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VECTOR CONTROL IN RURAL AREAS

by

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1. INTRODUCTION

In rural areas yellow fever is transmitted by *Aedes aegypti* and also by forest mosquitos.

Although, in Africa at least, *Ae. aegypti* may form populations with an exclusively forest habitat, in villages it is generally a domiciliary or peridomiciliary species with man-made larval breeding places.

Forest vectors use a wide-range of natural breeding places such as: holes in rocks and trees, cut bamboos, axils of plants with sheath-like leaves, etc. The multiplication of certain species may be favoured by the cultivation of host plants for use or ornament. In Africa, this applies particularly to *Aedes simpsoni*.

Vector control may be undertaken as a preventive measure or when cases of yellow fever occur.

2. PREVENTION OF VECTOR MULTIPLICATION

Man-made larval breeding places should be removed whenever their presence is not essential. Water storage containers which cannot be removed should be emptied and carefully cleaned at least twice a week to prevent any larval development leading to the production of adult mosquitos. When neither removal nor periodic cleaning is possible, such breeding places may be treated with insecticides to prevent any *Ae. aegypti* larvae developing.

The same measures may be applied to natural sites. Holes in trees, bamboos or rocks can be filled in. Plants with sheath-like leaves should be destroyed wherever possible. Those which it is essential to keep should be treated periodically with larvicides. Insecticide treatment should, however, be the exception.

Environmental hygiene and health education are the main preventive measures and it is up to the inhabitants and communities concerned to take the necessary precautions. Coercive measures should generally be provided for to deal with individual negligence. *Ae. aegypti* may thus at little cost, be prevented from multiplying but it is much more difficult to control the numbers of wild vectors except in restricted areas where there is a dense human population and few natural larval breeding places.

The application of chlorinated organic insecticides in houses and in and immediately around (perifocal treatment) potential larval breeding places was for a long time the basis of preventive chemical control of Ae. aegypti. These compounds are now going out of use following the widespread appearance of Ae. aegypti populations resistant to DDT, BHC and dieldrin (Anonymous, 1970; Mouchet et al. 1970). At present the use of fairly persistent larvicides is recommended. These may be applied to potential larval breeding places to kill the larvae as they hatch out. The most promising compound is abate which has practically no acute or chronic toxicity for mammals (Gaines et al. 1967; Laws et al. 1967 and 1968) and has been approved by WHO for the treatment of drinking-water (Anonymous, 1967). This product added to water storage containers in the form of sand granules containing one per cent. abate to give an initial concentration of 1 ppm, shows marked effectiveness for approximately one month (Gayral & Pichon, 1969) and, under very favourable conditions, may eliminate Ae. aegypti for two to five months (Bang & Tonn, 1969b). In containers and natural sites where the water is unlikely to be used for drinking the initial concentration of abate may be raised to 5 ppm, or this product may be replaced by dursban at 1 ppm, which gives even better results (Taylor, 1968; Bank & Tonn, 1969a).

3. DESTRUCTION OF ADULT MOSQUITOS

The appearance of cases of yellow fever indicates the presence in the infected area of female vectors that are infective or likely to become so, and the best way of restricting the spread of the disease is to destroy such vectors rapidly.

Since what is required is to cover a more or less extensive area very quickly, the domiciliary application of residual insecticides, which of necessity proceeds very slowly, can only be regarded as a procedure followed for want of a better.

Where transmission seems due to domiciliary or peridomiciliary populations of Ae. aegypti alone, and where a limited area has to be treated, portable fogging equipment may be used (Elliot & Fitz-Jones, 1953; Sales & Eyraud, 1970). Where transmission is due wholly or in part to forest vectors, or where extensive areas have to be treated, the use of high powered equipment which is tractor-drawn or otherwise transported is essential.

The development of application techniques using very small volumes of insecticides that are liquid at normal temperatures or may be obtained as highly concentrated solutions, now enables extensive areas to be treated quickly. These techniques are now extensively applied in agriculture (Taylor, 1970) and have been used in the United States of America to halt (Kilpatrick, 1967) or prevent (Lofgren, 1970) epidemics of virus encephalitis. Special Air Force units treated 14 000 km^2 in Texas and Florida with a dose of 22 litres of malathion per km^2. These techniques have the advantage of rapidity: the equipment used in the United States of America can treat 72 km^2 in two hours flying time with a single load of insecticide. Recent experiments have shown that the specialised equipment required can be adapted to various types of light aircraft in a very short time (Lofgren et al. 1970c; Glancey et al.).

Evaluation of these techniques using malathion has been made under WHO auspices in Thailand against Ae. aegypti (Kilpatrick et al. 1970b; Lofgren et al. 1970a and 1970b) and in Ethiopia against Ae. simpsoni (Brooks et al. 1970). Similar studies have been carried out in Viet-Nam (Lofgren, 1970) and in Panama (Lofgren et al. 1968). In lightly wooded areas good results have been obtained using 22 litres of malathion per km^2, but this dose had to be doubled for effective coverage not only of mosquitos resting on vegetation but also of those inside houses. In areas with dense vegetation (the Panama jungle, wild banana groves in Ethiopia) between 58 and 147 litres per km^2 of malathion are required to give satisfactory results.

This type of treatment has only very low residual properties and must be carried out several times at intervals of a few days to be fully effective. By applying malathion together with an equivalent dose of abate it is possible to kill both larvae and adults, for the residual effect may exceed two weeks (14 + 14, or 28 + 28 litres per km^2) and this considerably enhances the value of treatment (Kilpatrick et al. 1970a). There is still room for improvement in both the spraying technique and the type and dosage of insecticides to be used (Lofgren, 1970; Lofgren et al. 1970c). Tests should be carried out over a greater range of habitats and vegetation zones so that ways of applying this new technique in different regions may be specified.

The products currently authorised for fogging in inhabited areas are malathion, fenthion, naled (= dibrom) and abate. Tests have also been made with dursban. The danger of respiratory contamination from these organo-phosphorus compounds used for fogging is extremely low (Hartwell & Hayes, 1965) and bears no comparison to the risks run by a population during an epidemic (Hayes, 1967). Unfortunately, the present fairly high price of organo-phosphorus compounds, together with the cost per hour of aircraft flight, makes such operations extremely expensive and developing countries can hardly consider them outside the context of foreign aid.

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