parathion, aldrin, and Trithion; Ae. sollicitans and Ae. taeniorhynchus to DDT, dieldrin, BHC, chlordane, and malathion; Ae. vexans and Anopheles crucians to DDT; A. quadrimaculatus to DDT, dieldrin, BHC and chlordane; Culex pipiens to DDT, BHC, toxaphene, heptachlor and malathion; C. nigropalpis and C. salinarius to DDT; C. tarsalis to DDT, dieldrin, BHC, toxaphene, chlordane, heptachlor, and malathion; and Psorophora confinis and P. discolor to dieldrin.

Standard test kits for determining the susceptibility levels of field populations of mosquito adults and larvae are available from the World Health Organization at nominal prices. At present the kits for testing larvae permit evaluations with DDT, dieldrin, BHC, malathion, and parathion. The kit for testing adults permits evaluations with DDT and dieldrin only. Each type of kit has instructions for use and a guide to the interpretation of results.

In evaluating susceptibility levels, allowance must be made for differences in the response of the mosquitoes to the insecticide arising from differences in age, sex, testing temperatures, and exposure conditions.

The presence of resistance in a field population may be expressed (a) as a plateau of uniform mortality response over an increasing range of concentration or exposure time, (b) as a shift to a lower slope of the probit-mortality log-dosage line, or (c) as a shift in the line toward more stringent test conditions such as increased dosage or exposure conditions to produce the desired mortalities.

If resistance is detected by the test method, it is still necessary to determine (a) its geographical extent in the field, (b) the specificity of the resistance with regard to a series of chemicals, and (c) the actual effectiveness of the field control measures on the population, since these measures involve different formulations and exposure conditions. A check on these field factors then acts

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as a guide in deciding on any change of operations. The test methods indicate that a change has occurred in the response of the field populations to a given insecticide but results do not form the basis on which to change operations. The latter must be based on actual field observations.

SURVEY OF PESTICIDE REGULATIONS OF THE REGION

By - Edward Duda, Director
Bartlett Tree Research Laboratory, Stamford, Connecticut.

Inasmuch as you are familiar with existing laws, I will review them briefly and then discuss pending legislation.

MAINE The only law covering spraying, Chapter 36, 1954 as amended, is primarily a law licensing men for spraying trees, but might apply to mosquito spraying if the spray is applied to trees.

Two bills are now pending. S.P. 46 for the Regulation of Pesticides would amend the Revised Statutes by adding Chapter 25 E, to be called the Chemical Pesticides Act of 1961. The proposed law would create a Board of Pesticide Control composed of Commissioner of Health and Welfare, Chairman; Commissioner of Agriculture; Forest Commissioner; and Chairman of Water Improvement Commission. This Board shall:-
I. Regulate transportation, testing, inspection, packaging, labeling, handling, and advertising of chemical pesticides. II. License persons engaged in custom spraying and require surety bond and liability insurance. III. Prescribe materials and methods used in custom and contract pesticide applications. IV. Regulate and supervise pesticide use in any State Project or by any public agency under jurisdiction of the State.

The second bill H.P. 65 would prohibit the use of pesticides near Waters of the State. It would amend Chapter 141 by adding a new section 11-B to prohibit use of pesticides within 20 feet of any river, stream, lake, pond or tidal water. Violations are fined \$25 to \$100 plus costs.

NEW HAMPSHIRE has no law that applies exclusively to mosquito control except indirectly, an Apiary Law, Chapter 440 Revised Statutes which restricts spraying of trees during bloom. The State now has permissive legislation (1962) enabling the creation of pest abatement districts formed by vote of towns or lesser groups. A newly proposed bill would provide for mosquito survey of corrective measures for mosquito control in the coastal towns.

VERMONT does not have any direct legislation regarding the use of pesticides. However, a pesticide act pertains to registration of pesticides sold within the State. There is also a regulation that aerial applications have a permit from the Aeronautics Board. The application must specify complete details of the proposed control. The application is also viewed by the Department of Agriculture, Forests and Parks, and Fish and Game;

MASSACHUSETTS has a Pesticide Board, Chapter 521 (1962) established in the Department of Public Health. The Board consists of the Commissioner of Public Health, Chairman; the Commissioners of Agriculture; Natural Resources; Public Works; and the Chairman of the State Reclamation Board. The Board regulates aerial applications by the use of permits and is making preparations to license operators where "pesticides are applied on the property of another". This, at present, would not apply to pesticide applications in or under structures or to farmer's applica-